MZBOT

VORON B

The Manual

DRAFT

SECTION A : PREP

A.1 Printing Parts

Material

For majority of the parts on the printer, I recommend using ABS plastic (Black if you really want to replicate the look). Electronics enclosures can be printed with PLA as they don't really have to handle mechanical loads or high temperatures.

Nozzle size

With exception of the X Carriage components, everything is designed to be printed with a 0.6mm nozzle. You can use a smaller nozzle, of course, but be warned that some of the parts will take a significant time to print, and won't be as strong.

Print settings

In my experience the minimum settings to produce mechanically sound parts are:

- Layer height 50% of the nozzle width
- 5 layers for top and bottom
- 3 shells
- 40% infill (grid or honeycomb work equally well)

A.2 Tools

Although no specialty instruments are required, you will need some basic tools to build this bot. If you've built a RapRap before, you already have almost everything you need.

- Set of metric hex keys (I highly recommend ball-end ones)
- Set of metric drill bits (for cleaning out holes and making mount points in the bed)
- Drill
- Small knife
- Torx T25 driver
- Phillips screwdriver (#1)
- Soldering iron
- Pliers
- Wire cutters
- Ruler

Optional tools (they make the process less painful)

- Dupont connector crimpers (I highly recommend Engineer PA-09)

A.3 Greasing the bearings

It is recommended that you pre-grease all of your LMU bearings before you begin the assembly process.

Linear bearings usually come covered in a thin oil. This oil is intended for **transport only**, and should not be used as the only means of lubrication. You'll need to pack the linear bearings with grease.

I recommend using a PTFE impregnated grease, as it has a lower coefficient of friction than most bearing greases, and will ensure smooth and quiet operation. Having grease in a squeeze tube makes this step easier. You can also use lithium based grease, which seems to not be as slippery, but does provide some additional noise reduction.

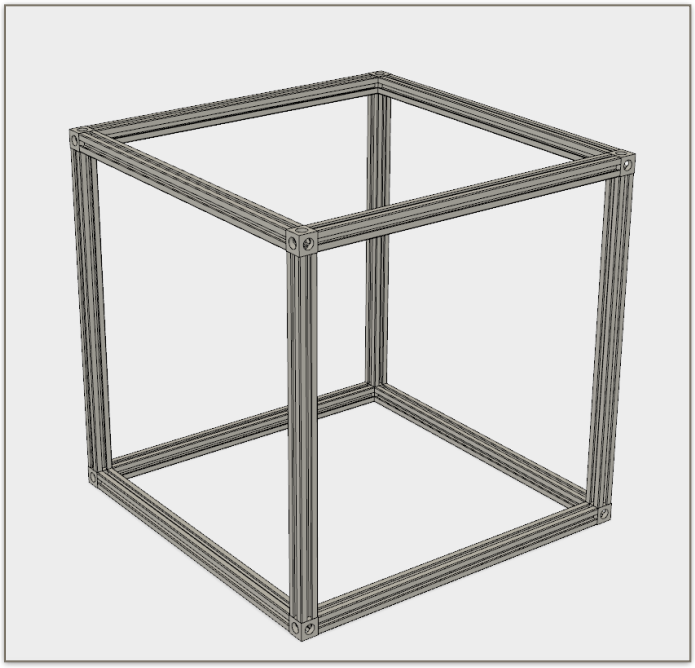
It's almost impossible to over-pack the bearings, as the shafts will push out any access grease when inserted.

To properly pack the bearings with grease without using a specialized tool, squeeze some grease into the end of the bearing, and use two 8mm shafts, inserted at each end, to compress the grease. **Apply very gentle pressure**, as you don't want to pop the seals on the bearings. Once you see the grease being squeezed out of each seal, remove one of the shafts, and push the other one all the way through to remove any access grease. Run the bearing up and down the shaft to fully distribute the grease and wipe off any excess.

This procedure will force the grease into the ball raceways and provide long-lasting lubrication and noise reduction.

Big thanks to ***dgcaste*** on VORON GitHub for this procedure.

SECTION1 : FRAME

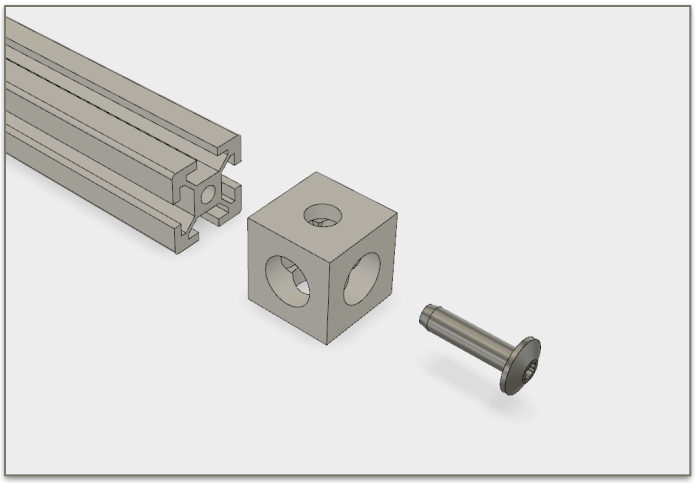


Items required:

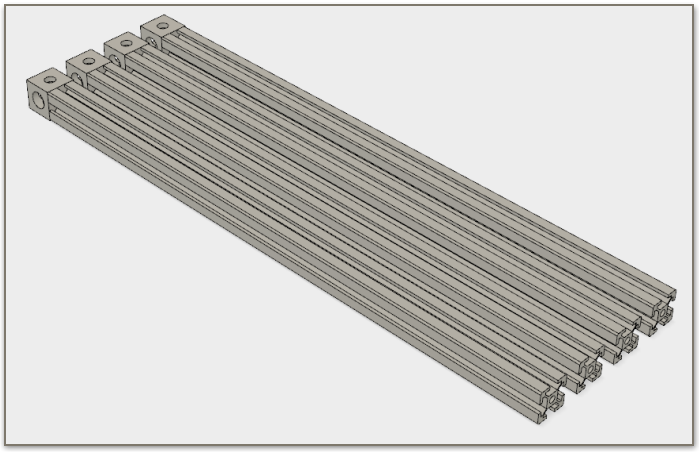
- 370mm 2020 Aluminum extrusions
- Cube Corner Connectors
- Self Tapping Torx Screws
- T Slot Nuts (M5)

We'll be building 2 squares and joining them together. Each length of 2020 extrusion needs to have the T Nuts inserted during indicated step as they will be sealed inside the structure afterwards.

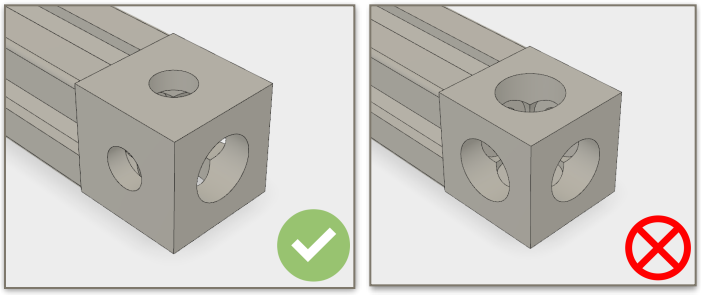
TIP: Put a piece of tape with a label on the top of each extrusion for easier orientation.



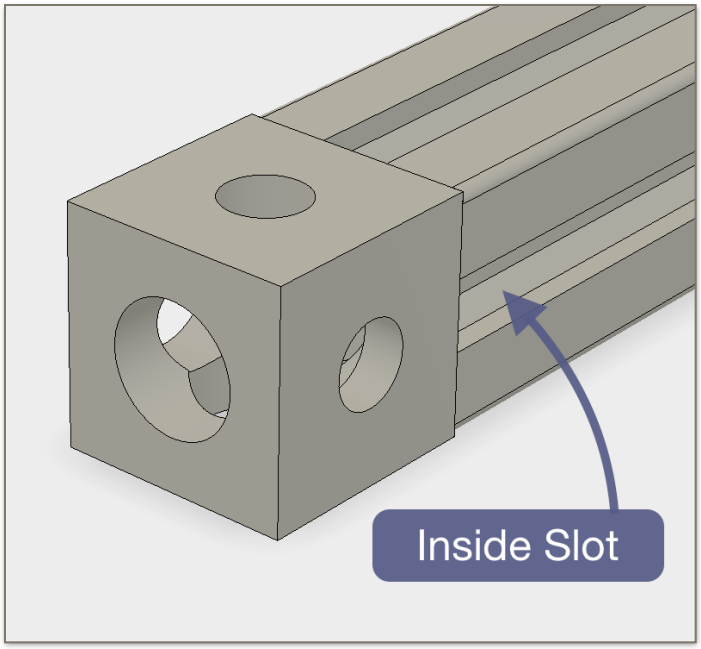
Step 1: Pre-assemble 4 lengths of bottom square. Start with the lower square. Take one of the extrusions and secure a corner connector on it using the self tapping screw. Tighten it slightly, and back it out 1/8 of a turn so it can rotate. Repeat for the remaining 3 bottom extrusions.



You now have 4 extrusions that are closed off on one end.

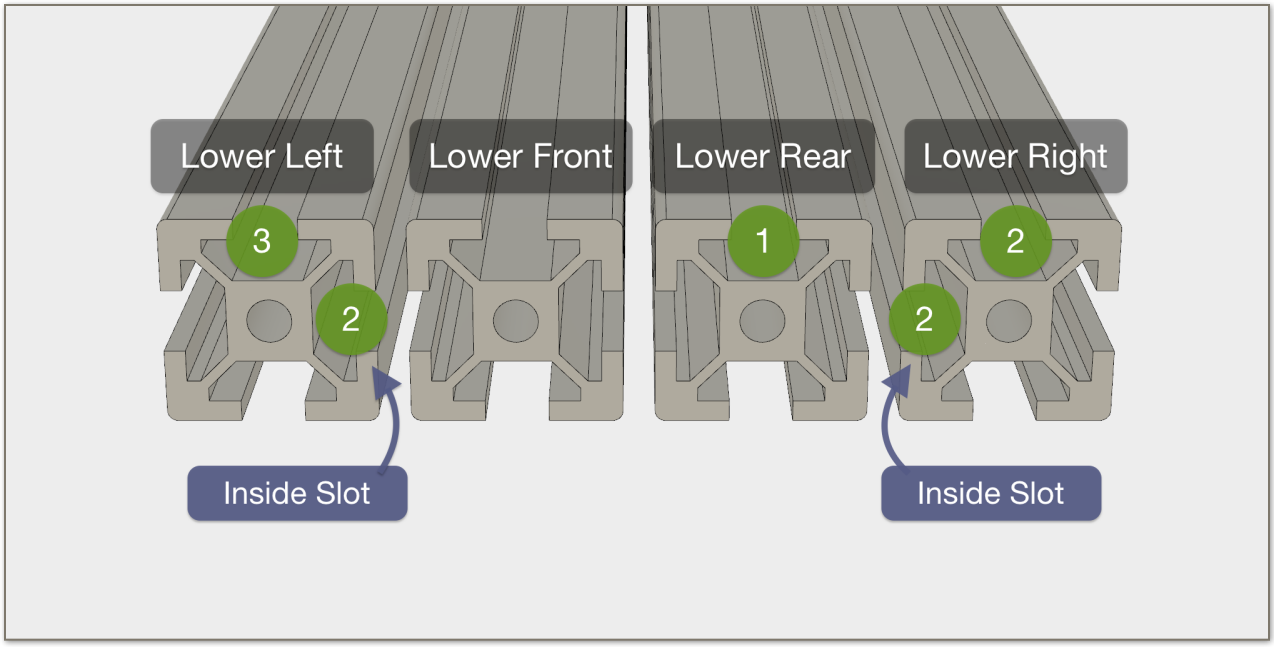


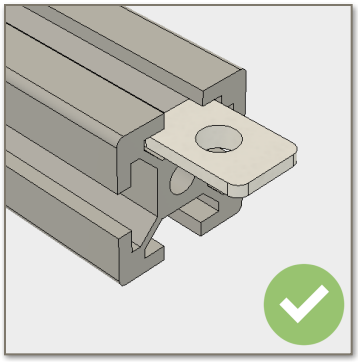
Before we insert T Nuts, make sure the extrusions are oriented correctly. For bottom extrusions, the smaller hole on the Cube Connector should face the top.

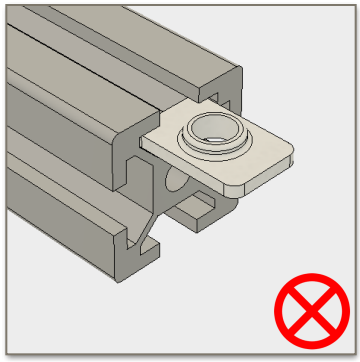


Another important thing to note is the inside vs outside slots on the rails. Inside slots face the inside of the square. The smaller hole on the Cube Connector will always be on the side of the inside slot.

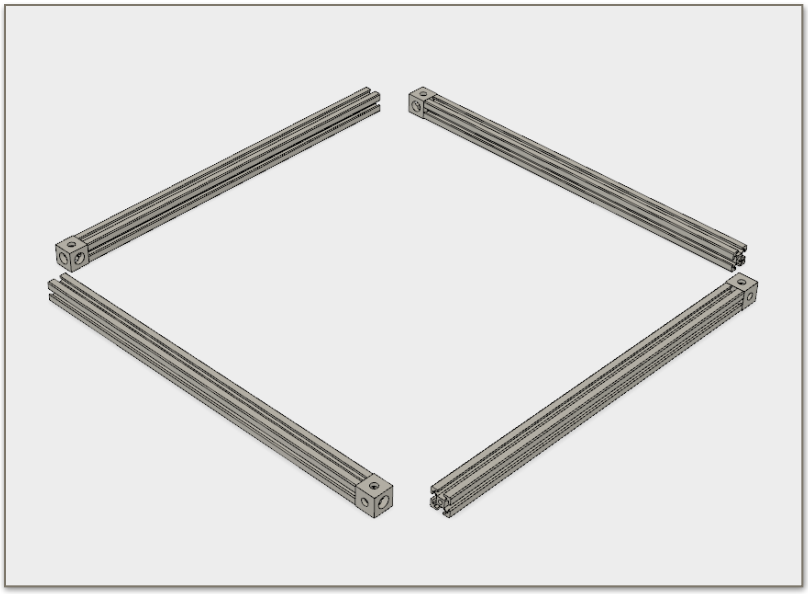
Step 2: Insert the required number of T Nuts (indicated by the green circles) into each side of the lower extrusions.



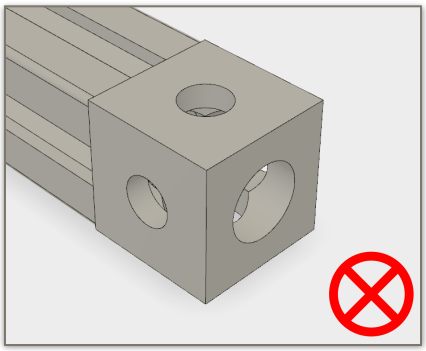


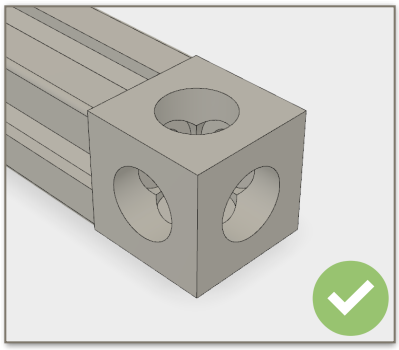


NOTE: The flat side of the T Nut should always face the outside of any extrusion slot



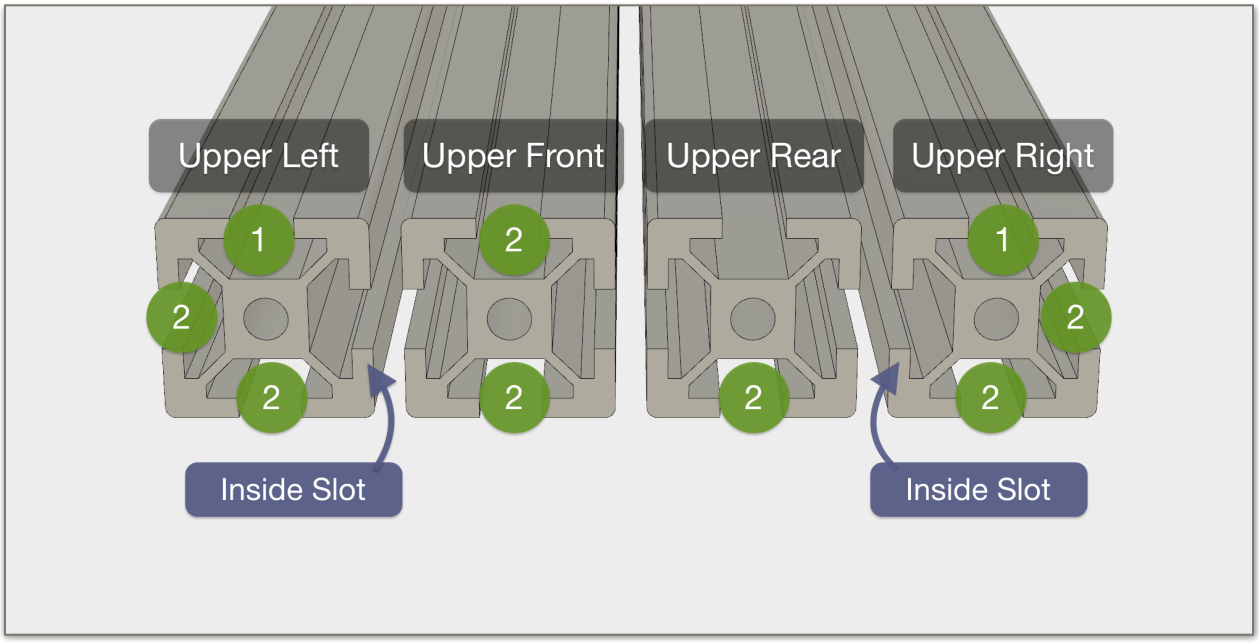
Step 3: Join the 4 pieces into a square, being mindful of the orientation and the label of each extrusion. You'll have to apply some force to get the screws to go in all the way. It's a really tight fit inside the cube. Don't worry, it'll connect. Just go slow and make sure the screws are all the way in. You can then back them out 1/8 of a turn. Make sure you are applying ample thrust so the Torx drive doesn't slip. Make sure you are on a flat surface, and tighten the screws while pushing down on extrusions.



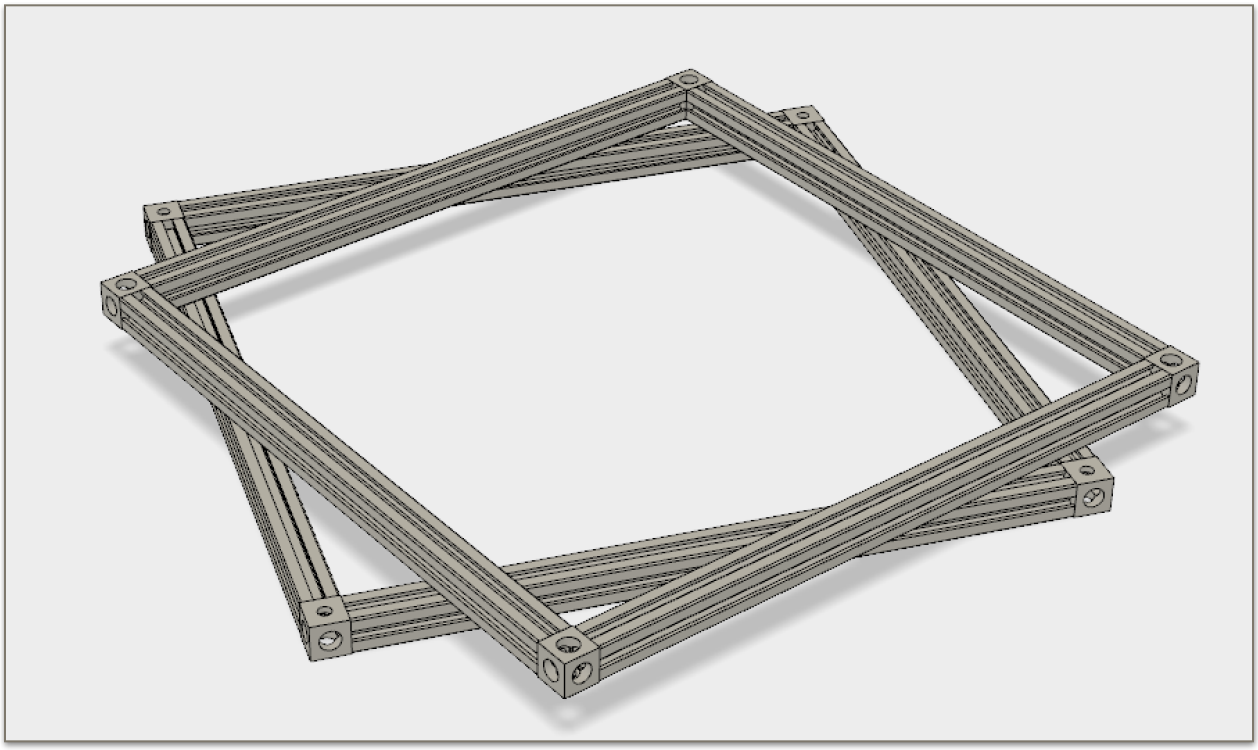


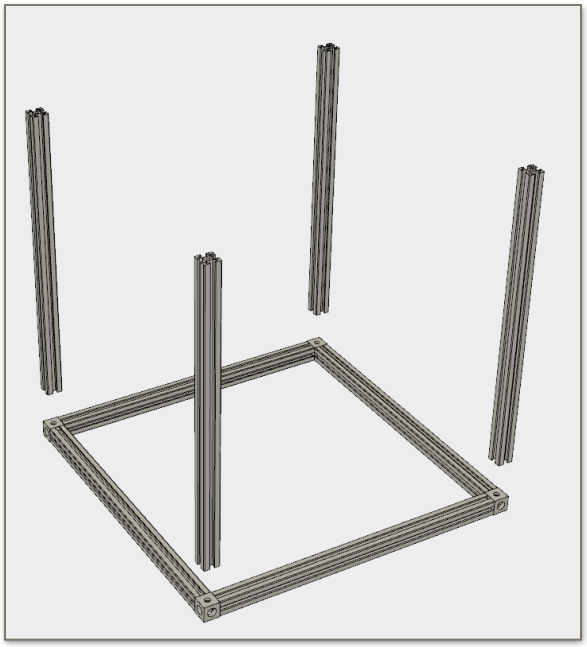
Step 4: Repeat Step 1 for the upper 4 extrusions, making sure the smaller holes on the Cubes are facing the bottom this time. This will orient them properly.

Step 5: Insert the required number of T Nuts (indicated by the green circles) into each side of the upper extrusions.



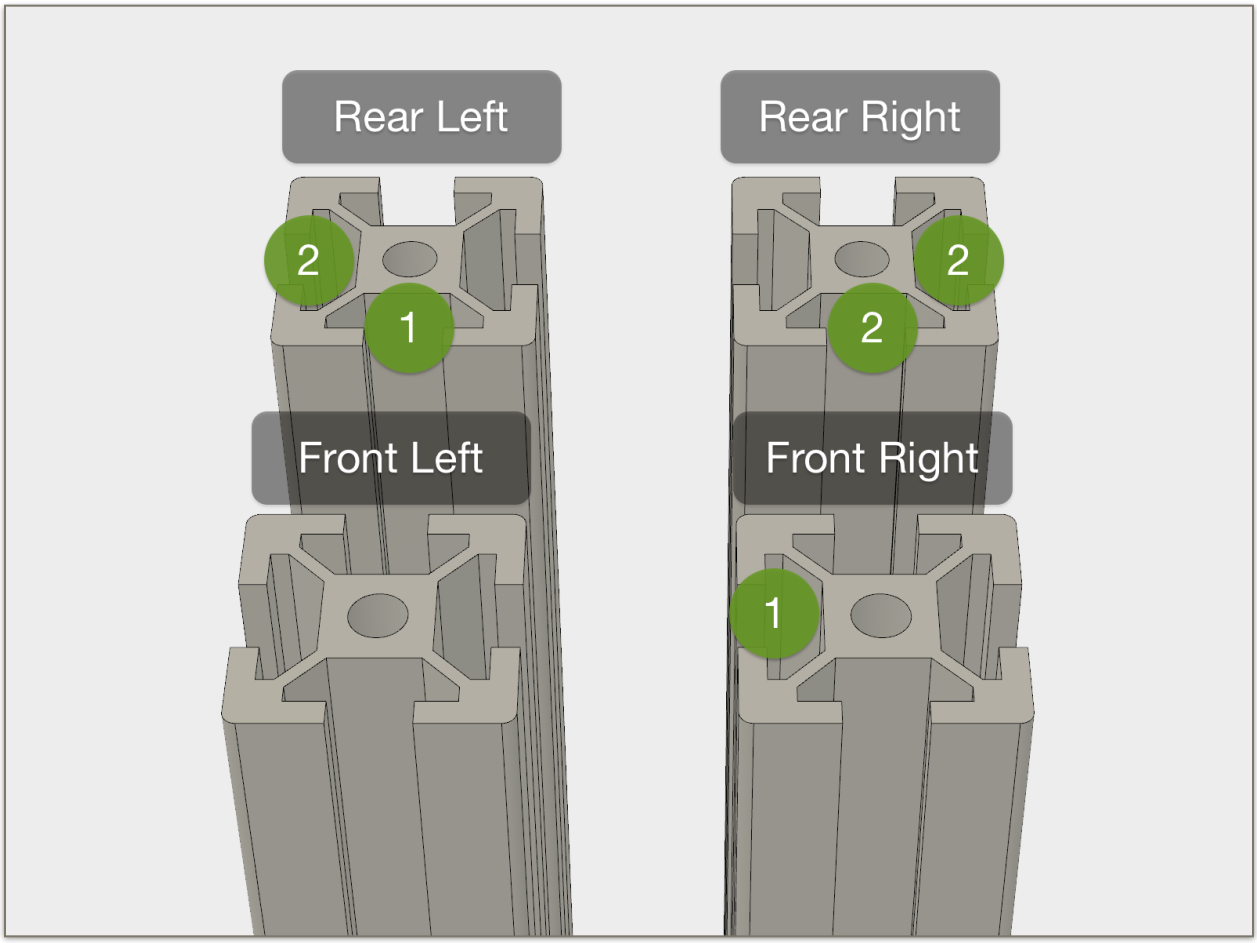
Step 6: Join the upper extrusions together same way you did the bottom ones. You should now have 2 squares full of T Nuts.



