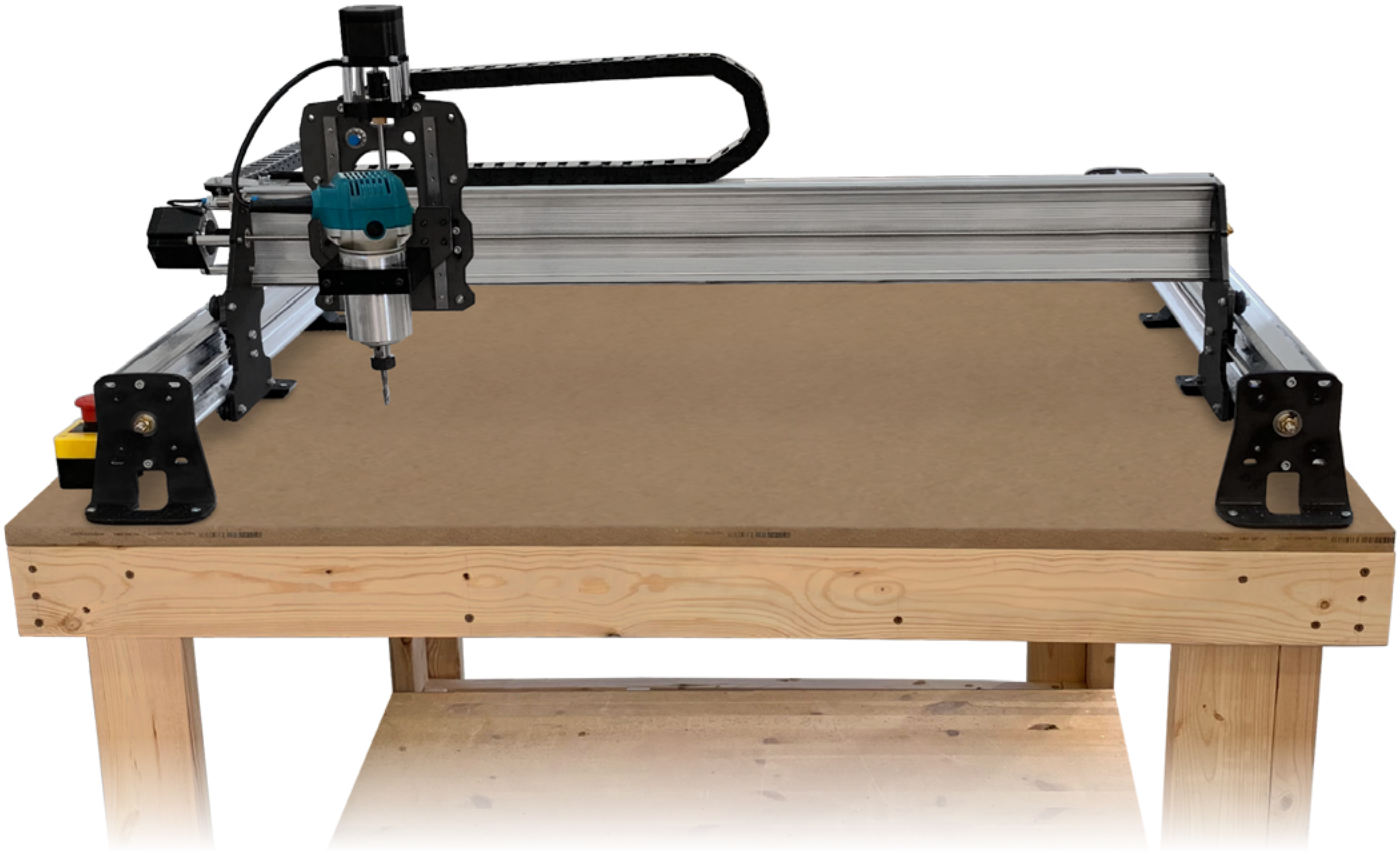
LONGMILL

LongMill MK 2 Assembly Manual



MK 2

SIENCI LABS

IDEAS INTO REALITY

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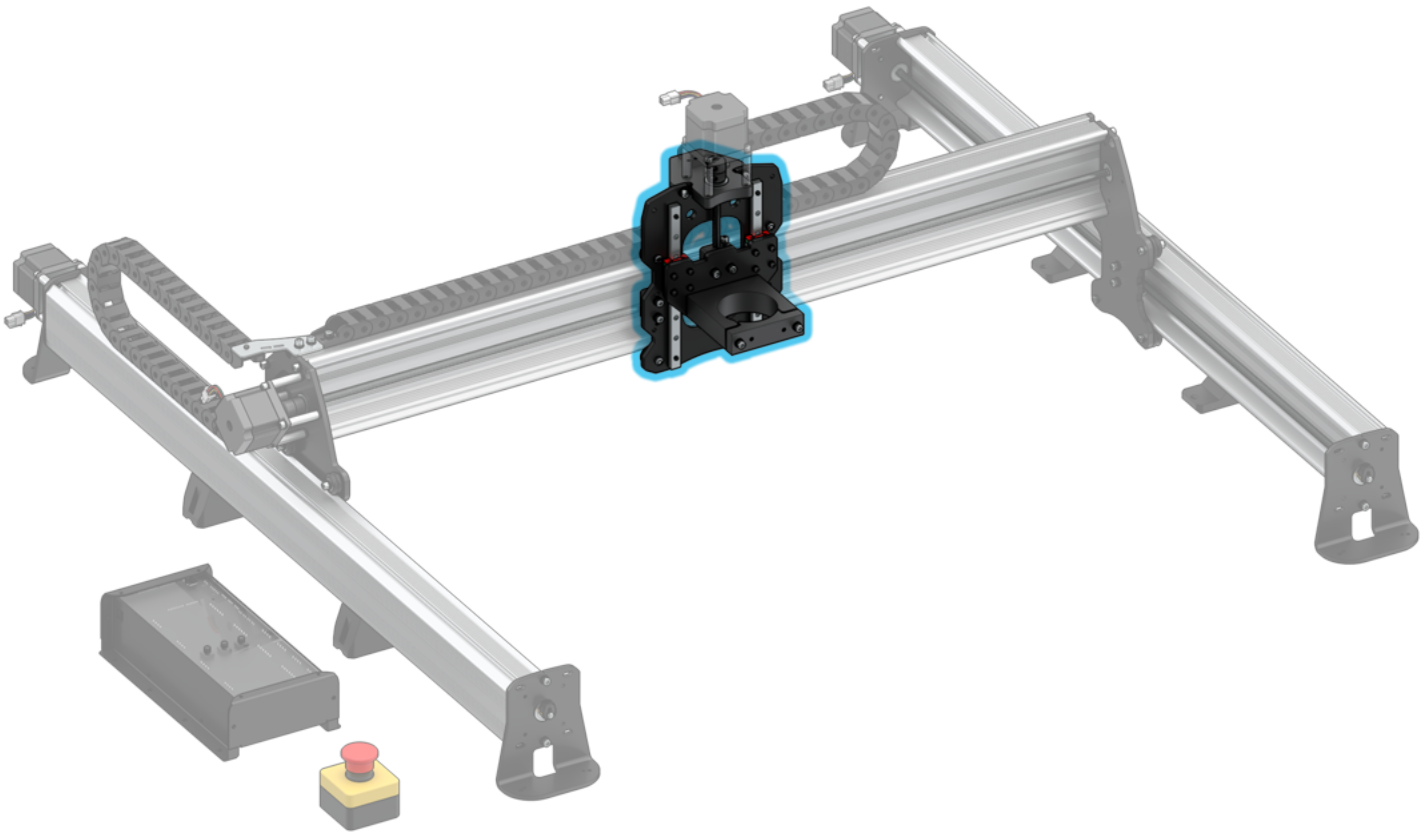
Part 1

X & Z-Axes



Nut Assemblies

Parts Needed:

 x4

Locking ACME nut & set screw

 x4

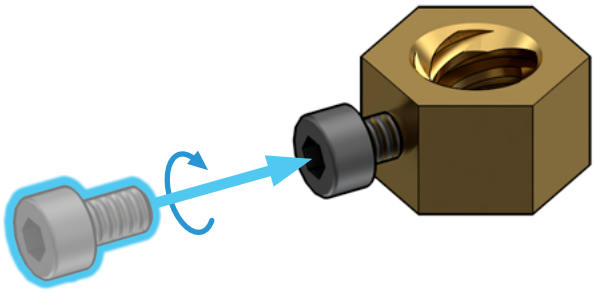
Delrin anti-backlash nut

 x8

M5-nylock nut

 x4

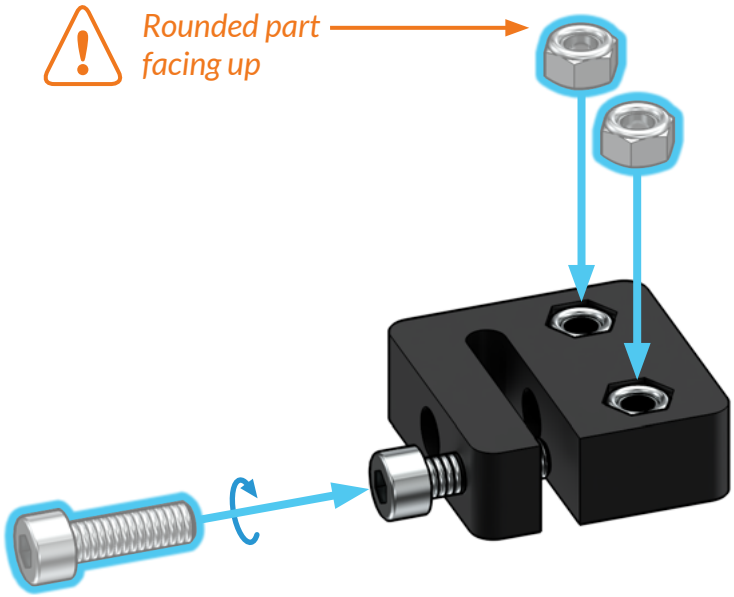
M5-16mm bolt

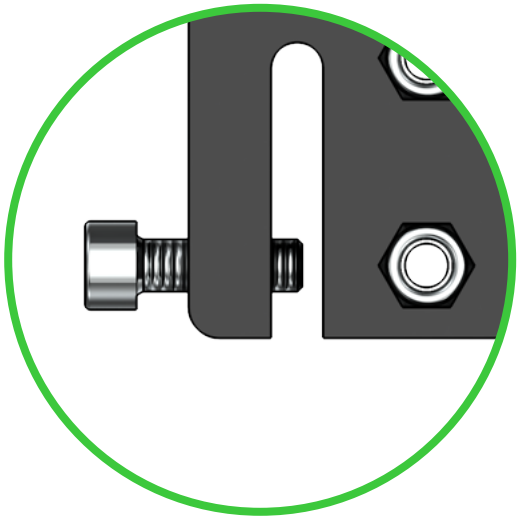


x4

We will start with the hardware bag marked with a green sticker; dump the contents out. This hardware is most of what's needed for the first half of assembly so you can assume that hardware comes from here unless mentioned otherwise.

Dumping out the green bag, you should see a bag containing some large hex nuts and small set screws. These are called locking ACME nuts. Loosely thread one set screw into the ACME nut by about 2 turns. Prepare 4 pieces and set them aside.





Leave a gap

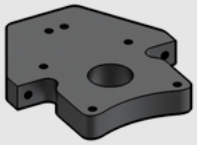
Start by pressing the M5-nylock nuts into the hexagonal cutouts. Make sure that you point the round end of the nut towards you, as you want the first part of the thread to be metal before your bolt gets to the nylon locking part. There may be some force required to push the nuts into the openings.

The bag which had the backlash nuts will also contain a set of set-screws and nuts that are used to tension and reduce backlash. You can either install these or use some of the M5-16mm bolts, the set-screws are shorter so they don't impede as much on the motion of the machine but they're harder to get to for adjustment. If you're not sure, go with the long M5 bolts for now then feel free to replace them with the shorter set-screws later on. Prepare 4 sets of these blocks and set them aside for later.

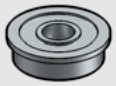
Now install one M5-16mm bolt into each anti-backlash nut. Don't tighten the bolt all the way, leave a gap. With four blocks ready, set them aside.

Z-axis Motor Mount

Parts Needed:

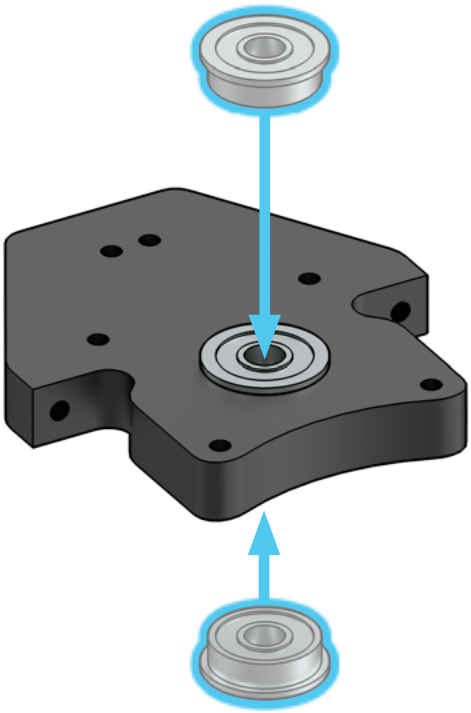


Z-axis motor mount



x2

608ZZ flange bearing



With the prep out of the way, let's continue on to the overall XZ-axis assembly. First you'll want to get your Z-axis motor mount from where it would've been kept with the rest of the cutting tools and add-ons, we call this box the 'variable box'. It'll be a wrapped aluminum part similar in size to the router mount.

With this in hand you'll also want to get the bag with bearings in it, of which you'll just need two for now. Press these into both sides of the bore on the Z-axis motor mount. You should be able to assemble these easily with your thumbs.

Z-axis Mount Sub-assembly

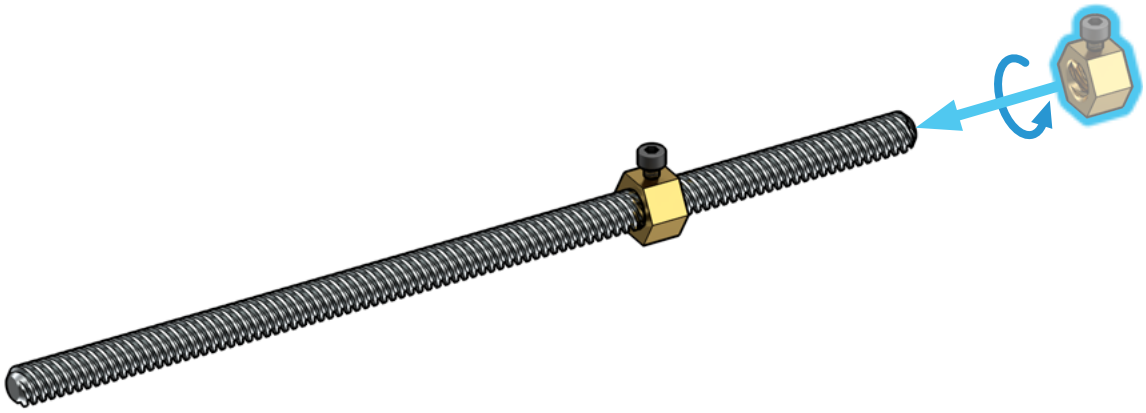
Parts Needed:

6.35mm to 8mm coupler

200mm lead screw

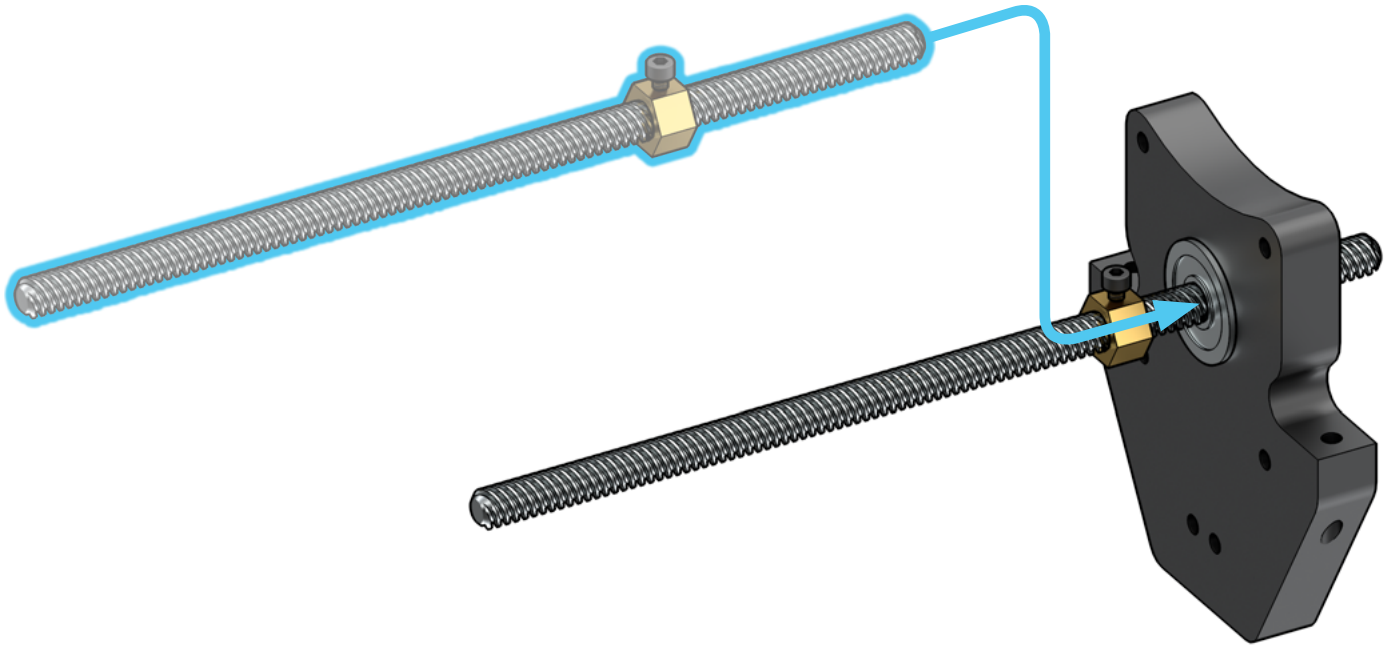
Previously Assembled

Locking ACME nut assembly



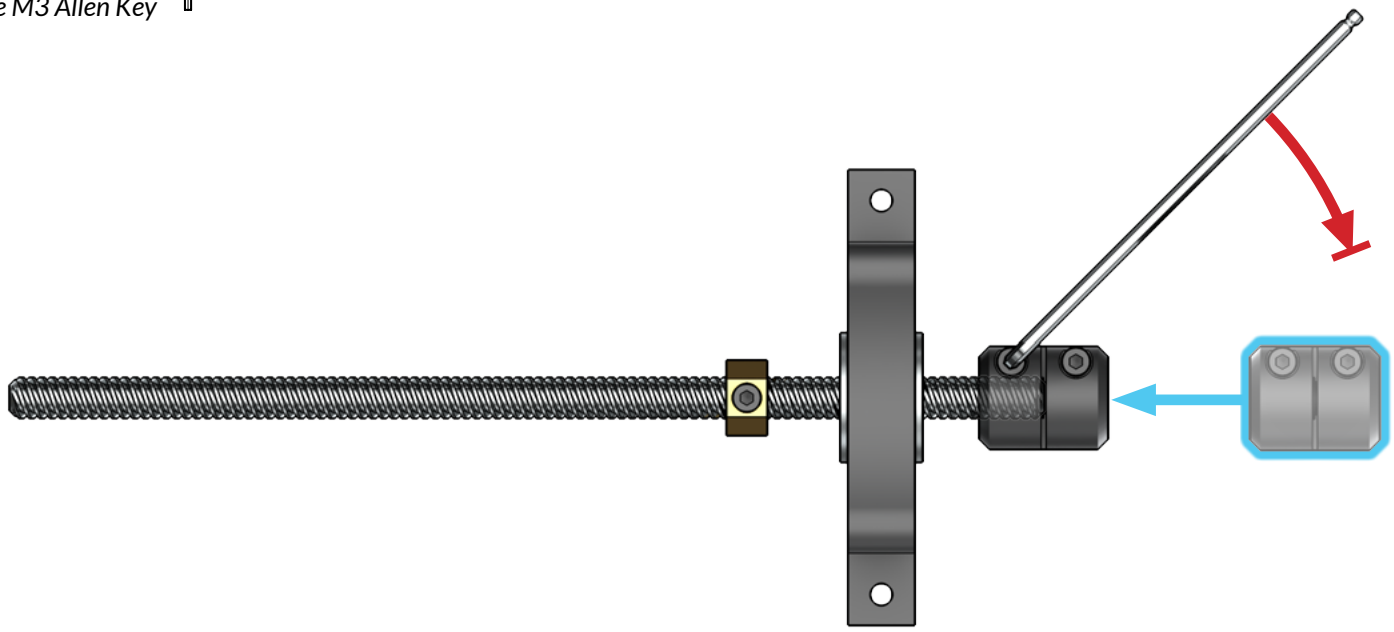
Going back to the parts, you'll want to look for the short lead screw which will be packaged alongside the rest. This step will also use a previously assembled locking ACME nut and a coupler from the bag of couplers.

Grab the ACME nut and thread a couple inches (as pictured) onto the lead screw. Make sure the ACME nut still has its set screw.

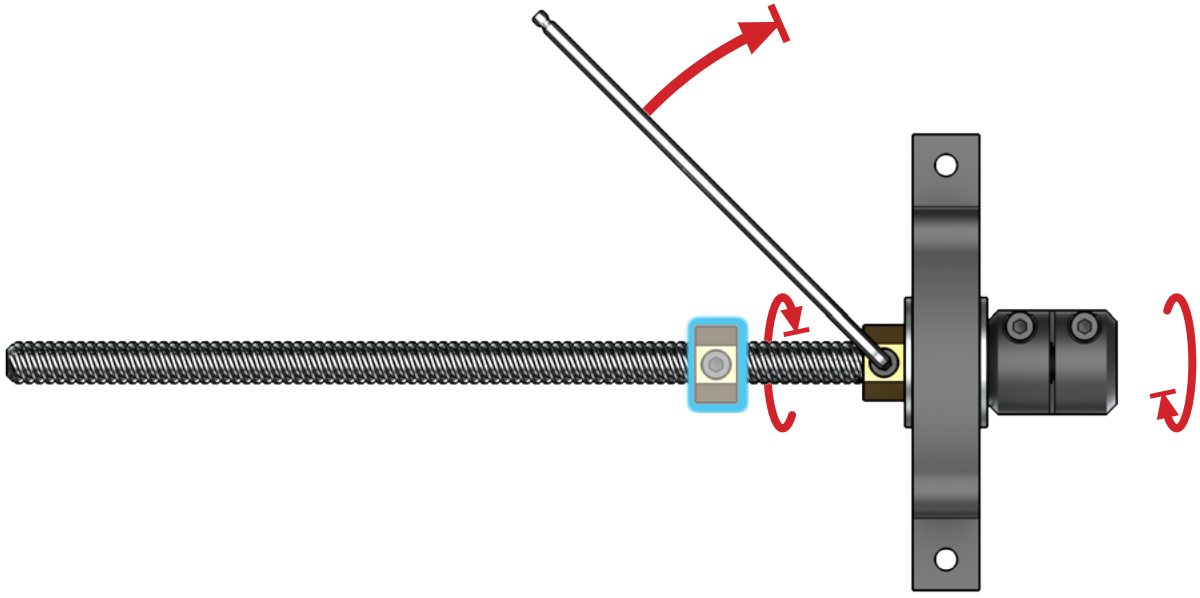


Next, slide this short end of the lead screw through the bearings on the Z-axis motor mount. This fit may be tight so just do your best to hold everything in place and try to wiggle the lead screw or tap it with a mallet if needed. Make sure the bearings are sitting in the bore straight before applying force.

Use M3 Allen Key



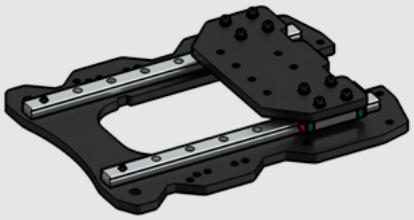
On the coupler, identify the end with the larger hole. This will be the only side that fits onto the lead screw. Push the coupler on until it bottoms out, then tighten the set screw using an M3 Allen key to clamp it onto the lead screw. **BEWARE!** Only tighten ONE of the set screws - the one on the lead screw side (as pictured). When you attach the motors near the end of machine assembly you'll tighten the other set screw to hold onto the motor shaft. If you overtighten the wrong set screw it can deform your coupler and cause issues with assembly.



Now rotate the coupler and ACME nut in opposite directions so that they come together to clamp onto the two bearings. Once they've all come together to make a 'bolted sandwich' everything should be touching (as pictured). Once in this position, tighten the set screw on the locking ACME nut. If assembled properly, this should now feel like a solid, single piece where the lead screw should only be allowed to rotate, and not move forwards or backwards. Set this assembly aside for now.