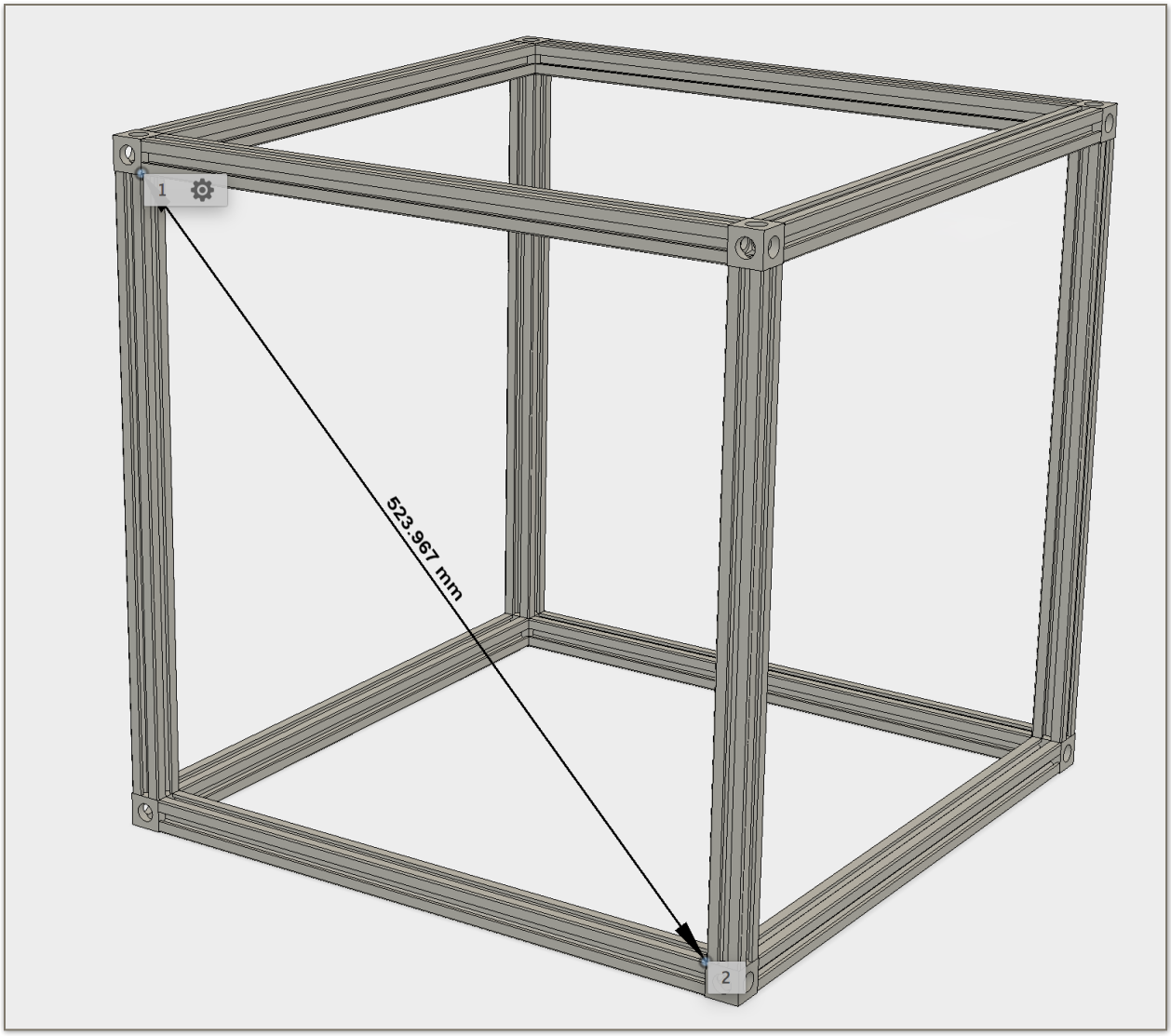


Step 6: Screw in the verticals. Make sure they don't look rotated after you've tightened them. This will throw off some dimensions later on.

Step 7: Insert the remaining T Nuts into the verticals:



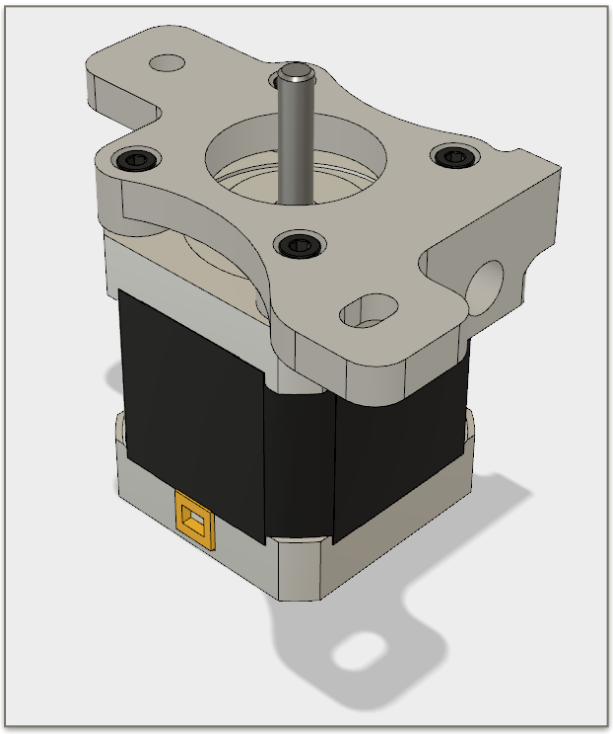
Step 8: Attach the upper square to the verticals. Tighten everything and check the diagonals with a ruler. The diagonals need to be as close to 524mm as possible. If they are off too much, you'll need to loosen some screws and re-tighten them on a flat surface. If they are still tweaked, you can gently guide them into true with some strategically applied pressure. Having a square frame will save you a lot of calibration headaches in the future.



Congrats! You now have a solid frame to build your printer on. On to the more fun bits.

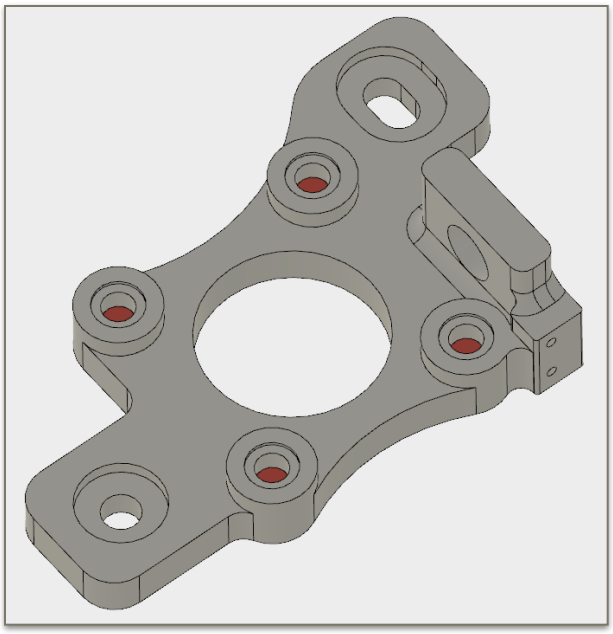
SECTION2 : GANTRY

2.1 A/B Motor Mounts



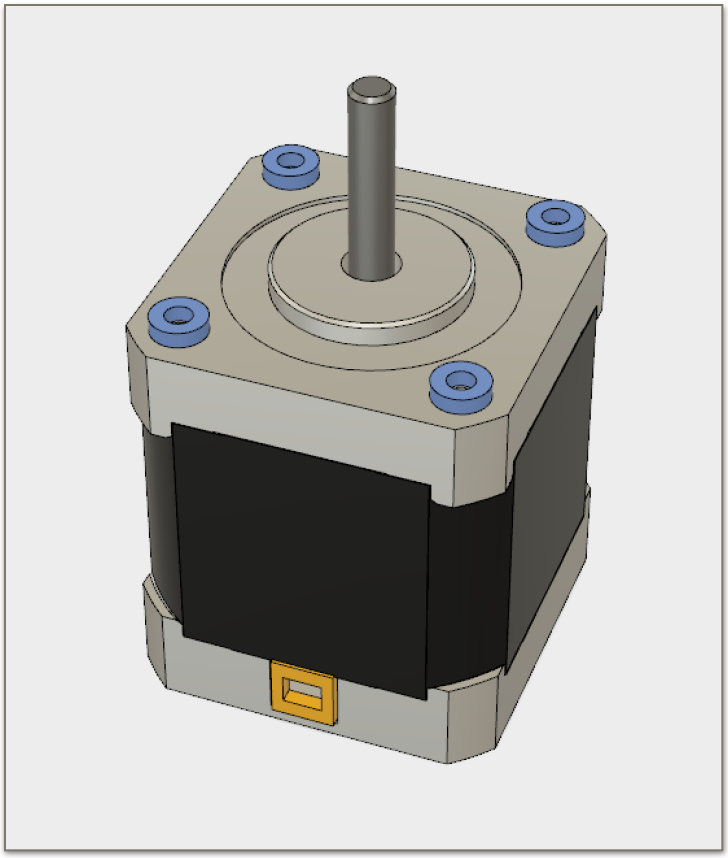
Items required:

- A and B Motor Mount printed parts
- NEMA17 Stepper Motors
- M3 Silicone Washers
- M3 8mm screws

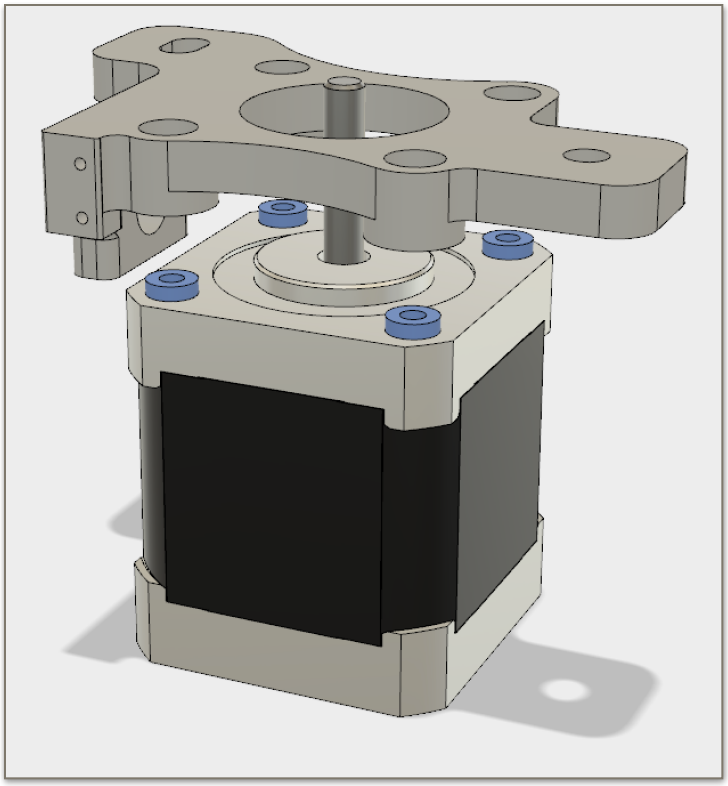


Step 1: First, a little cleanup. You'll need to remove some bridging support material from the motor mount holes (colored red in the illustration). 4mm drill bit does the job quite well, but a small knife will do the trick.

Now is a good time to check if the 8mm shaft fits into its mount point. It should be a snug fit, but go in with only a little pressure. If you feel you have to hammer it in, *stop* and clean out the hole a little.



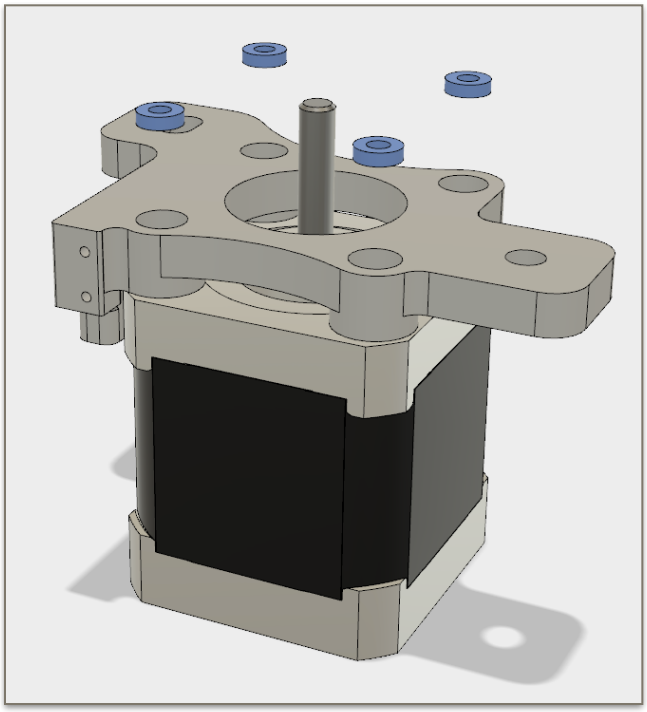
Step 2: Place the NEMA17 stepper on a level surface, and place 4 silicone washers on top of it, aligning them with the holes on the stepper. The washers are a little sticky and should stay in place.

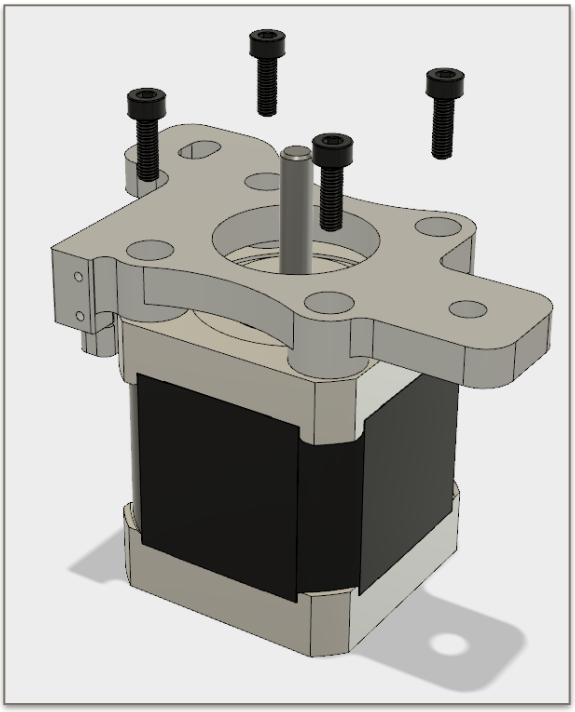


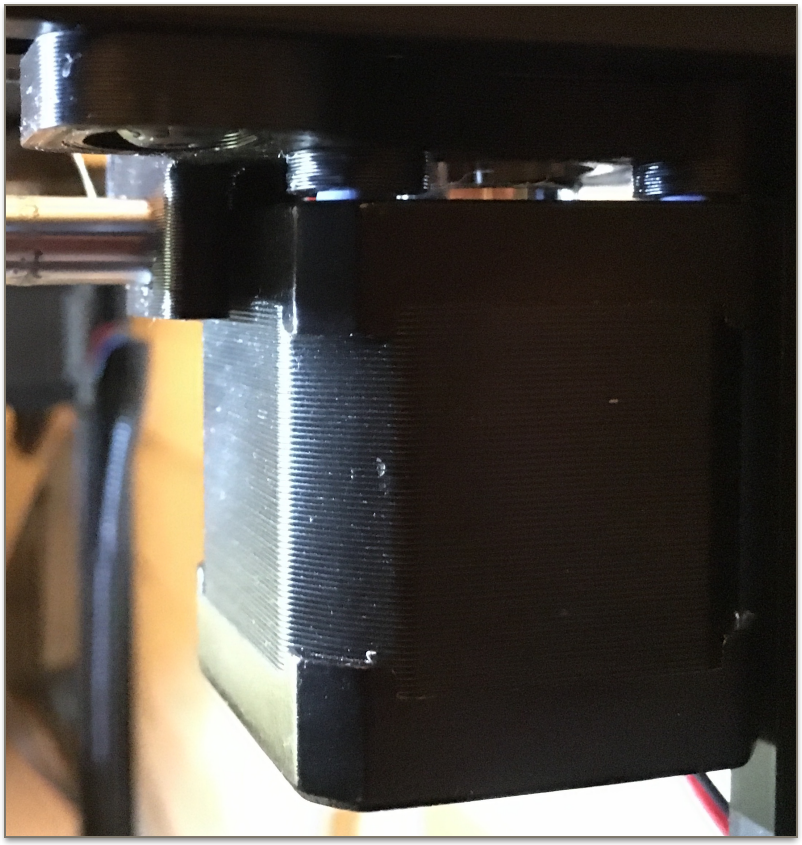
Step 3: Line up the motor mount over the 4 holes, and lower it on top of the washers. The small shoulders on the A/B mount should catch the washers, so if you have to move the mount to get everything to line up properly, the washers should now move with it.

Make sure the motor wires are on the opposite side of the 8mm mount point, so they face the rear when installed on the frame.

Step 4: Insert 4 silicone washers into the top holes, and secure the motor with 4 M3 8mm screws



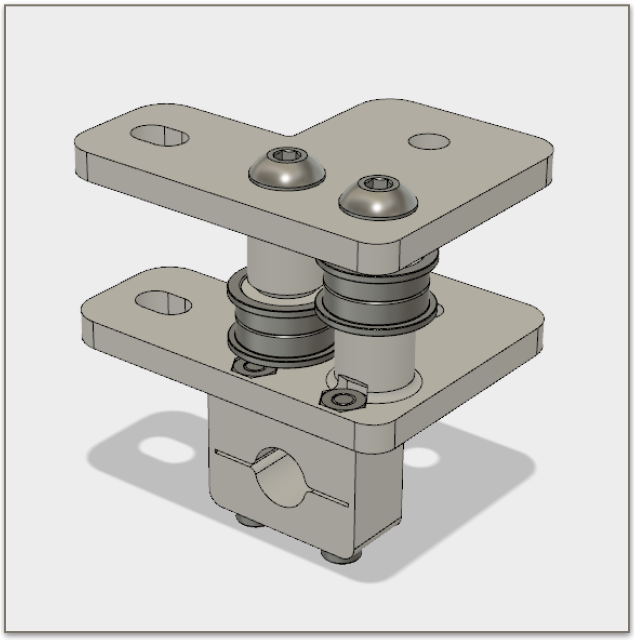




Tighten the screws until there's about 0.5mm gap between mount and the motor. You should still be able to see the blue washers between the stepper and the mount. We're trying to stiffen the joint, while preventing the stepper from making contact.

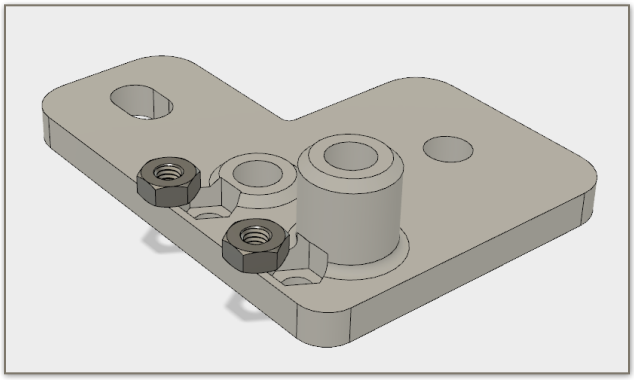
Repeat this process for the other motor mount.

2.2 A/B Idler



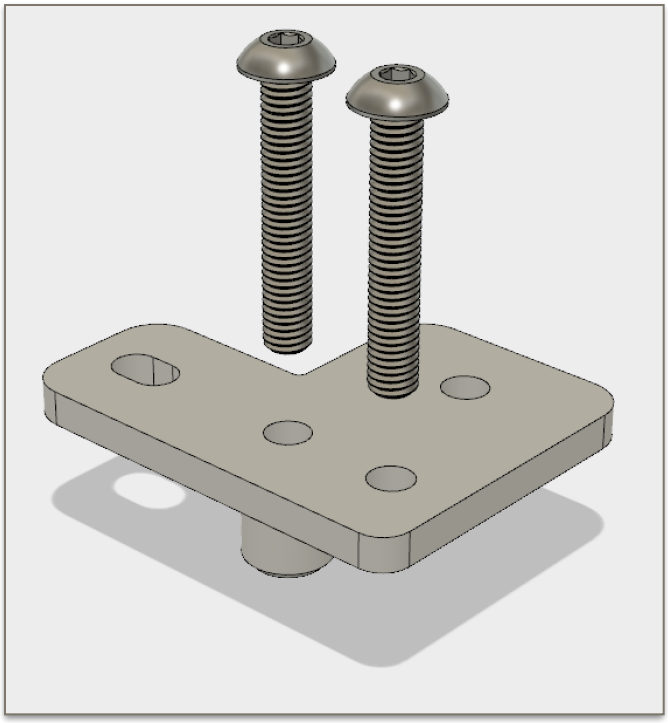
Items required:

- A and B Idler Mount printed parts
- M5 30mm screws
- F695 bearings
- M3 hexnuts
- M3 20mm screws

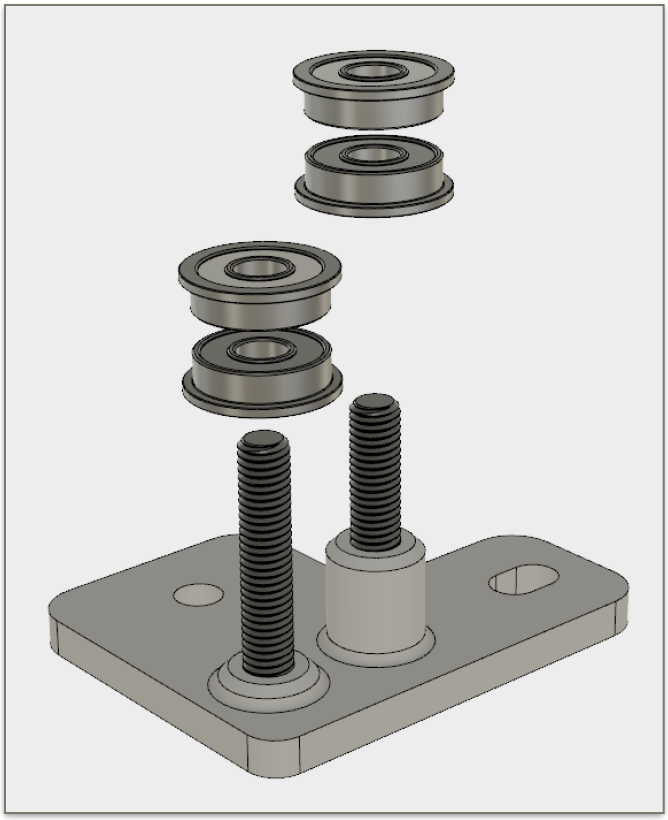


Step 1: Insert M3 hex nuts into the lower idler plate.

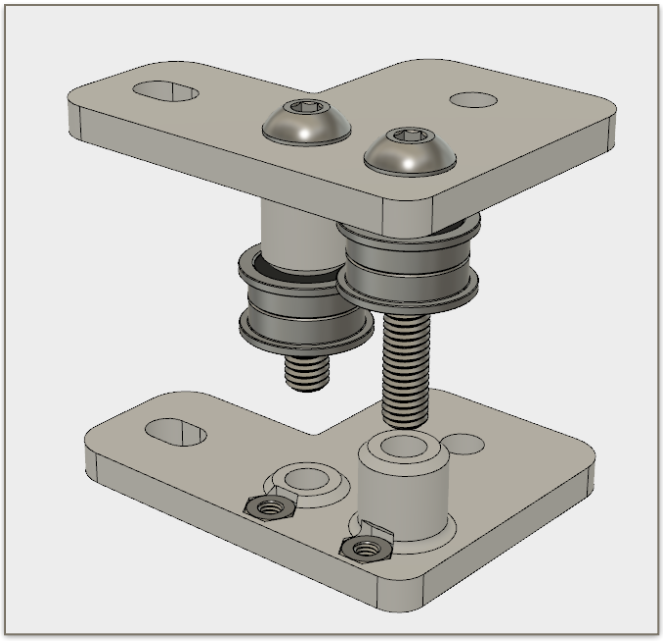
WARNING: Do not drill out the bottom 2 idler posts. We need them to be snug so the screws have something to form threads in.



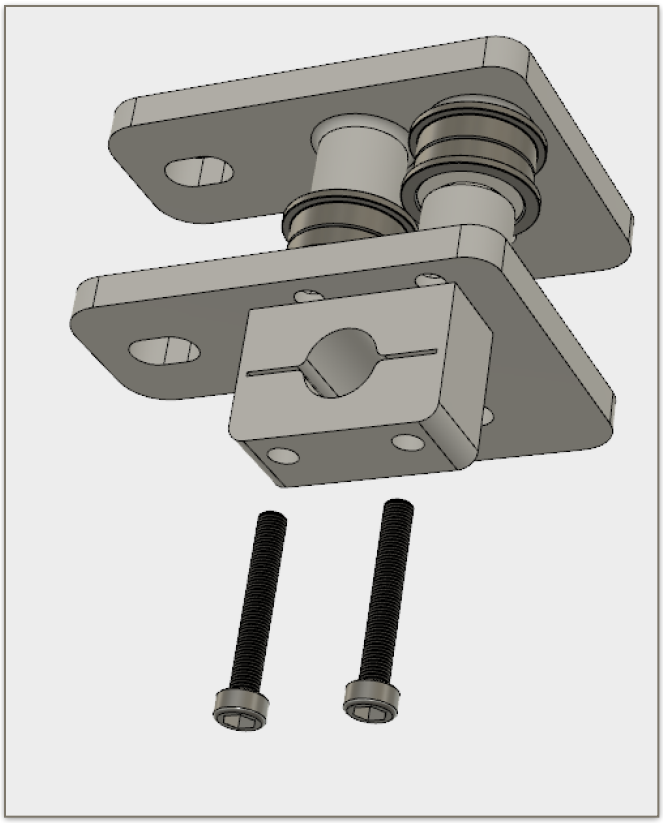
Step 2: Screw the M5 30mm screws into the upper idler plate, and give them a few twists so they break the threads they just formed in the plastic. These holes have intentionally tight tolerances.



Step 3: Slide the F695 bearings over the screws as pictured. The flanges will form the shoulders of the belt idler.



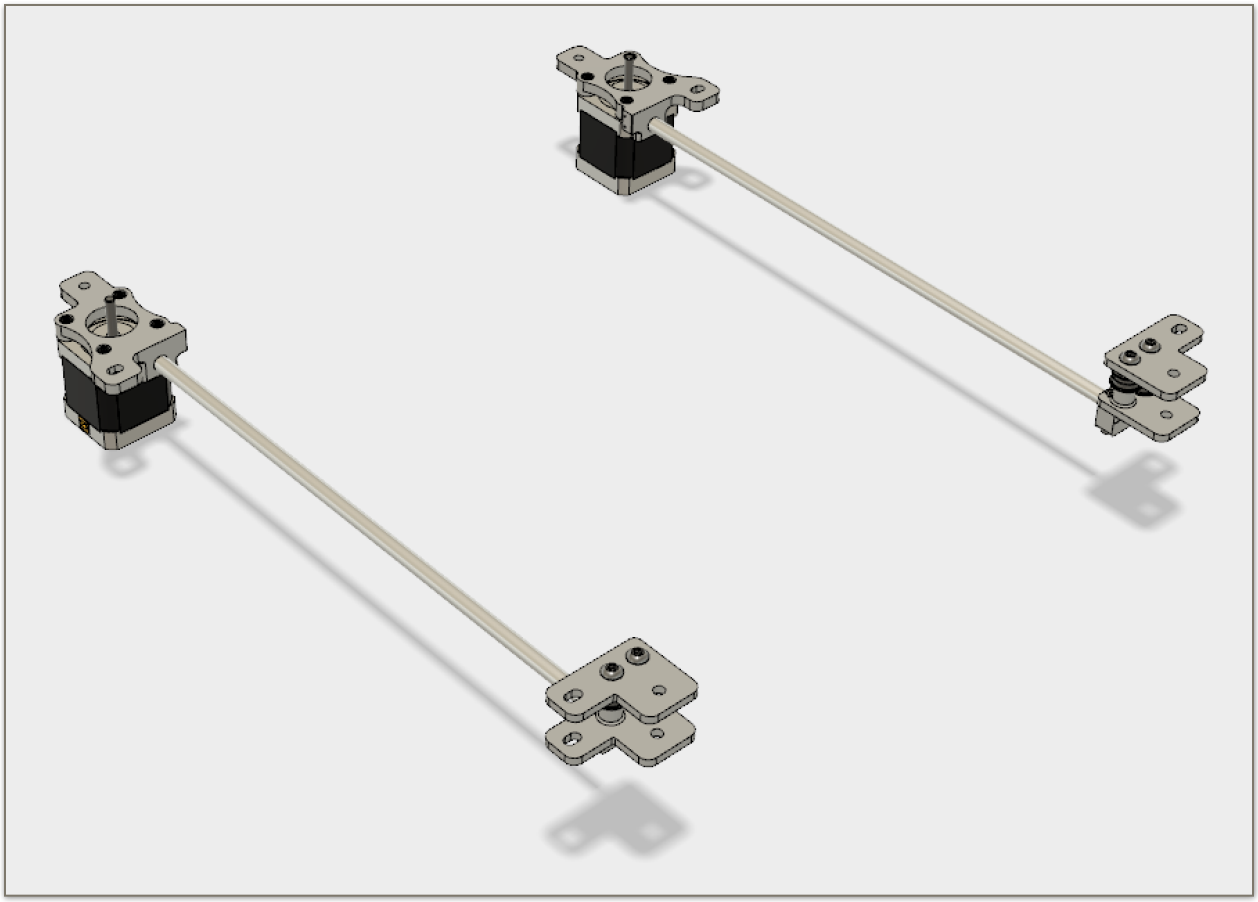
Step 4: Screw on the bottom idler plate. Do one turn per screw and alternate to keep them level with each other. Don't over-tighten. Remember, you are threading into printed plastic. These screws are only going to experience lateral forces, and the actual force of keeping the two plates together will come from the 4 screws that will secure this part to the frame.



Step 5: Using 2 M3 20mm screws, secure the Y shaft retainer into the lower idler plate. We're not tightening these yet, just keeping them in place for later.

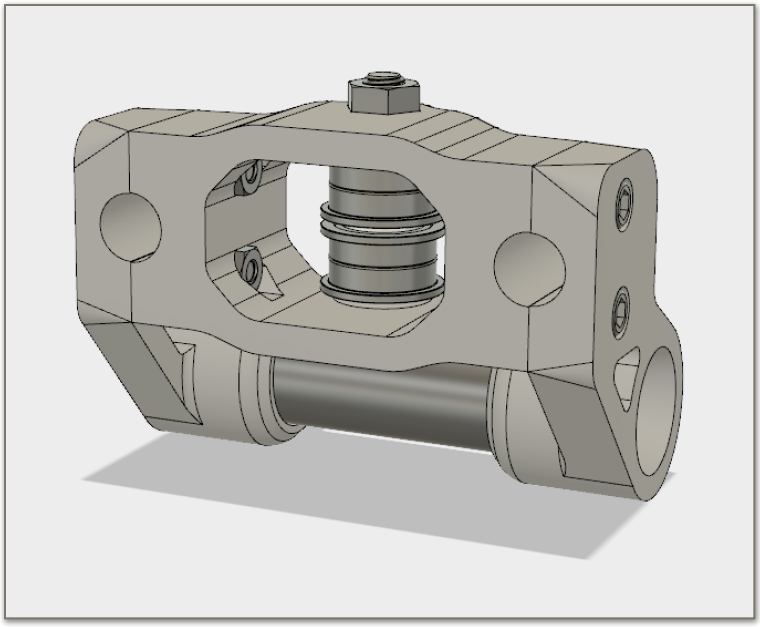
Repeat these steps for the other idler.

Woo! You now have a Y axis!



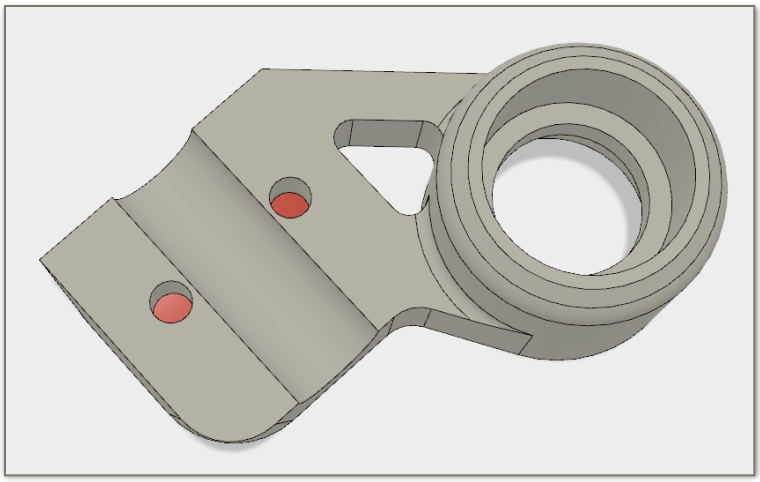
After you're done admiring your handiwork, remove the Y shafts. They will be installed after the components are bolted into the frame.

2.3 XY Joint

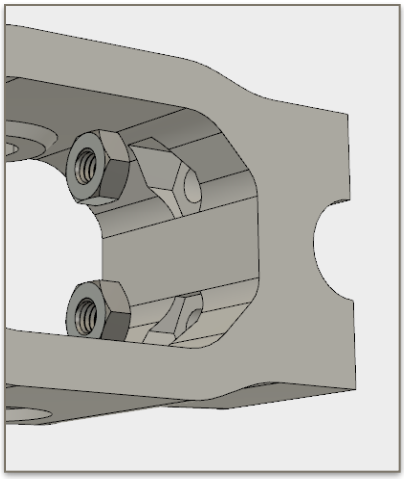


Items Required:

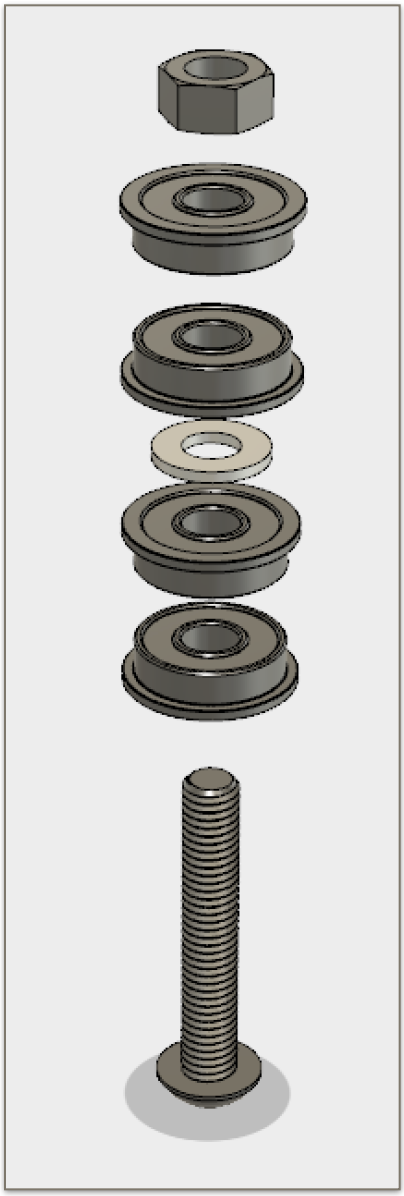
- XY Joint printed parts
- M5 30mm screws
- M5 hex nuts
- M5 washer
- M3 16mm screws
- M3 hex nuts
- F695 bearings
- LM8LUU bearings



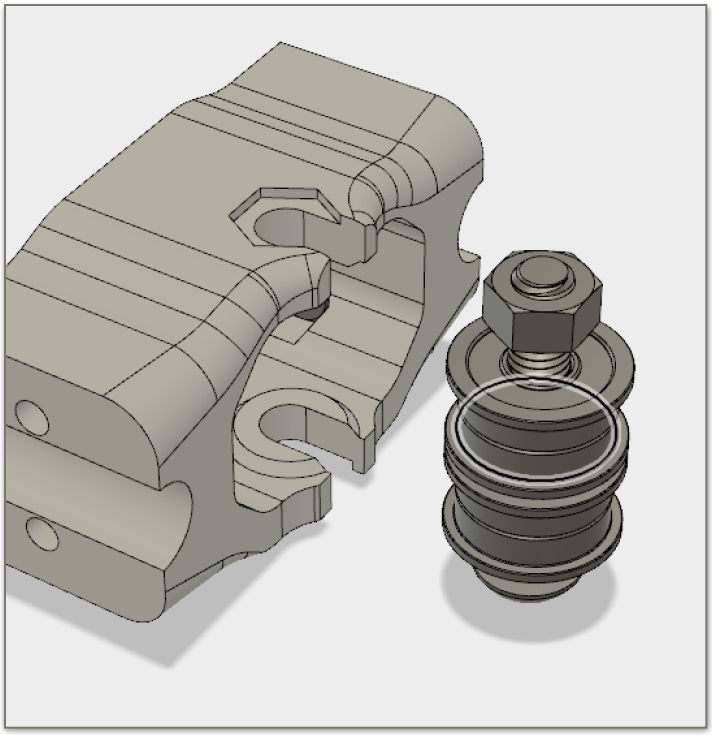
Step 1: Clean out bringing supports from the M3 holes on each side pieces of the XY Joints. You can use a 3mm drill bit here.



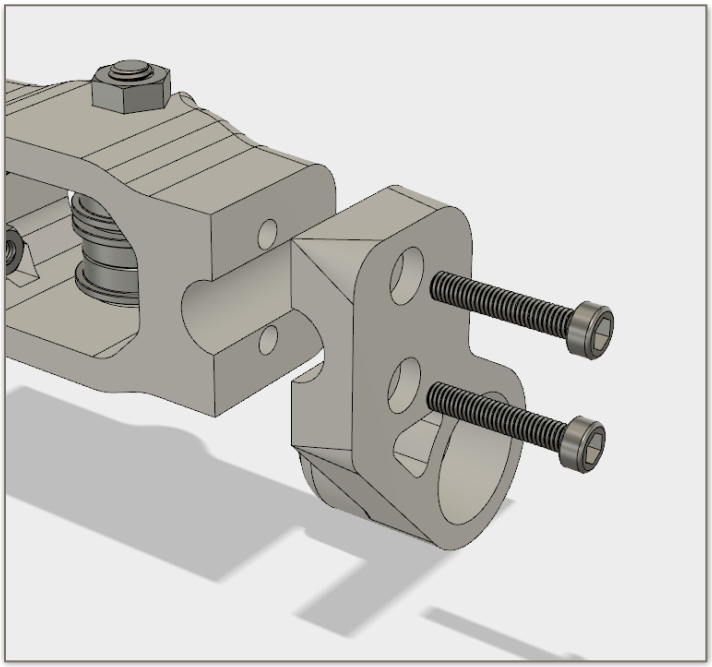
Step 2: Insert M3 hex nuts into both inner walls of the mid section.



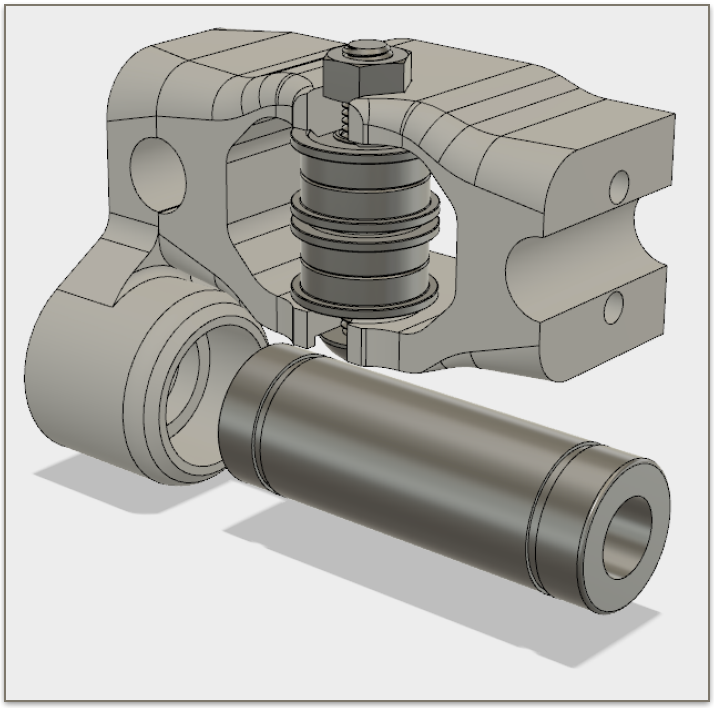
Step 3: Stack F695 bearings and an M5 washer to form an idler assembly. Close the screw off with the M5 nut, but don't tighten it yet. You just want the assembly to not fall apart.



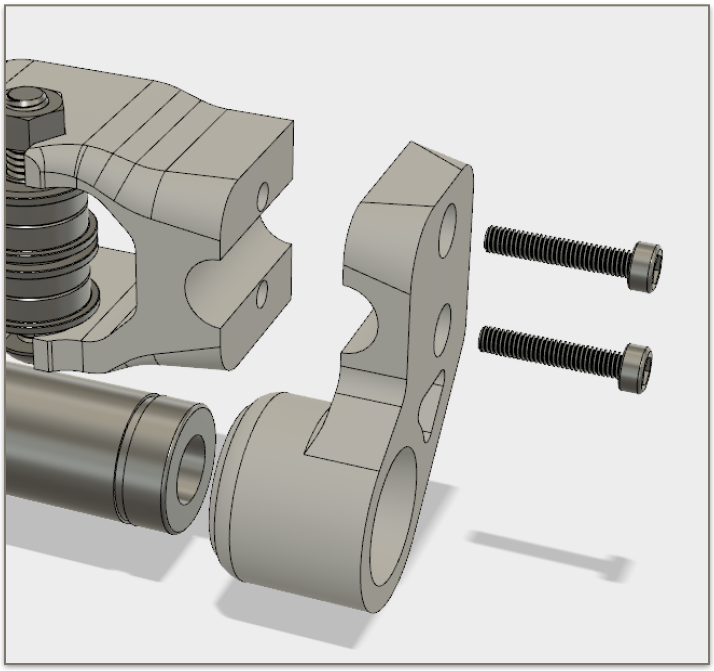
Step 4: Slide the idler assembly into the slots on the midsection. **Make sure the hex nut is facing up**. Line it up with the hex nut trap on the mid section when inserting. Tighten the assembly, but be careful not to over tighten it. Depending on the tolerances on the bearings, too much tension may cause them to bind.



Step 5: Attach one of the sides to the mid section using the M3 16mm screws. Don’t tighten them yet. Again, the M5 nut indicates the top.



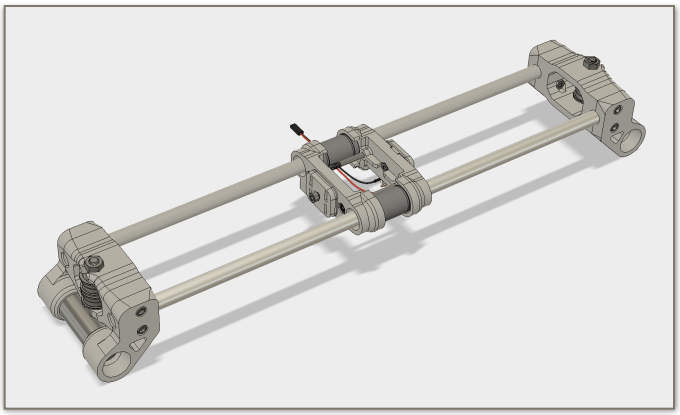
Step 6: Slide a pre-greased LM8LUU bearing into the side. I'll be a snug fit. Press the bearing in until it hits the lip inside it's retainer.



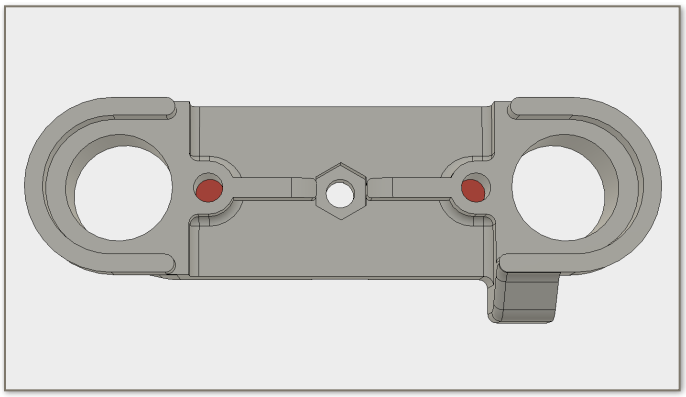
Step 7: Attach the other side of the XY Joint, while pressing it onto the other end of the LM8LUU bearing. Again, don't fully tighten the M3 screws yet.

Repeat the steps for the other XY Joint.

2.4 X Carriage / X Axis (REV B)

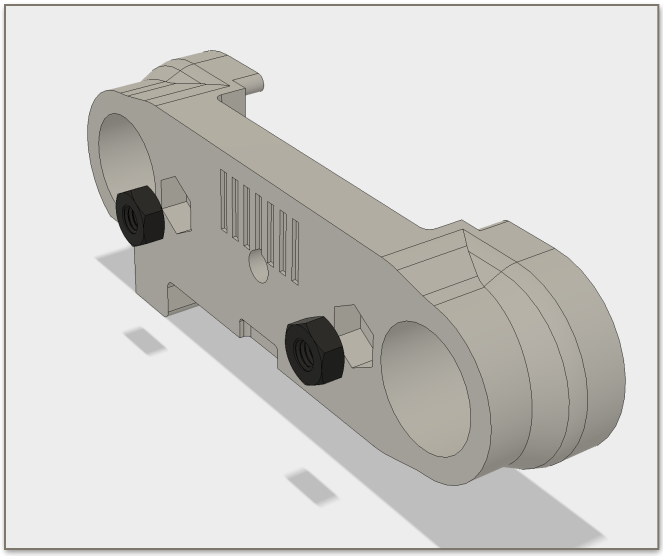


Items Required:
- Assembled XY Joints
- 8mm rods
- X Carriage printed parts
- Endstop Microswitch
- M3 hex nuts
- M3 Threaded inserts
- Phillips Screws No. 1
- LM8UU bearings
- M3 40mm screws

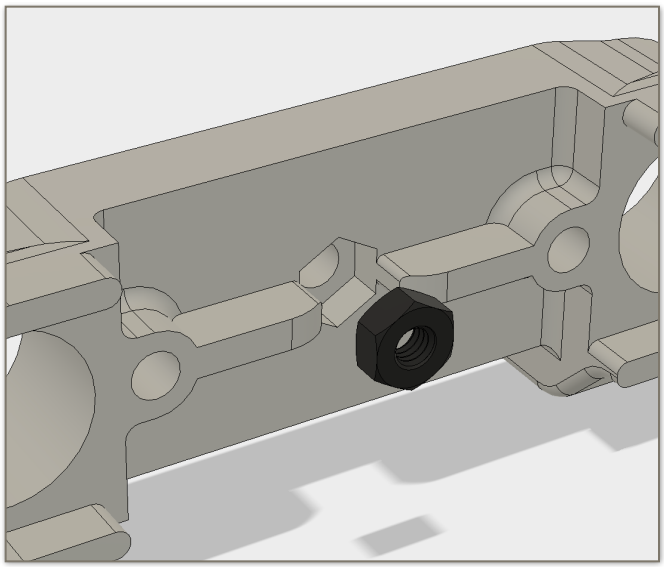


Step 1: Clean out the 3mm holes on both X Carriage Ends (indicated in red).

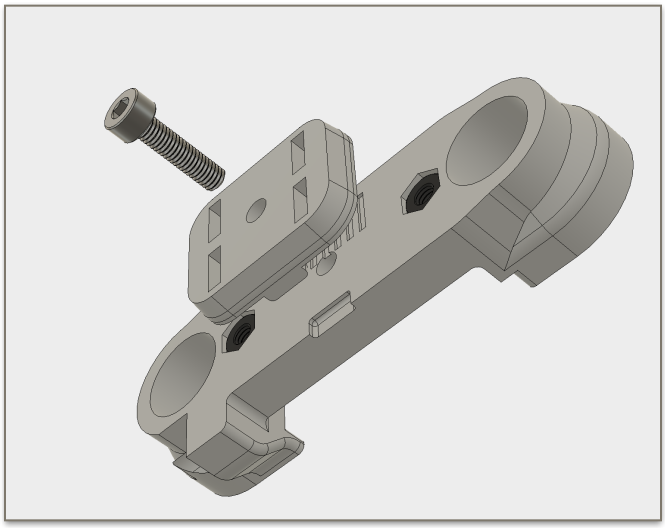
Step 2: Install M3 hex nuts into the nut traps on one of the X Carriage Ends.



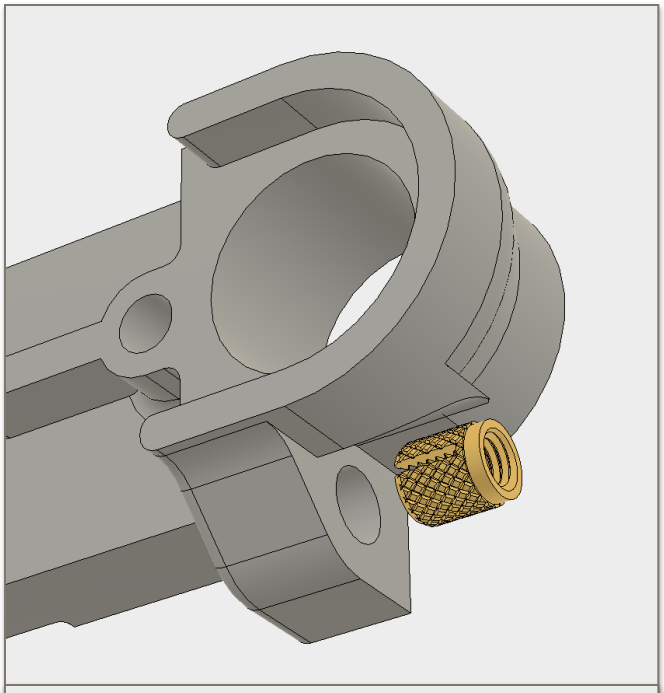
The inside M3 screws need to go into both Carriage Ends.



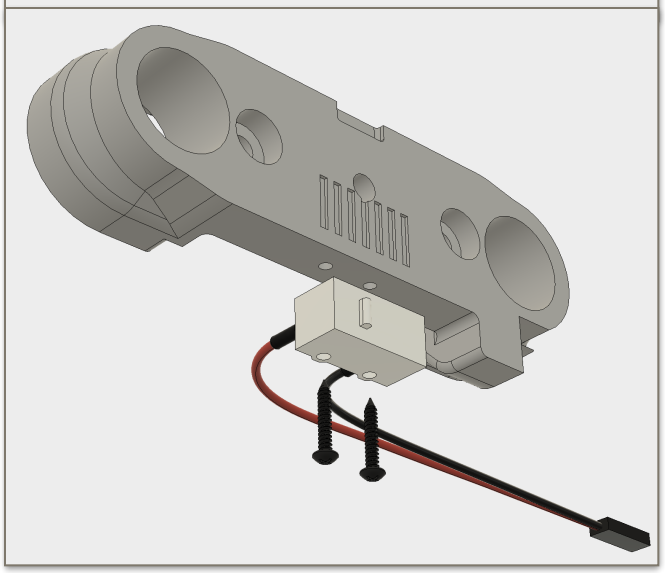
Step 3: Attach the belt clips to each Carriage End. Make sure the locating pin on the clip lines up with the slot on the Carriage End.