XZ-axis Gantry Sub-assembly

Parts Needed:



XZ-gantry assembly

x12

V-wheel

x12

M5-25mm bolt

x2

M5-nylock nut

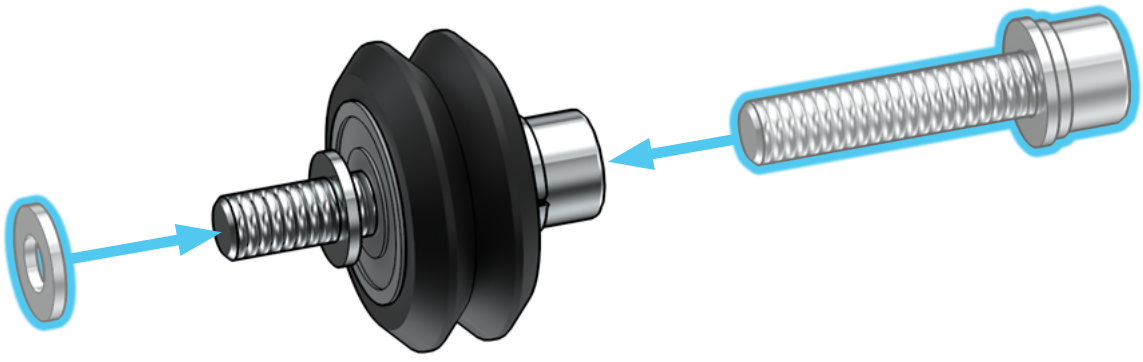
x2

Eccentric nut

x12

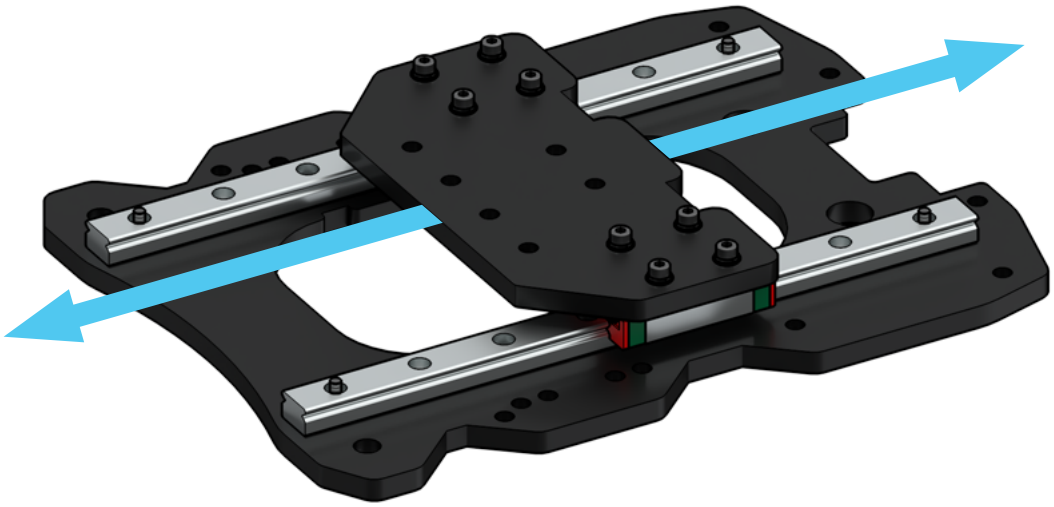
M5 washer

From the green bag, grab the M5 washers, M5-25mm bolts and the Delrin V-wheels. If the V-wheels have an off-centered ring in the middle (pictured), use a small Allen key to move the ring back to the center.

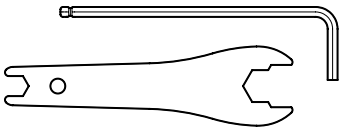


x12

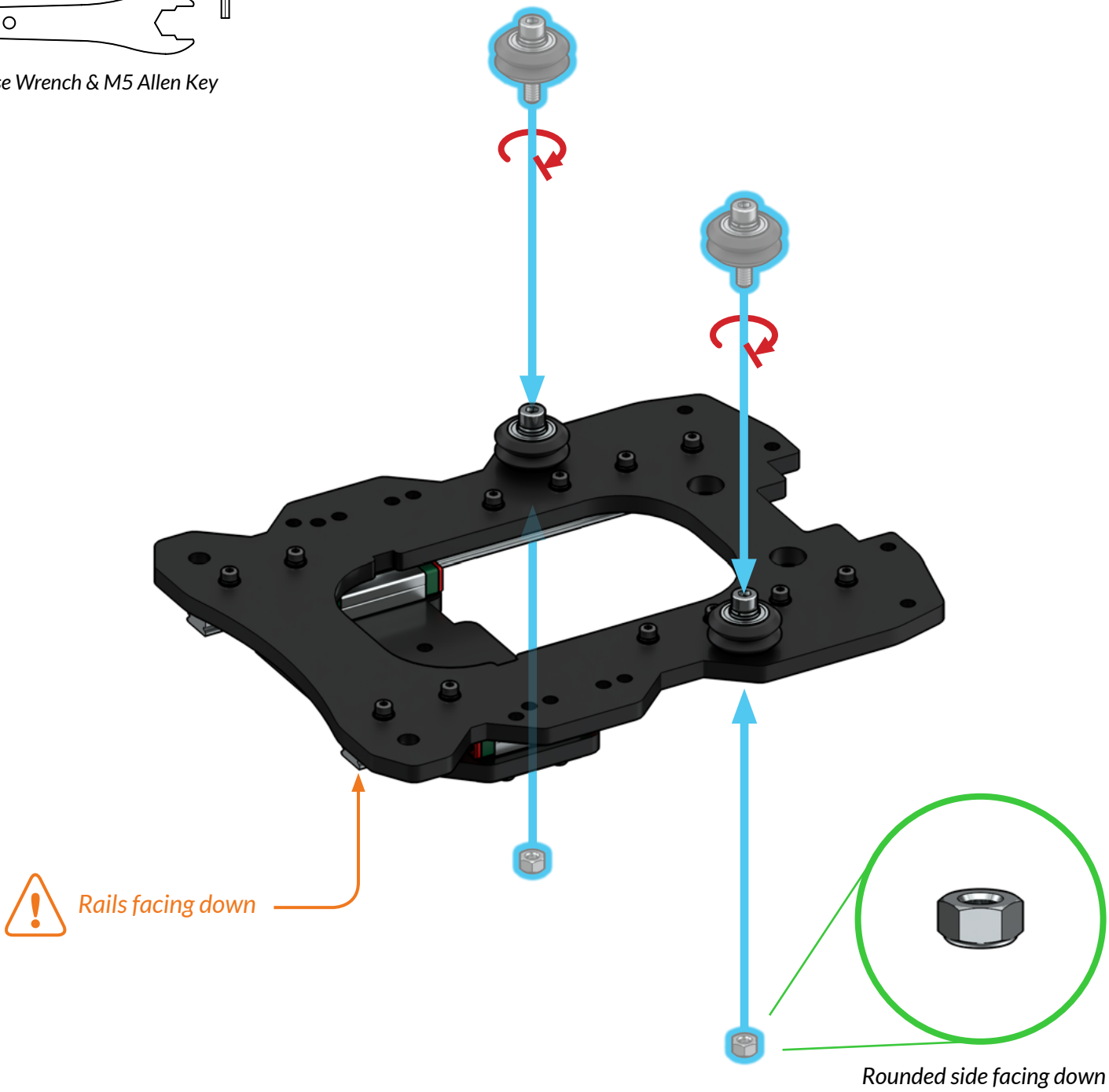
Assemble by putting the bolt through the V-wheel. Then install the washer on the other side of the V-wheel. It's very important that the washer is in the correct place, because this keeps the wheel from rubbing against the gantry, and provides the correct spacing between the gantry and the lead screw. Prepare 12 of these assemblies.

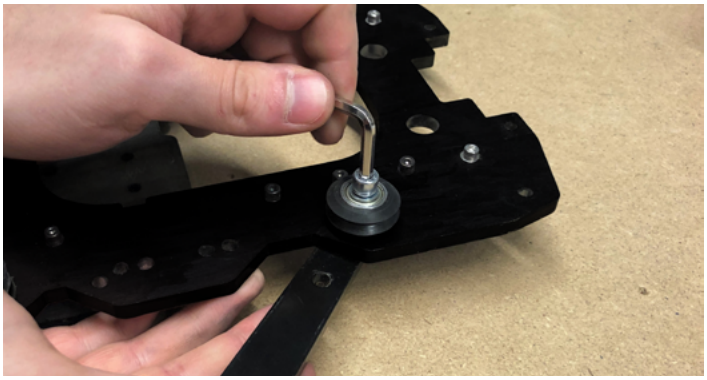


You should find the XZ-gantry assembly in the labelled bubble mailer. When you open the mailer, you should see a smaller steel plate (Z-gantry) attached to a larger steel plate (X-gantry) via two sliding rails. First, check that the movement of the Z-gantry is smooth by moving it up and down with your hand. The motion should be smooth, and there should not be any binding.

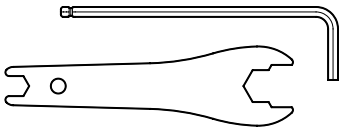


Use Wrench & M5 Allen Key

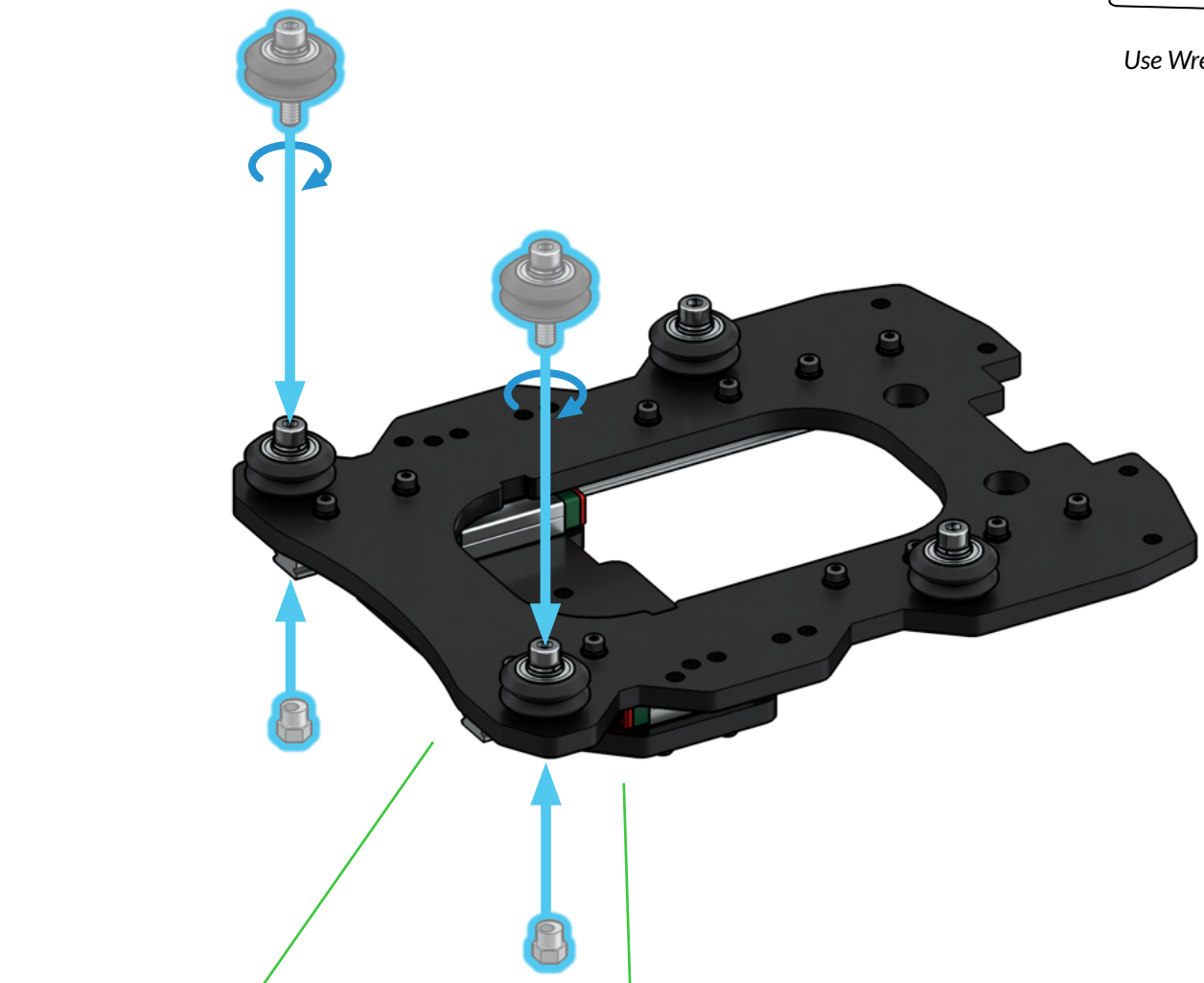




Install two of the V-wheel assemblies onto the XZ-gantry assembly with two nylock nuts. Ensure that the V-wheels are installed in the correct location, relative to the X-gantry. Use the included wrench to keep the nuts in place, while you use an M5 (size 4) Allen key to tighten the V-wheels. The rounded end of the nylock nuts should face away from the gantry. Ensure that the nylock nuts are firmly secured.



Use Wrench & M5 Allen Key



Install two V-wheel assemblies at the bottom edge of the gantry - except this time, use two eccentric nuts. When placing the eccentric nuts inside the gantry holes, ensure the inner holes of the nuts are oriented towards the bottom edge of the gantry (pictured). Use the included wrench to keep the nuts in place, while you use an M5 (size 4) Allen key to loosely secure the V-wheels.

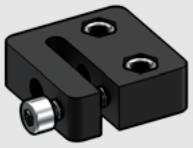
Attaching Anti-backlash Nuts

Parts Needed:

x4

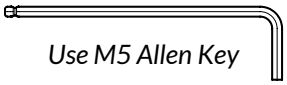
M5-25mm bolt

Previously Assembled

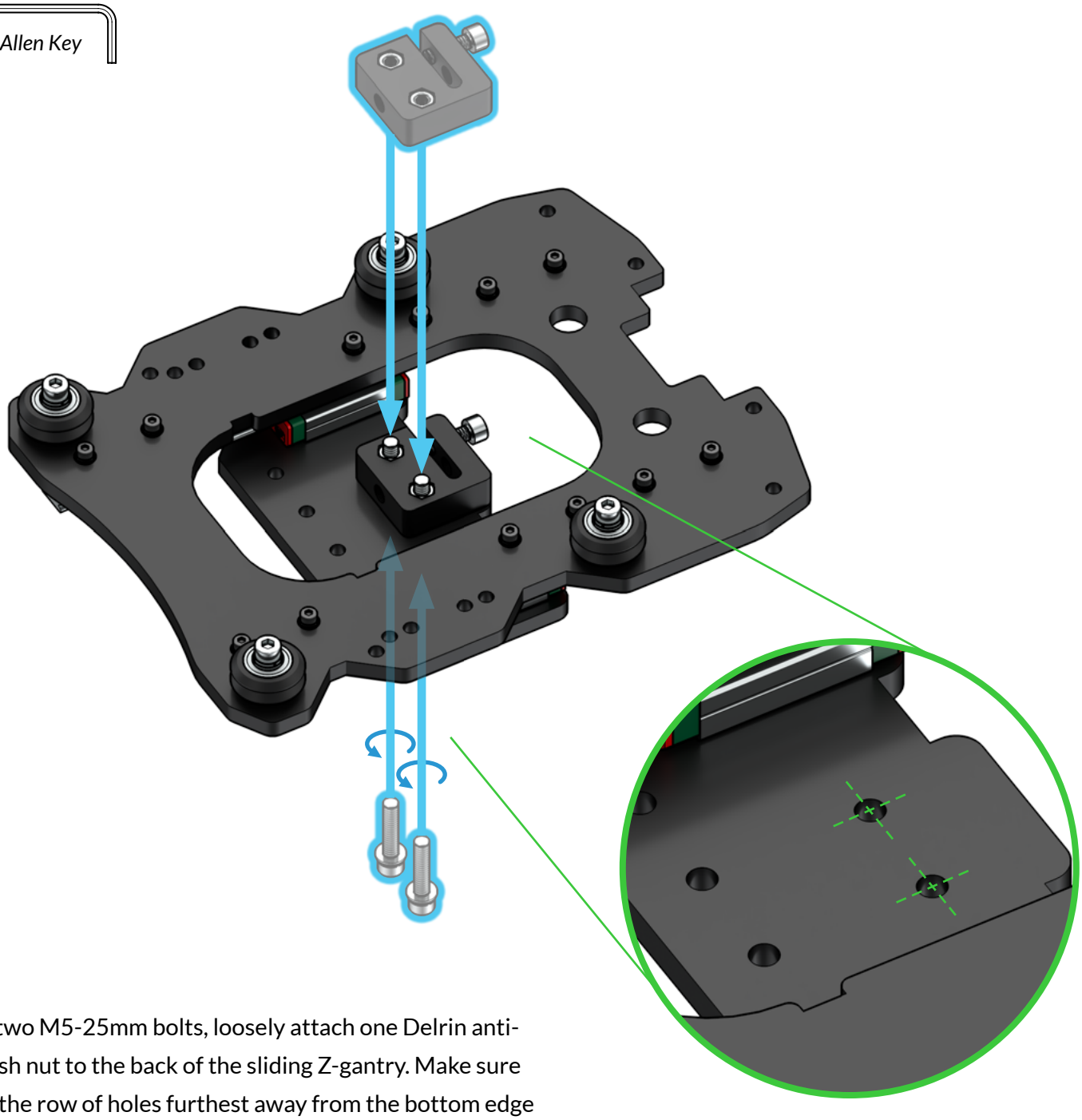


x2

Delrin anti- backlash nut assembly

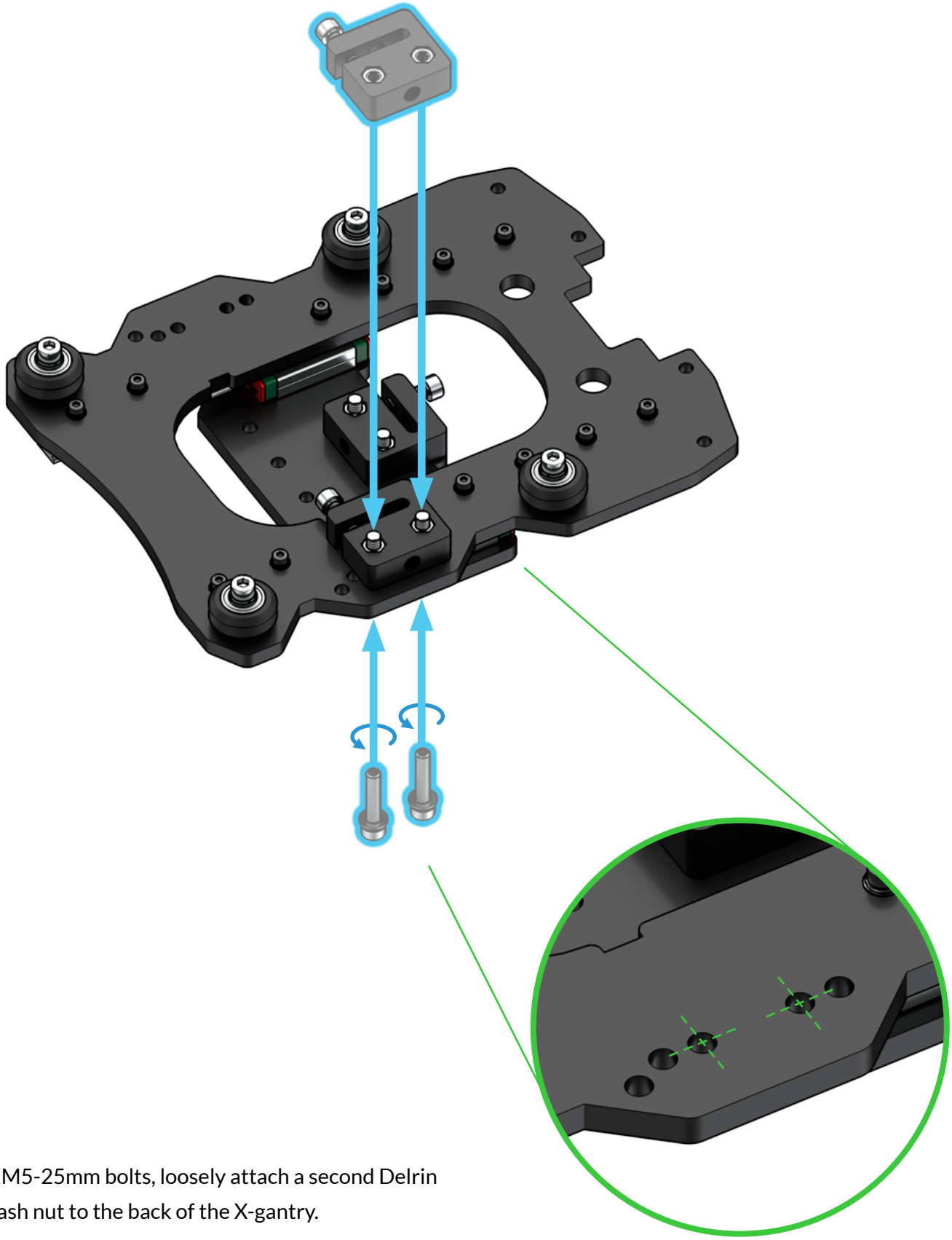


Use M5 Allen Key



Using two M5-25mm bolts, loosely attach one Delrin anti-backlash nut to the back of the sliding Z-gantry. Make sure to use the row of holes furthest away from the bottom edge of the X-gantry (pictured).

Use M5 Allen Key



Using two M5-25mm bolts, loosely attach a second Delrin anti-backlash nut to the back of the X-gantry.

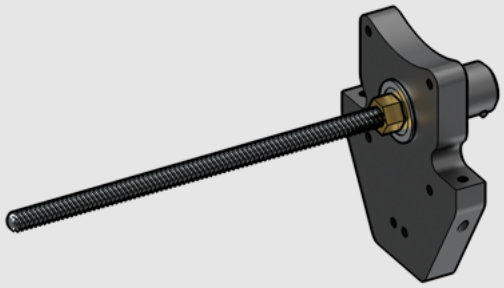
Connecting the Sub-assemblies

Parts Needed:

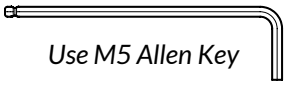
x2

M5-25mm bolt

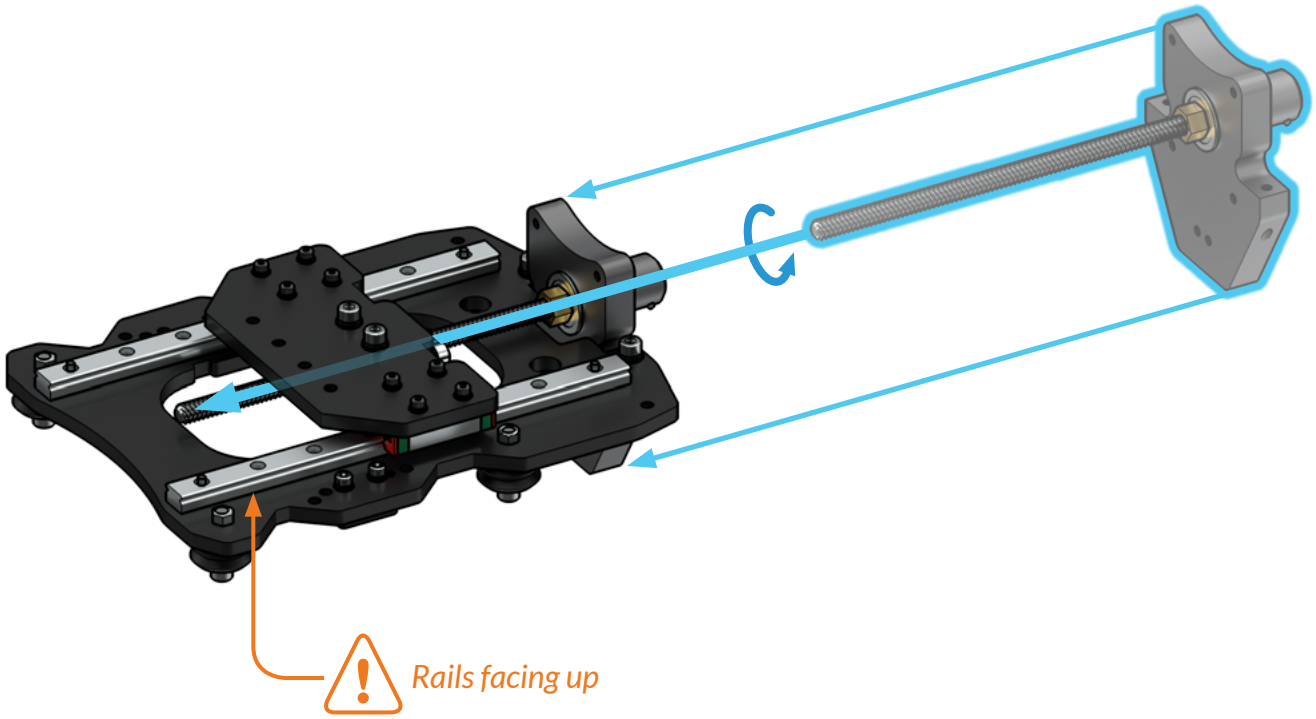
Previously Assembled

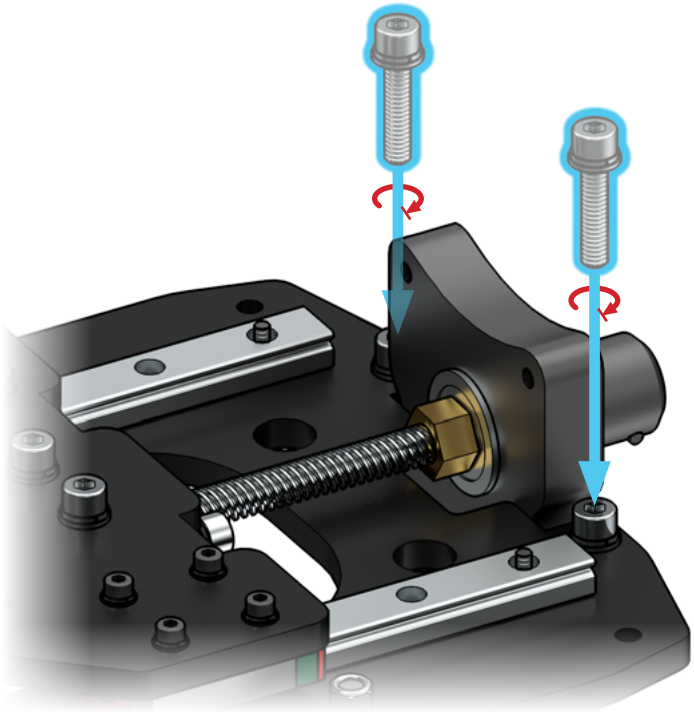


Z-axis motor mount

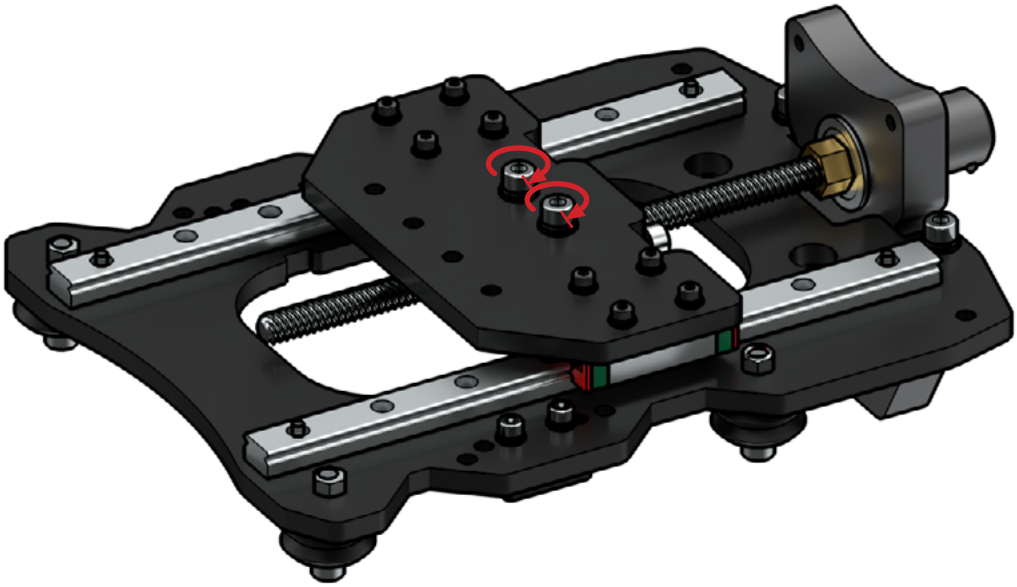


Use M5 Allen Key





Slide the Z-axis motor mount onto the XZ gantry assembly, checking that the orientation is correct (pictured). Thread the lead screw into the Z-gantry anti-backlash block, between the two steel plates. Fasten two M5-25mm bolts on both sides of the Z-axis motor mount to secure the two assemblies together.