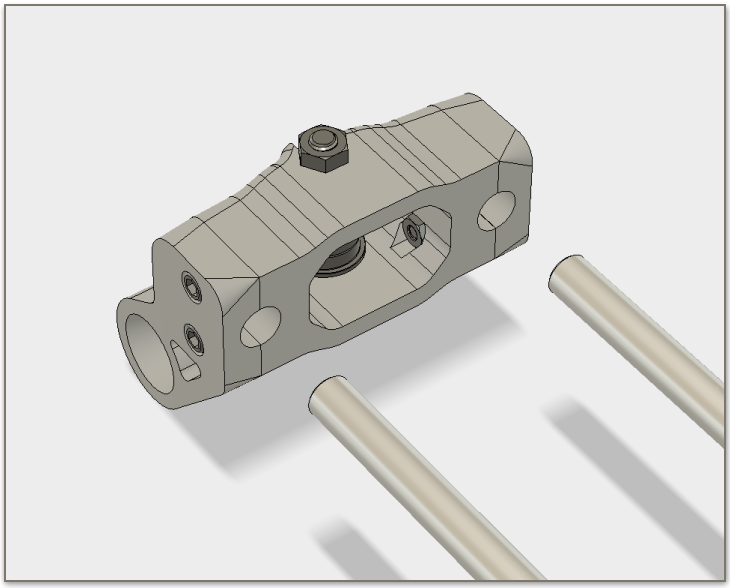
Step 4: Install the M3 threaded inserts into the back of both X Carriage Ends. Use a soldering



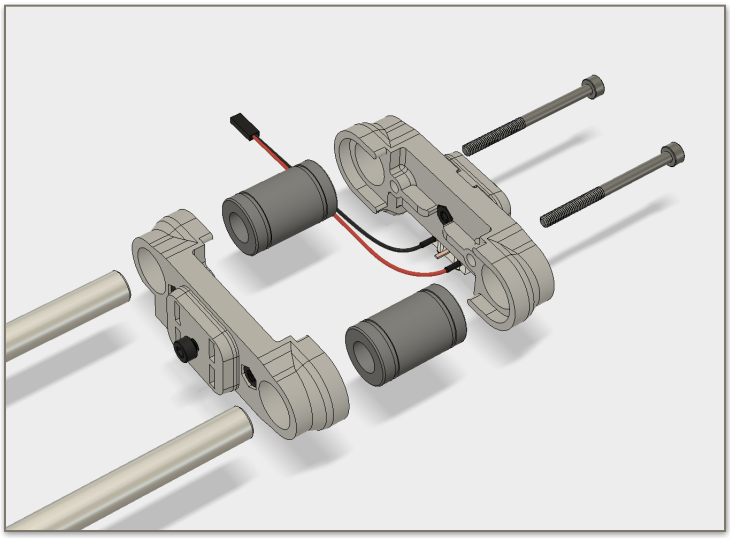
iron to heat the inserts as you insert them. This will insure you don't break the printed part in the process, and cement the insert in place. After it cools, you can trim off any leaked out plastic with a knife.



Step 5: Attach about 100mm of wire with a Dupont connector to the end-stop microswitch. Make sure to wire it as normally closed (NC). Use the phillips screws to attach it to the Carriage End. The holes are only on one of the carriage ends. Don't over-tighten the screws.

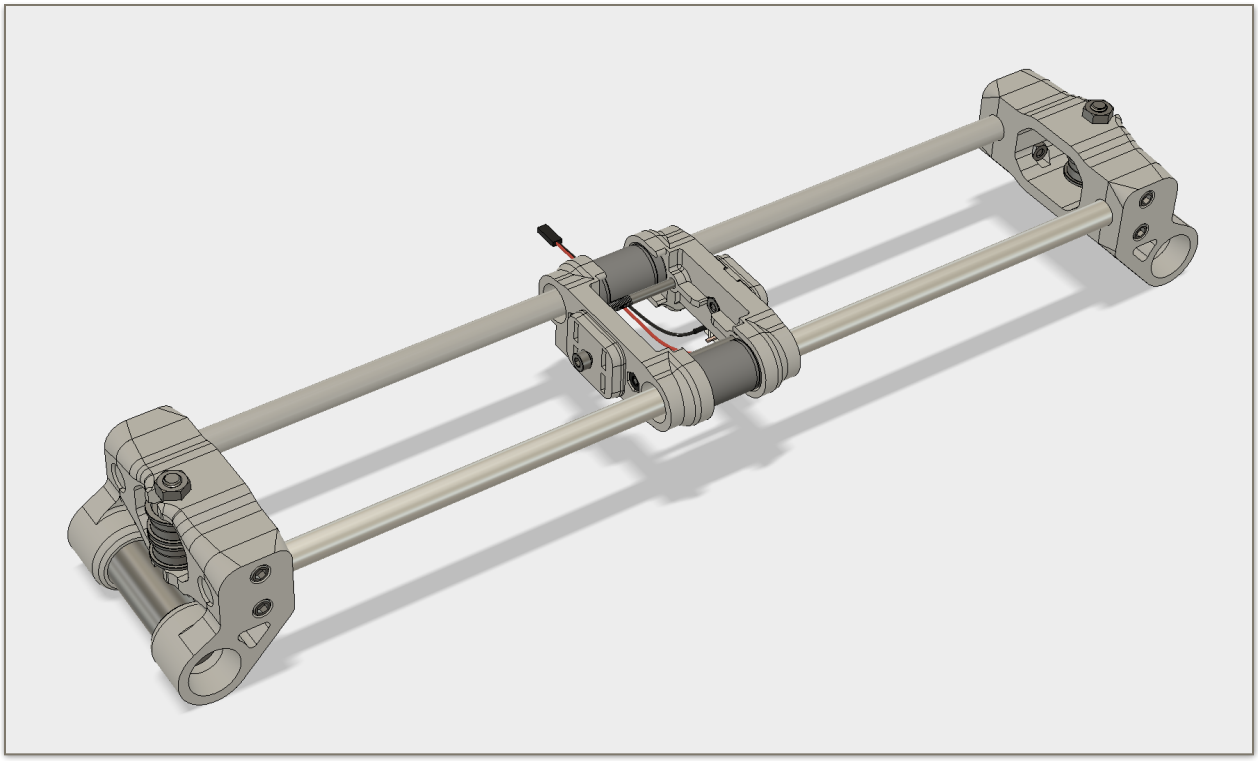


Step 6: Slide the 8mm shafts into one of the XY Joints. Tighten the side screws so the rods won't slide out, but are still able to be rotated by hand.



Step 7: Slide the Carriage Ends and the pre-greased LM8UU bearings onto the 8mm shafts. Make sure the threaded inserts are on the bottom and are facing the same direction. You can keep the assembly together using the M3 40mm screws. Just don't torque them down yet.

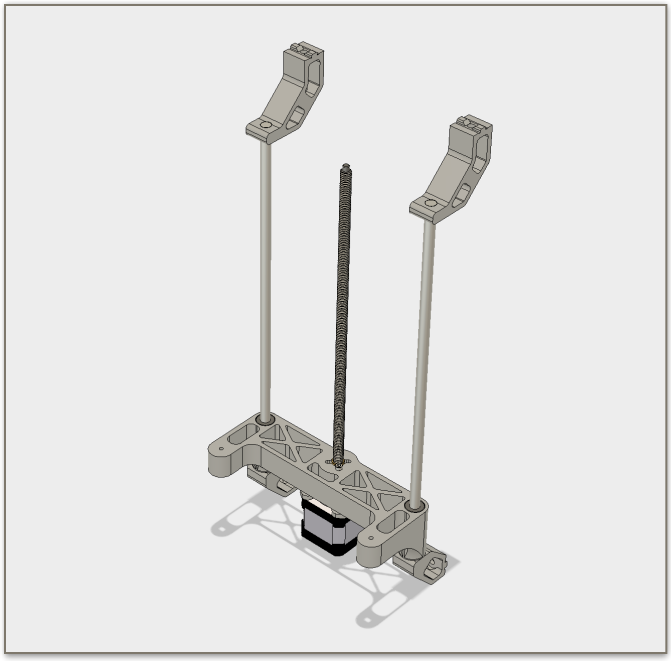
Slide the remaining XY Joint onto the other end of the shafts.



Alright! You have your X axis now, and with that your gantry is ready to be installed onto the frame.

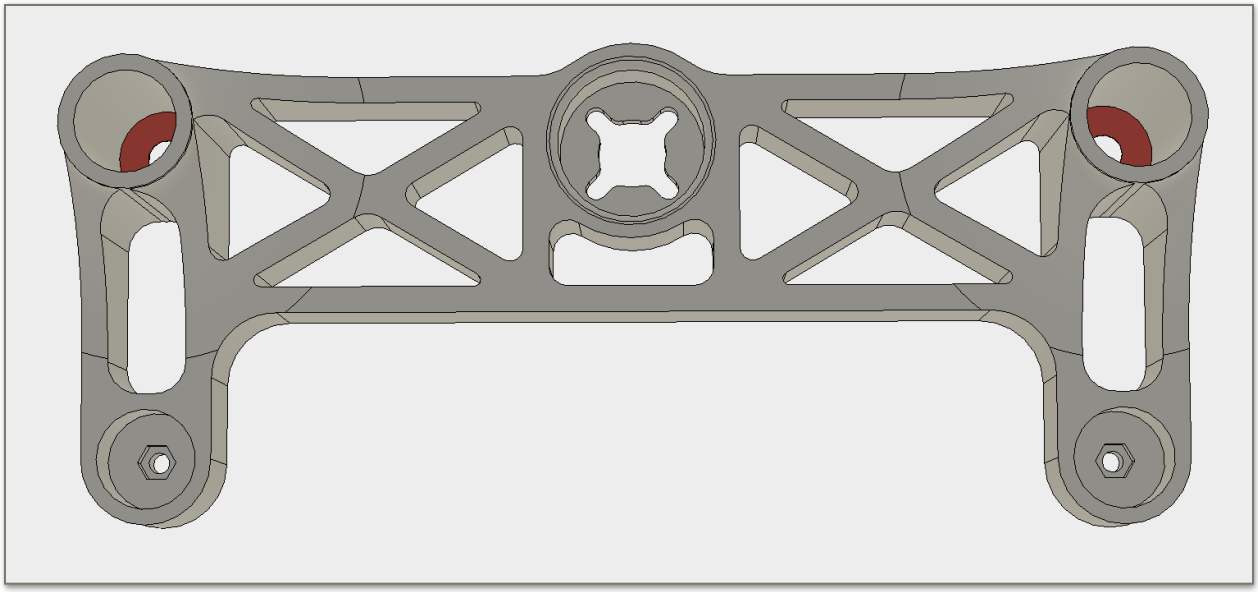
We will attach the rest of the components to it after we align everything.

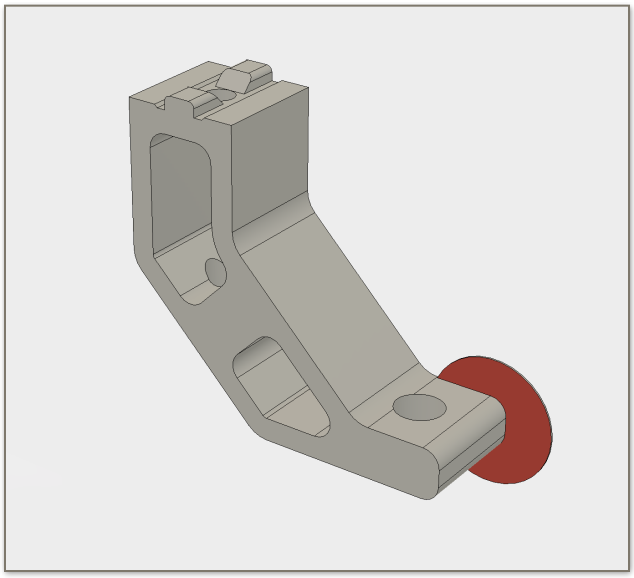
SECTION3 : Z TOWERS

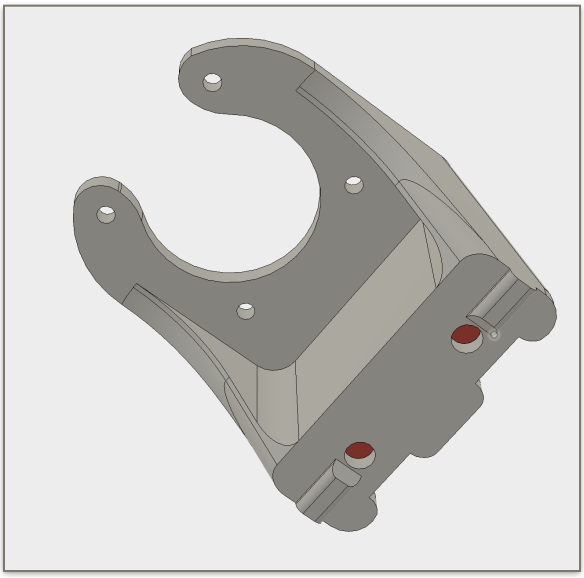


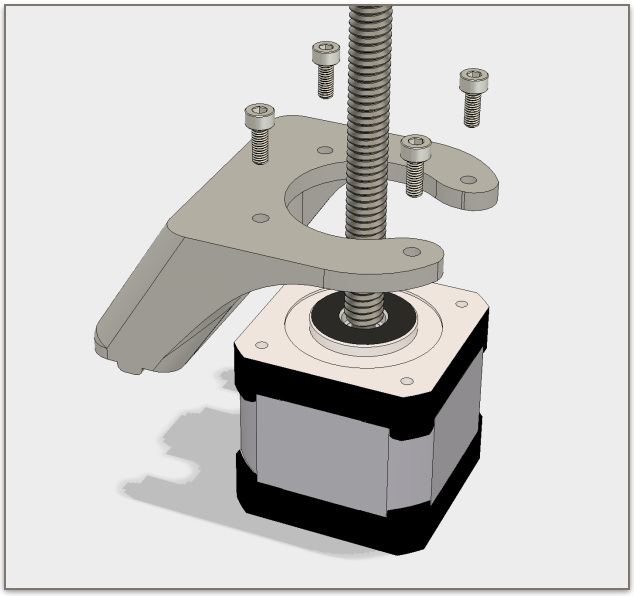
Items Required:
- Z Tower printed parts
- 8mm shafts
- TR8x2 NEMA17 linear motors
- TR8x2 nuts
- LM8LUU bearings
- M3 8mm screws
- M3 lock nuts

Step 1: Prepare the printed parts for assembly by removing adhesion tabs, and clearing out any holes that have bride supports.

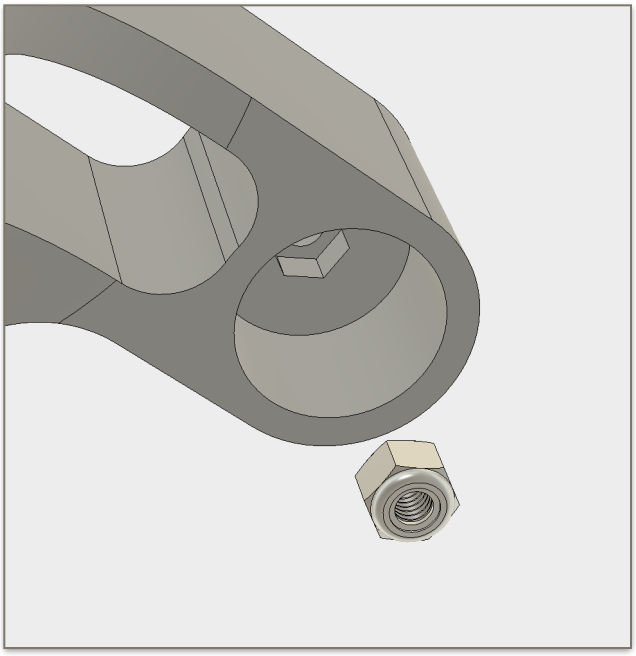




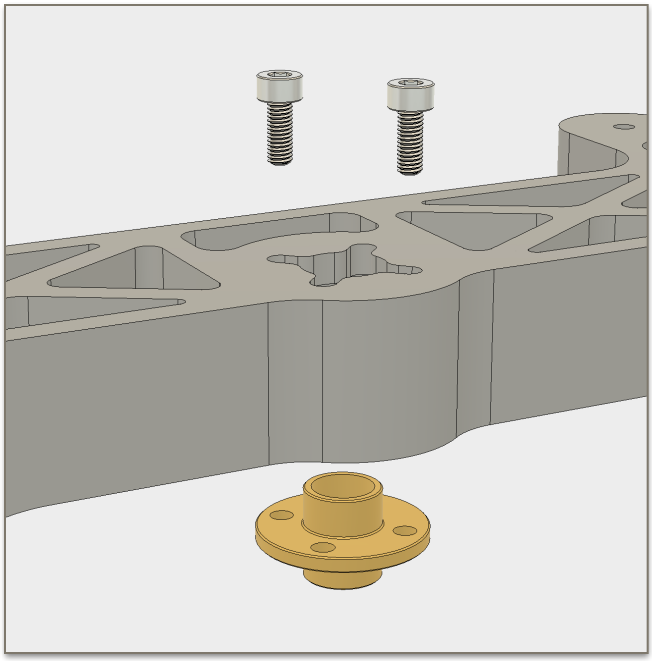




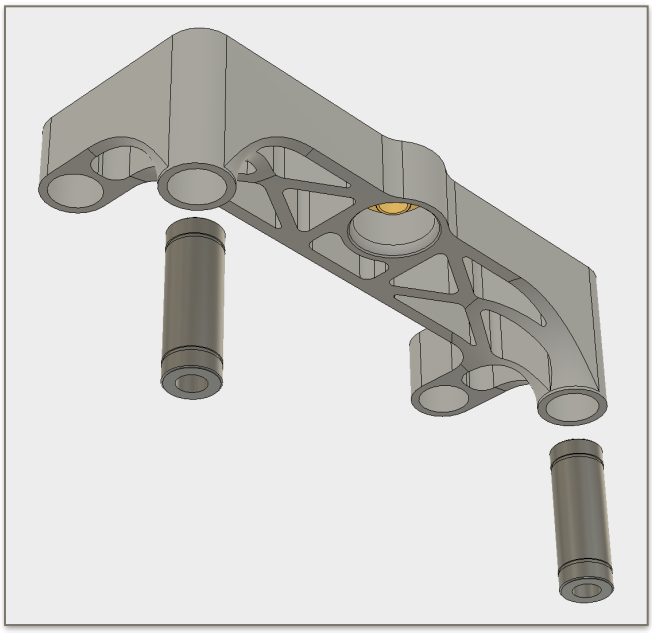
Step 2: Attach the NEMA17 linear motor to the Z motor mount using the M3 8mm screws.



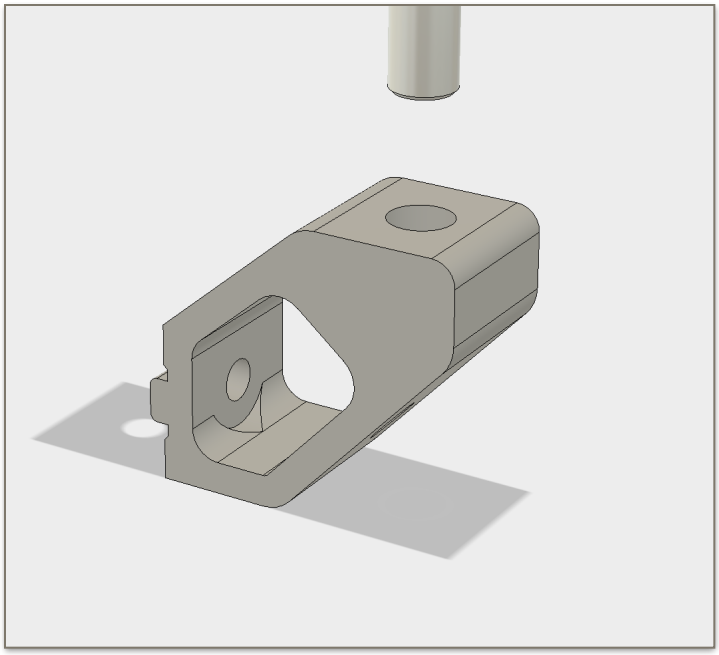
Step 2: Insert the M3 lock nuts into the nut traps on the bed carriage



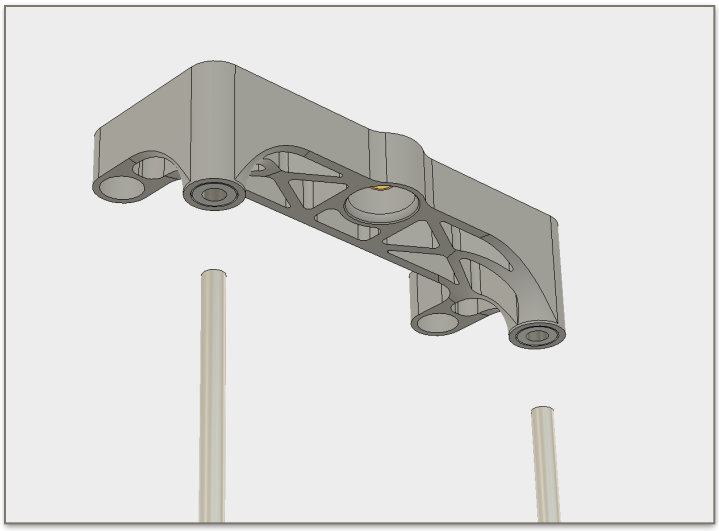
Step 3: Insert the TR8 nut from the bottom, and secure it with 2 M3 8mm screws on any of the 2 diagonal slots in the bed carriage.



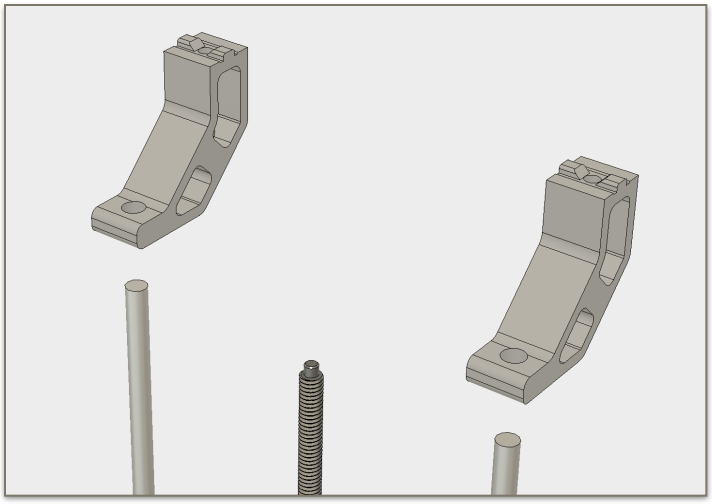
Step 4: Insert two pre-greased LM8LUU bearings into its retainers.



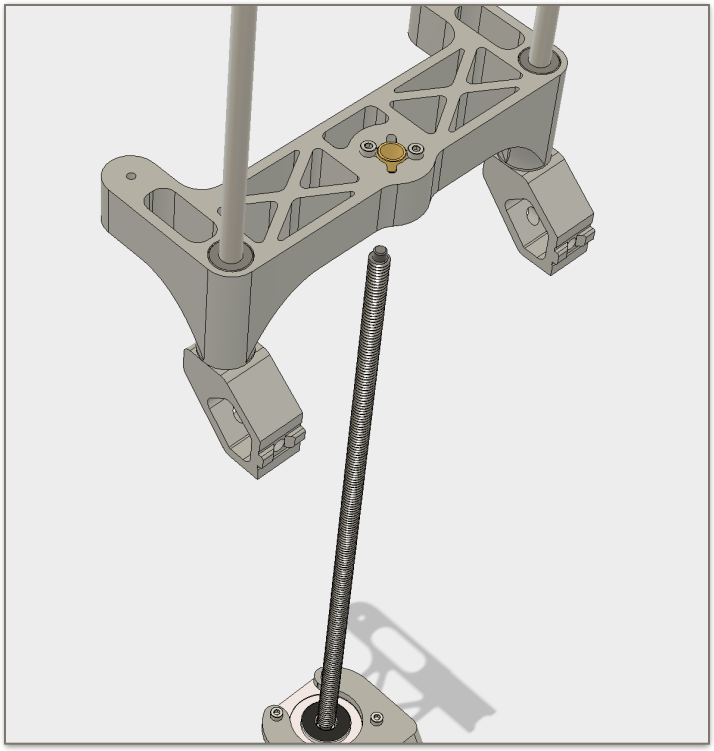
Step 5: Insert the 8mm shafts into the lower Z shaft supports. It'll be a snug fit, and you may need to clean out the hole a little.



Step 6: Insert the shafts into the bearings in the bed carriage.



Step 7: Cap the shafts with the upper Z shaft supports.

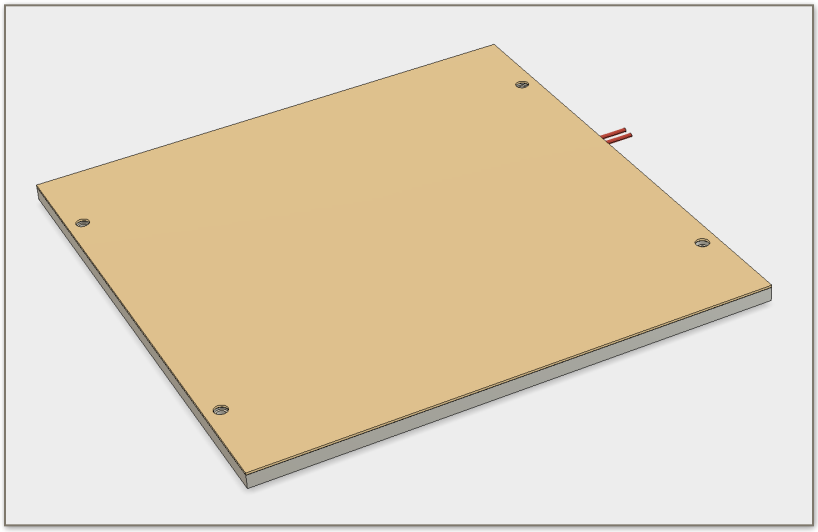


Step 8: Screw in the Z motor assembly into the TR8 nuts on the bed carriage

Repeat these steps for the other Z tower. The two towers are identical.

Nice! Let’s go drill some holes!

SECTION4 : BED PLATE

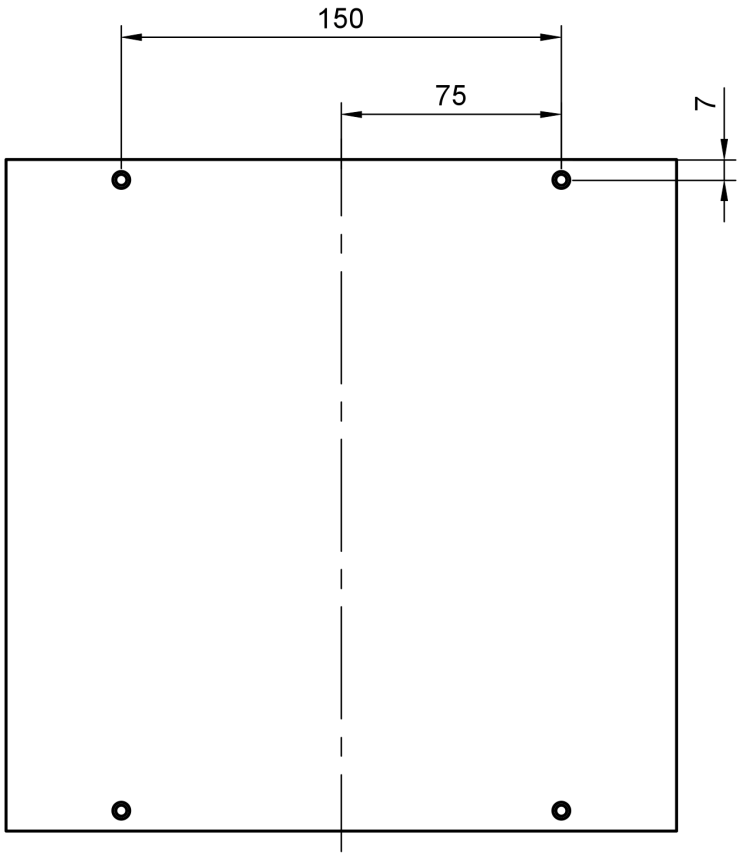


Items Required:
-MIC6 Aluminum tooling plate
-PEI sheet
-3M Adhesive sheet
-Silicone Heater Mat
-Cartridge thermistor
-Drill and some metric drill bits
- Optionally: nylon sleeving

Step 1: Cut the sheet of PEI to the dimensions of your aluminum plate. You can use a ruler and the tip of a sharp knife to make progressively deeper groves in the plastic, and once you are about half way through, you can snap off the piece along your grove. Remove any protective plastic from PEI.

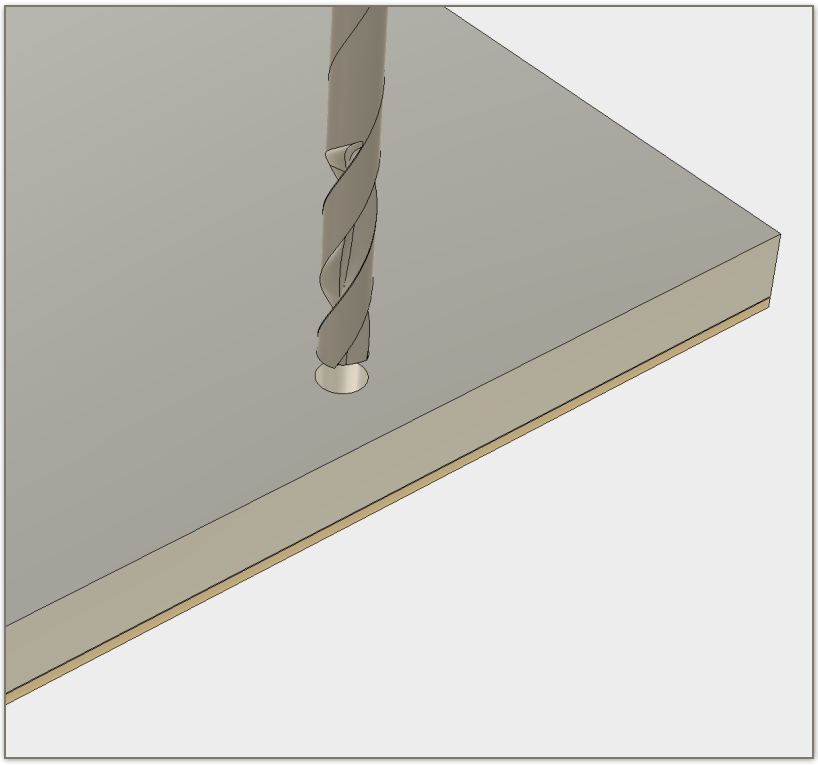
Remove the protective plastic from one of the sides of the aluminum plate and de-grease it using alcohol. You want the surface as clean as possible.

Use the 3M adhesive sheet to laminate the PEI to the aluminum plate. Trim off any overhanging adhesive with a razor.



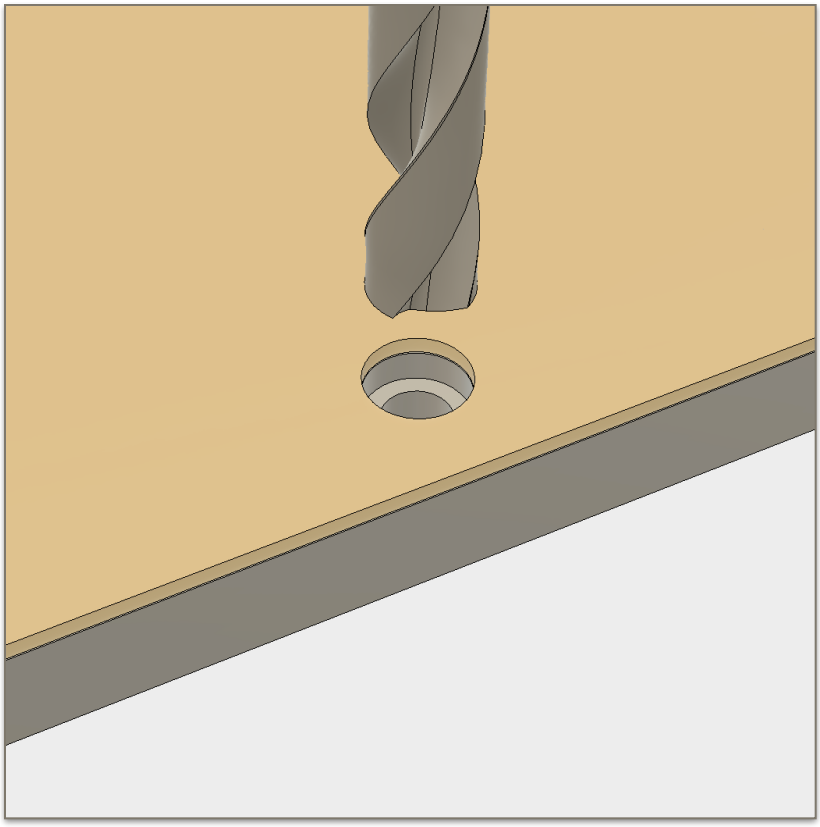
Step 2: Mark the holes for the mounting screws on the plate according to the drawing. As long as you find the center of the bed, and measure from there, the actual size of the bed doesn't matter.

Use the side that still has the plastic on it for marking it out.



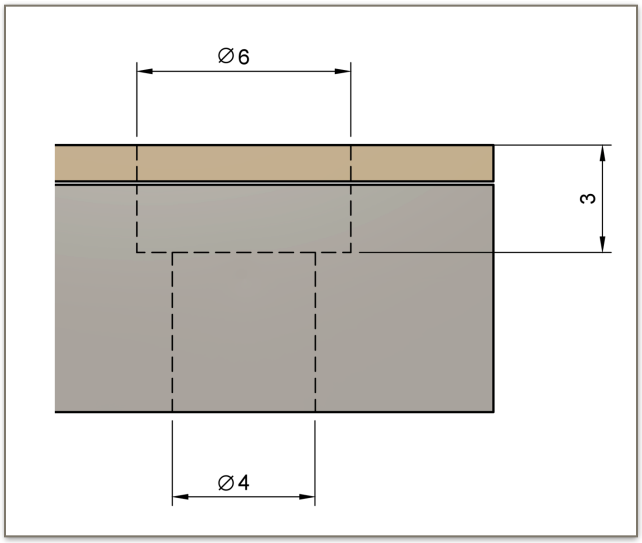
Step 3: Drill 4mm diameter holes all the way through the bed.

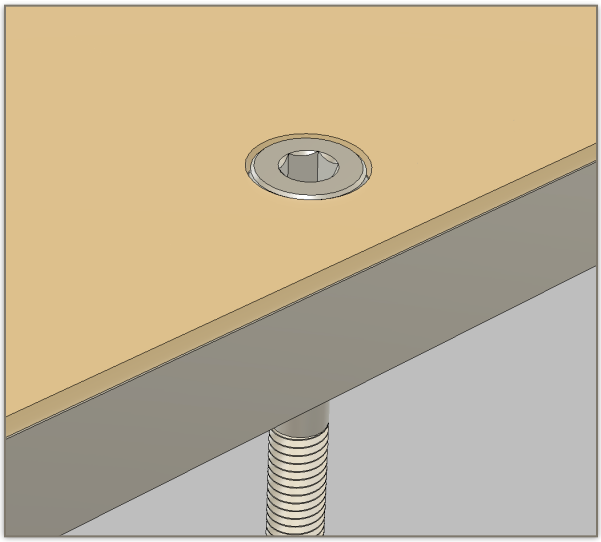
Try to keep the drill perpendicular to the plate. If you have a drill press, use it!



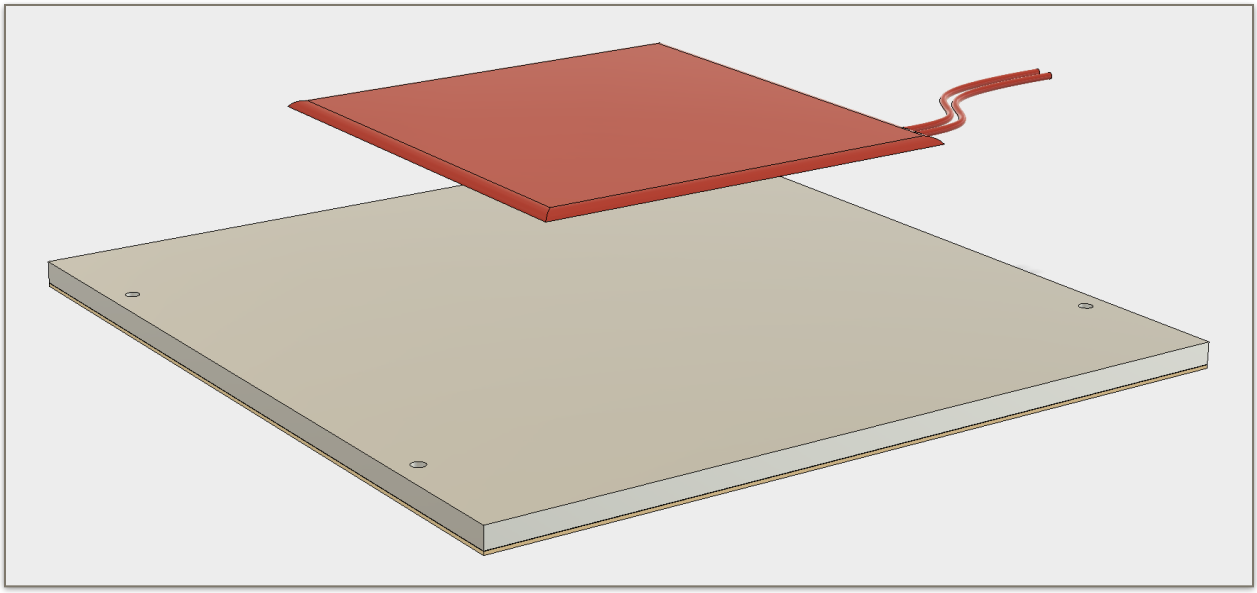
Step 4: Flip the bed plate over, and drill a 6mm diameter hole to the depth of 3mm. Basically, we're counter-sinking the M3 screw. You want just enough depth to make an M3 screw flush with the bed surface.

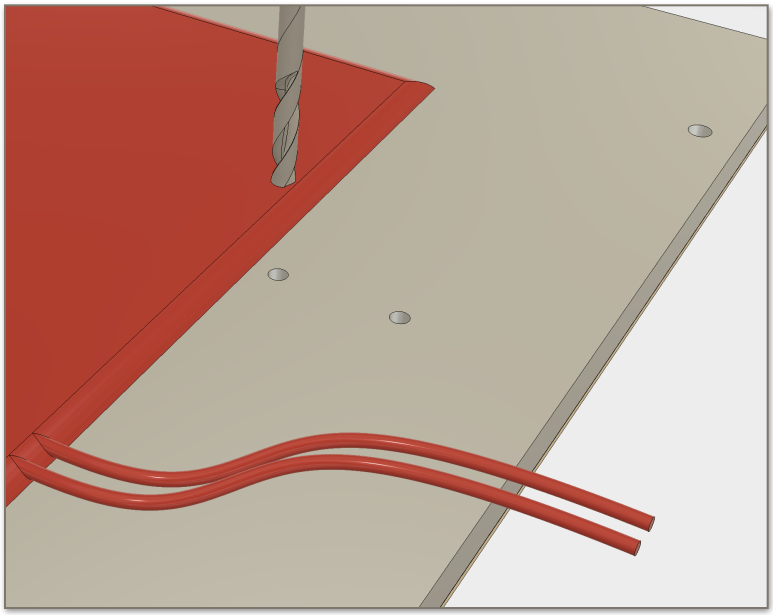
You can test the fit using any of the M3 socket head screws and drill a deeper hole if required.



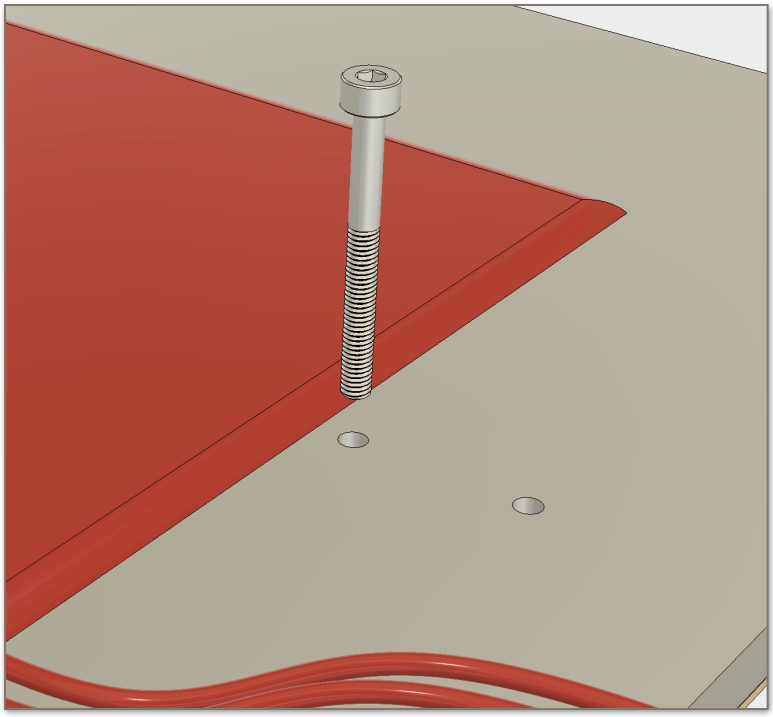


Step 5: Flip the bed plate over again, and remove the remaining plastic from it. Thoroughly de-grease the surface with alcohol. Orient the wires towards the right edge of the bed. Attach the heater to the bed plate using the 3M adhesive that should come pre-attached to the heater. Start with one corner, and roll the heater onto the plate using significant pressure. If any air bubbles get trapped in the process, the heater will over-heat the adhesive, and detach.

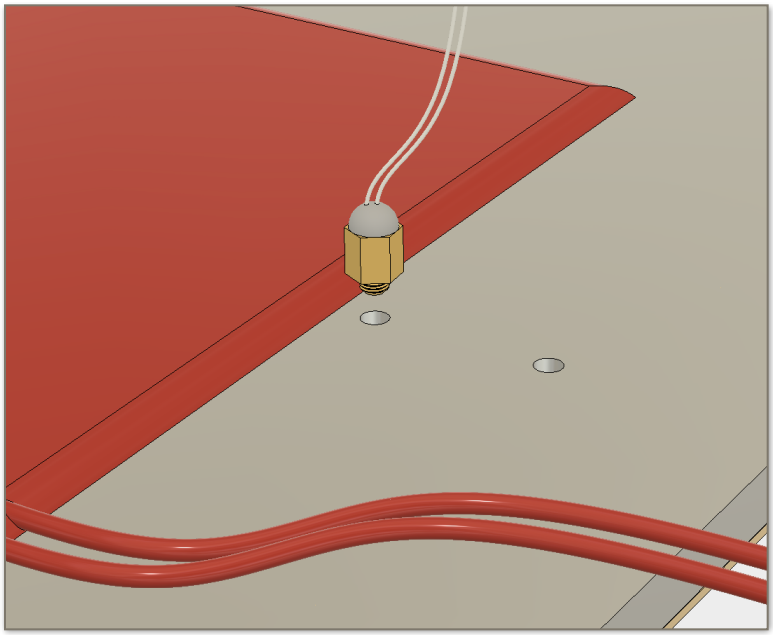




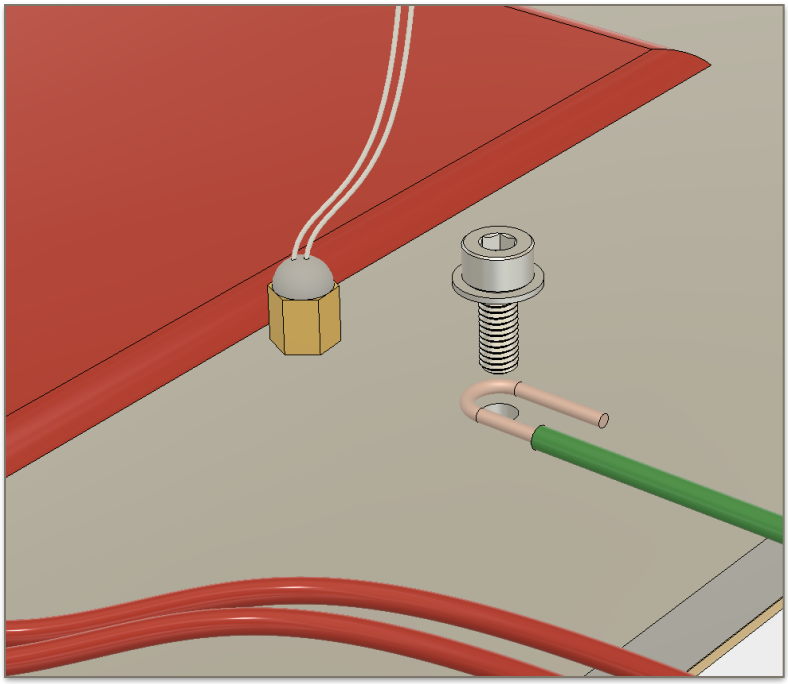
Step 6: Pick a spot close to the heater (about 5mm from the edge) and drill a 2.5mm diameter hole. You can use any close match in the imperial drill bit size for this. The hole only needs to be 4mm deep. Don't punch through the other side. Drill another hole of the same size about 15mm away from it. None of these have to be exact.



Step 7: Since MIC6 plate is soft, you can use any M3 steel screw to form threads in the holes you just drilled.

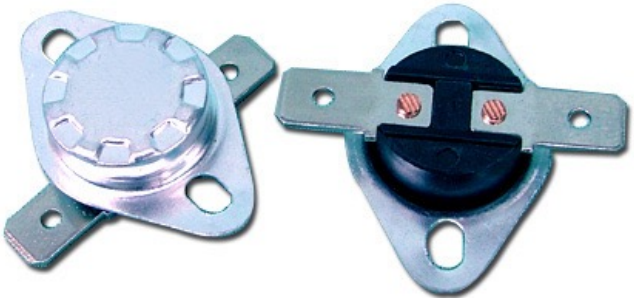


Step 8: Screw in the cartridge thermistor into the hole closest to the heater.



Step 8: Use about 400mm of wire, and ground the bed using an M3 screw and a washer. We just need a good connection to the plate. This carries any induced current off the plate, as well as protect you from shock should the heater fail and short mains voltage to the bed plate.

You'll need about 400mm for the heater wires, and close to 1 meter for the thermistor to reach the controller board. Optionally wrap the wire bundle using nylon sleeving to provide strain relief.

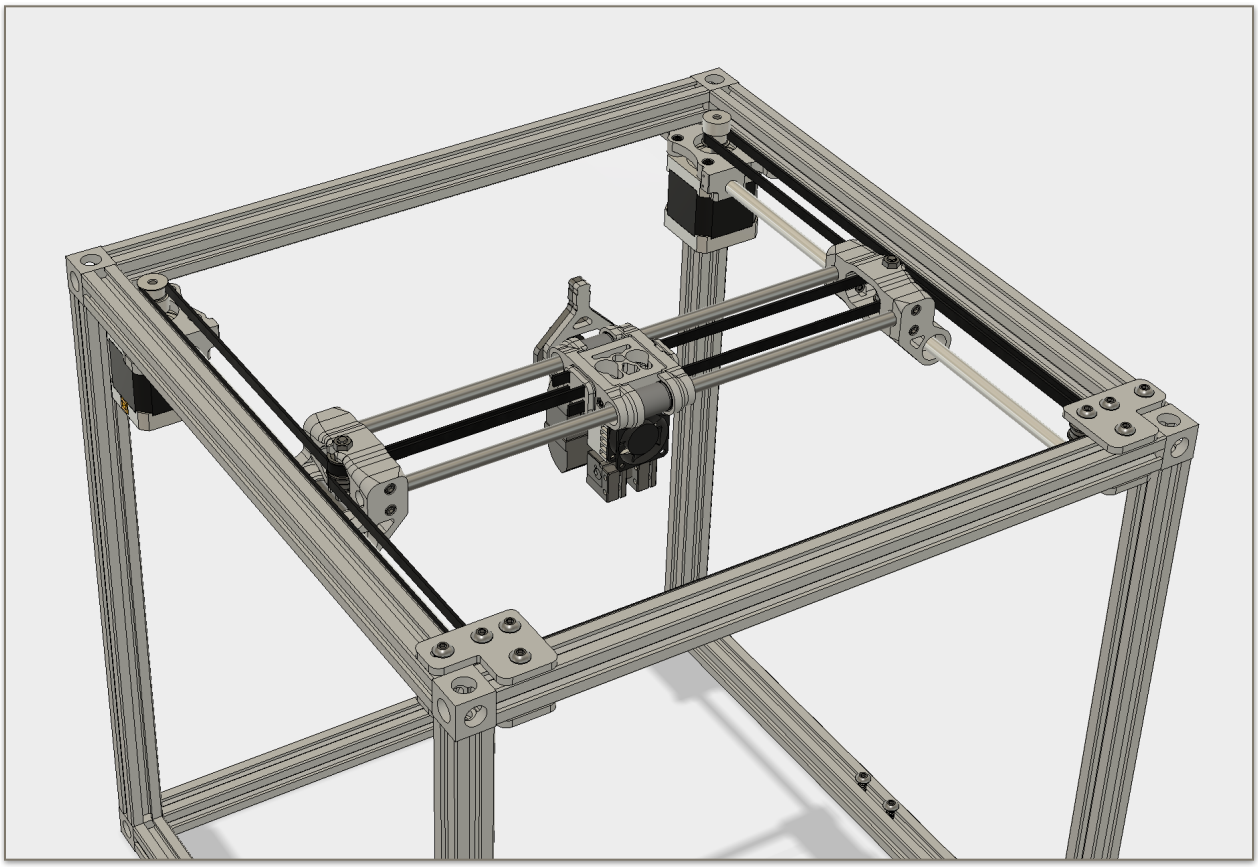


If you want an extra layer of safety, use the same technique to attach a thermal fuze to the bed plate (see BOM for the part number), and wire the heater through it. This adds an extra level of thermal protection.

Big thanks to ***codexmas*** on VORON GitHub for suggesting this.

You are now a fabricator!