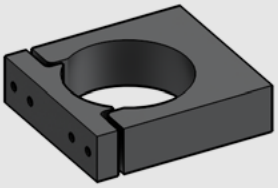
Fully tighten the two M5-25mm bolts, which previously loosely attached the Delrin anti-backlash nut to the X-gantry.

Attaching the Roter Mount

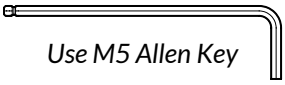
Parts Needed:

x6

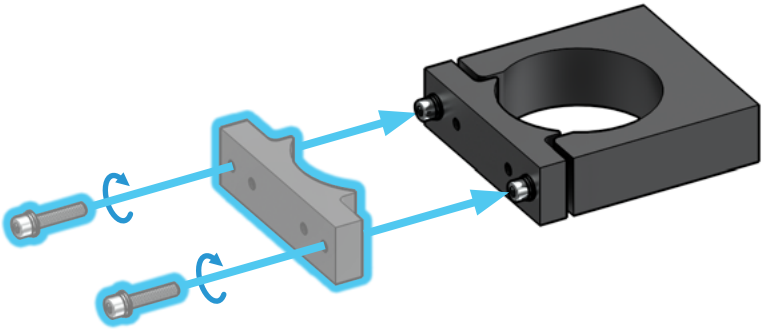
M5-25mm bolt

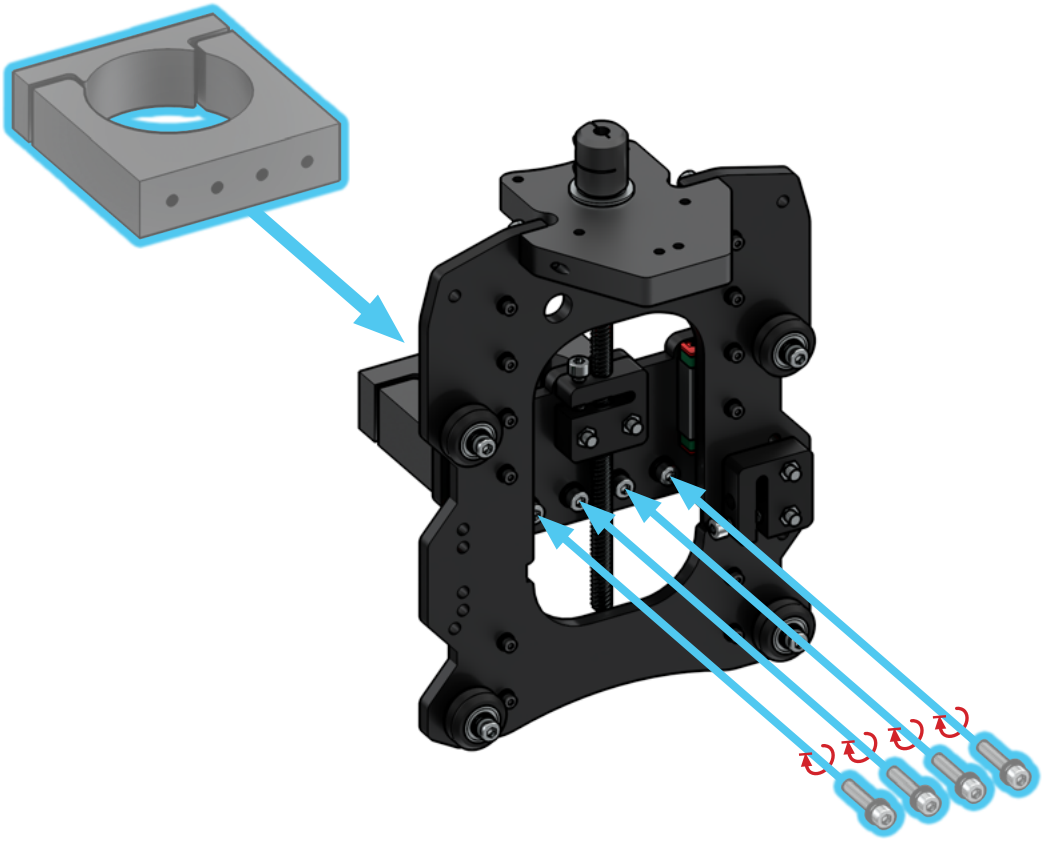


Aluminum router mount



Use M5 Allen Key

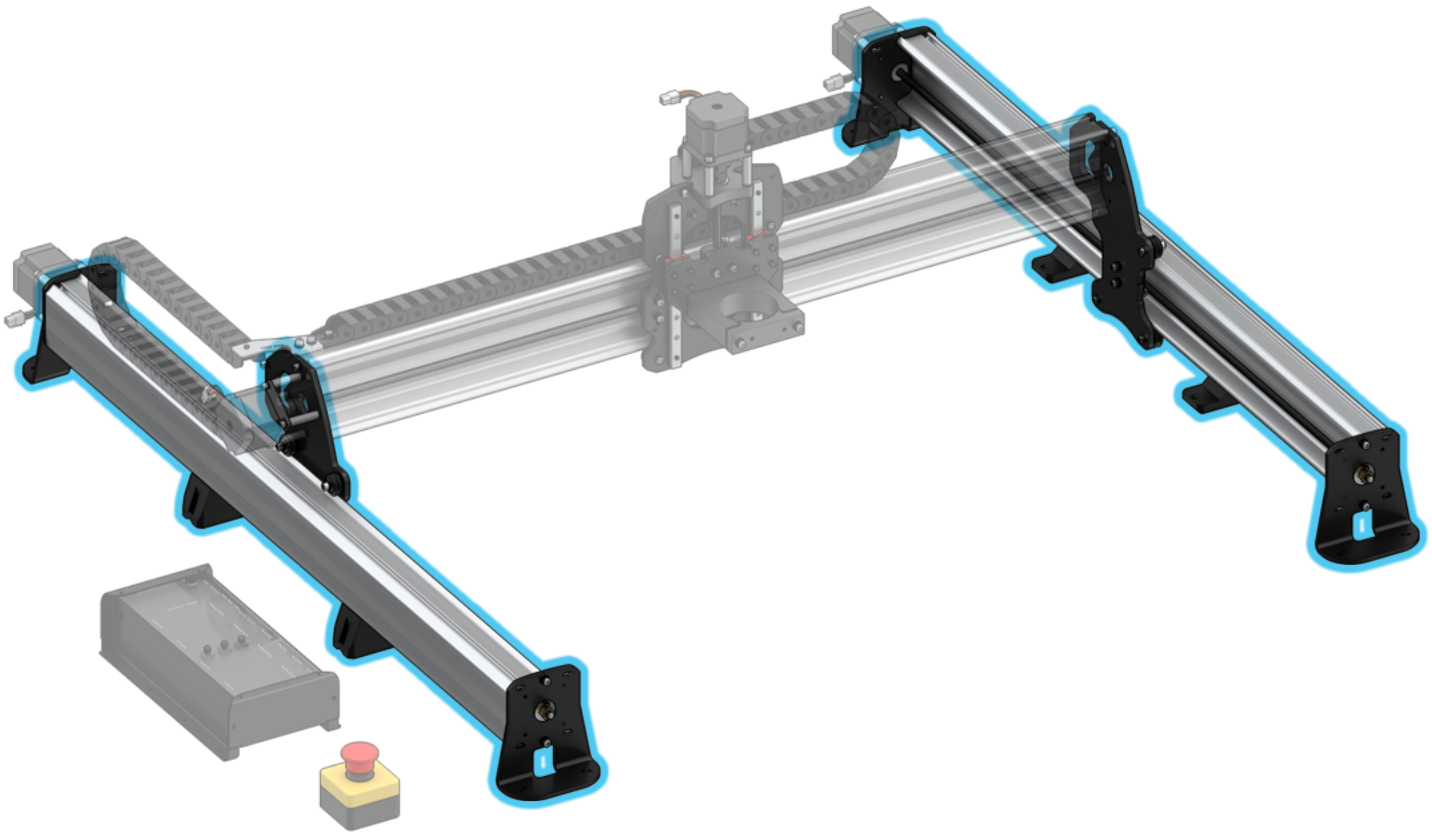




Attach the two router mount pieces with two M5-25mm bolts, then assemble this router mount to the XZ gantry assembly with four M5-25mm bolts. Ensure bottom of router mount is flush with bottom of Z gantry

Part 2

Y-Axis Gantries



Y-Gantry Wheels

Parts Needed:

x2

Y-axis gantry

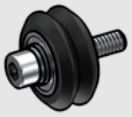
x4

M5-nylock nut

x4

Eccentric nut

Previously Assembled

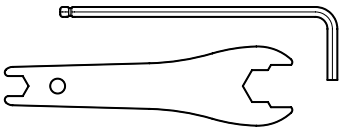


x8

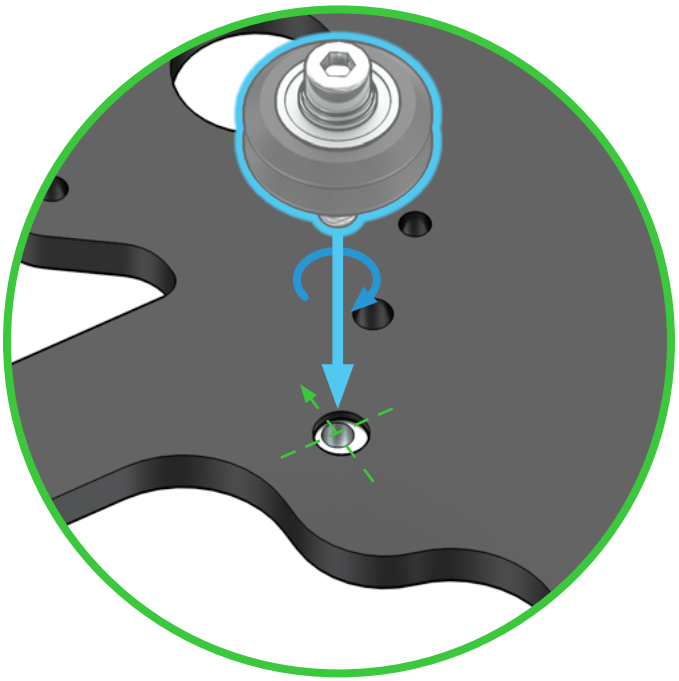
V-wheel assembly

Use Wrench & M5 Allen Key

Install two V-wheel assemblies to each Y-axis gantry using nylock nuts, and make sure that these V-wheels are installed at the bottom edge of the gantry. Similar to previous steps, use the M5 Allen key and included wrench to firmly secure the nylock nuts.



Use Wrench & M5 Allen Key



Now, loosely install two V-wheel assemblies in the upper row of holes on each Y-axis gantry, using eccentric nuts. Orient the inner holes of the eccentric nuts away from the bottom edge of the gantry (pictured).

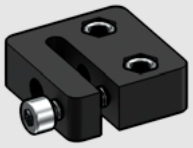
Y-axis Anti-backlash Nuts

Parts Needed:

x4

M5-25mm bolt

Previously Assembled



x2

Delrin anti- backlash nut assembly

Use M5 Allen Key

Using two M5-25mm bolts, loosely attach the Delrin anti-backlash nut to the back of the Y-gantry. Do this for the second Y-gantry.

Y-axis Middle Feet

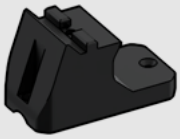
Parts Needed:

x4

M5-25mm bolt

x4

T-nut



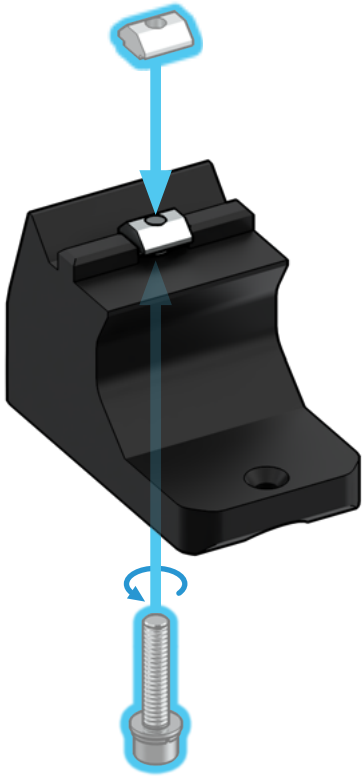
x4

Middle foot

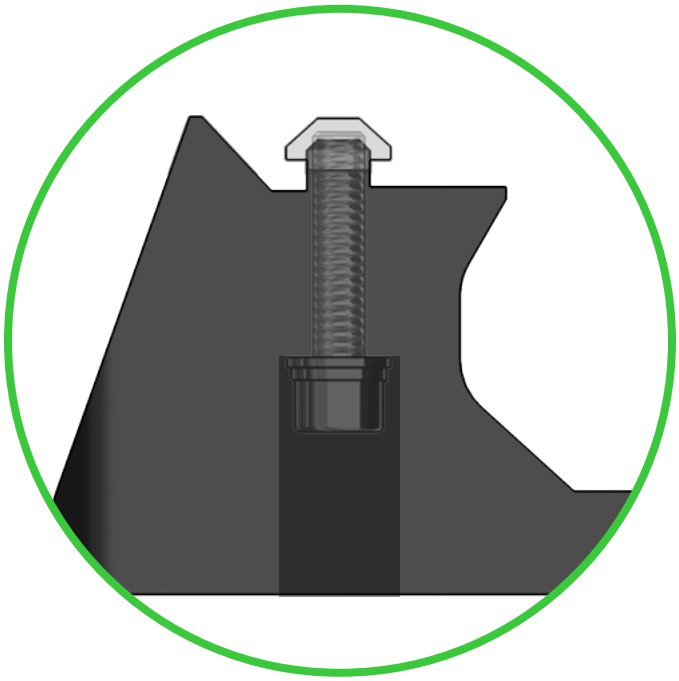
x2

Y-axis rails
(shorter in you have the 12x30 LM)

Use M5 Allen Key

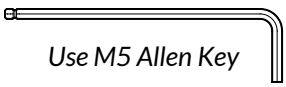


x4

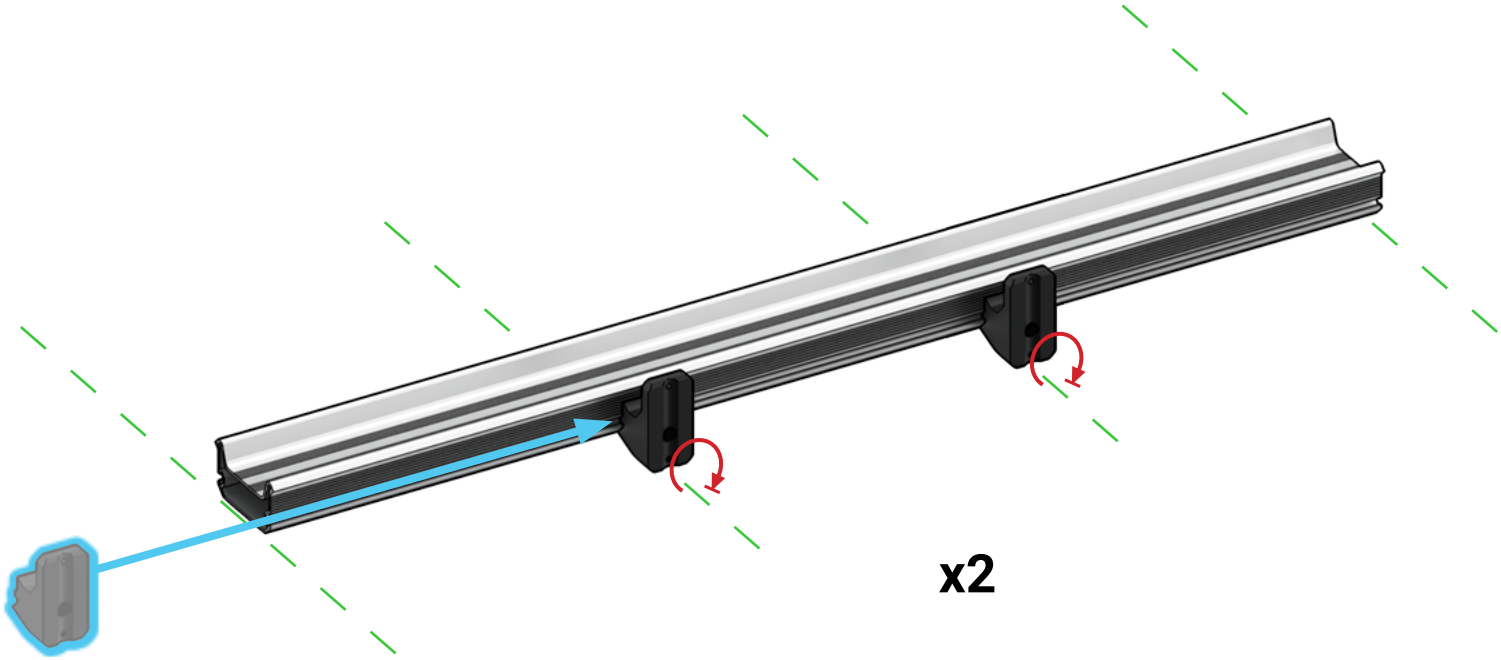


At this point of the assembly process, we will begin using hardware from the yellow bag, in addition to the green bag.

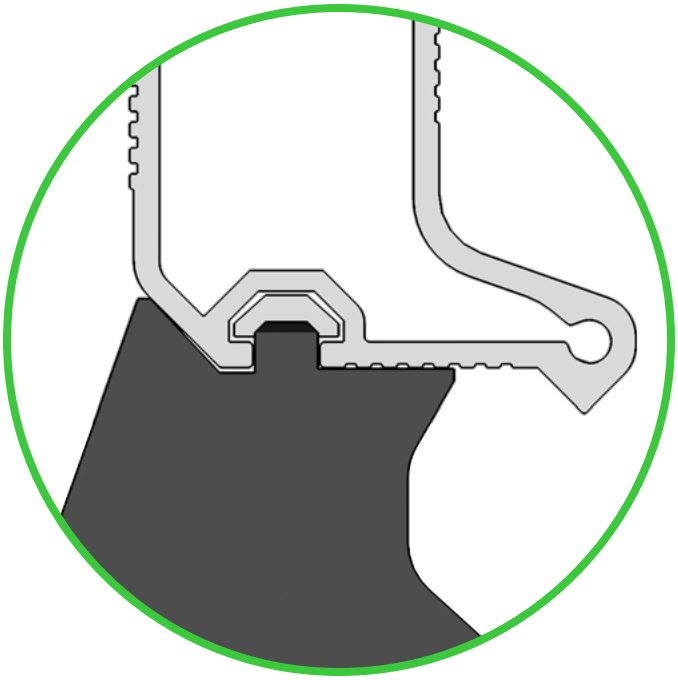
From the yellow sticker bag, grab four T-nuts. For all four middle feet, insert M5-25mm bolts through, and thread in the T-nuts loosely until they are held in. There should be some resistance when the bolt bottoms out at the T-nut.



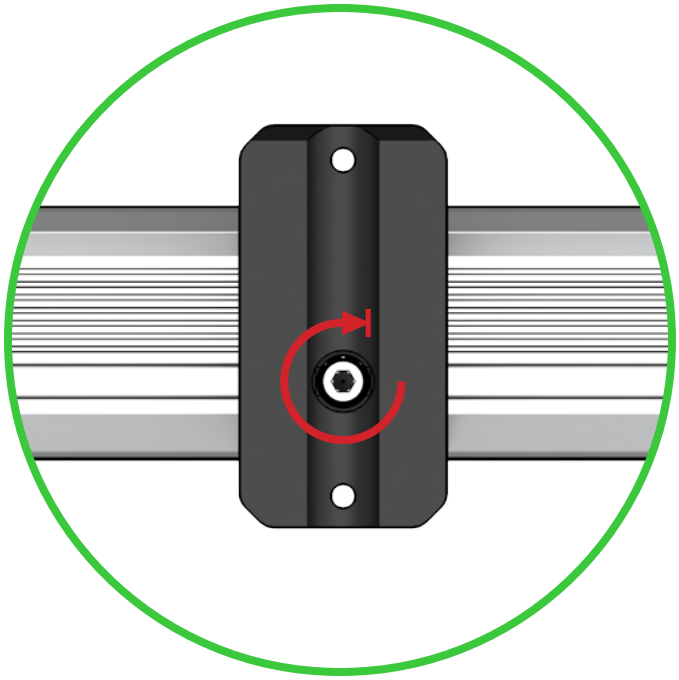
Use M5 Allen Key



Slide in two feet assemblies through the slots of each Y-axis. Position them about 1/3 from each end. Then, tighten the M5 bolts at the bottom of each foot.



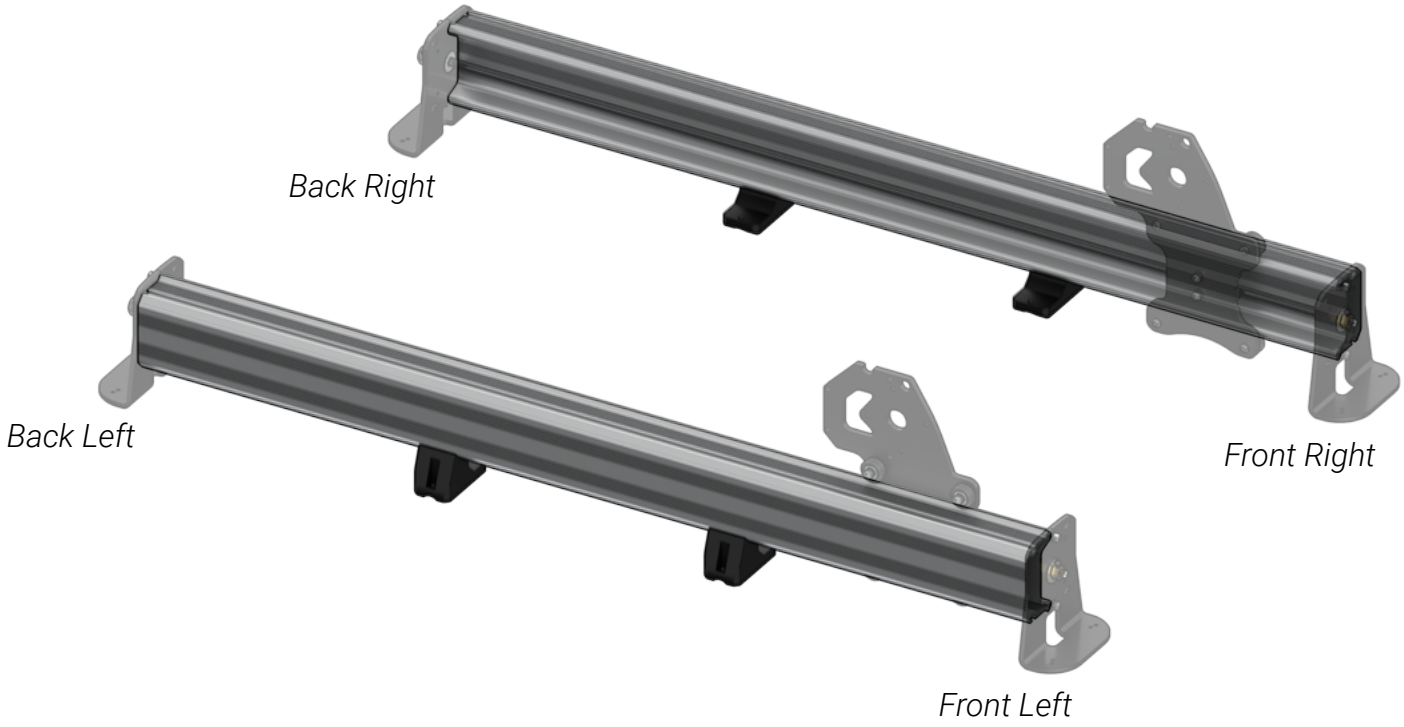
Sliding the foot onto the rail



Tightening the screws on underside of each foot

INTERMISSION

From this point onwards until the completion of the Y-axis rail assemblies, we will only show the steps for the **right** Y-axis rail. While you are assembling the right Y-axis rail, complete the steps again for the left Y-axis rail.



The following icon will be shown on each page where you should be repeating the steps for the second rail, but mirrored.

Mirror Mode

Y-axis End Feet

Parts Needed:

x8

M5-25mm bolt

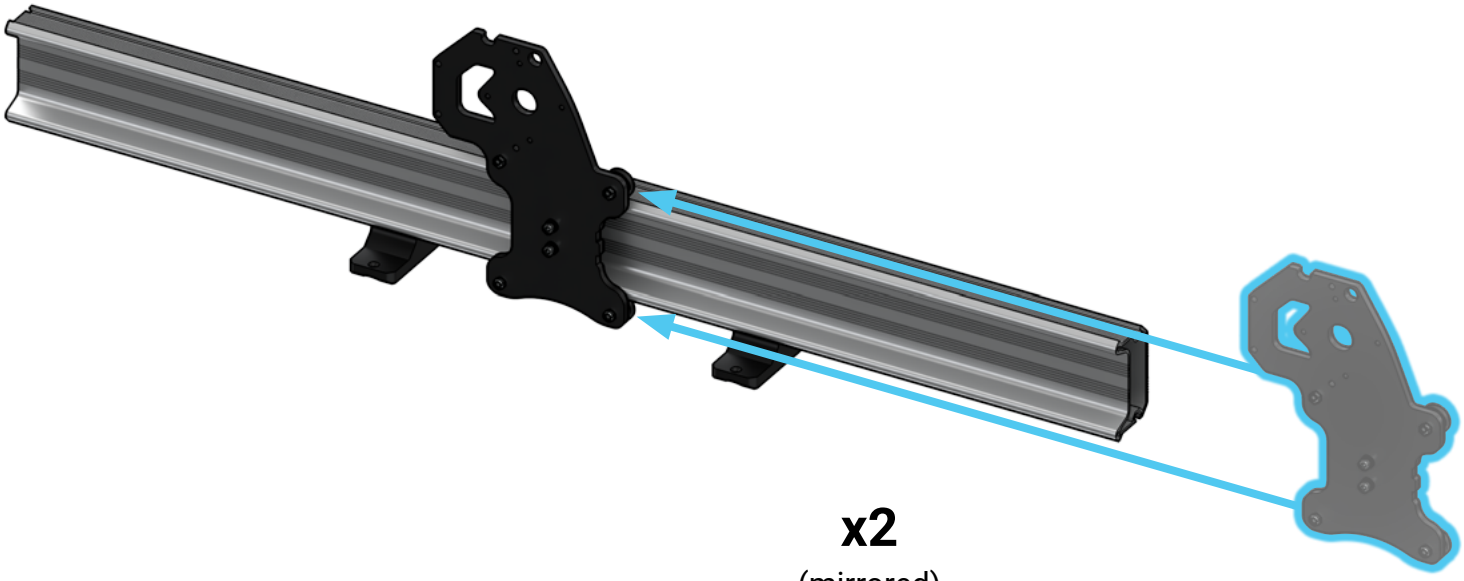
x4

End foot

Previously Assembled

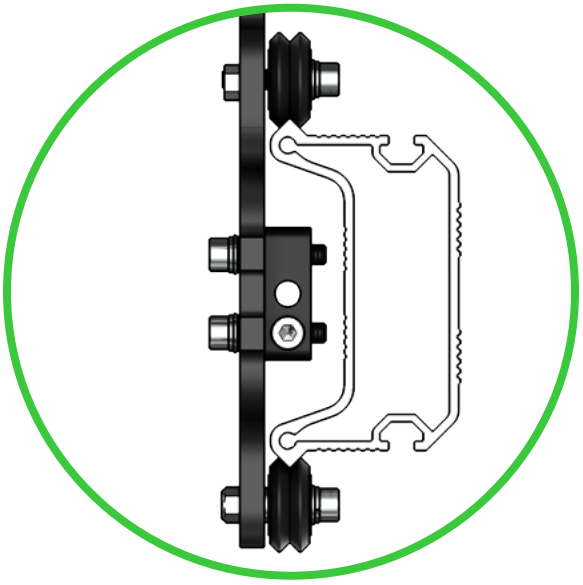
Left y-axis gantry assembly

Right y-axis gantry assembly



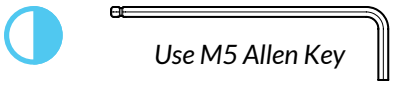
x2

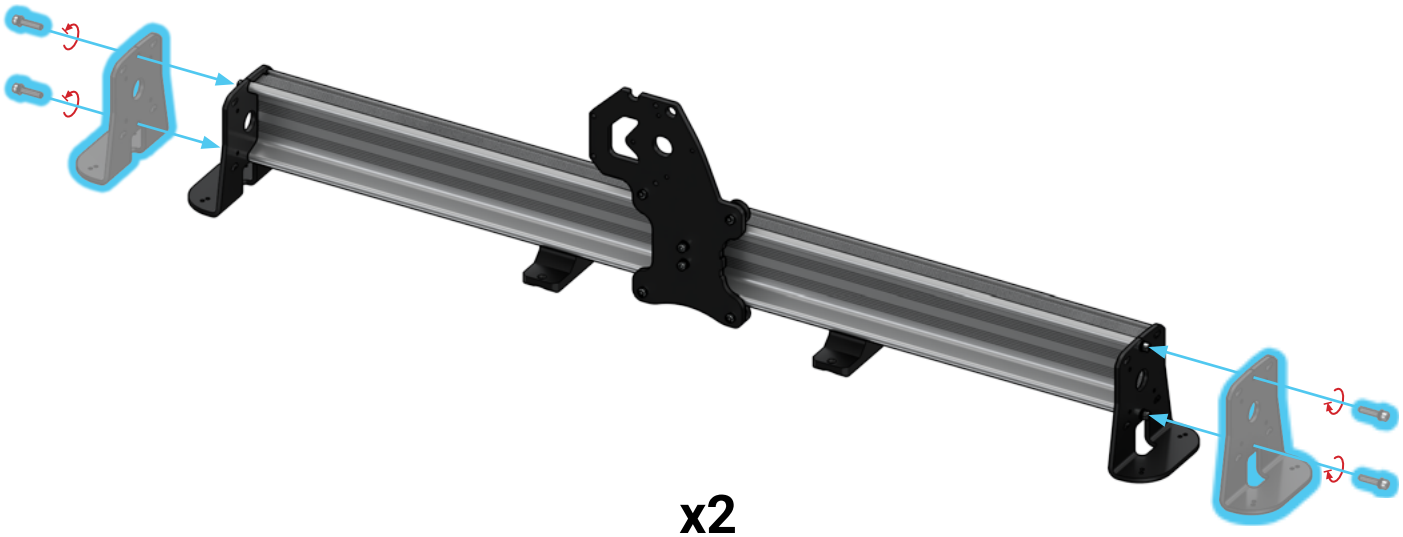
(mirrored)



Delrin wheels rolling onto the Y-rail

Slide the Y-gantry plate onto the Y-rail. The V-wheels should sit on the pointed edges on each side of the Y-rail (pictured).

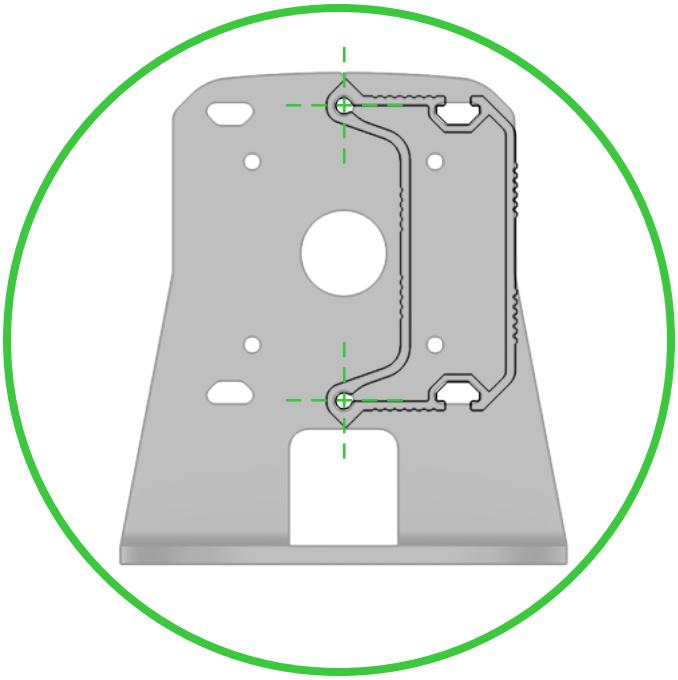




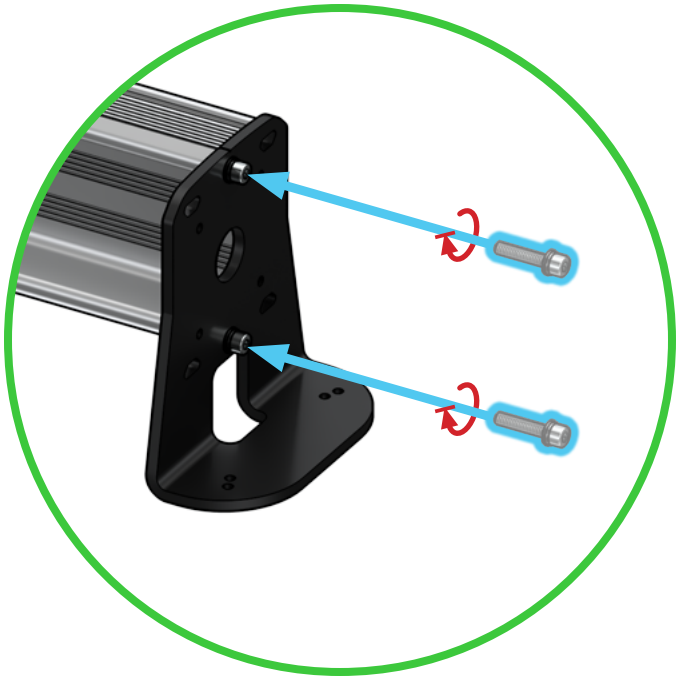
x2

(mirrored)

Attach two end feet onto each end of the Y-axis rail, using two M5-25mm bolts for each foot.



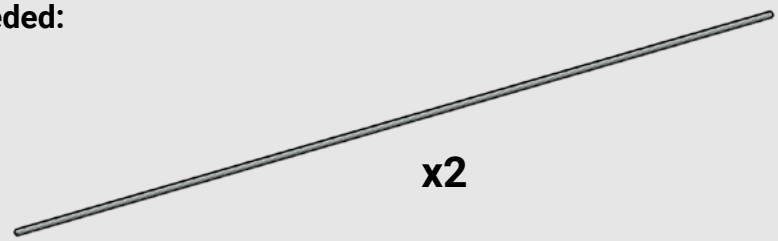
Foot aligning to the rail



Bolting feet into place

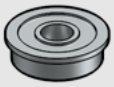
Y-axis Lead Screws

Parts Needed:



x2

1000mm lead screw



x4

608ZZ flange bearing

x2

6.35mm to 8mm coupler

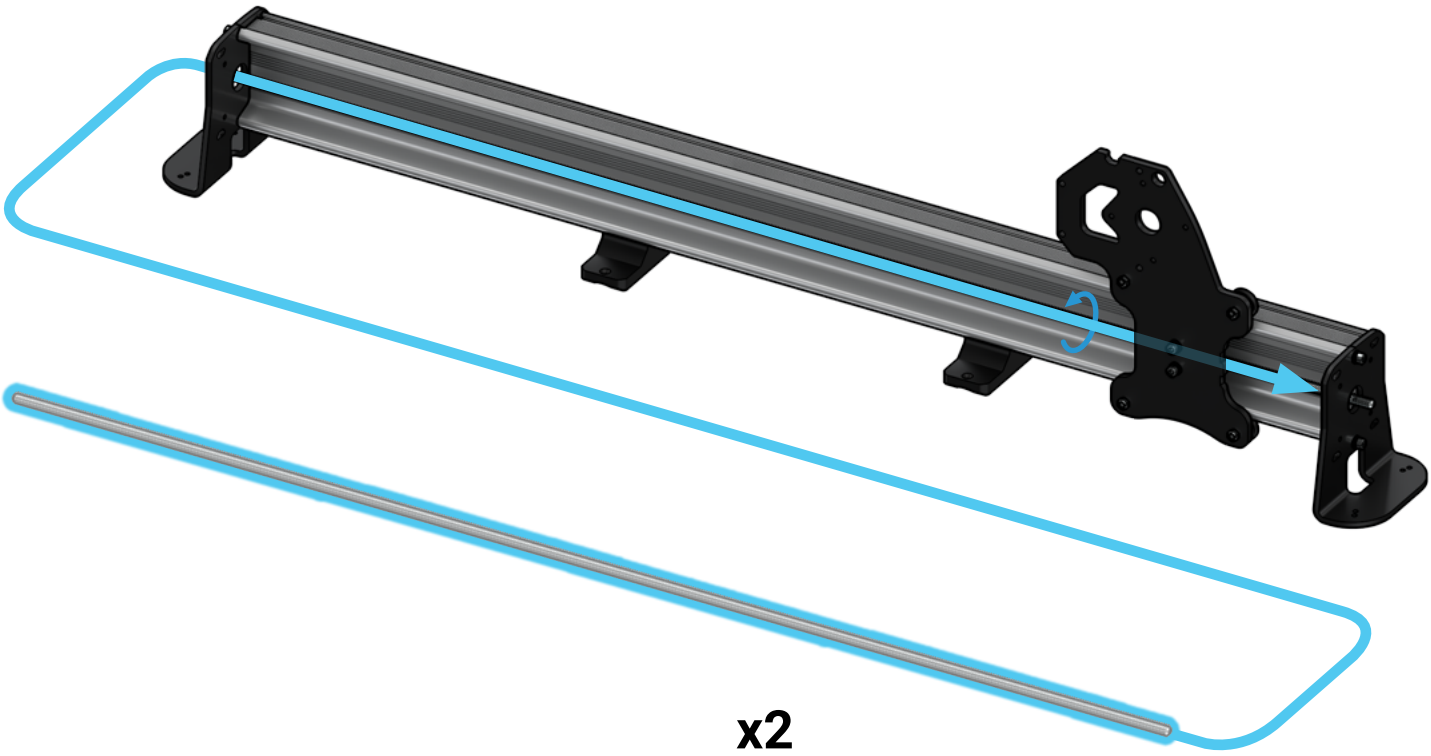
x2

M5-25mm bolt

Previously Assembled

x2

Delrin anti- backlash nut assembly

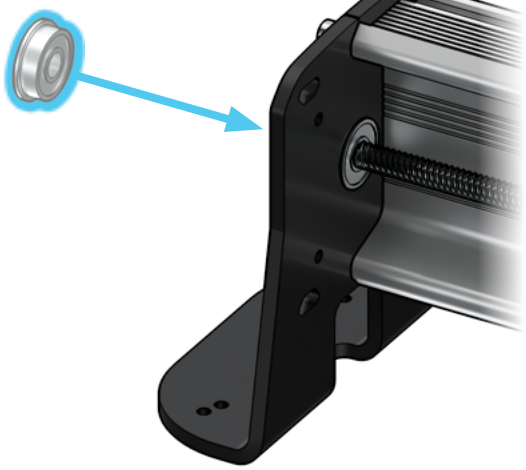


x2

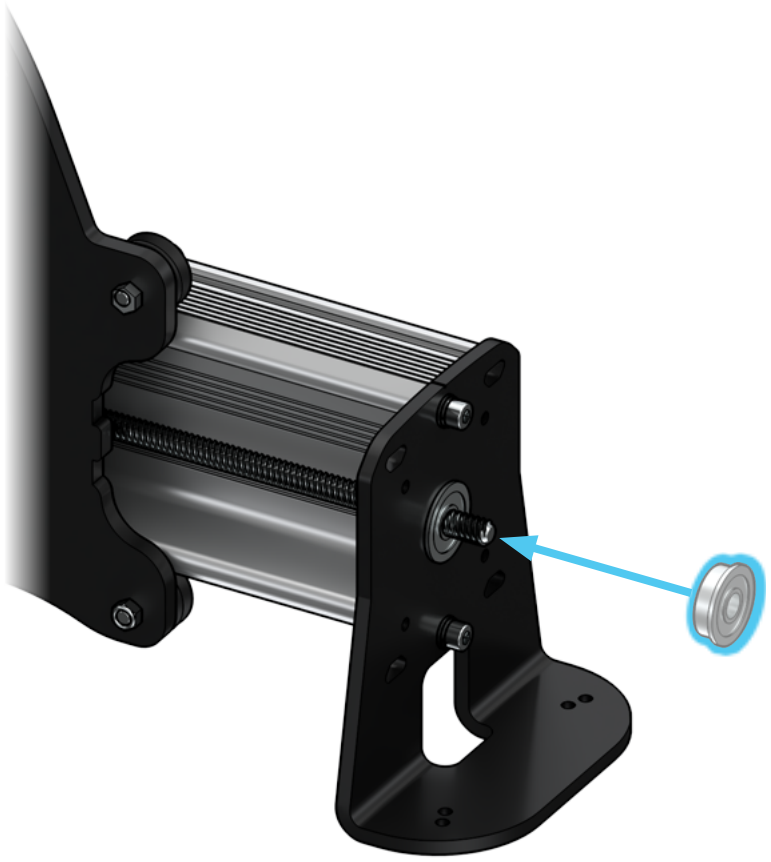
(mirrored)

Thread the longest lead screw through the anti-backlash block behind the Y-gantry. The ends of the lead screw should be resting in the cutouts on both end feet.

the anti-backlash nuts may be difficult to thread on, sometimes the alignment of the threads can be resolved by pressing the thinner arm down to help the threads line up while threading in the lead screw. Worst case, can remove the Y-gantry again and check the anti-backlash nut for burrs and debris that may be in the threads then try to clean them out and check the fit of the lead screw before rolling the gantry back on.



Back foot



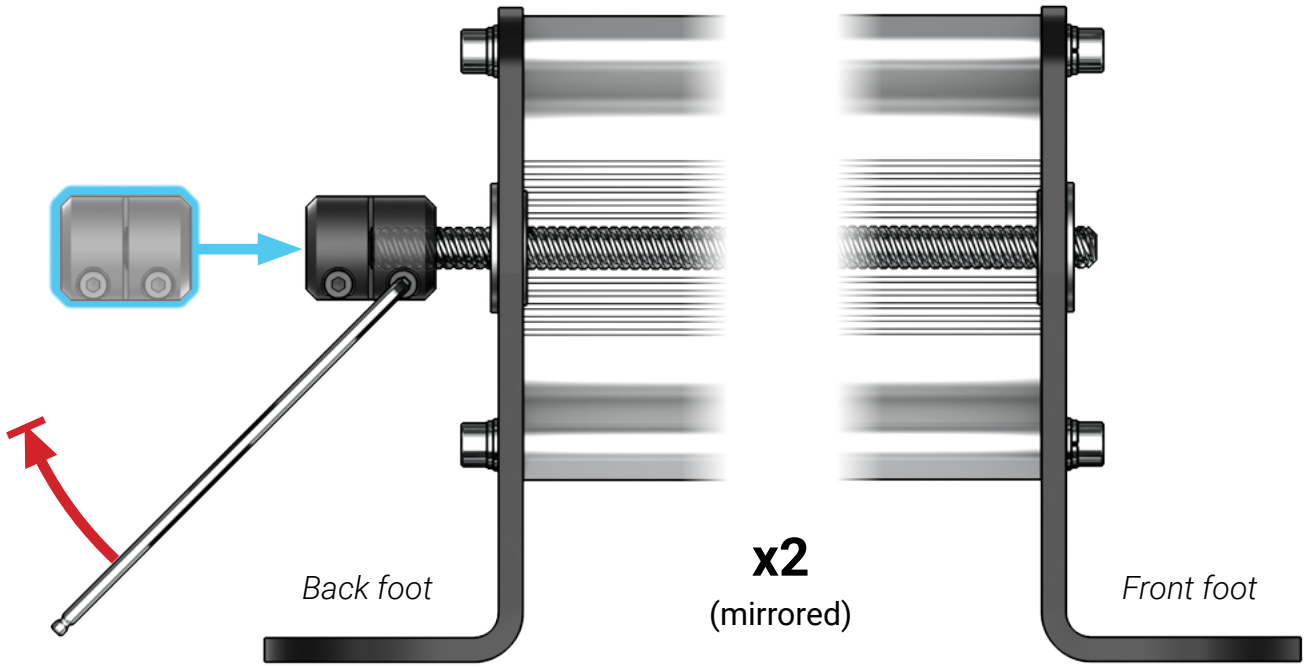
Front foot

x2

(mirrored)

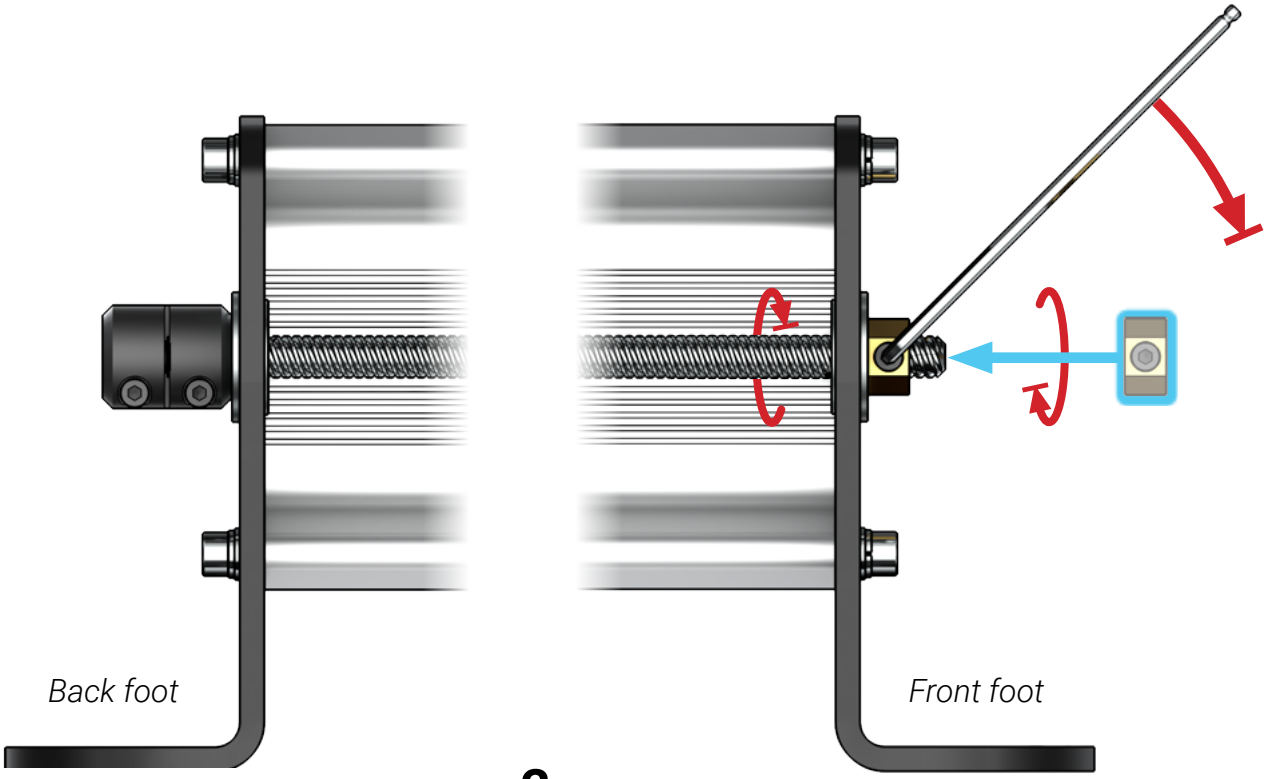
Insert one flange bearing on each end foot, making sure the lead screw goes through the bearing.

Use M3 Allen Key



For the right Y-axis rail, identify the back end foot. At this end, slide the coupler on until it bottoms out on the lead screw. Firmly secure the coupler at the set screw using an M3 (size 2.5) Allen key.

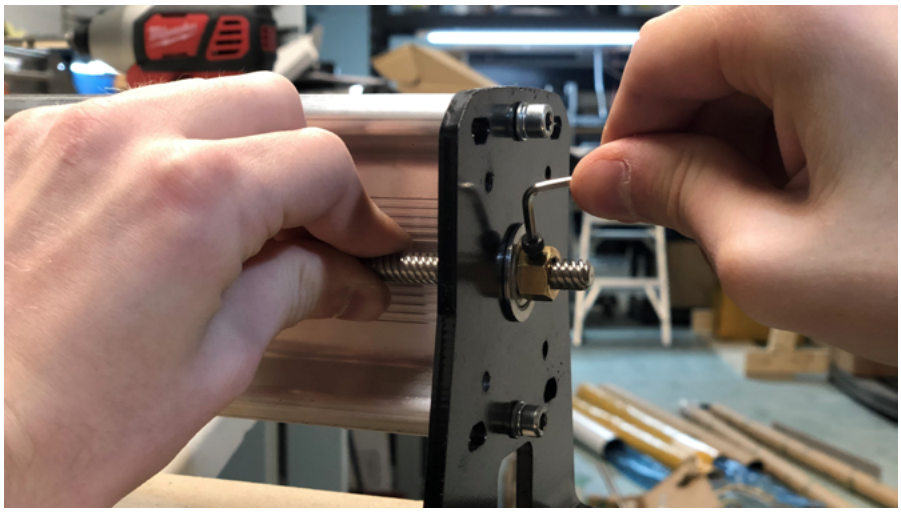
Use M3 Allen Key



x2

(mirrored)

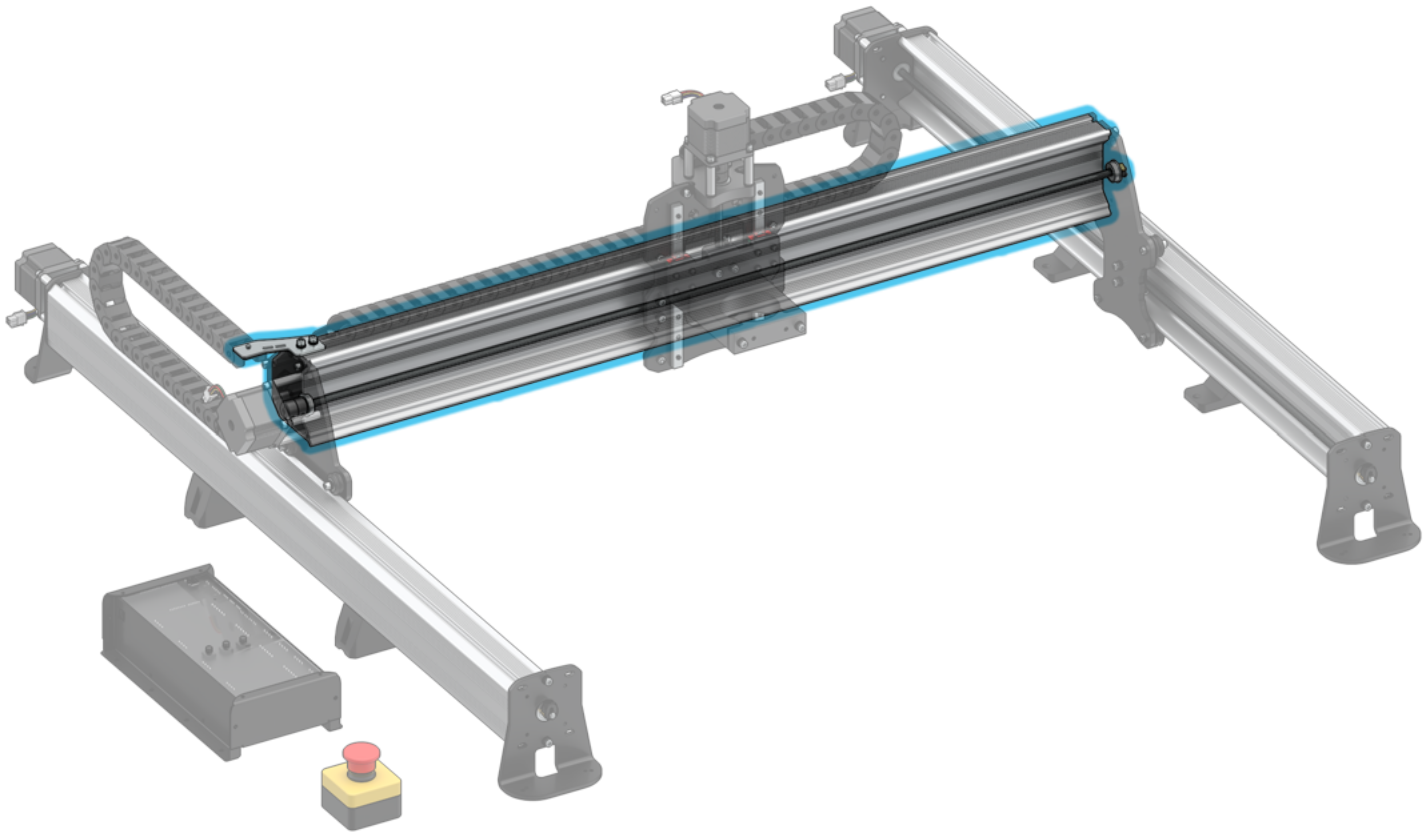
Pull the lead screw with the attached coupler towards the front end of the rail, until the coupler is flush against the back foot flange bearing. At the front, thread on the ACME nut until it is flush with the flange bearing. While the lead screw is being pulled towards the front, firmly tighten the set screw on the ACME nut. There should not be a gap between the ACME nut and flange bearing. This ensures that the lead screw is properly tensioned to reduce vibrations.