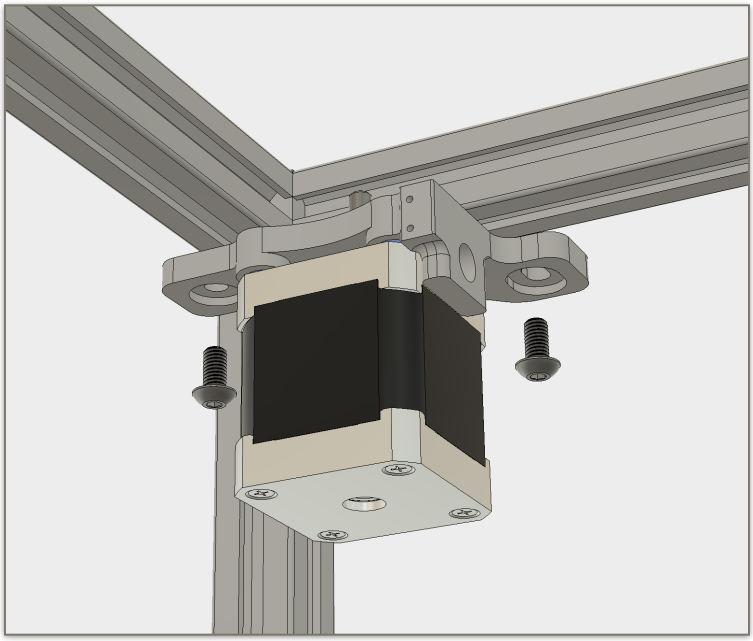
SECTION5 : GANTRY INSTALLATION



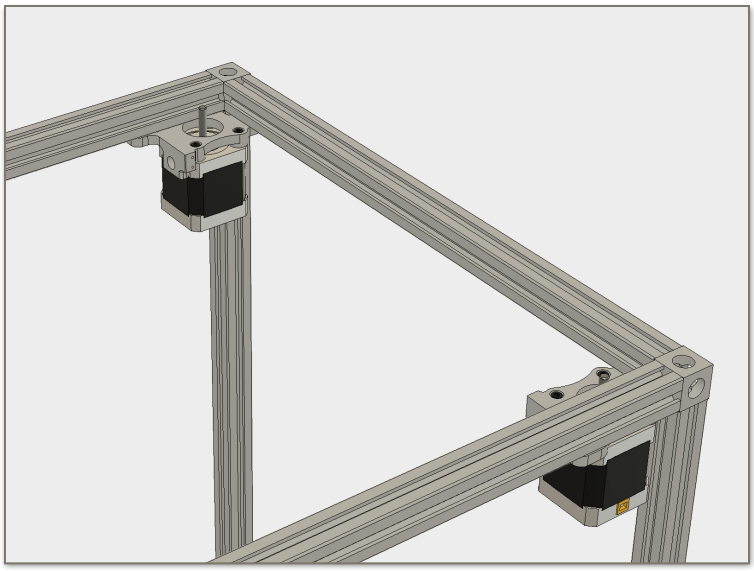
Items Required:

- Assembled X and Y sub-components
- Frame
- GT2 belts
- GT2 pulleys
- M5 cap screws

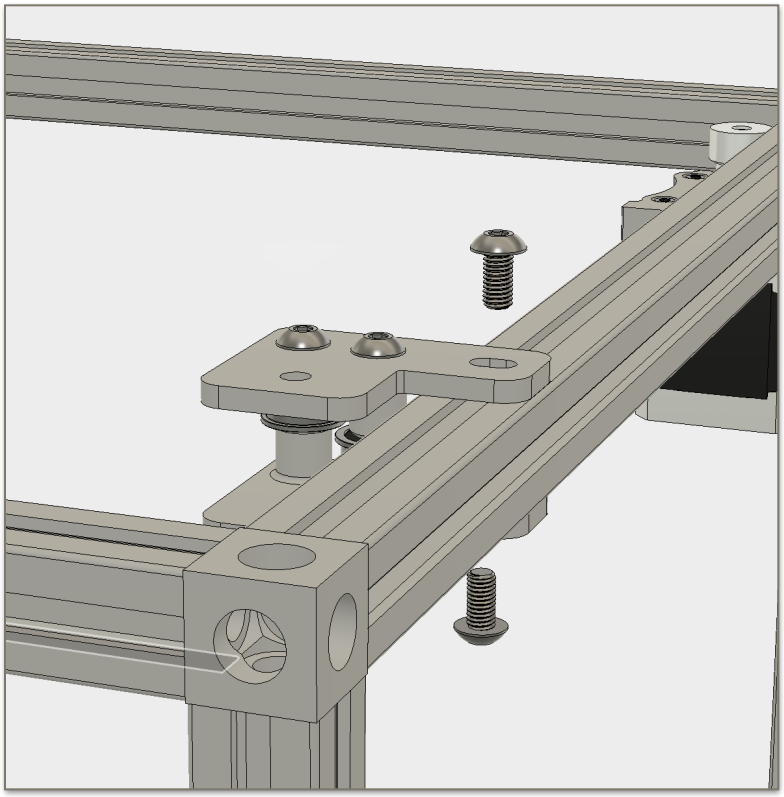
5.1 Installation



Step 1: Attach A and B motor to the back corners of the frame. Don't tighten the down completely. We need them to move side to side for alignment. The Y shaft hole should face the front.



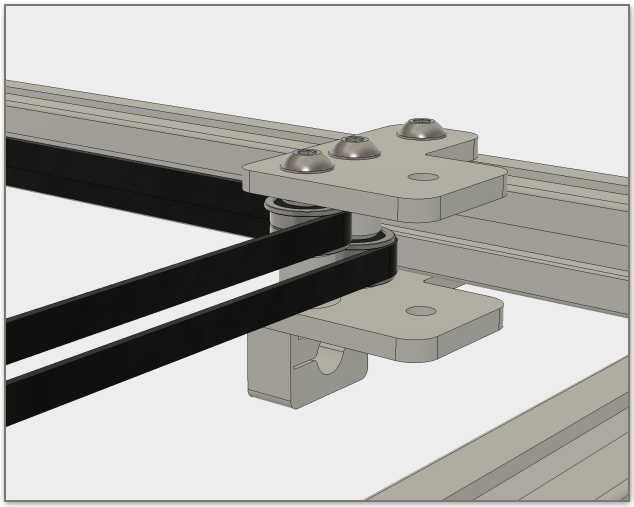
Assembly should look like this after this step

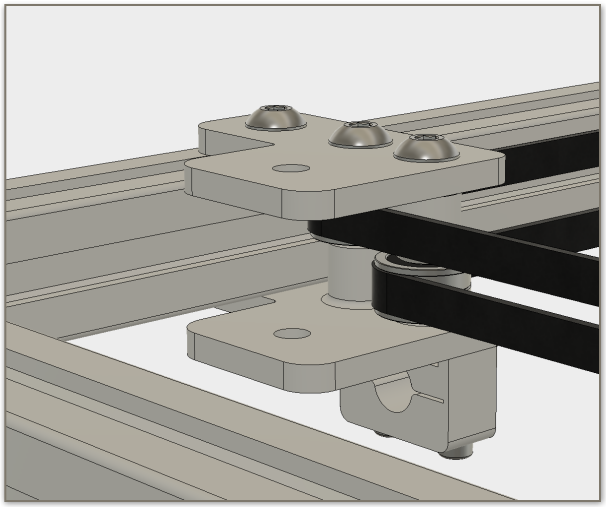


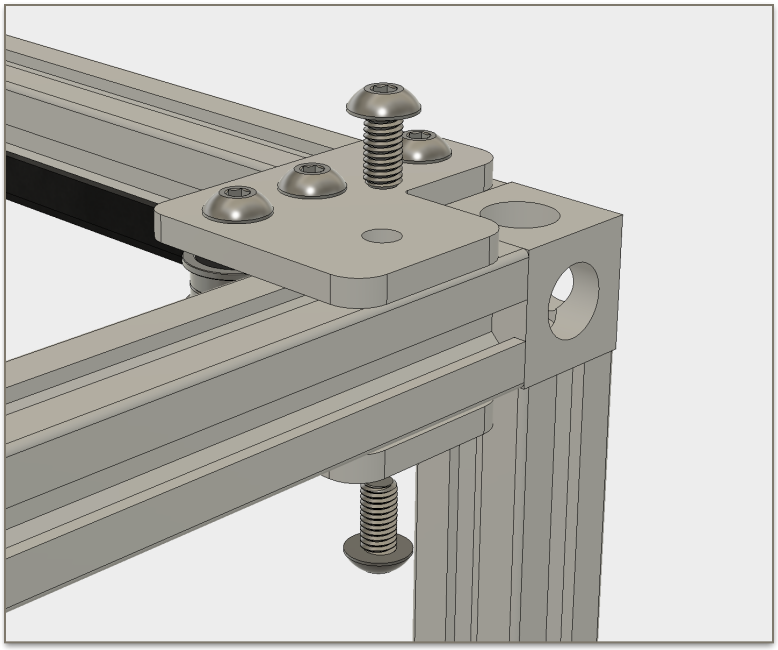
Step 2: Attach the A and B idlers to the side extrusions, leaving some space to thread the belts into them. It's easier to do this now, rather then when they are tucked into their corners.

Again, don't tighten them, as they will need to be able to slide.

Step 3: Thread the 2 lengths of the belts over the idlers as shown. The teeth of the belts should be facing the idlers, and the belts should run parallel to each other. If they slip out of place, it's not a big deal. You can move them into place later on.

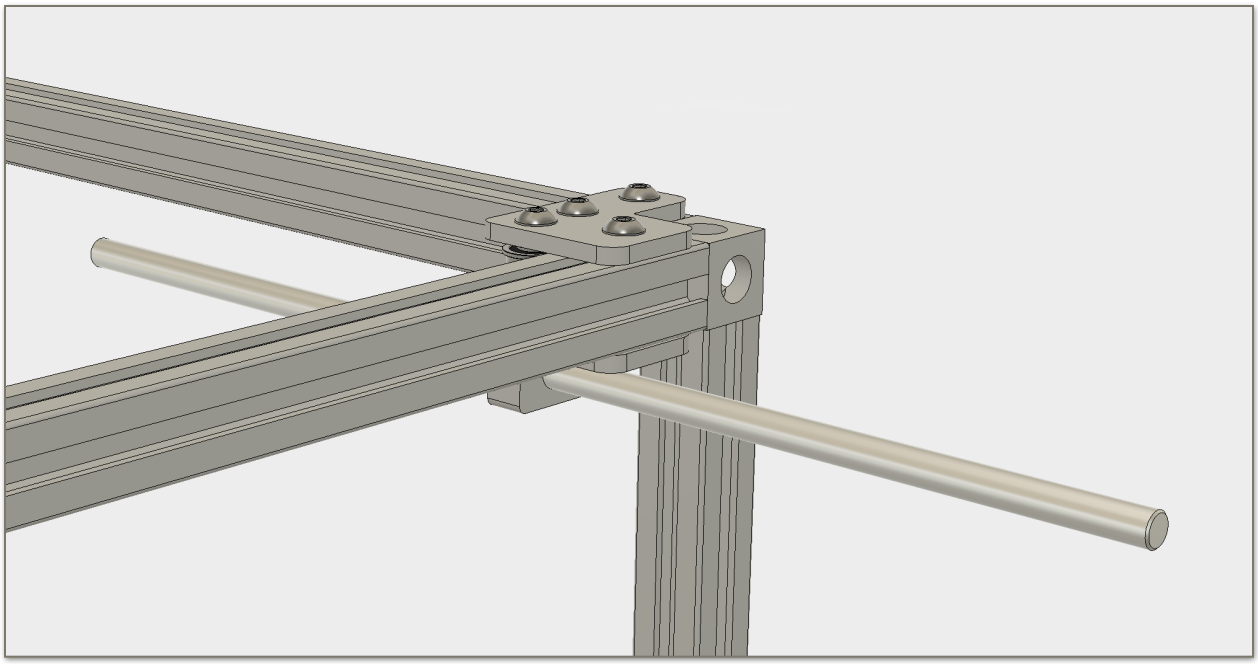


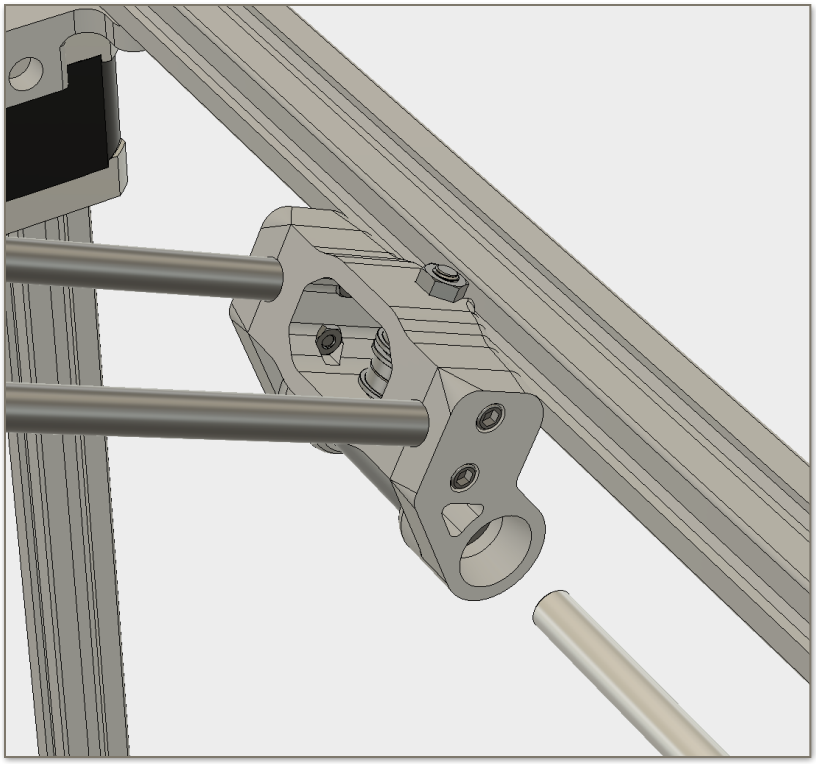




Step 4: Slide the idlers into place, and secure them with M5 cap screw to the front extrusion. Don't tighten them down now. They should be able to move side to side.

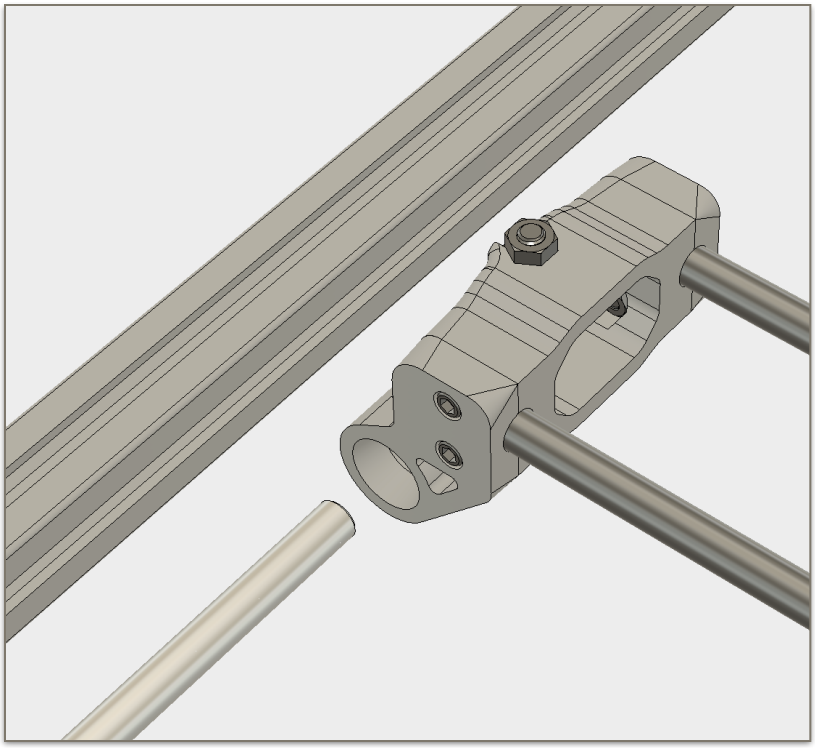
Step 5: Insert the Y shafts half way into their mounts on the idlers. If the mounts are too loose, and the shafts feel like they are about to fall out, tighten them slightly, but make sure you can still move the shafts in and out.



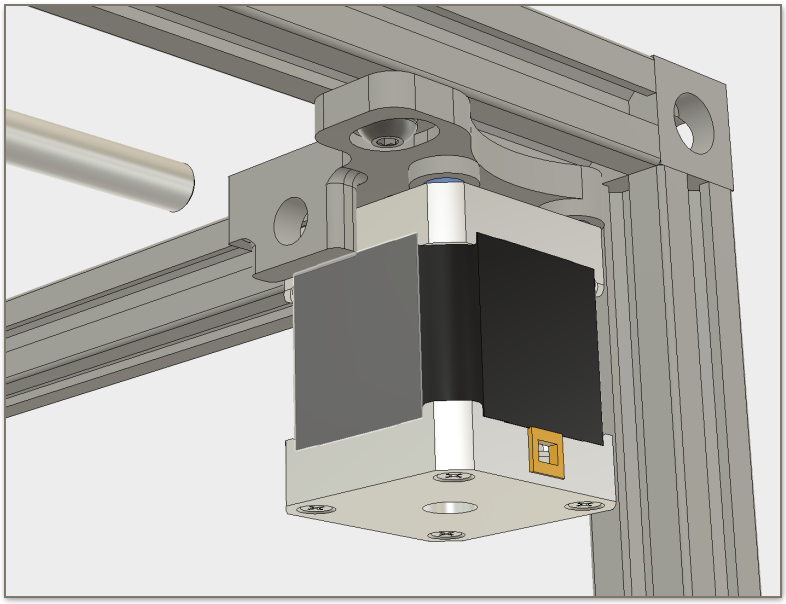


Step 6: Slide one of the sides of the gantry onto the Y shaft. Be careful not to dislodge any balls in the bearings in the process.

You can push this Y shaft in a little now to give that side of the gantry a better resting place.

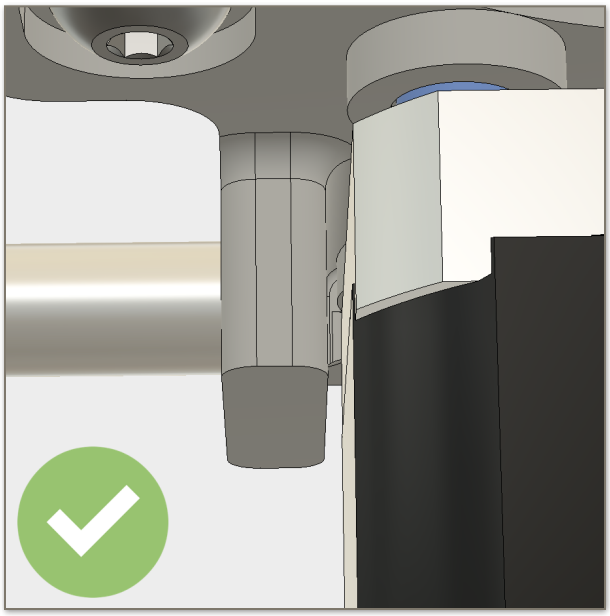


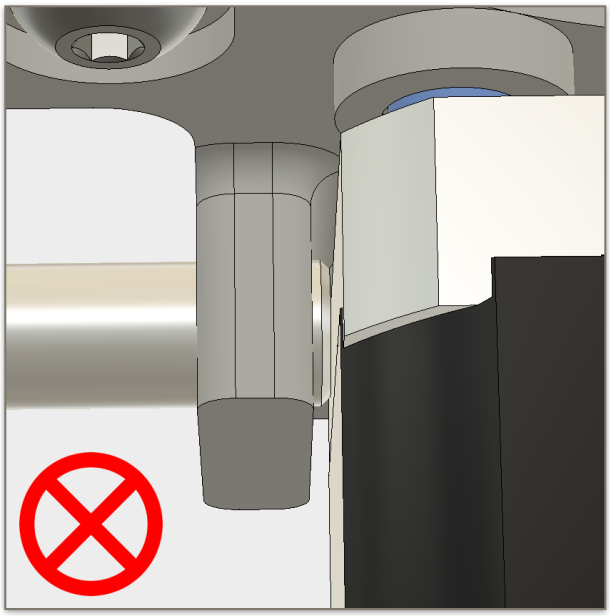
Step 7: Line up the other side of the carriage with the other Y shaft, and carefully guide the carriage onto the other shaft. **Don't force this process**. You can move the shaft around to get the right angle of attack. Since all of this is lose, you should be able to easily find an angle that works.

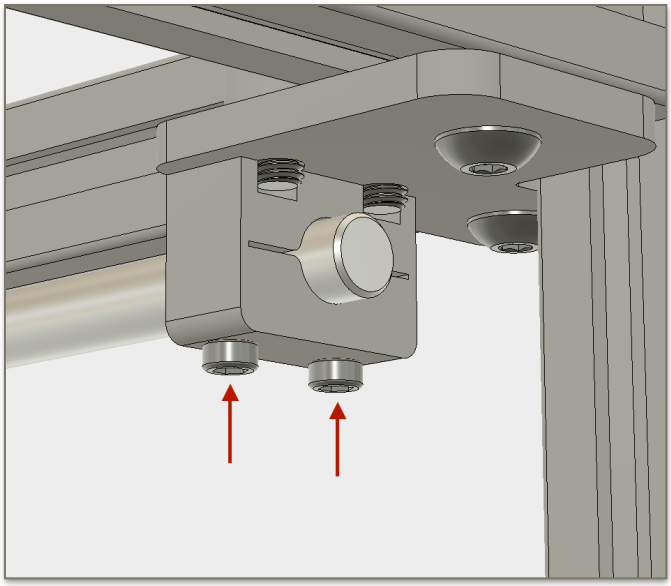


Step 8: Push both Y shafts into their retainers on the motor mounts.

NOTE: Make sure the shafts are not making contact with the motors. This will nullify any vibration isolation we're trying to achieve.

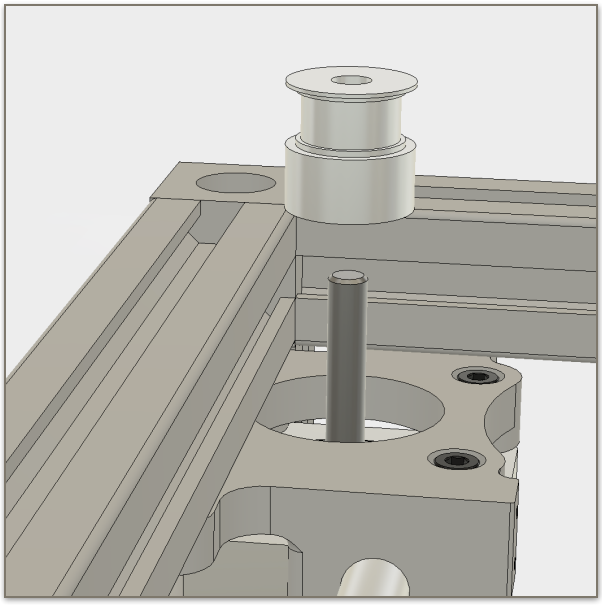


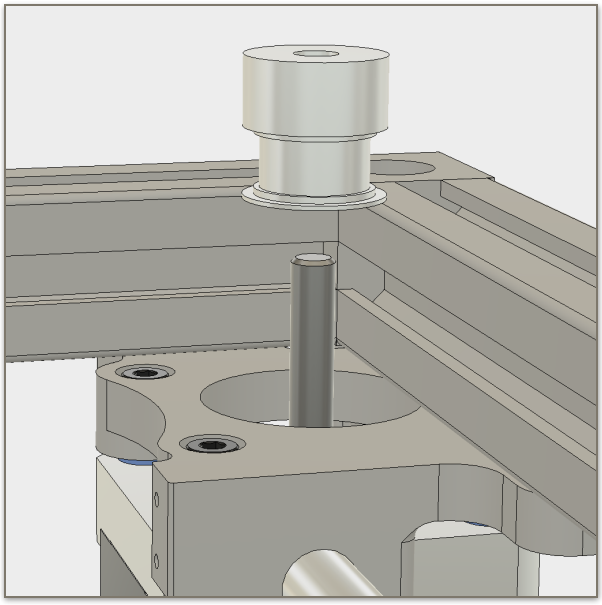




Step 9: Tighten down the Y shaft retainers.

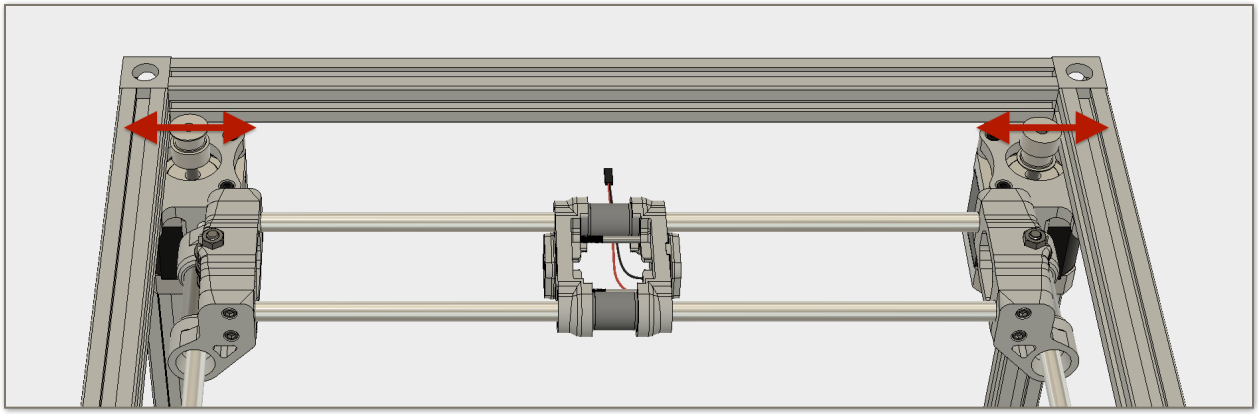
Step 10: Install the GT2 pulleys onto the A and B motor shafts. A motor pulley is flipped, where as B motor pulley is installed right side up.



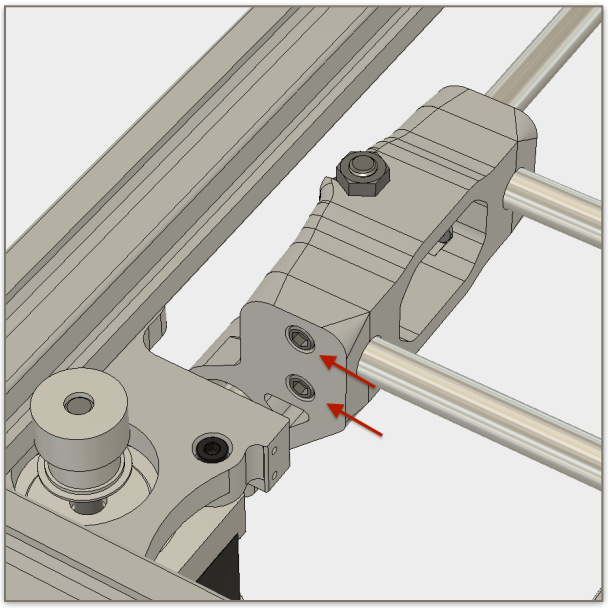


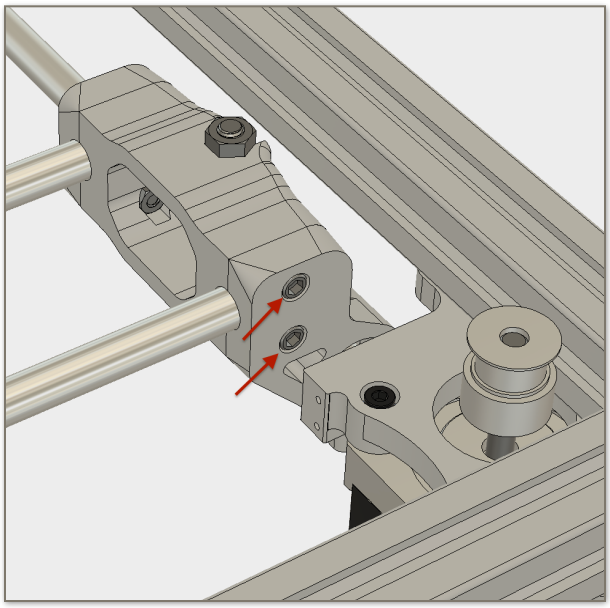
5.2 Alignment

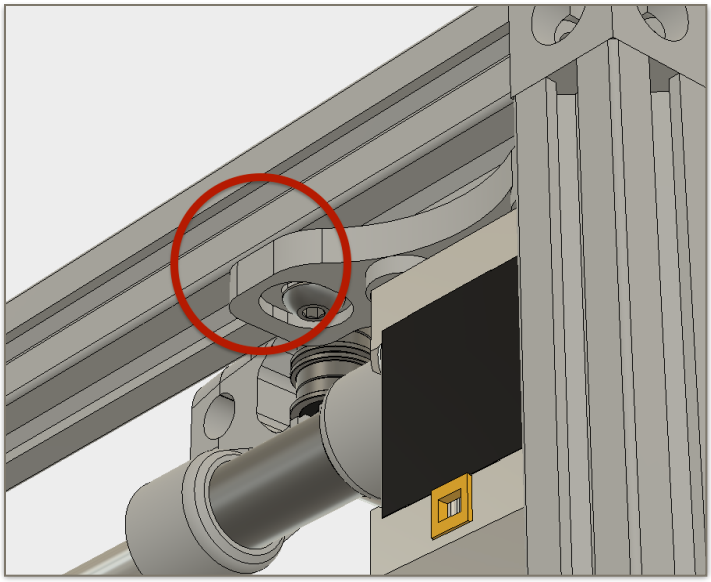
Step 11: Move the X axis all the way back. We'll use it to help with alignment. Move each motor mount (and everything it takes with it) so that the GT2 pulleys are roughly 2mm from the extrusions.