You should now have two Y-axis rail assemblies! They should be a mirror copy of each other.

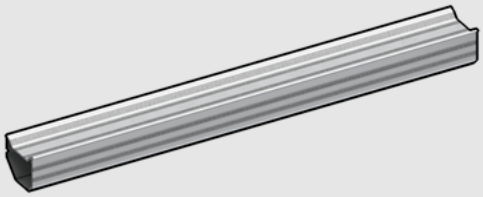
Part 3

Axes Completion



Drag Chain Mount and Connecting Rails

Parts Needed:



X-rail

Previously Assembled

Right Y-rail assembly

Drag chain mount

x4

M5-25mm bolt

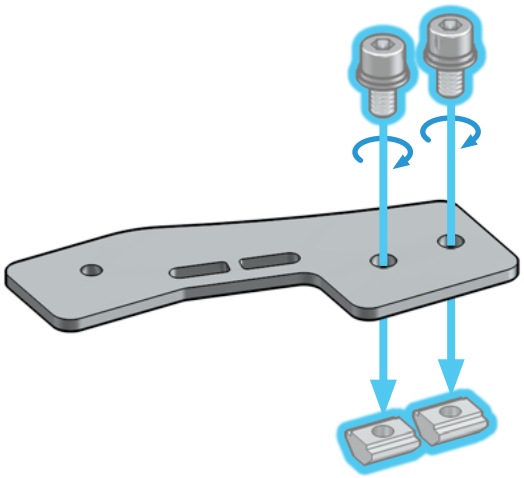
x2

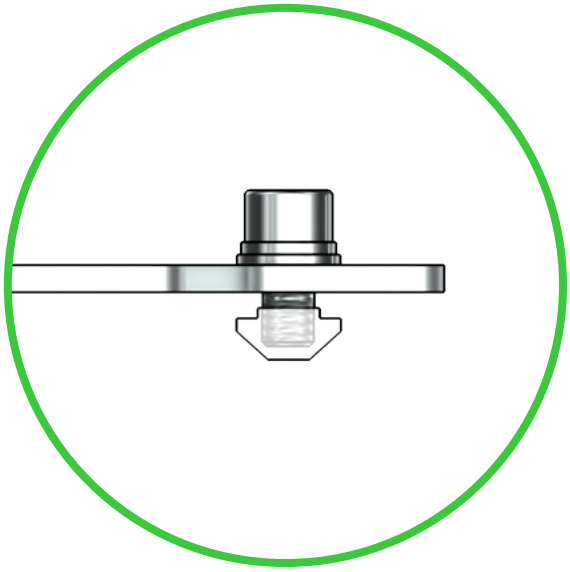
M5-10mm bolt

x2

T-nut

If you want your control box on the right side, then all the next steps should be flipped

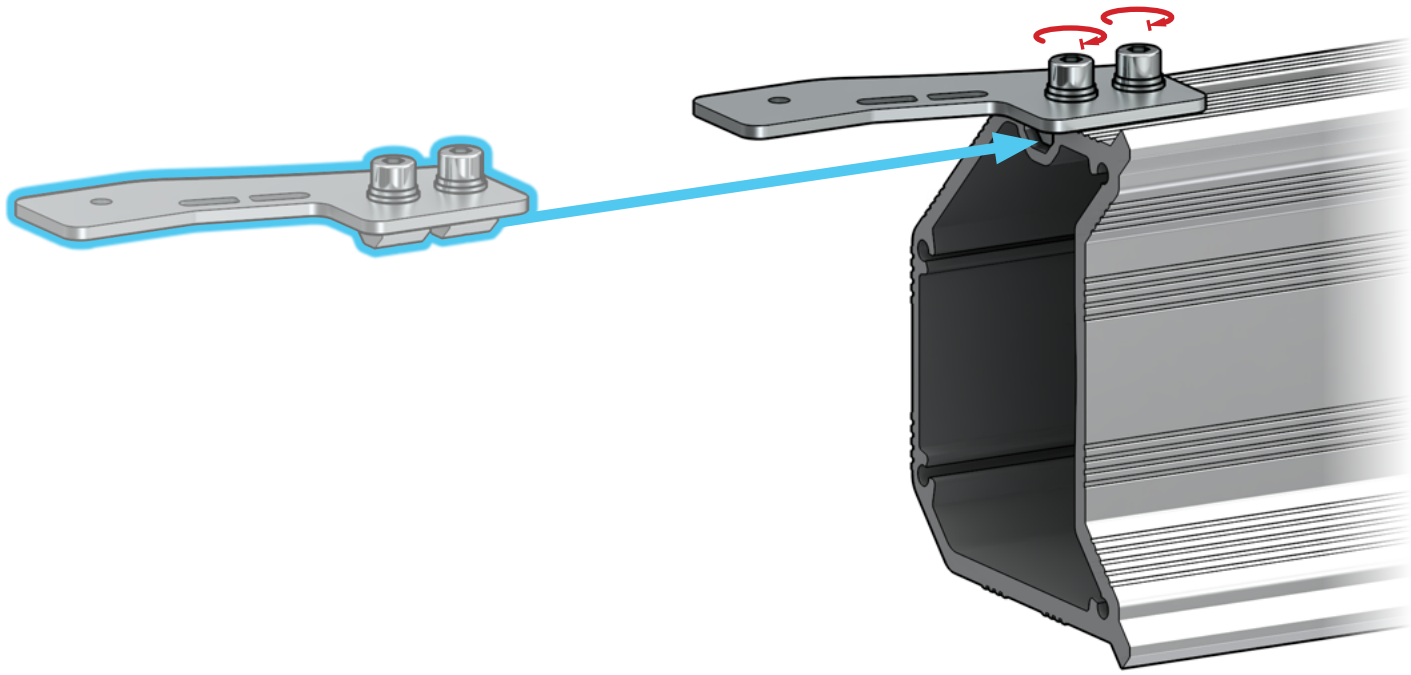




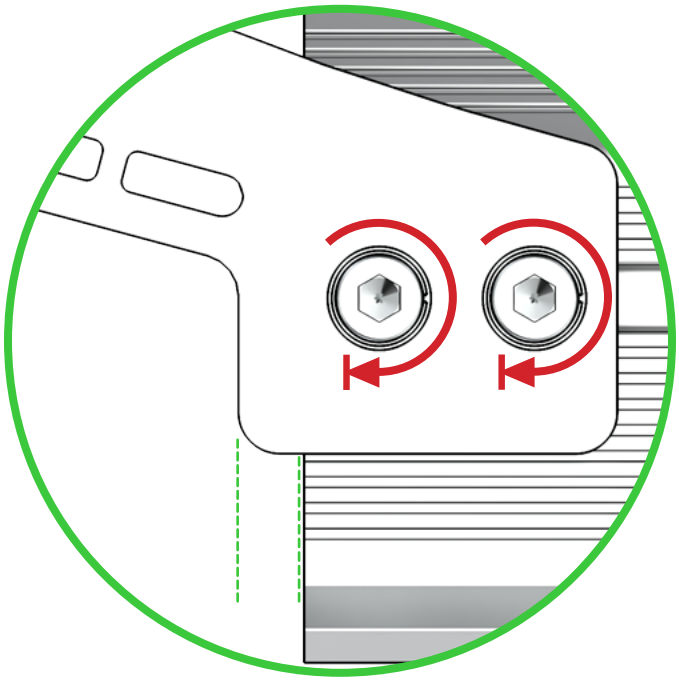
Leave a gap between the T-nut and mount

Grab the M5-10mm bolts and T-nuts from the yellow hardware bag. Prepare the drag chain mount by loosely threading two M5-10mm bolts into two T-nuts.

Use M5 Allen Key

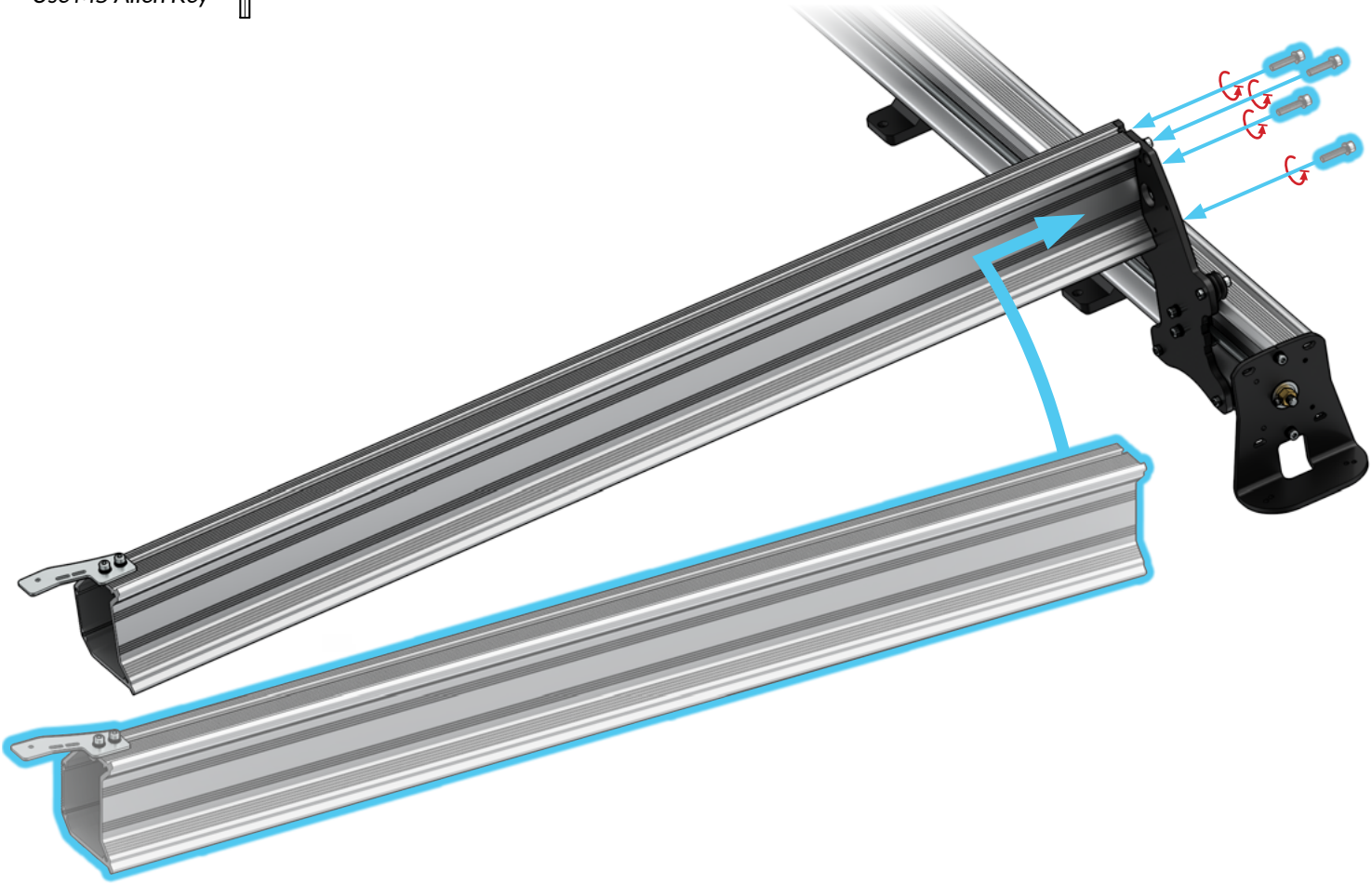


Attach the drag chain mount through the left side of the X-axis rail, by sliding two T-nuts onto the top slot of the rail. Before fastening the drag chain mount, ensure that it is offset from the edge of the rail by ¼" (pictured).

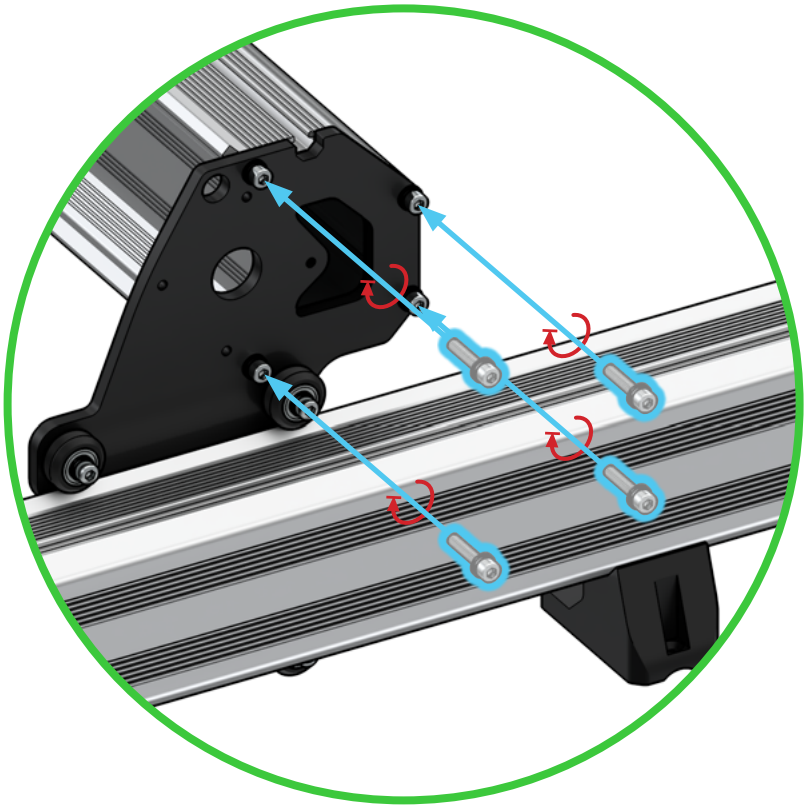


1/4" offset

Use M5 Allen Key



Lift the right side of the X-axis rail to assemble onto the right Y-gantry. Fully fasten using four M5-25mm bolts.



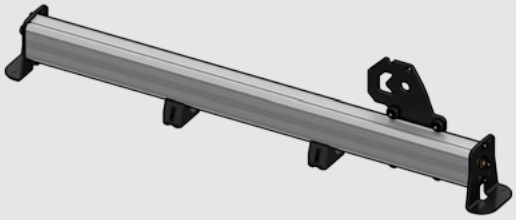
Connecting the Remaining Sub-asemblies

Parts Needed:

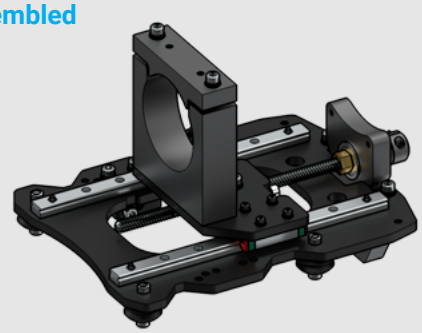
x4

M5-25mm bolt

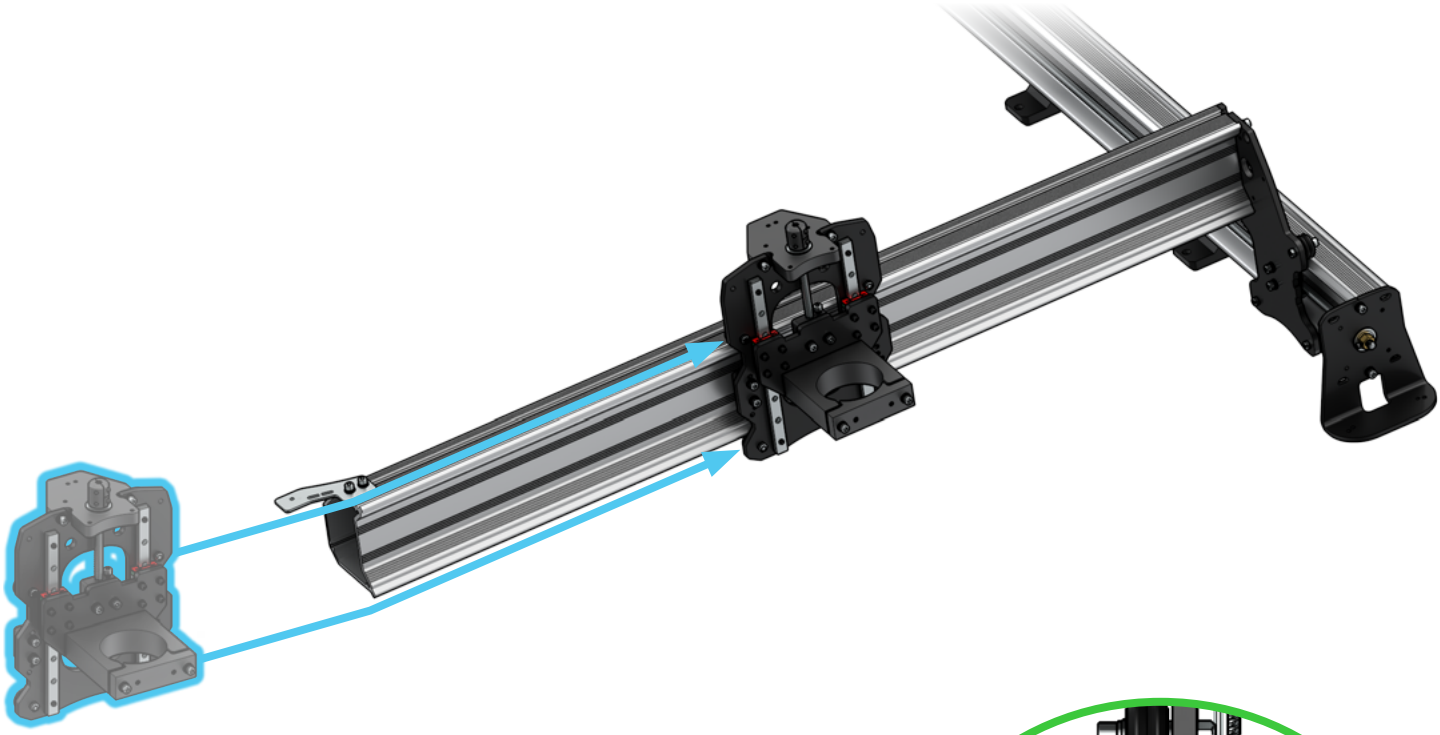
Previously Assembled



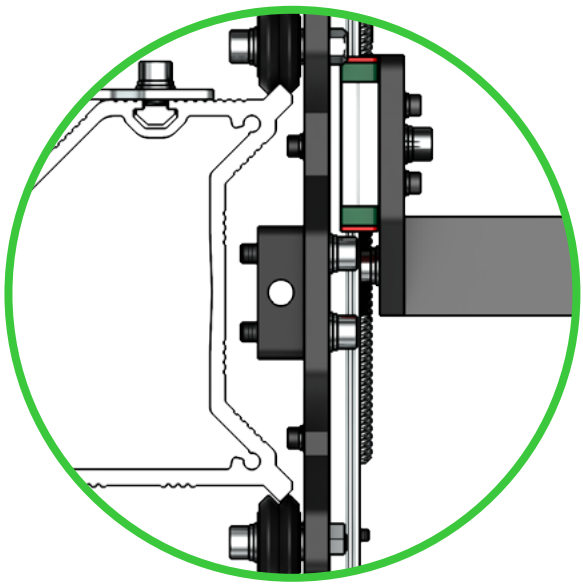
Left Y-rail assembly



XZ-gantry assembly

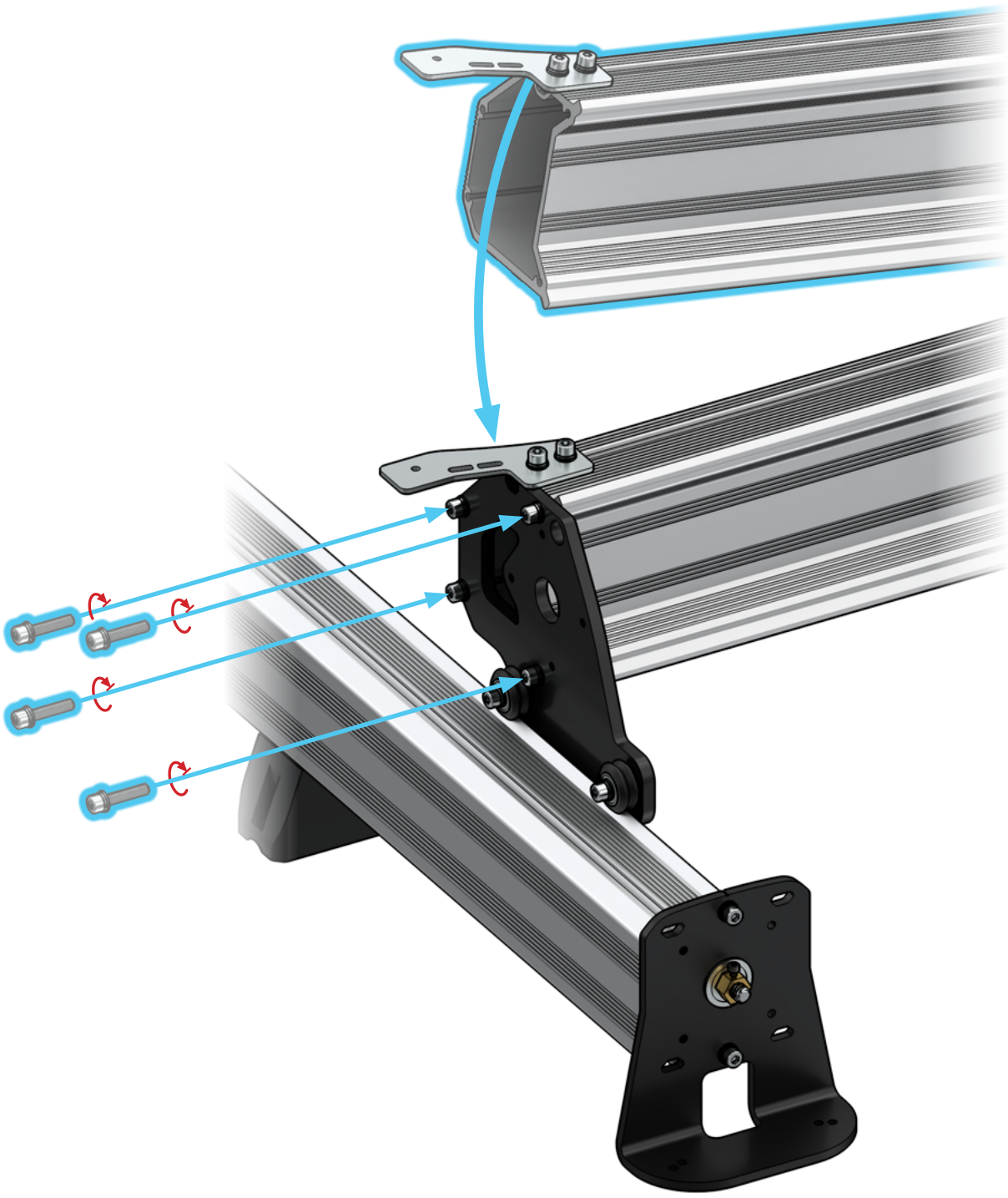


Slide the XZ gantry onto the X-axis rail. The V-wheels should sit on the pointed edges on each side of the X-axis rail (pictured).



Delrin wheels sliding onto the Y-rail

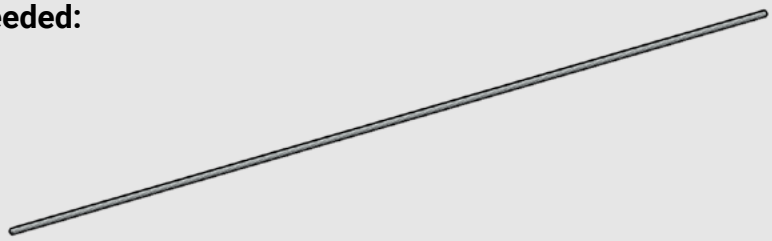
Use M5 Allen Key



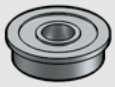
Lift the left side of the X-axis rail to assemble onto the left Y-gantry. Allow the drag chain mount to rest on top of the Y-gantry, to keep the rail in position during assembly. Fully fasten using four M5-25mm bolts.