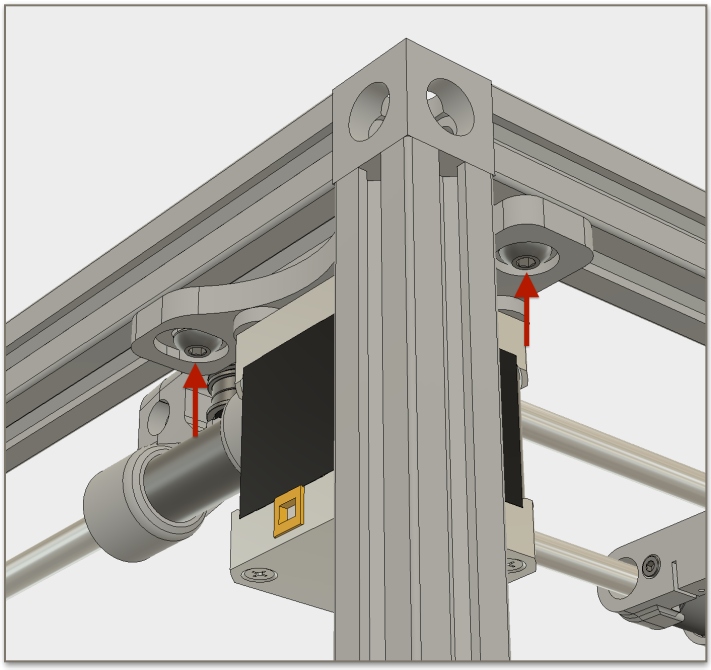
Step 12: Tighten down the XY Join screws on the side closest to the motor mounts.





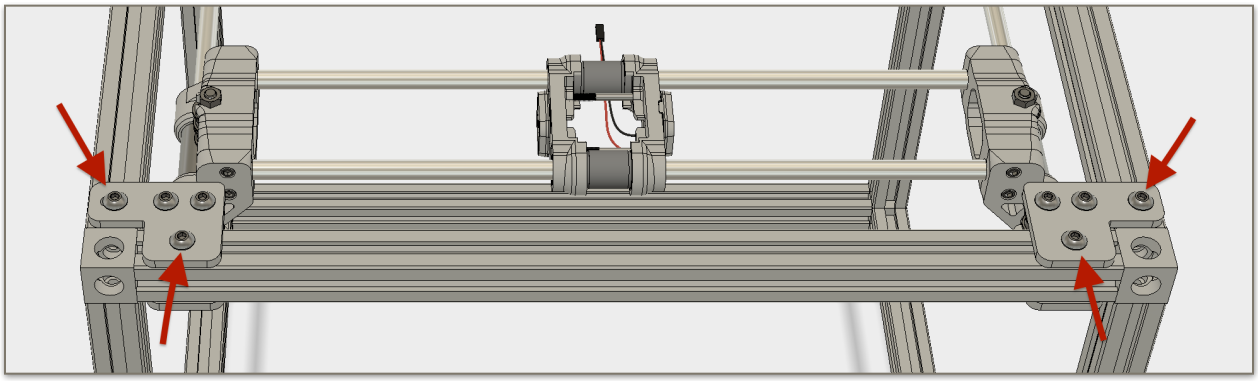


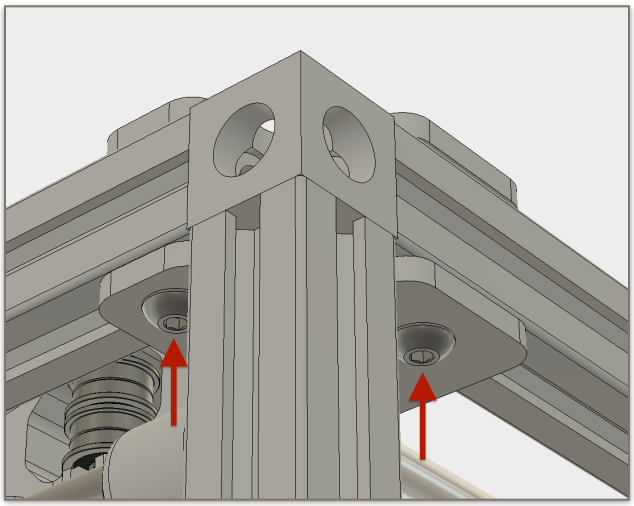
Step 13: Now that you have a rigid center, ensure the X axis is centered on the frame by moving the motor mounts side to side. The easiest way to tell if they are even is by placing the fingers on the extrusions, and having fingertips touching the side mount points (circles in red). You'll be able to feel when they are even.



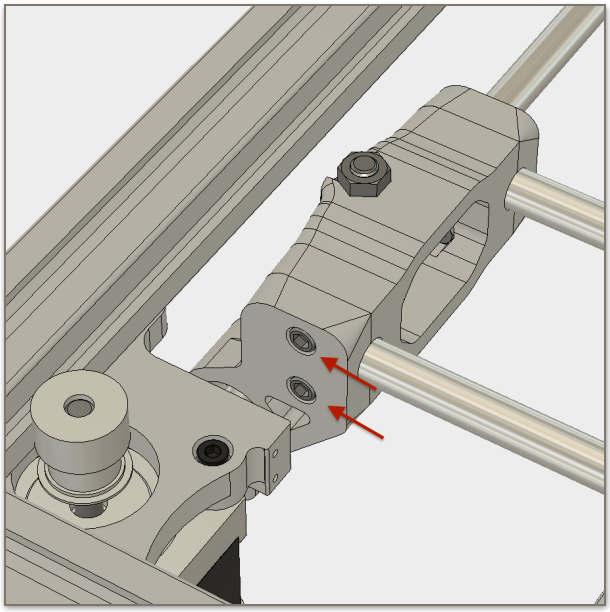
Step 14: Tighten down both motor mounts onto the frame.

Step 15: Move the X axis all the way to the front. By the time it reaches the idlers, the Y axis has already self-aligned itself. Simply make sure the idlers are even distance on each side, and tighten down the mounting screws.



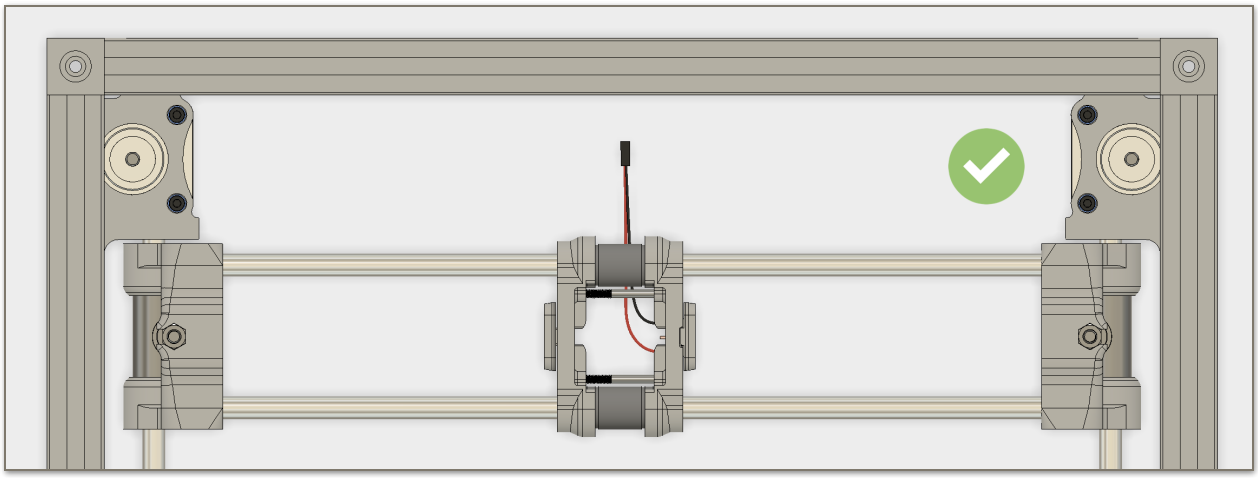


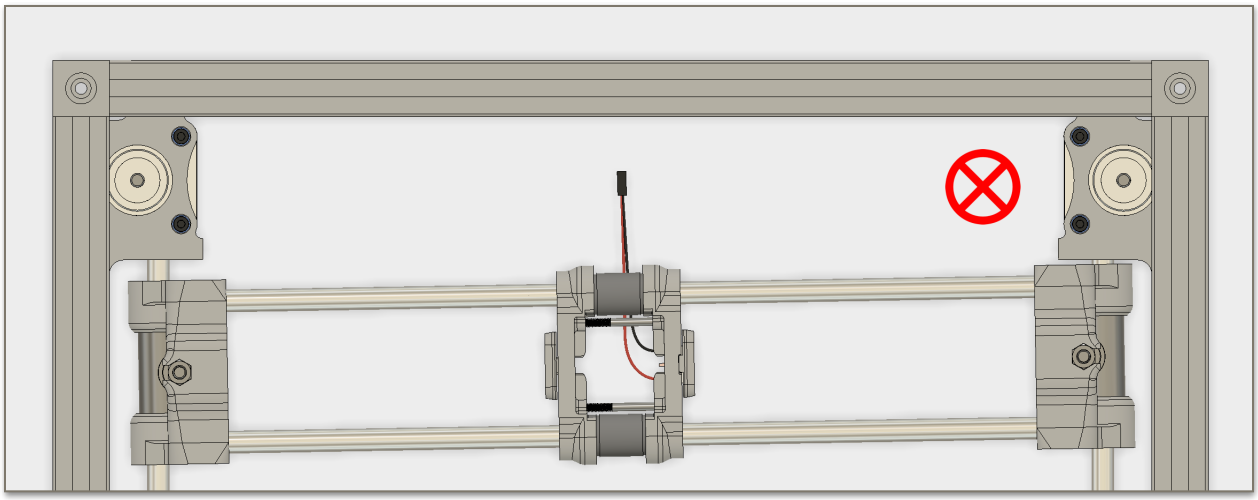
Don’t forget to tighten the bottom set of mounting screws on both idlers.



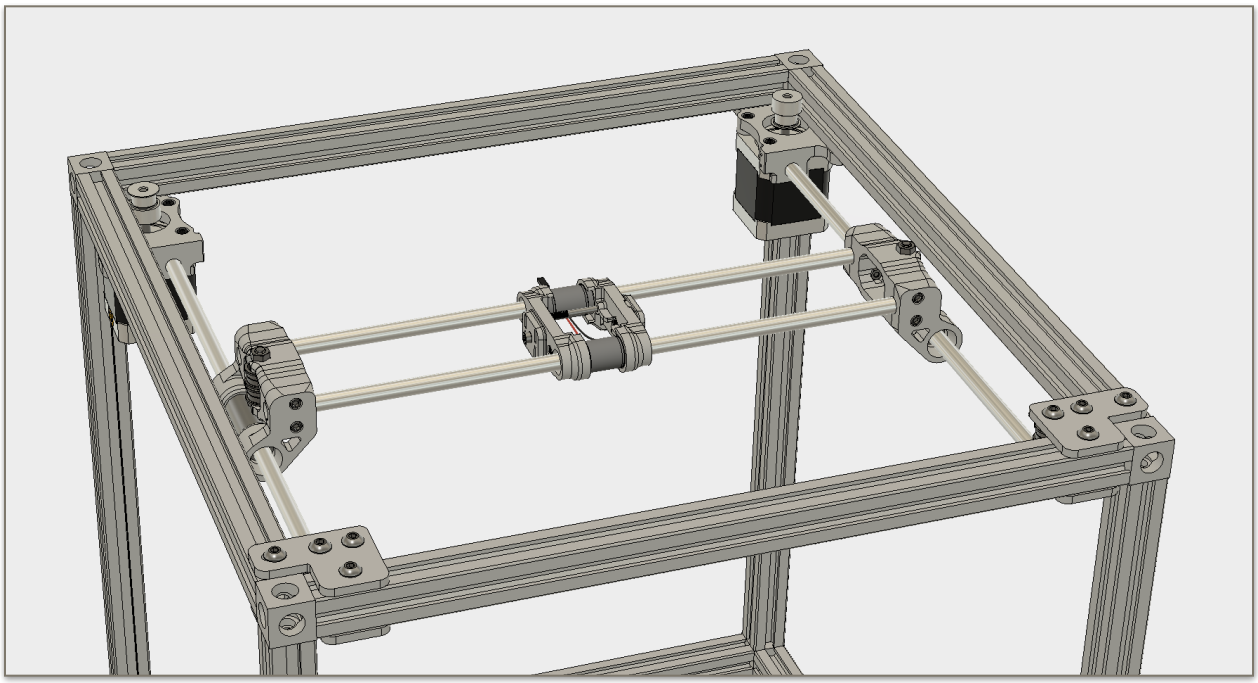
Step 16: Loosen one of the sides of the X axis, and move the axis to the back.

Make sure the X axis is not racked. It's easy to spot it by un-even space between the XY Joints and the motor mounts.





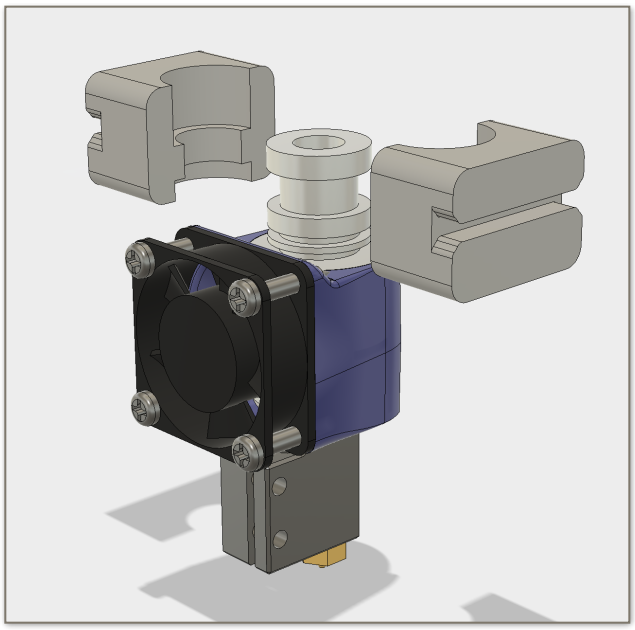
You can now tighten down all 8 XY Joint screws and check the carriage movement and alignment one more time.



5.2 X Carriage Payload

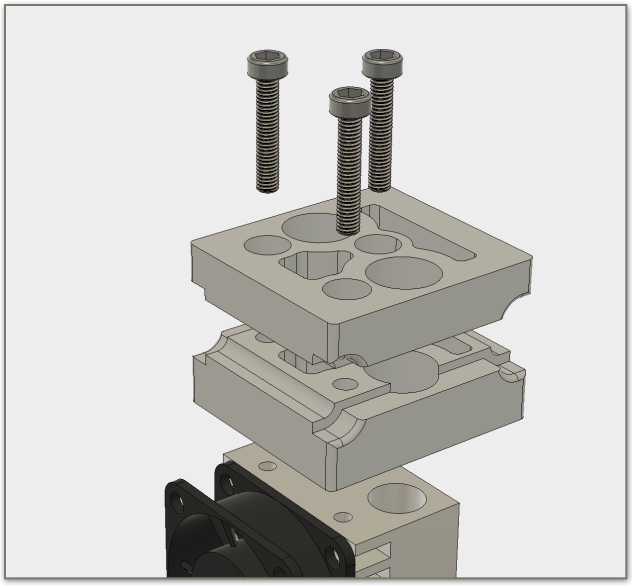
You have major 2 choices here: dual or single hot end.

Single Hot End (E3D v6):

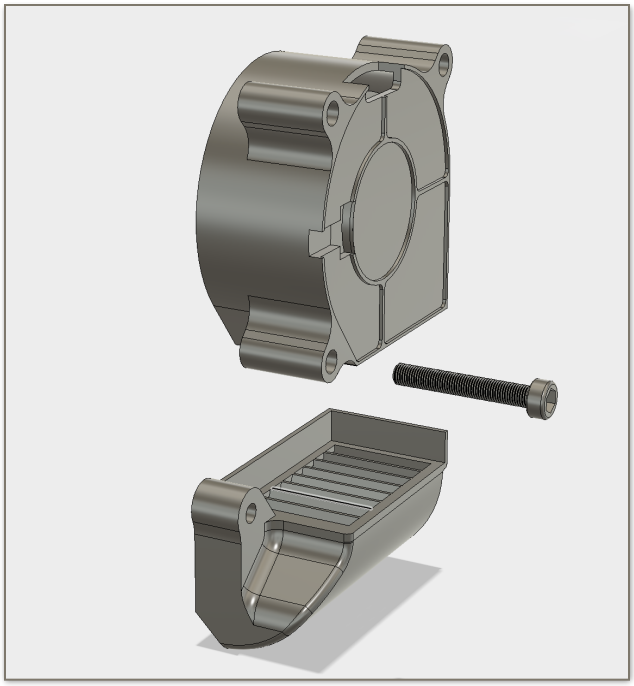


Step 1A: Snap the two part retainer around the hot end mount point and you're ready to install it

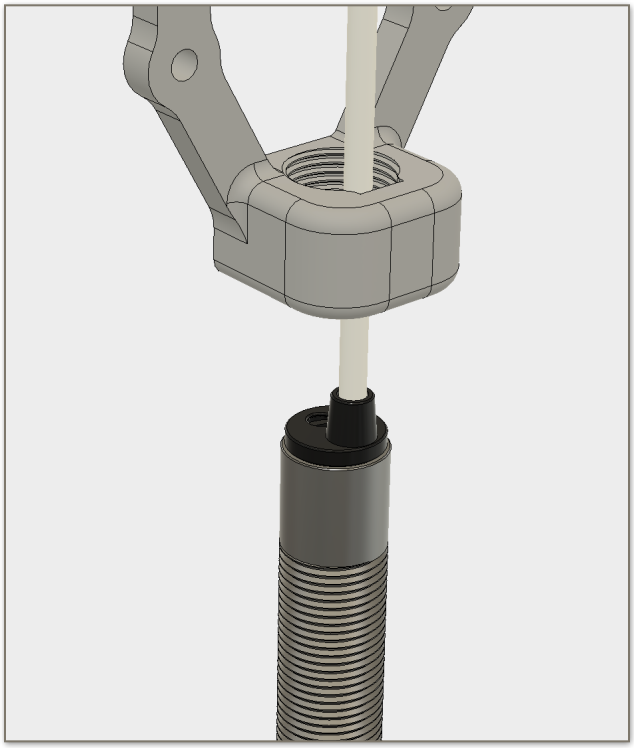
Dual Hot End (Chimera):



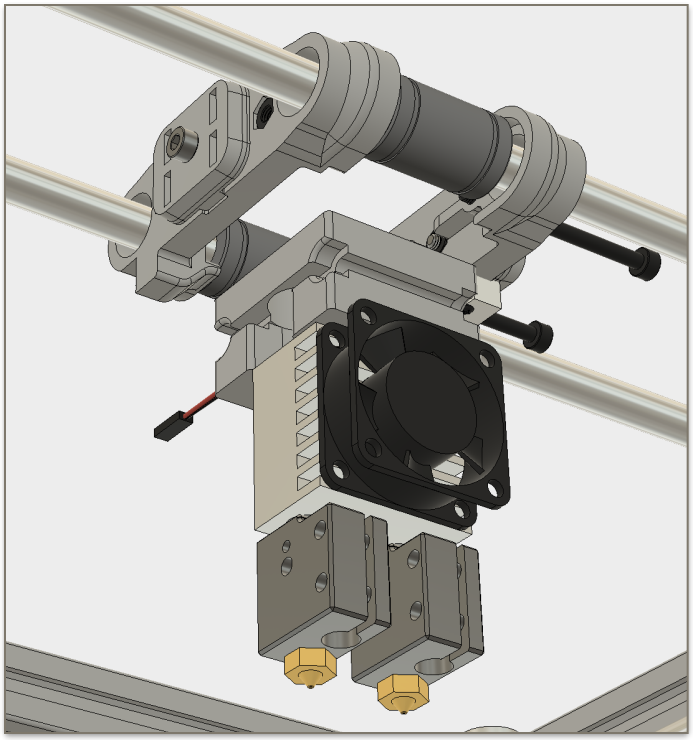
Step 1B: Clean out any bringing supports on the top portion of the mount block, and secure the 2 pieces to the Chimera heat sink using M3 16mm screws



Step 2: Install the fan shroud for your choice of the heater block (E3D v6, or Volcano). The M3 20mm screw is meant to thread into the printed plastic.



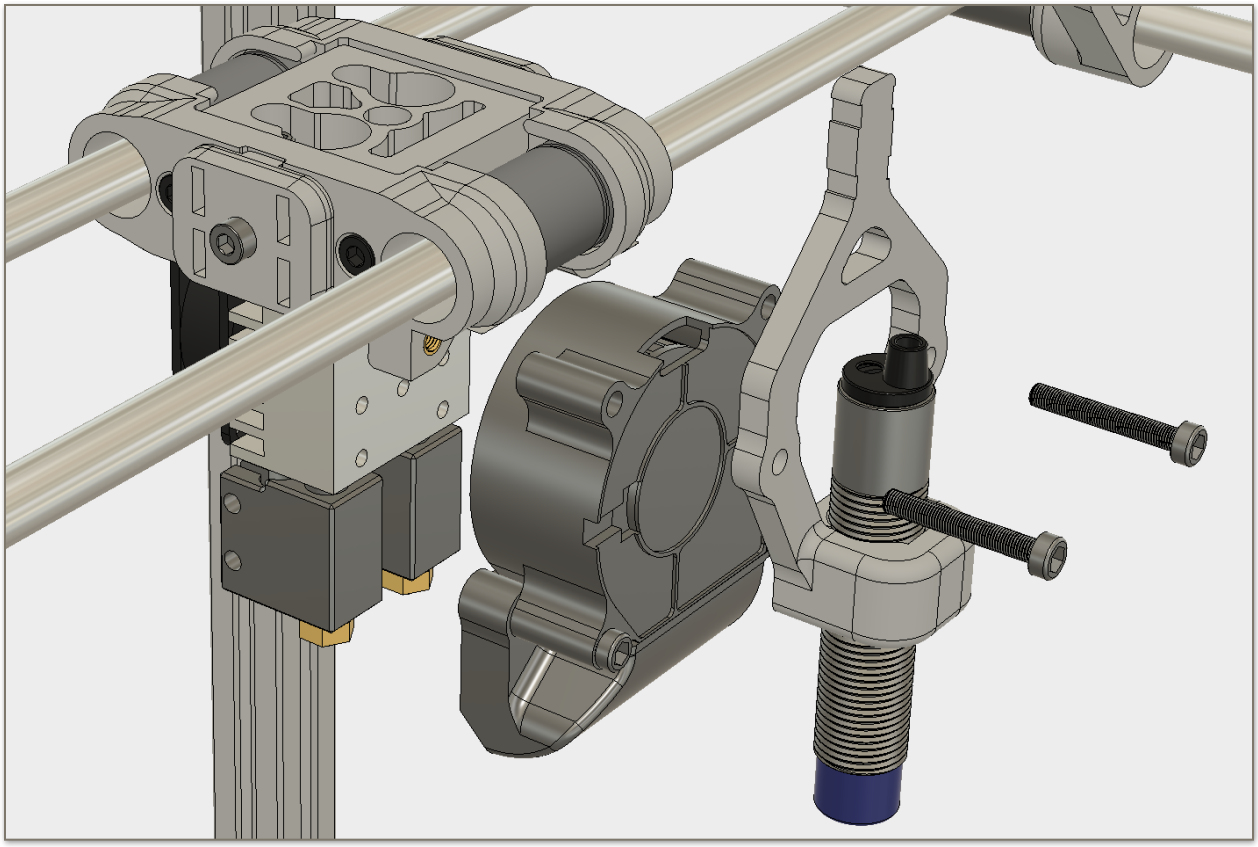
Step 3: If applicable to your build, screw in the inductive sensor into the sensor mount. The sensor mount will also serve as a cable harness anchor.

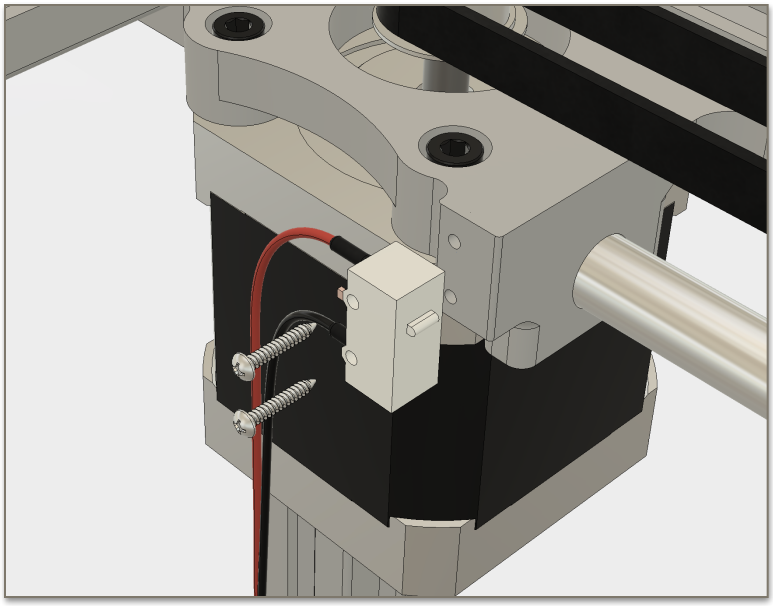


Step 4: Back out the carriage bolts, widen the gap between the two Carriage Ends, and slide your hot end assembly into place.

Snap the Carriage Ends around the hot end mount, then re-insert the carriage bolts. Get them to bite into the M3 nuts on the other Carriage End, but don't fully torque them down yet.

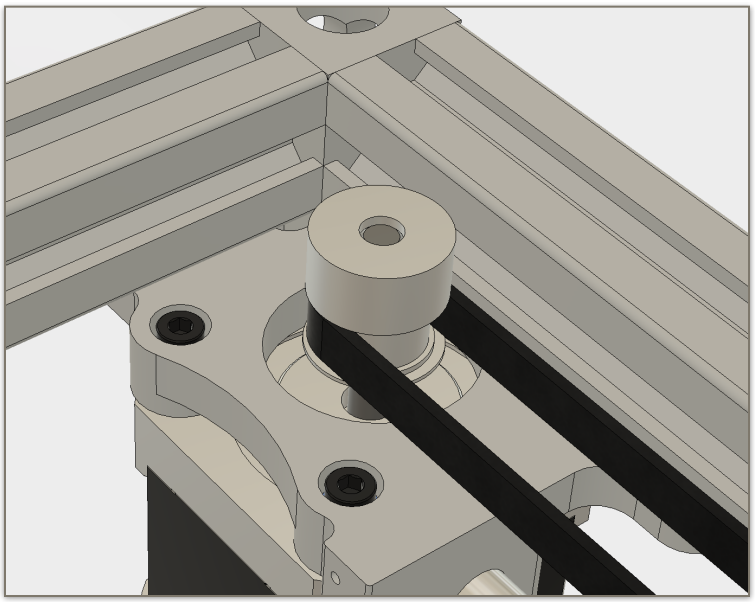
Step 5: Secure the fan and Z sensor mount to the rear of the carriage using M3 20mm screws.



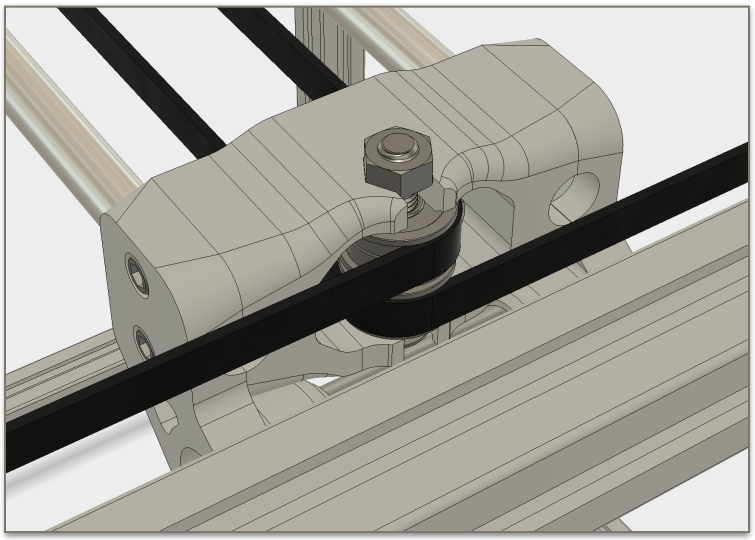


Step 6: Attach enough wire to reach the controller box onto the Y end stop switch, and secure it to one of the motor mounts using the plastics screws.

5.3 Belts

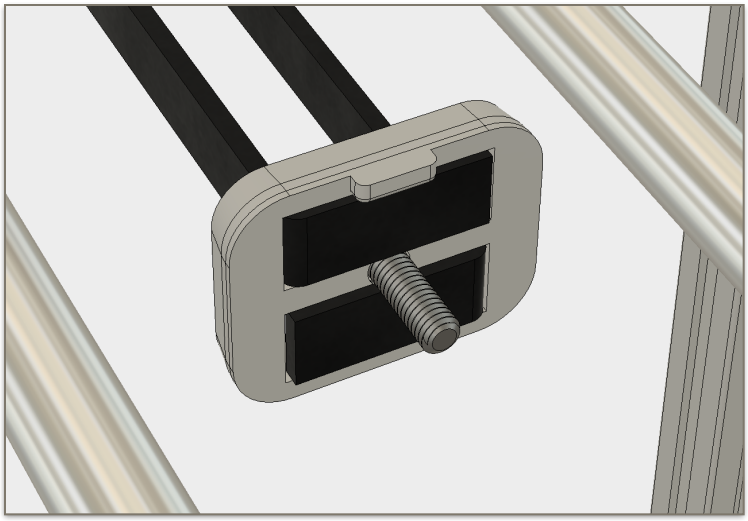


Step 1: Route each belt run around their respective motor pulleys.

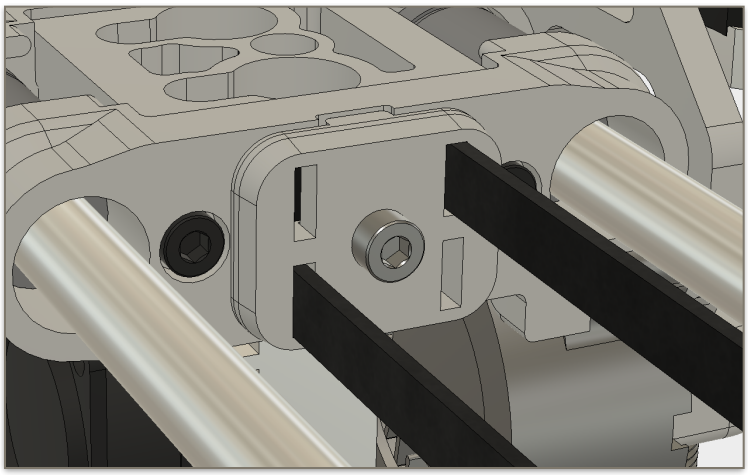


Step 2: Straighten out the belts and slip them around XY Joint idlers. Keep the belt runs in their respective plains.

Also make sure the belts are not twisted.

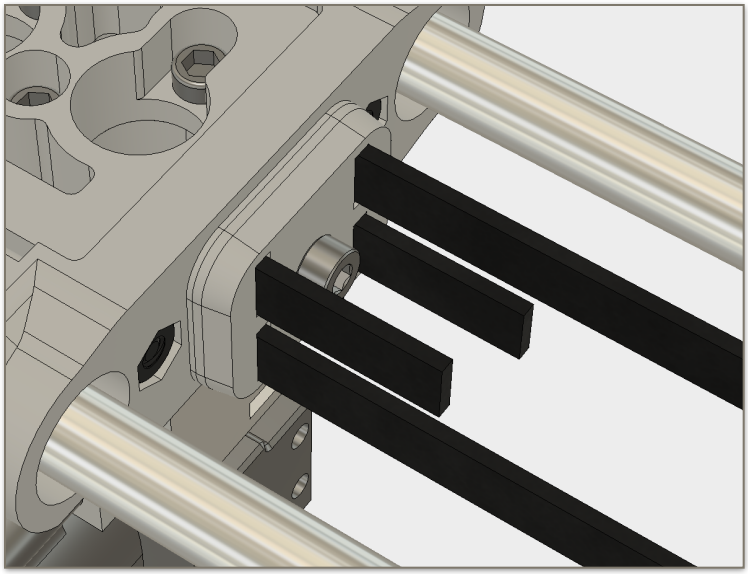


Step 3: Thread the belts into one of the belt clips, and fold them towards each other. Belt teeth should mesh with the toothed portion of the clip, and face out on the smooth portion. If that's not the case, flip the clip around.



Step 4: Secure the belt clip to the Carriage End, and tighten it down.

This is our initial anchor point.



Step 5: Repeat Steps 3 and 4 for the other side, but this time leave enough belt length so you can grab onto the ends without tearing them off. Attach the clip to the Carriage End, and tighten it just enough to enable belts to slip when pulled.

Belt Tensioning:

Before beginning the tensioning process, walk each length of the belt and make sure it's seated on each idler and pulley properly.

Using pliers, pull on each belt end until you are satisfied they have equal tension. You can use the strum technique, where you strum the belt and listen to the note it makes. We're going for a low G, but as long as they make the same sound, you're on the right track.

The belts will slip in discrete increments as the next set of belt teeth find their place in the printed slots. You can control how much tension you are able to apply to the belt before it slips back into previous position with the tensioning screw. This method prevents over-tensioning the belts, albeit using a fairly crude mechanism.

Once satisfied, tighten down the belt clip, and torque down the carriage bolts. Proper tension is about quarter turn pass the point where you can no longer twist the LMUs. This will also pull the belts towards each other and put the final tension on them.

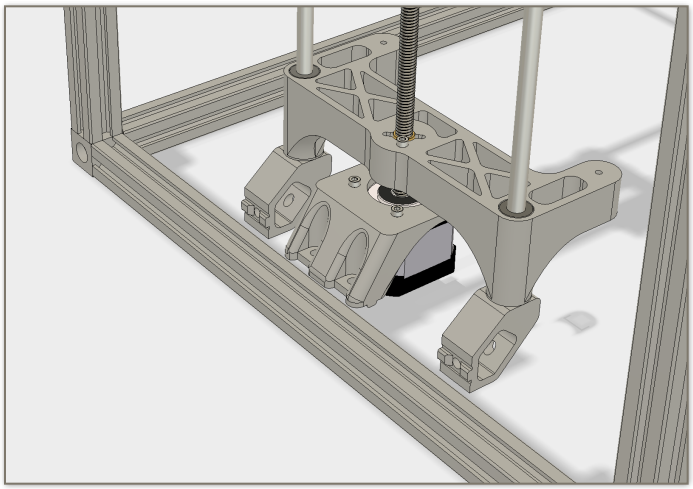
You can now trim some of the belt off, but keep enough length to be able to re-tension it in case you need to take the carriage apart. The XY Joint should have enough clearance inside it for amble belt length.

You can check if the X end stop is still able to be triggered by hand. Slide the carriage towards the right XY Joint. If you don't hear a click, you probably have too much belt length left over, and it's preventing the clip from fully tucking into the XY Joint.

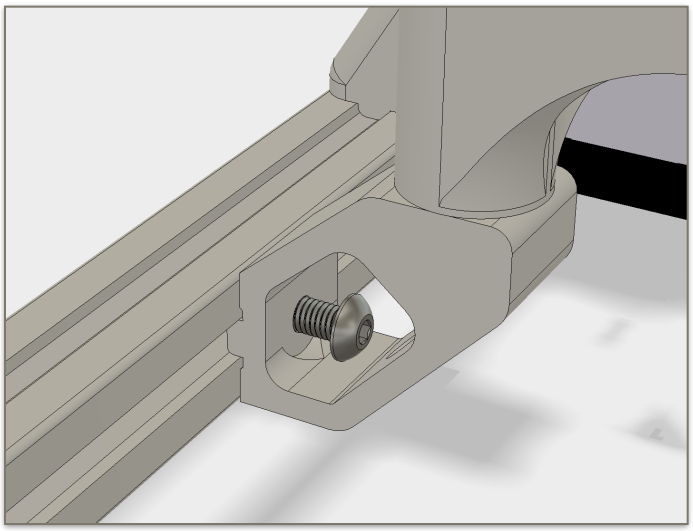
Getting closer!

SECTION6 : Z AXIS INSTALLATION

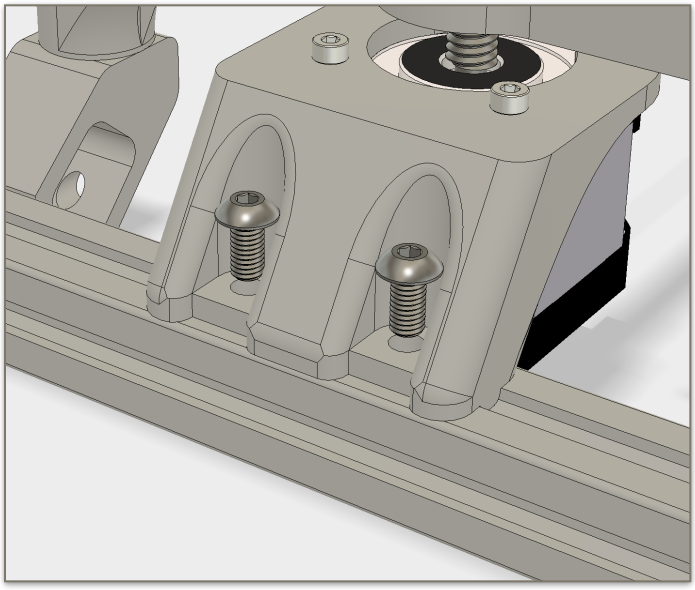
Items Required:
- Bed assembly
- Z tower assemblies
- M5 cap screws
- M3 30mm screws
- Springs



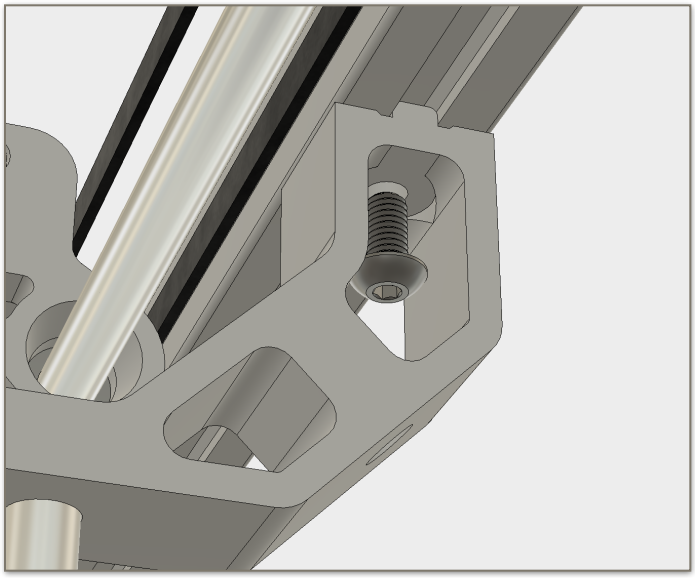
Step 1: Lower the Bed Carriage and position the Z tower on the lower side extrusion.



Step 2: Secure the lower Z shaft mounts using the M5 cap screw. Don't tighten them down all the way as we'll need them to be able to slide.

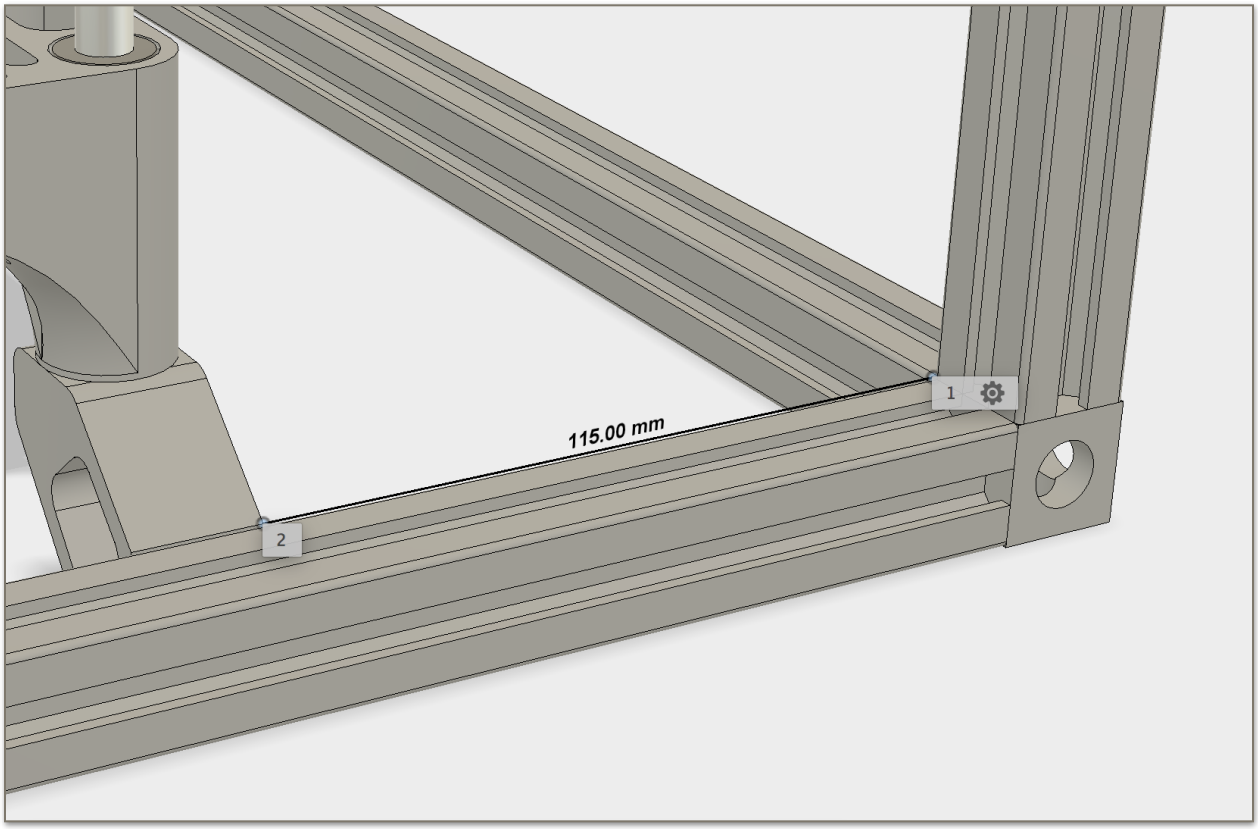


Step 3: Secure the Z motor mount using M5 cap screws. Again, don't fully tighten them yet.



Step 4: Secure the upper Z shaft supports to the top side rail using the M5 cap screws. Don't tighten those ether yet, but make sure they are straight.

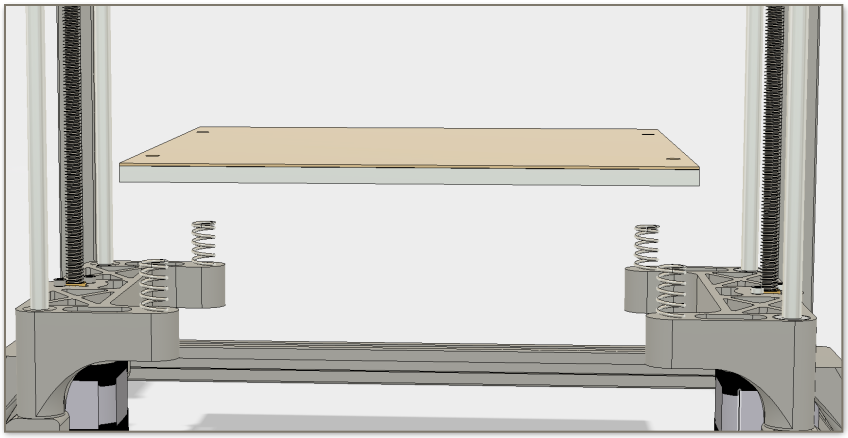
Step 5: Slide the Z tower until you can measure 115 mm from the back vertical to the edge of the lower Z shaft support. Tighten that support down. Make sure the bed carriage is still in the lower position, as we're using it to self-align the rest of the Z tower component. Wiggle the motor mount until the lead screw is pointing straight and it feel seated in its proper orientation, then tighten the motor mount down. You can now also tighten the other lower Z shaft support.



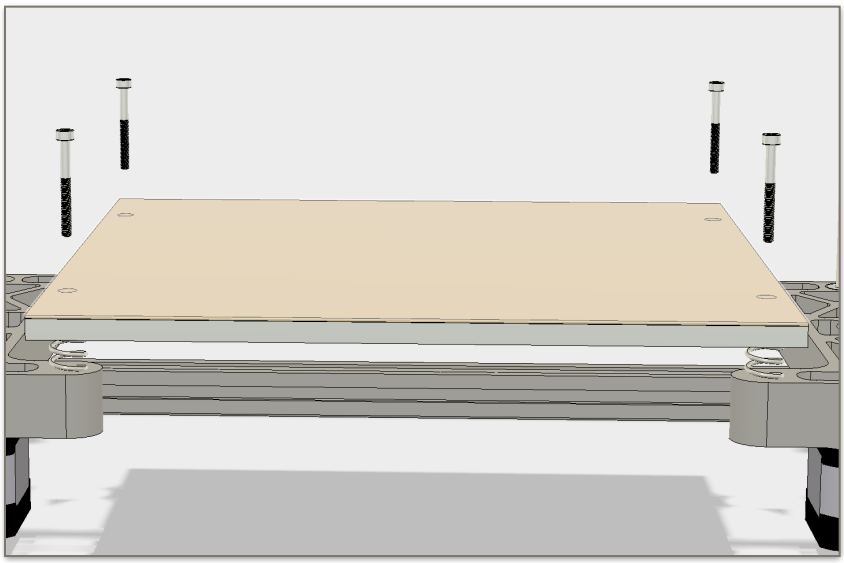
Step 6: Raise the bed carriage to the top-most position, and repeat this procedure for the upper Z shaft supports.

Repeat these steps for the other Z tower.

NOTE: If your bed size is something larger than 9"x9", subtract 9" from your bed length, convert the units to mm, and divide that number by 2. Add the result to 115mm and you'll have the proper distance for aligning the Z towers.

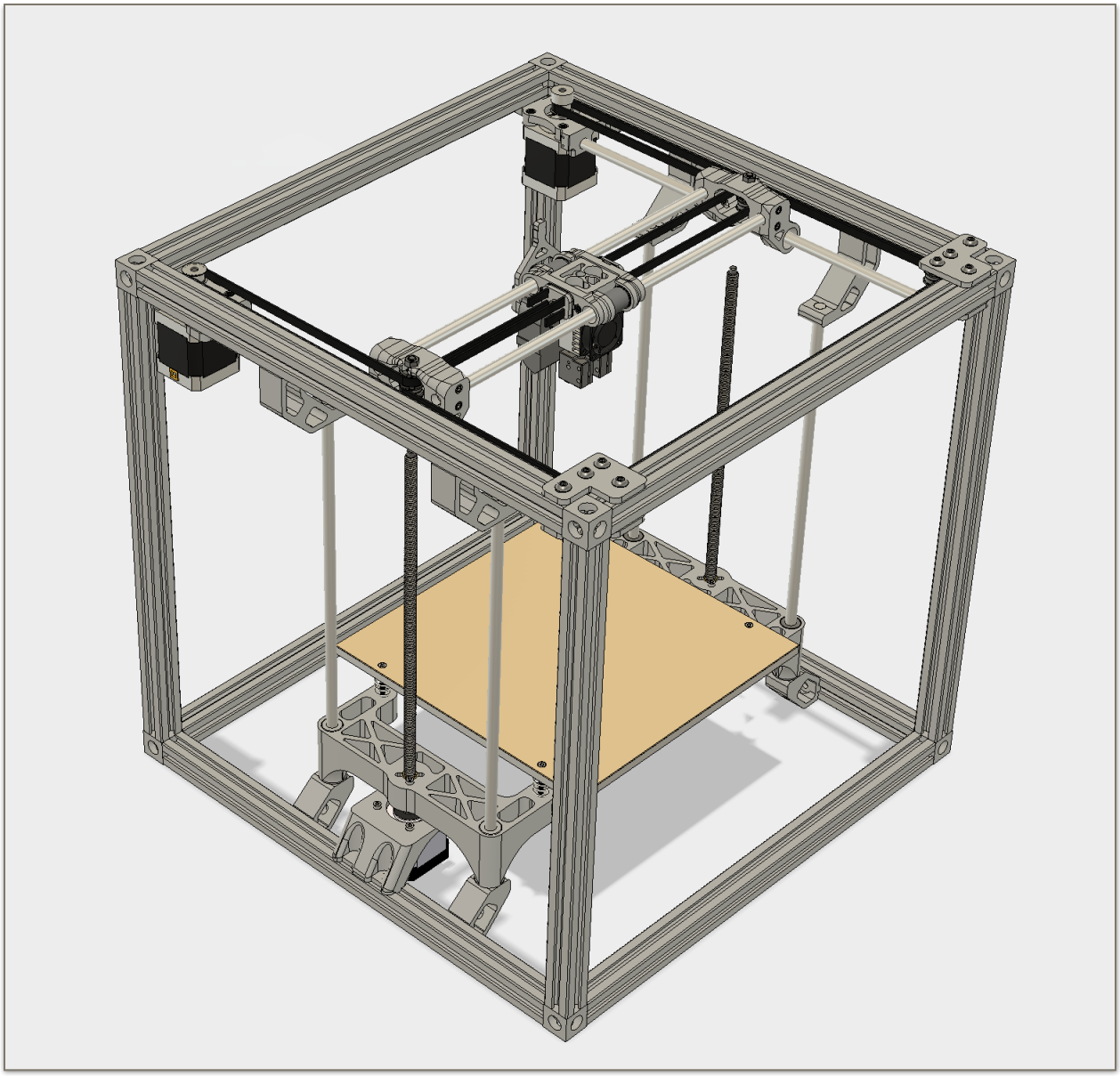


Step 7: Lower both Bed Carriages until they bottom out. Place the springs onto the bed mount points, and lower the bed assembly in top them.



Step 8: Secure the bed assembly to the bed carriages using the M3 30mm screws.

Tighten the screws down, compressing the springs, until you can’t move the bed around anymore easily.



Well done! Your VORON finally looks like a 3D printer.

Next, we'll tackle the filament feed system, and then wiring.