X-axis Lead Screw

Parts Needed:



1000mm lead screw



x2

608ZZ flange bearing

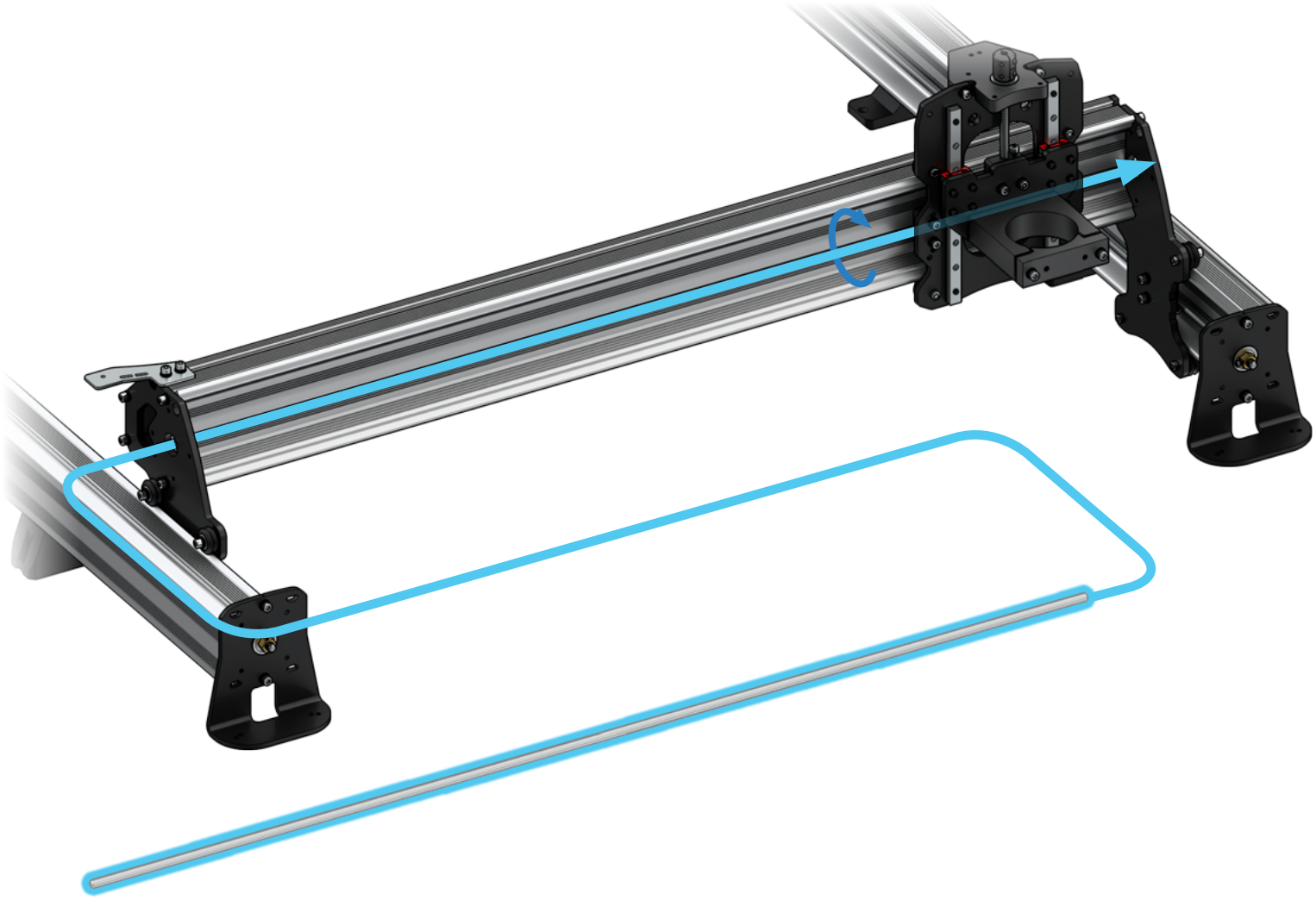
6.35mm to 8mm coupler

x2

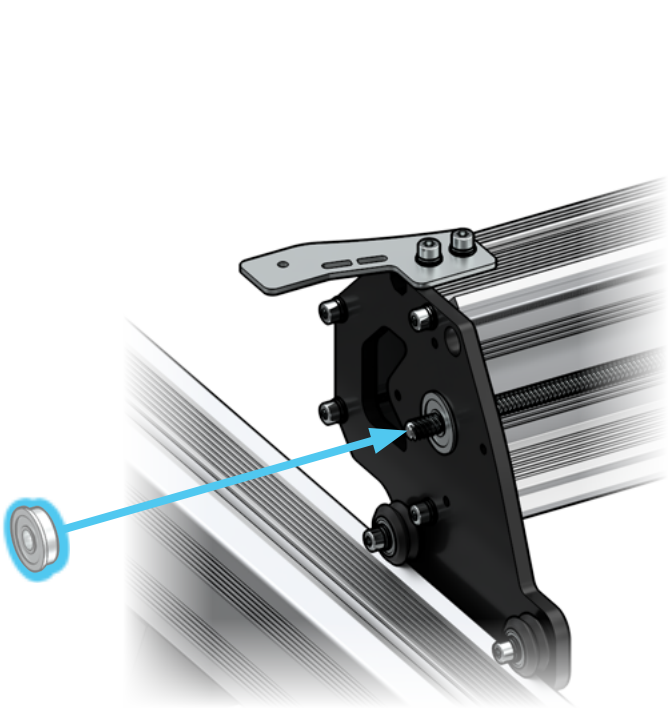
M5-25mm bolt

Previously Assembled

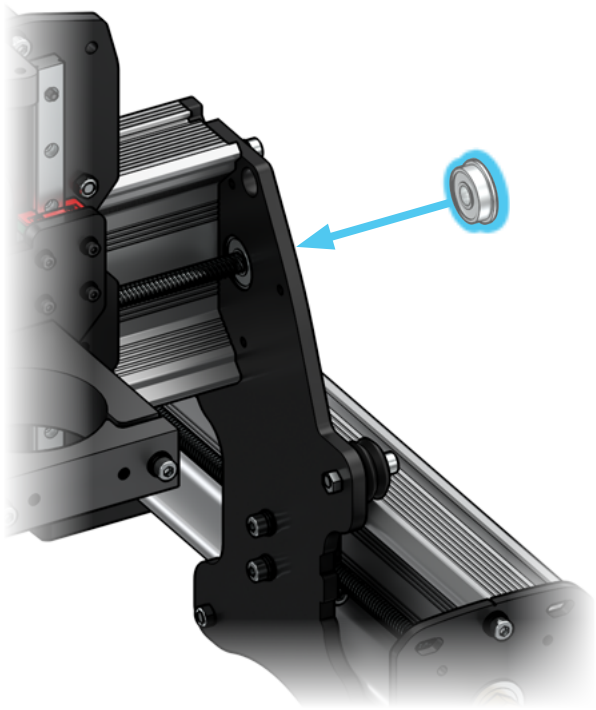
Delrin anti- backlash nut assembly



Thread the lead screw through the anti-backlash block behind the XZ-gantry. The ends of the lead screw should be resting in the cutouts on both Y-gantries.



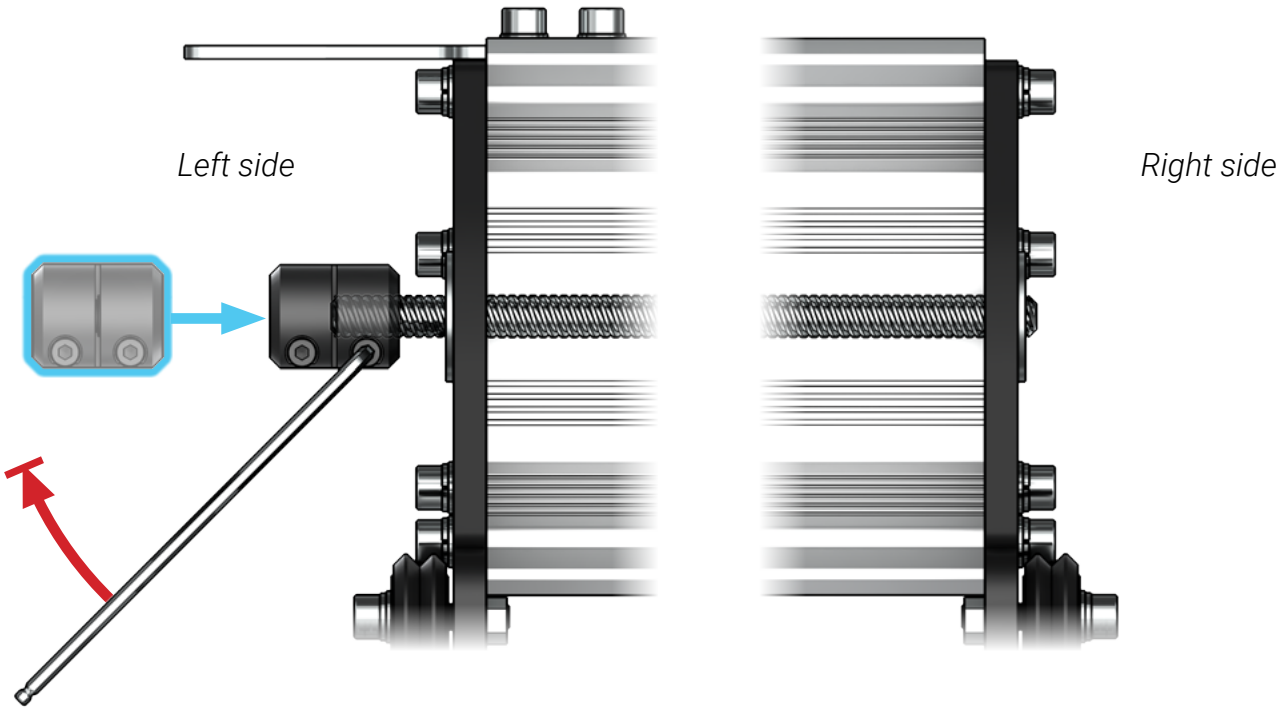
Left side



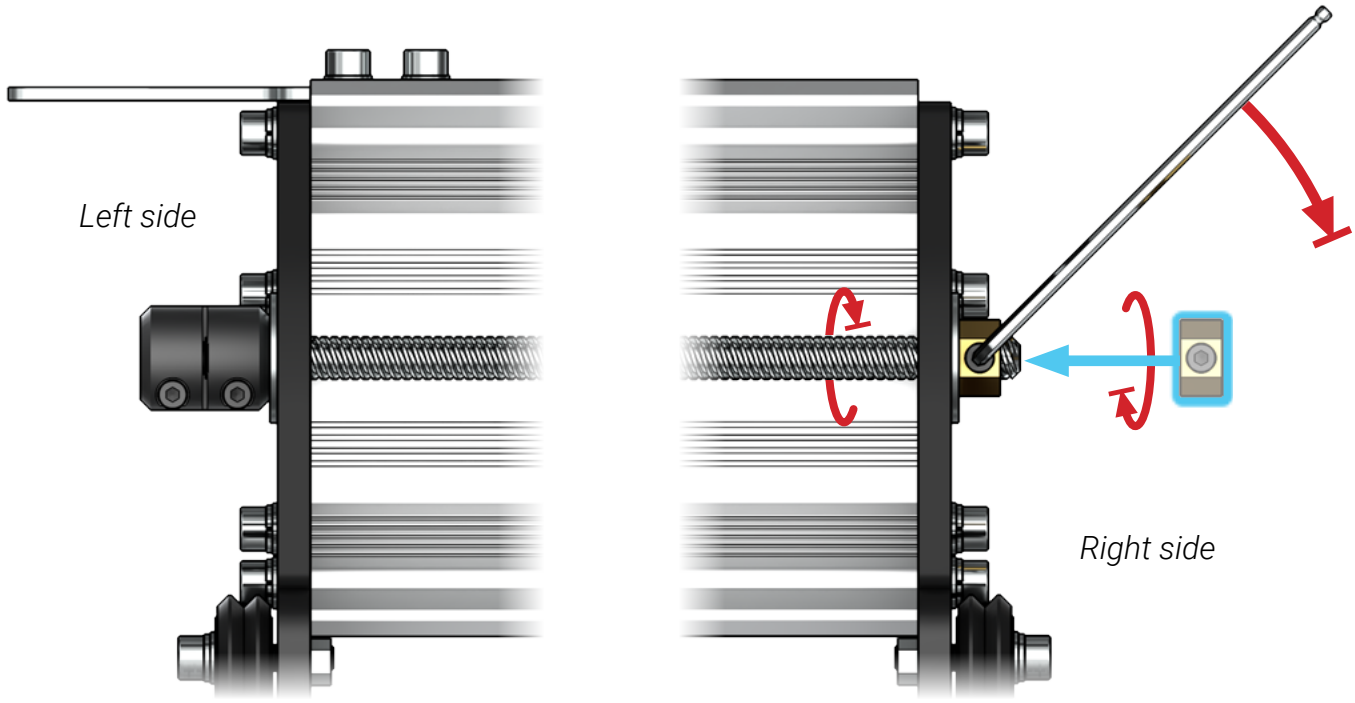
Right side

Insert one flange bearing on each Y-gantry, making sure the lead screw goes through the bearing.

Use M3 Allen Key



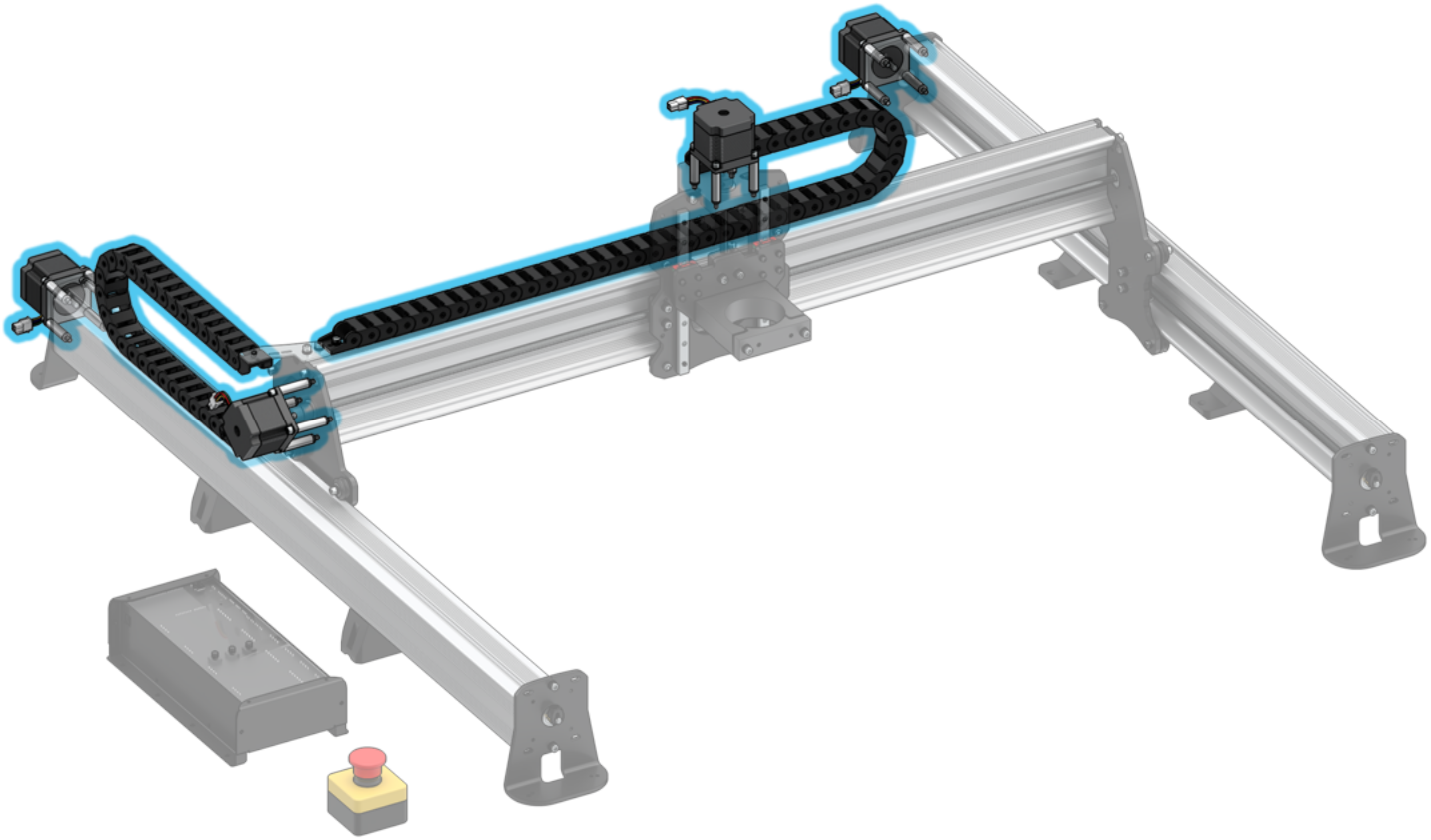
At the left side of the X-axis rail, slide the coupler on until it bottoms out on the lead screw. Firmly secure the coupler at the set screw using an M3 (size 2.5) Allen key.



Pull the lead screw with the attached coupler towards the right side of the X-axis rail, until the coupler is flush with the left Y-gantry flange bearing. At the right side, thread on the ACME nut until it is flush with the flange bearing. While the lead screw is being pulled towards the front, firmly tighten the set screw on the ACME nut. There should not be a gap between the ACME nut and flange bearing.

Part 4

Motors & Wiring



Stepper Motor Mounting

Parts Needed:

x16

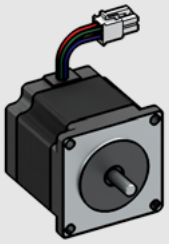
#10 nylon washer

x16

35mm aluminum spacer

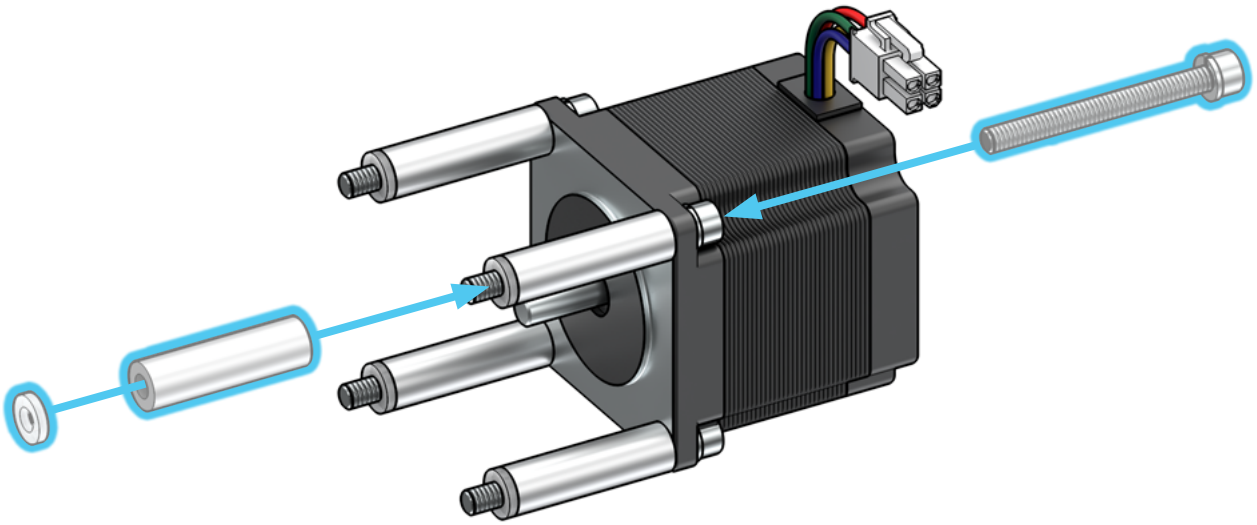
x16

M5-50mm bolt



x4

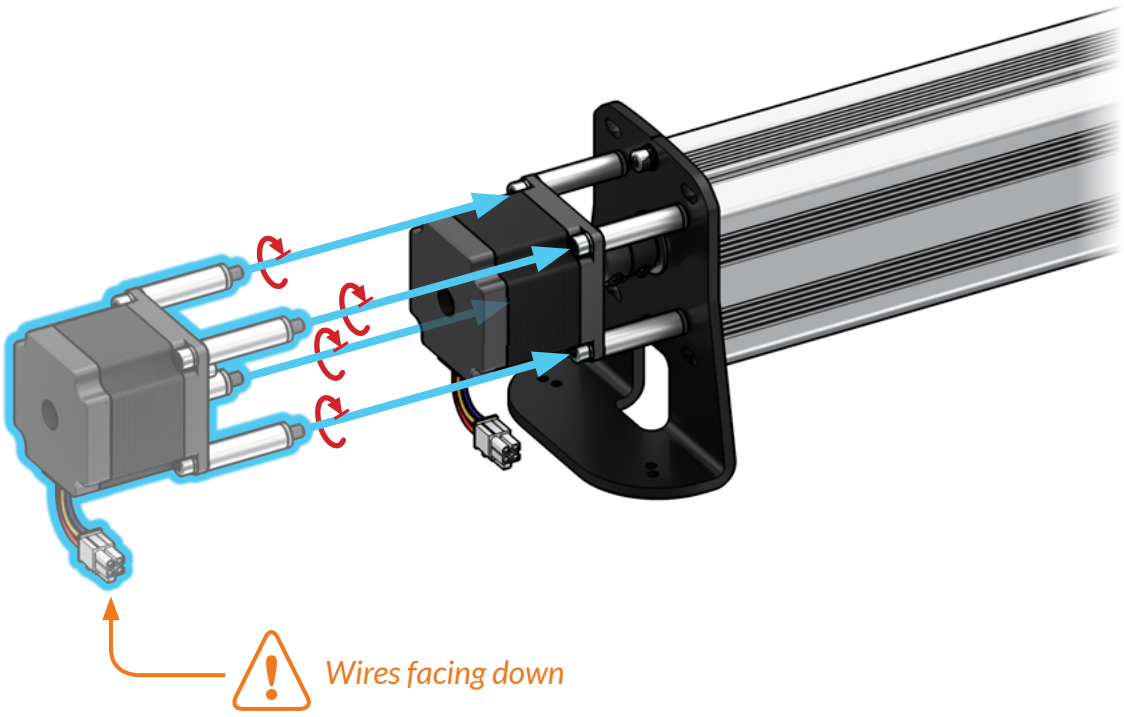
NEMA 23 motor



x4

Grab the spacers, M5-50mm bolts and nylon washers from the yellow bag. Insert the M5-50mm bolts into the holes on the motor, then slide four standoffs onto the bolts. Finally, add the spacers onto each bolt. Prepare four motor assemblies and set them aside.

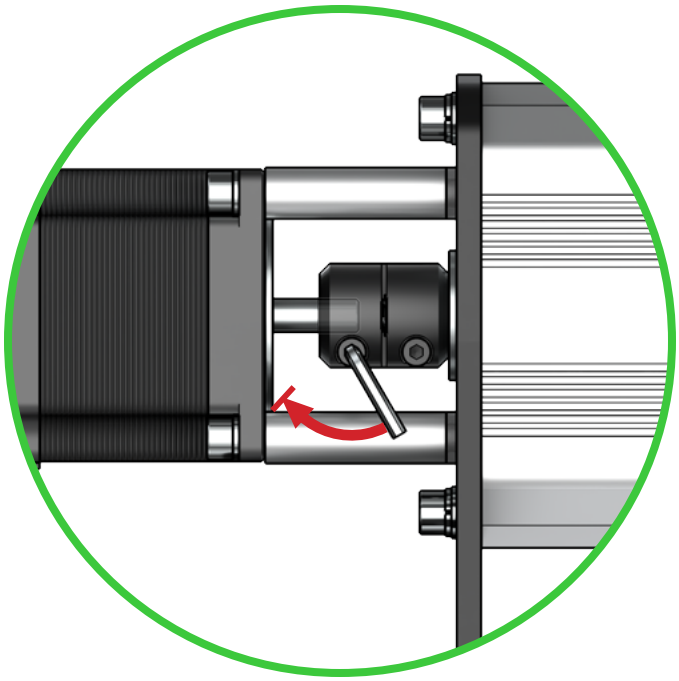
Use M5 & M3 Allen Key



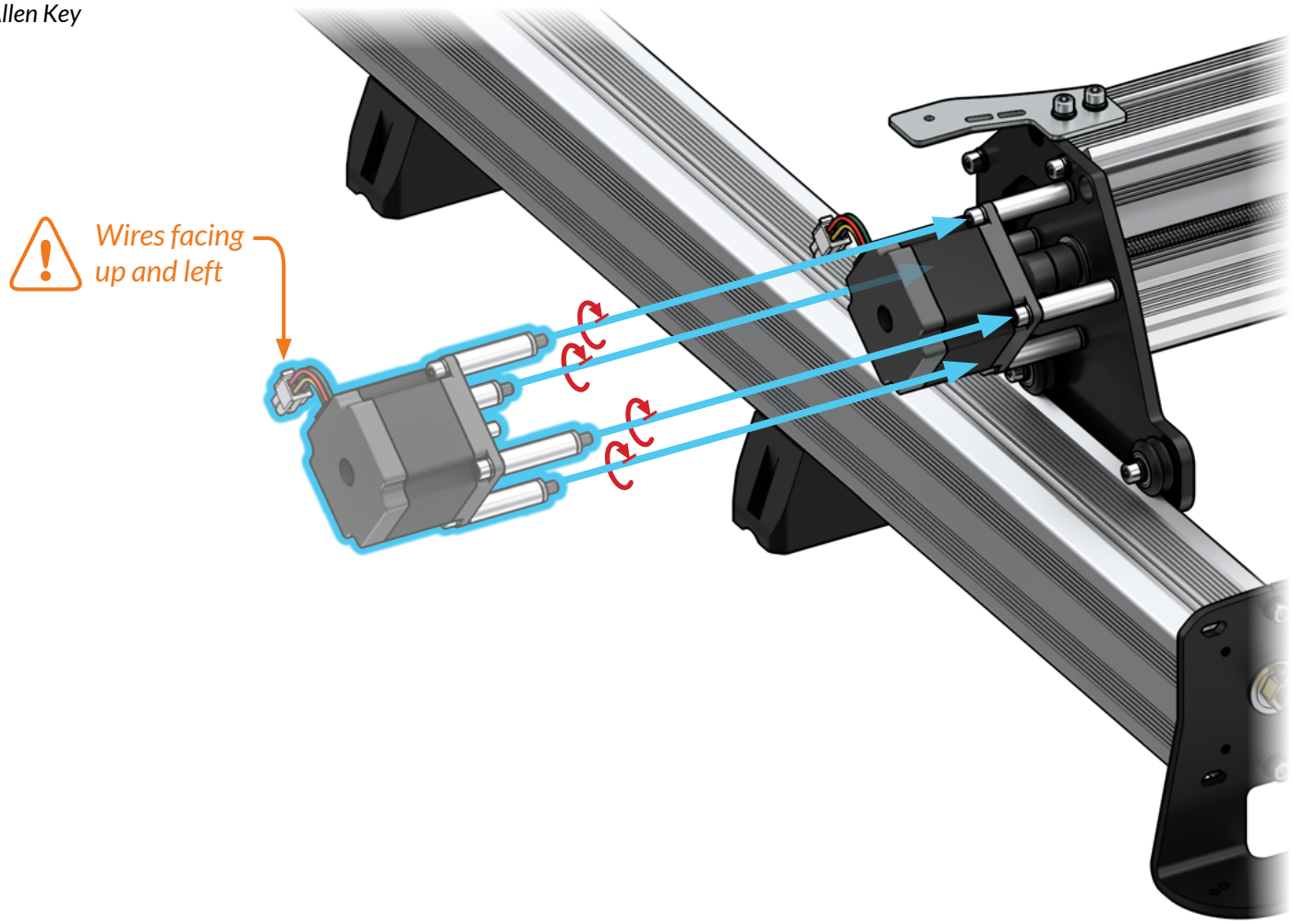
x2

(mirrored)

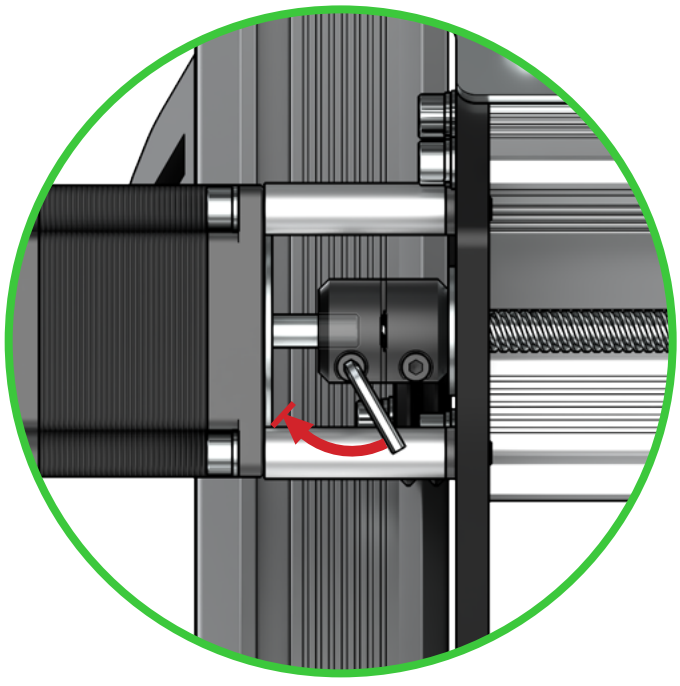
Bring one motor assembly to the back foot of a Y-axis rail. Slide the motor shaft into the coupler, then tighten the four M5-50mm screws into the foot. At the coupler, tighten the set screw at the motor side and ensure the screw can spin without excessive force. The motor should be oriented so that the motor wires face downwards. Complete these steps for the other Y-axis side.



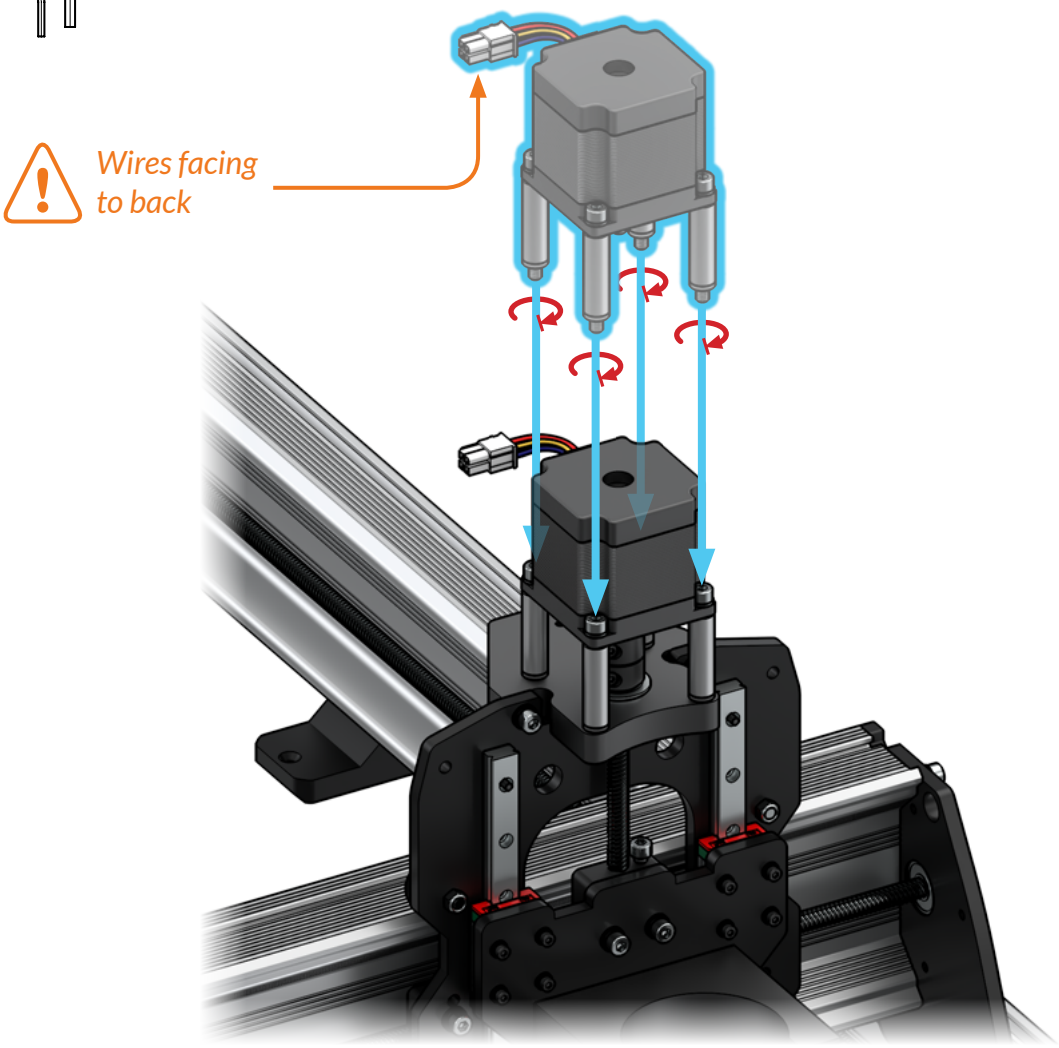
Use M5 & M3 Allen Key



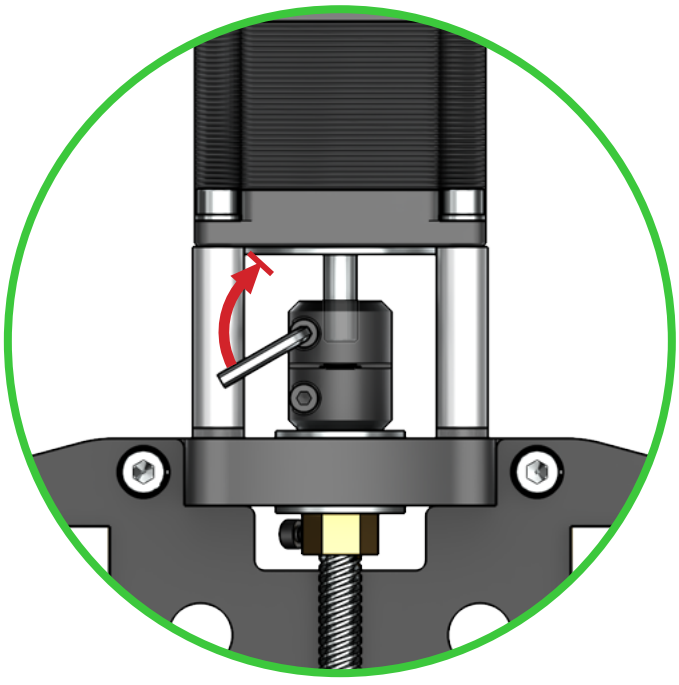
Bring one motor assembly to the left Y-gantry plate. Slide the motor shaft into the coupler, then tighten the four M5-50mm bolts into the gantry. At the coupler, tighten the set screw at the motor side and ensure the screw can spin without excessive force. The motor should be oriented so that the motor wires face the back of the machine.



Use M5 & M3 Allen Key



Bring the last motor assembly to the Z-axis motor mount. Slide the motor shaft into the coupler, then tighten the four M5-50mm bolts into the motor mount. At the coupler, tighten the set screw at the motor side and ensure the screw can spin without excessive force. The motor should be oriented so that the motor wires face the back of the machine.



Attaching Drag Chain Ends

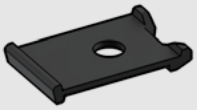
Parts Needed:

x4

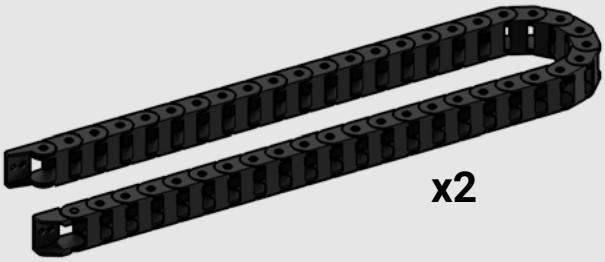
M5-10mm bolt

x2

T-nut



Chain Aligner

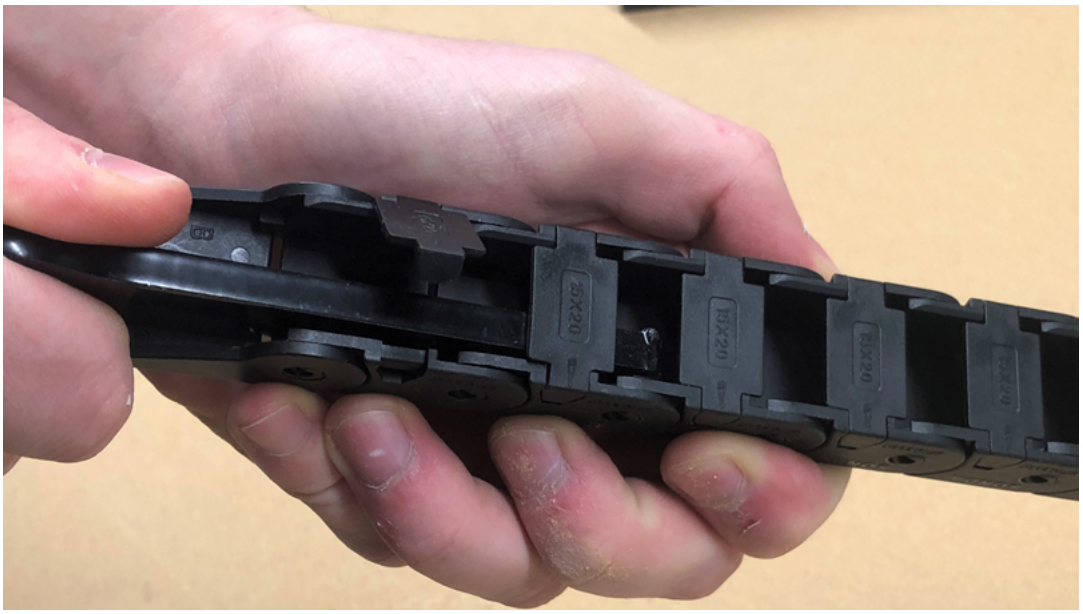


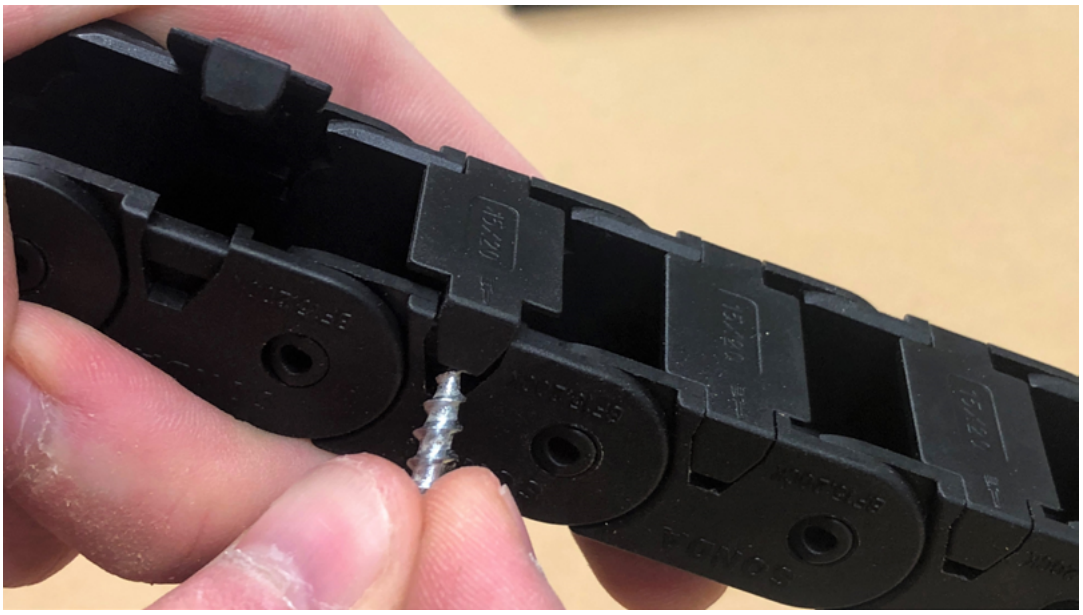
x2

Drag Chain

We will now be installing the drag chains - these contain and guide the wires on the LongMill so they aren't in the way during cutting. They also keep wires from wearing out from bending or being cinched around corners.

As mentioned previously, the chains can be found in the long rail box inside the y-axis rails and look as pictured. They come with detachable links so that you can adjust their length depending on the size of your LongMill.





We'll first start by unclipping the drag chain clips that hold the wires into the chain. These clips are designed to open on one side or be completely removed, giving flexibility to add or remove wires on your machine when needed.

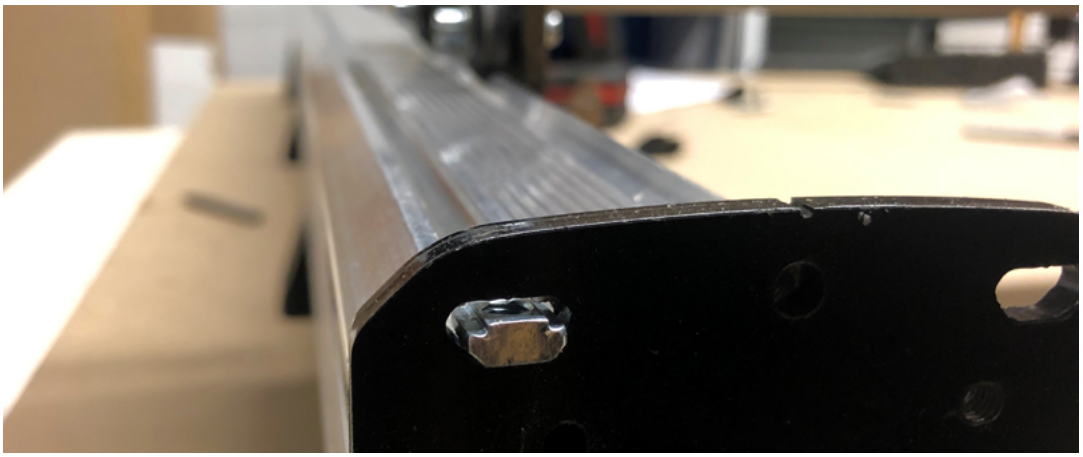
The clips keep in place well but the LongMill wrench has a taper that can assist you with popping them open. If the wrench isn't your cup of tea, it's also easy enough to slip a flat head screwdriver or anything else sharp like a wood screw underneath the clip tabs to pop them open.

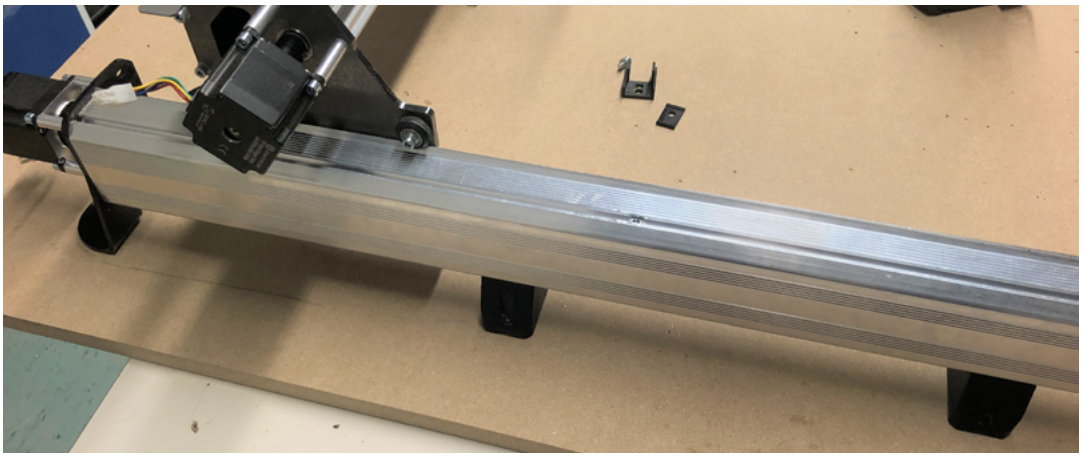
We'll first start by removing the end connector links from both drag chains. You can either pull or squeeze off the connector as shown in the photos. A flat head screwdriver or thin shim can also be handy for this, just be careful not to cut yourself in the process.

For the pin-type end link, squeeze the two sides of the link together, then twist and pull to disconnect

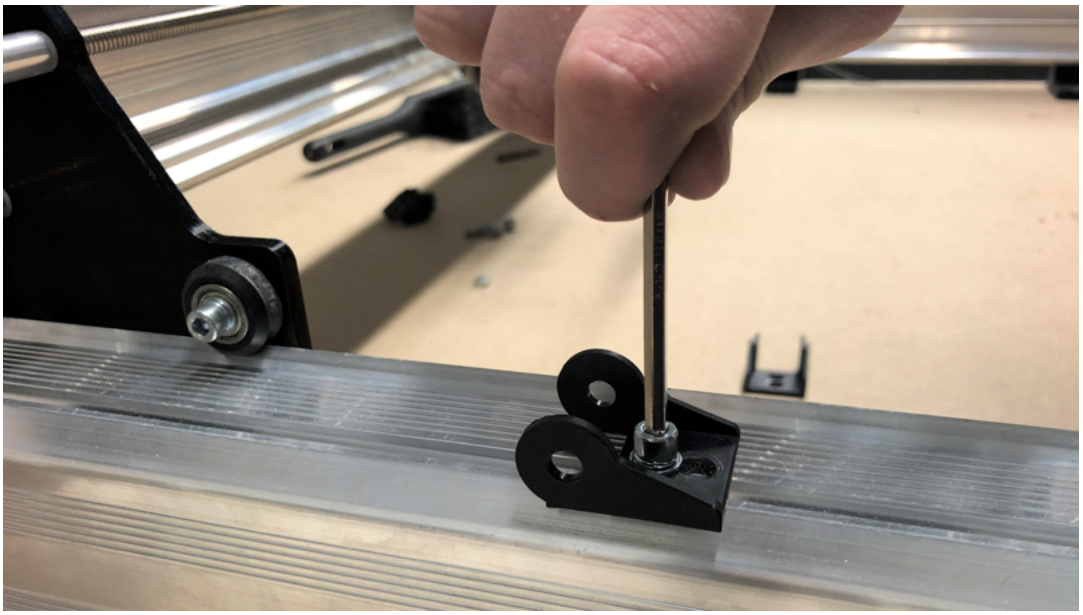
For the hole-type end link, pull on one side of the link then twist it away to separate it

Do this for all four end pieces, two hole-types and two pin types, and set them aside.

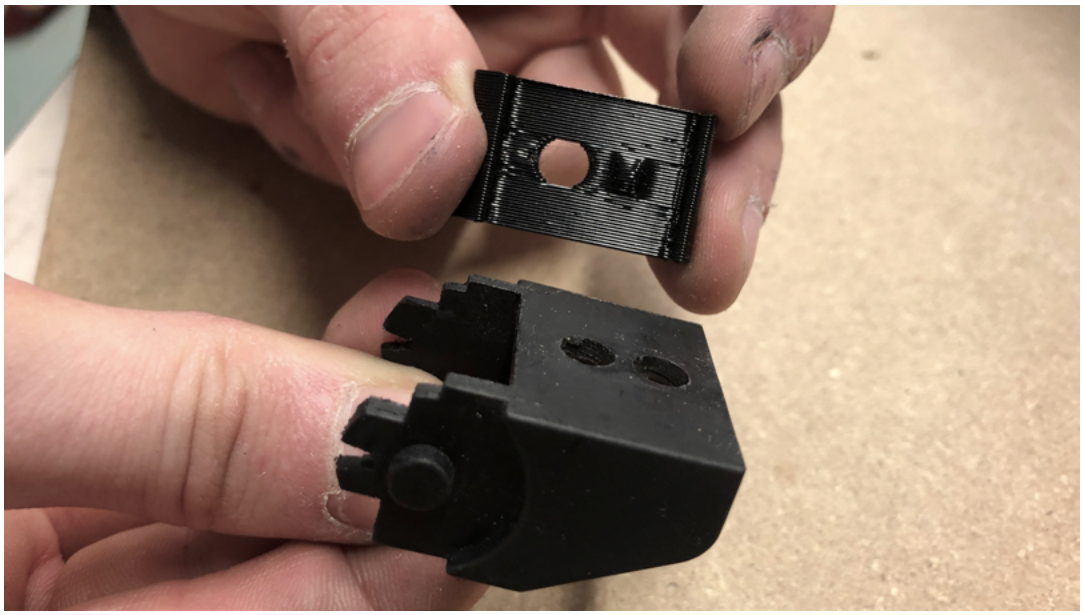


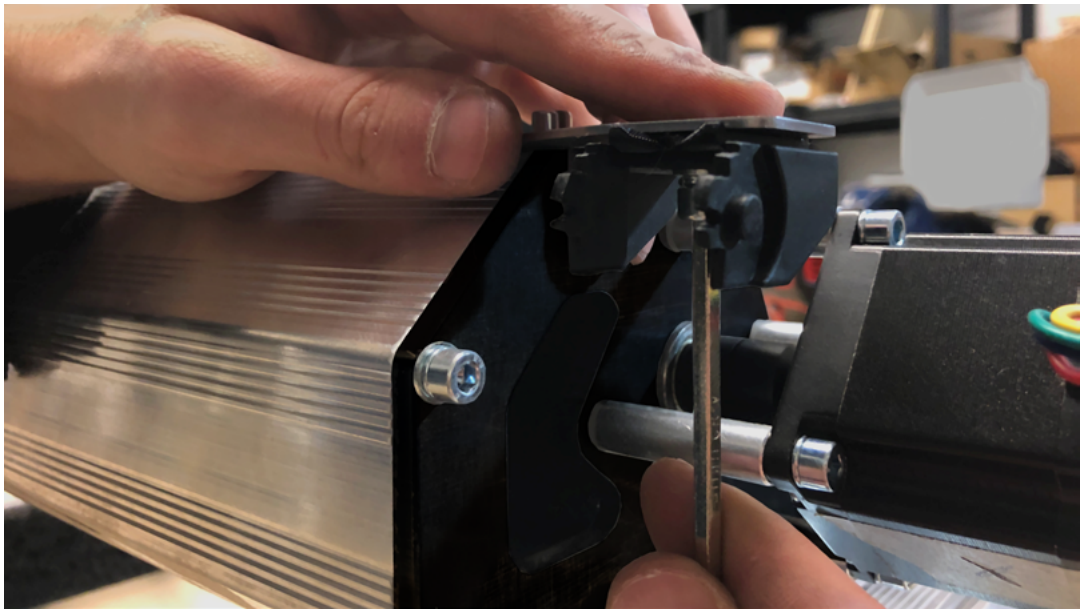


Grabbing the bag of t-nuts and M5-10mm bolts, we will attach these end links to the machine starting on the left y-axis. Slide a t-nut onto the y-axis rail through the hole in the front foot. You'll want to position it slightly further back than halfway on the rail for both machine models (30x30 pictured).

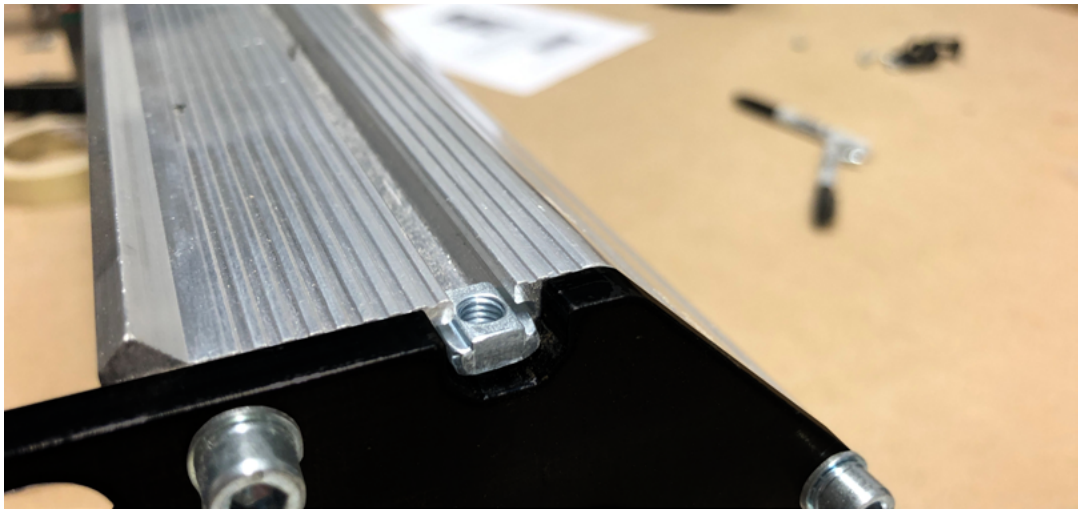


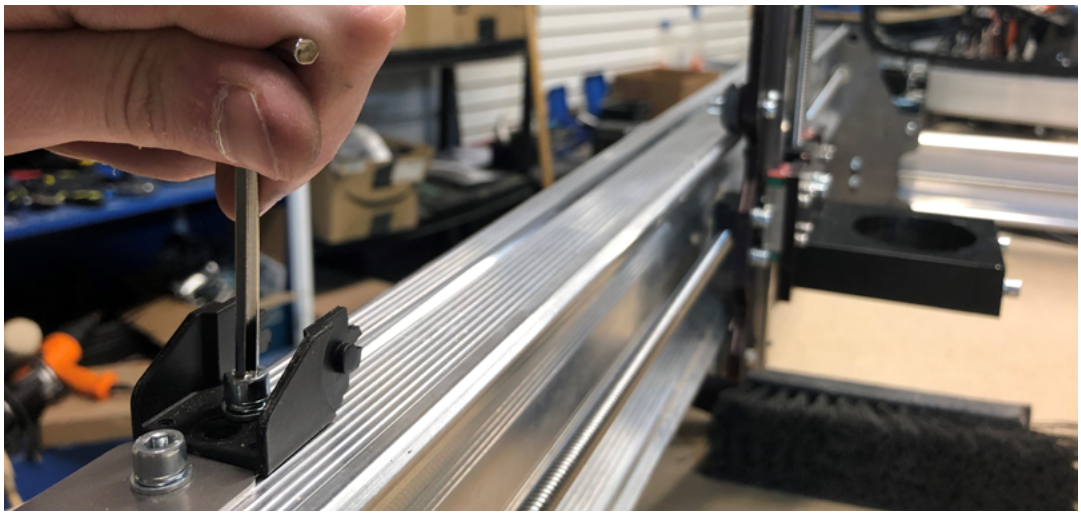
Once in position, use an M5-10mm bolt to fasten a **hole-type** end link in place with the M5 Allen key (pictured).



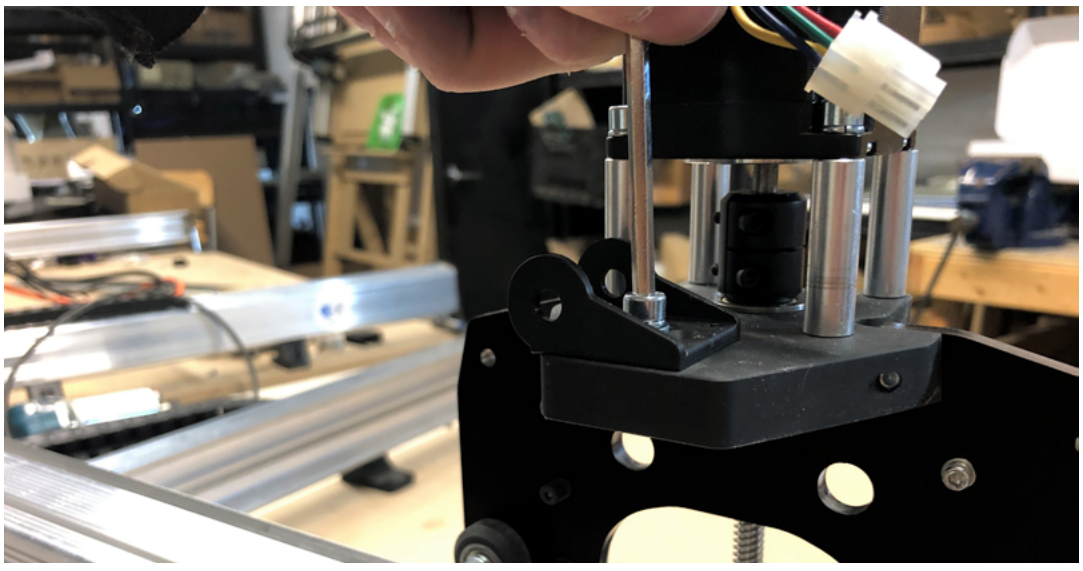


Now get a **pin-type** end link (pictured) along with the 3D printed chain aligner from the yellow hardware bag to mount the other end of the drag chain. This one will attach to the drag chain mount from the underside with another bolt. Note the printed aligner has a nub that will align to a hole in the end link (pictured).





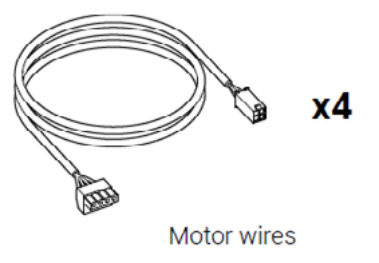
On the x-axis the process will be repeated. Slide in a t-nut through the hole in the right y-gantry and bring it all the way to the left side next to the drag chain mount where you'll bolt in a pin-type end link. Ensure the end link is snug up against the drag chain mount (pictured)

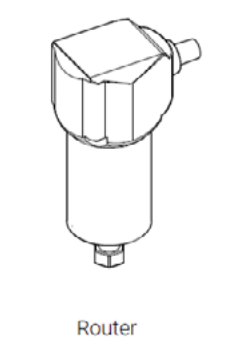


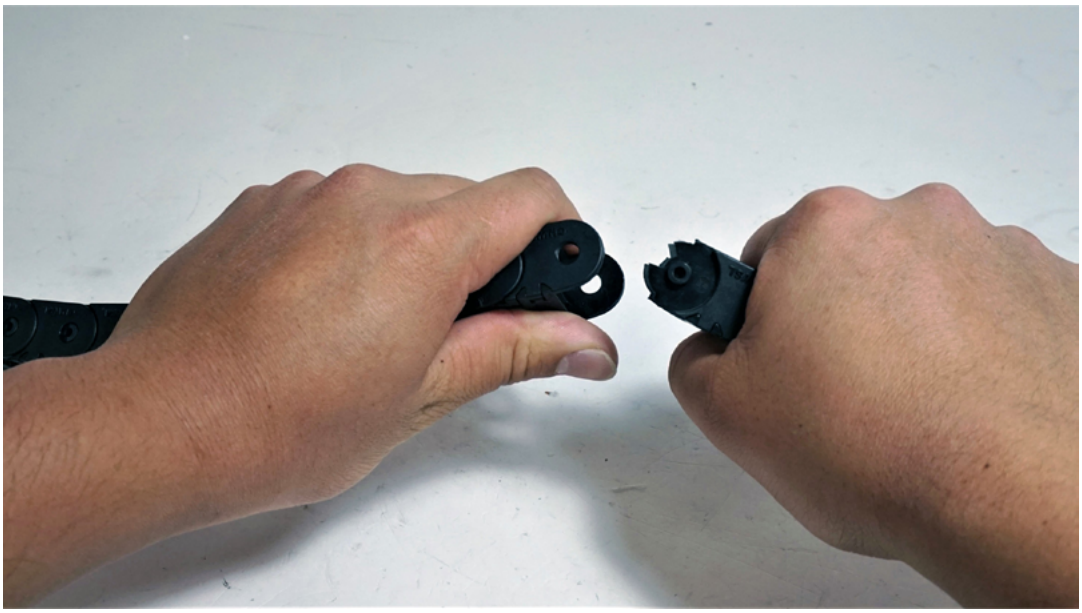
Lastly, attach the final end link onto the z-axis motor mount using one last bolt to the inner hole. Note the direction the link is facing.

Routing Wires

Parts Needed:







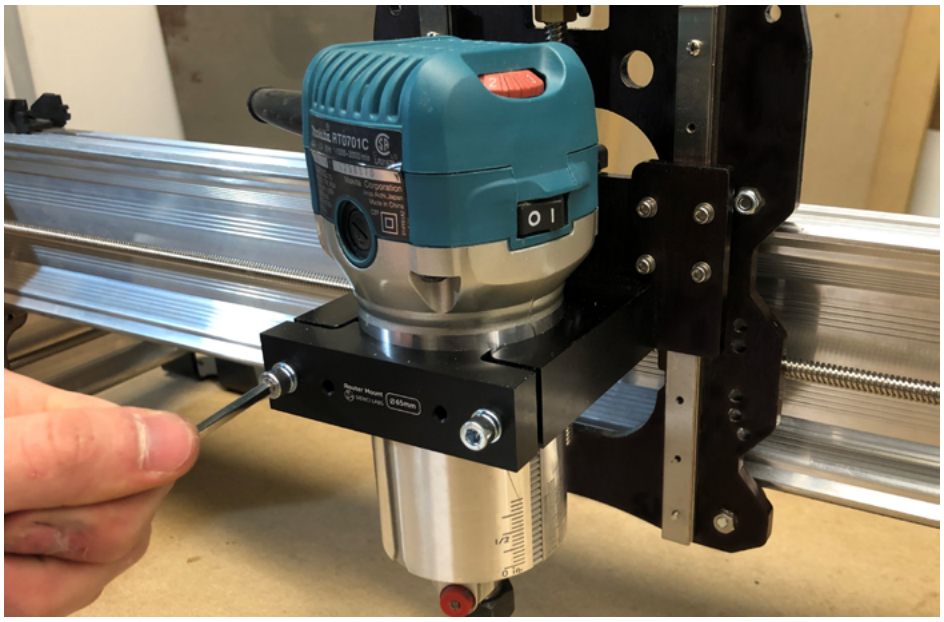
Before we attach the drag chains back onto the end links we'll be removing a couple of links to get the right fit. To do this, put your hands on either side of the link you want to break, then twist and pull them apart to disconnect. Set aside the remaining, unused links - they can come in use if you're planning on upgrading to a larger sized LongMill later.

On the 12×30 LongMill, remove enough links off the Y-axis drag chain so it's **16 links** long and add **3 links** onto the X-axis chain. In the case of a 30×30 machine, remove **13 links** off of the Y-axis drag chain, and add **3 links** to the X-axis drag chain. This modification will make it so the chains are the correct length to travel the whole range of motion of the machine while also staying as short as possible so it maximizes the wire length going to the controller.

Make sure to keep track of which chain is the shorter one so that you can re-attached them onto the correct axes.

At this stage, it's a good idea to grab the router you'll be using with your machine. We'll show these steps using the Makita RT0700 / RT0701 trim router that we recommend (pictured). Also, grab the motor wires from the motor box while you're at it.

****IMPORTANT NOTE: when using the Makita RT0700 / RT0701 you won't need to use the router base, just the main router body.**

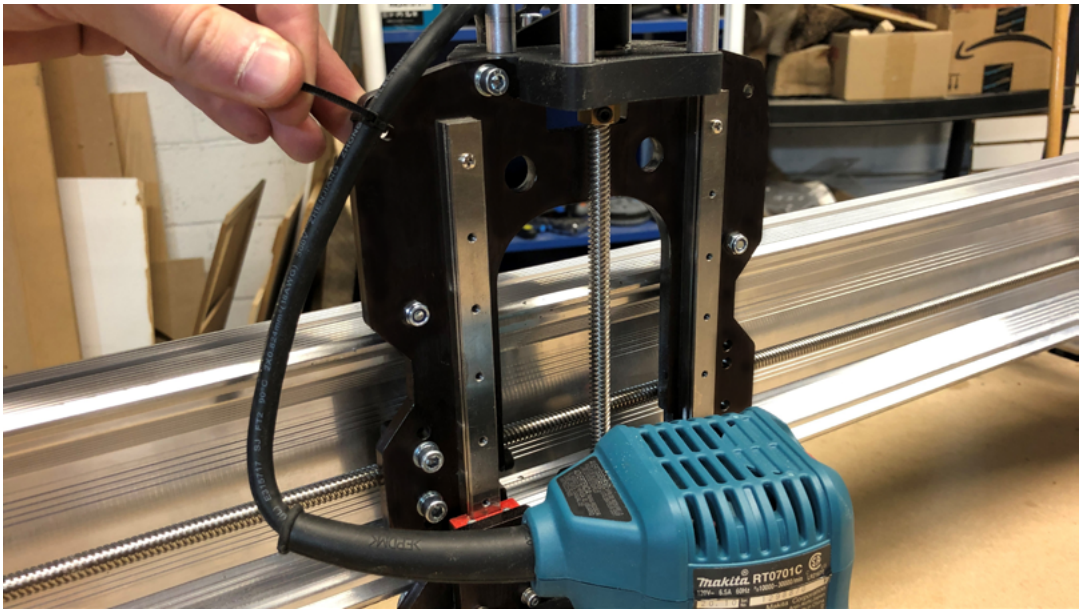


To mount your router, simply loosen off the two front bolts on the router mount until you can fit the router into it, then tighten back up to secure it. We recommend going back and forth between the two bolts to keep equal clamping force; and make sure not to over-tighten them.

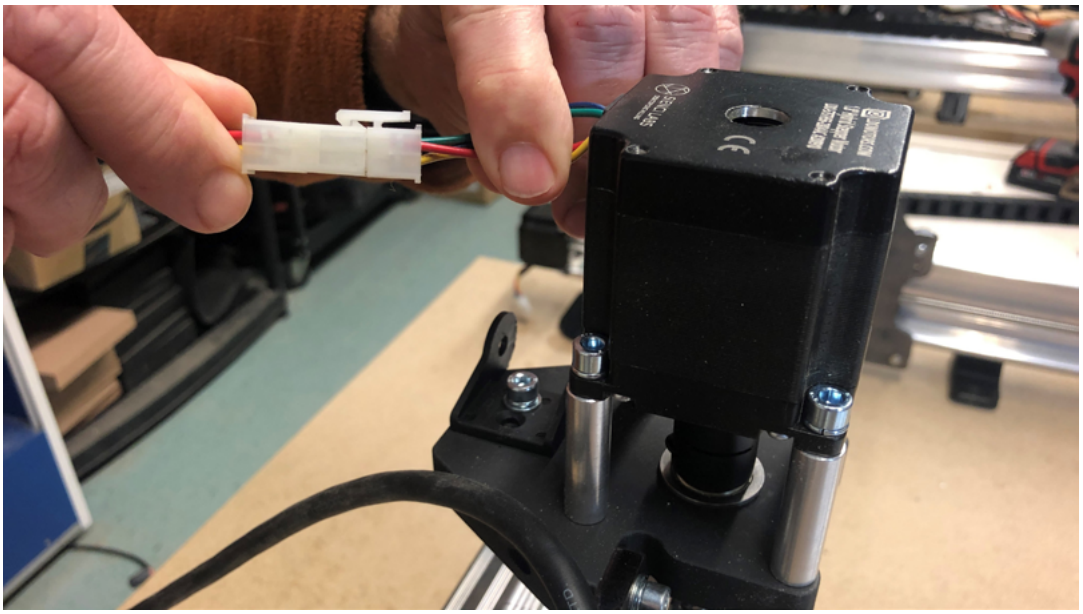
For now place the router at the height shown in the picture. You can adjust the height later depending on your setup - you might need to lower it all the way down in the mount if you're using tiny cutting tools or a bit further up if you're using longer cutting tools in combination with 3-4" thick material.

It's also best to face your router power cable towards the left side (pictured) and rotated slightly backward to provide good space for the cable and since the dust shoe requires some space on the right side. Check this angle by turning the Z-axis lead screw by hand till it's upper limit - the blue part of the router body shouldn't collide with the Z-axis motor mount at any point.

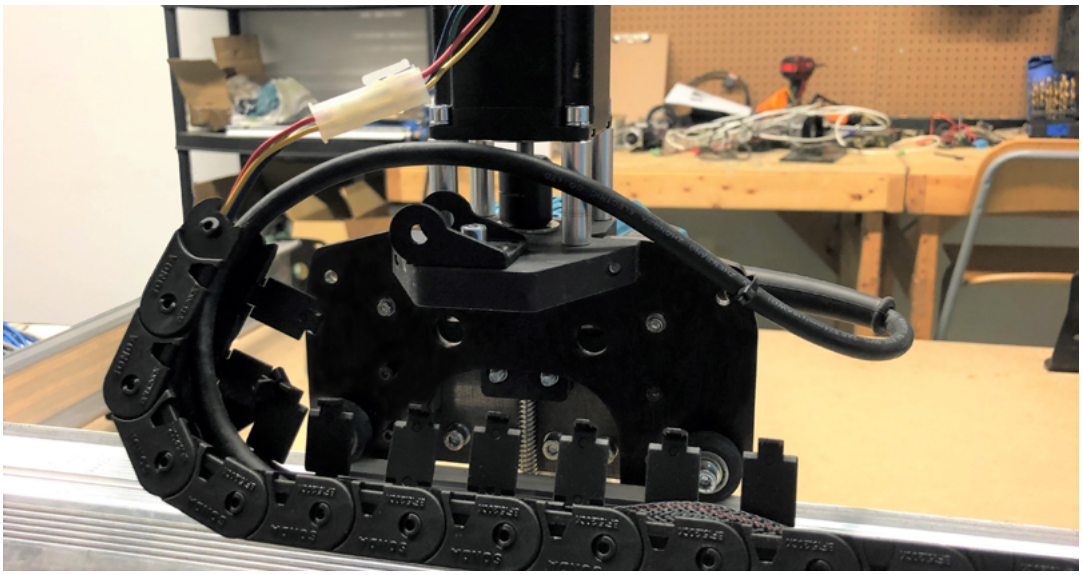
This position is also ideal for accessing the 4 bolts holding in the router mount from behind, through the X-gantry, if you want to swap the mount out or are thinking of performing some tramming. Even once the drag chain is here you can lift it out of the way, just be mindful not to damage the aluminum rail edge.

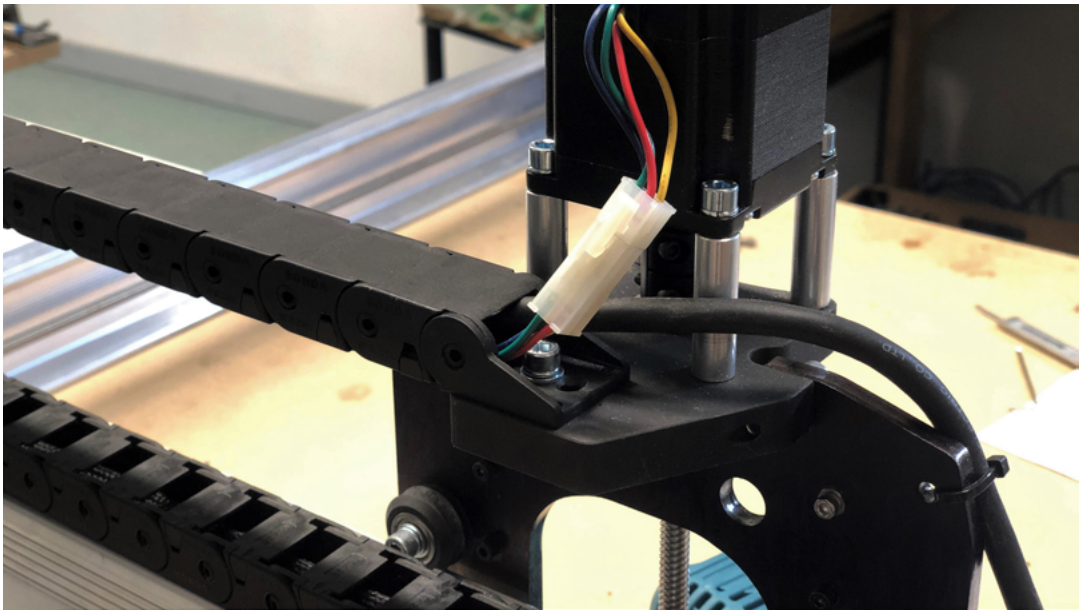


Optionally, you can also use the top left hole on the X-gantry as a zip tie point to keep your router wire out of the way during operation. To set it up right, move the Z-axis all the way down and then zip it on with some extra slack still available (pictured).



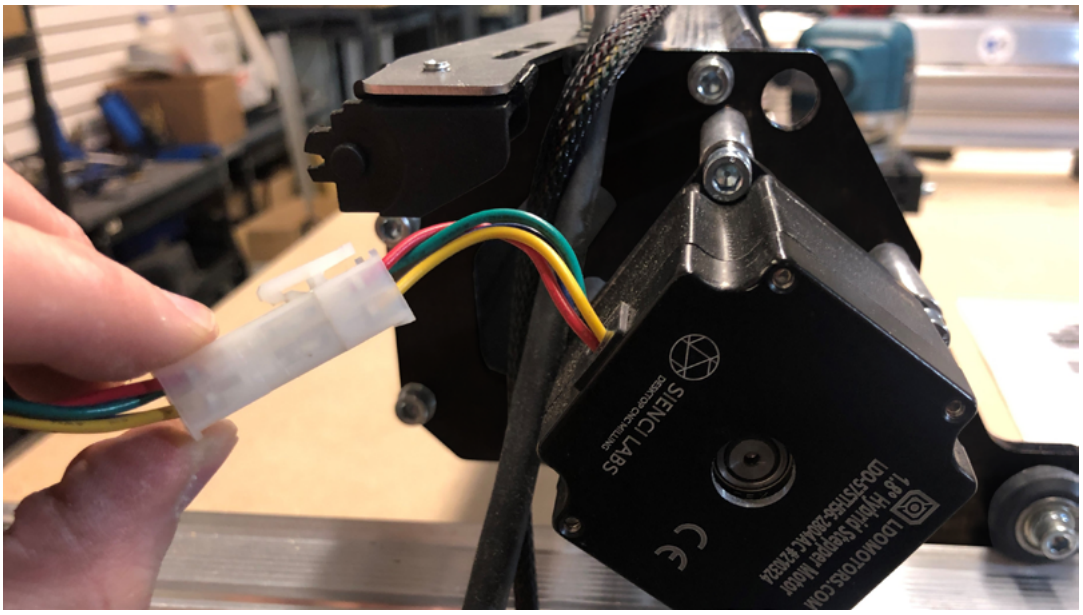
Now onto the remaining wiring. Grab a motor cable and connect it to the Z-axis NEMA 23 motor. The connector can only go in one way, so find the orientation where the connector attaches with ease.



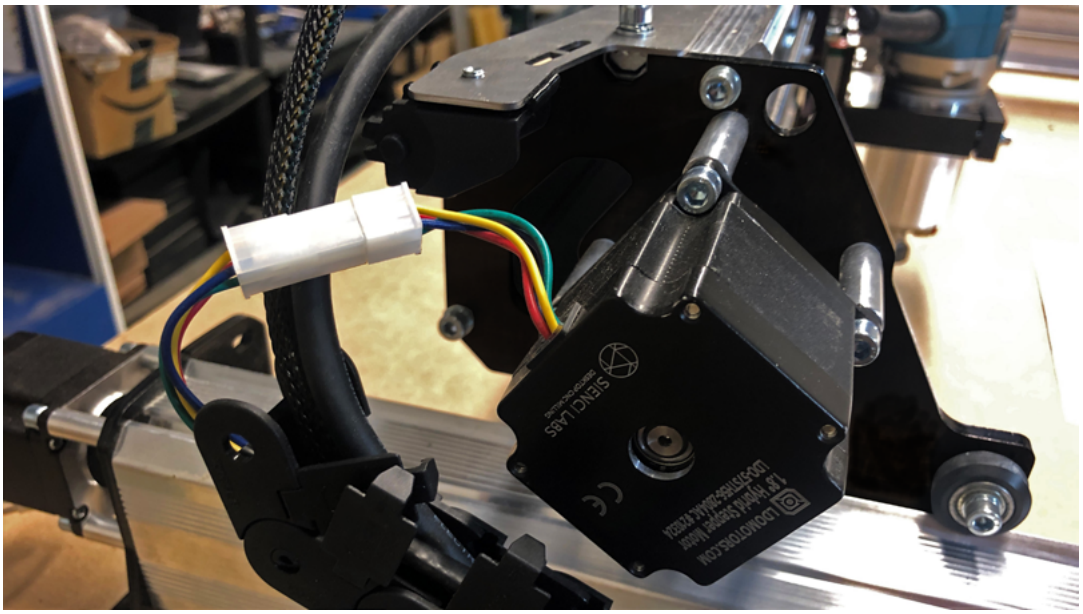


Grab the drag chain for the X-axis (the longer one) and seat the Z-axis motor cable and the router wire into the drag chain. Make sure that you have the correct end of the drag chain so it'll attach onto the end link and bend in the right direction against the X-axis. You can reattach it onto the end link and start to re-clip the clips into place.

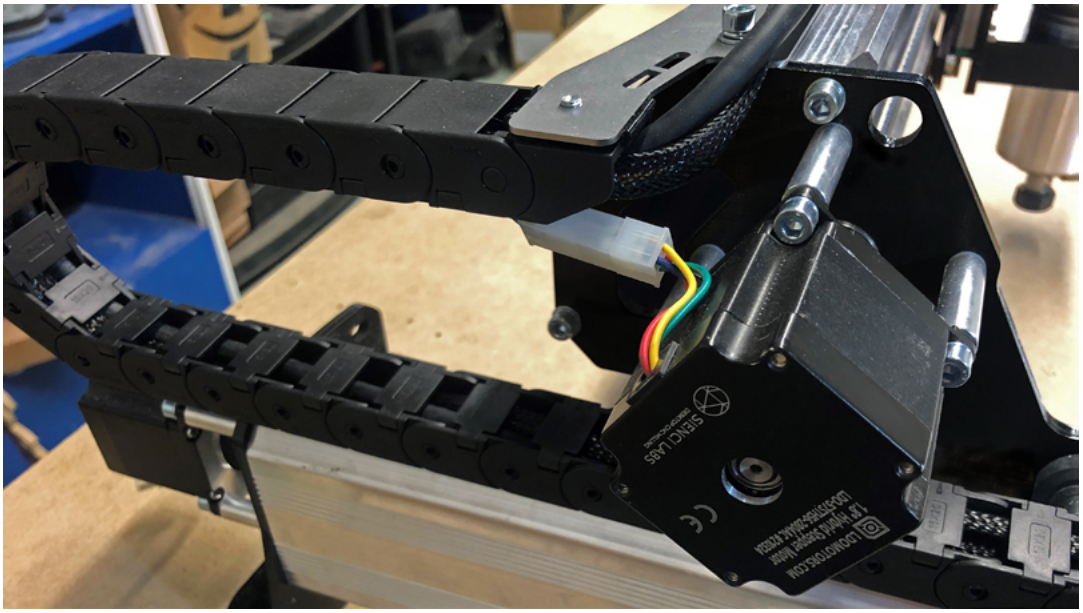
Bring the other end of the drag chain around and attach it onto the other end link on the X-axis rail. Pull the wires through and around the drag chain mount.



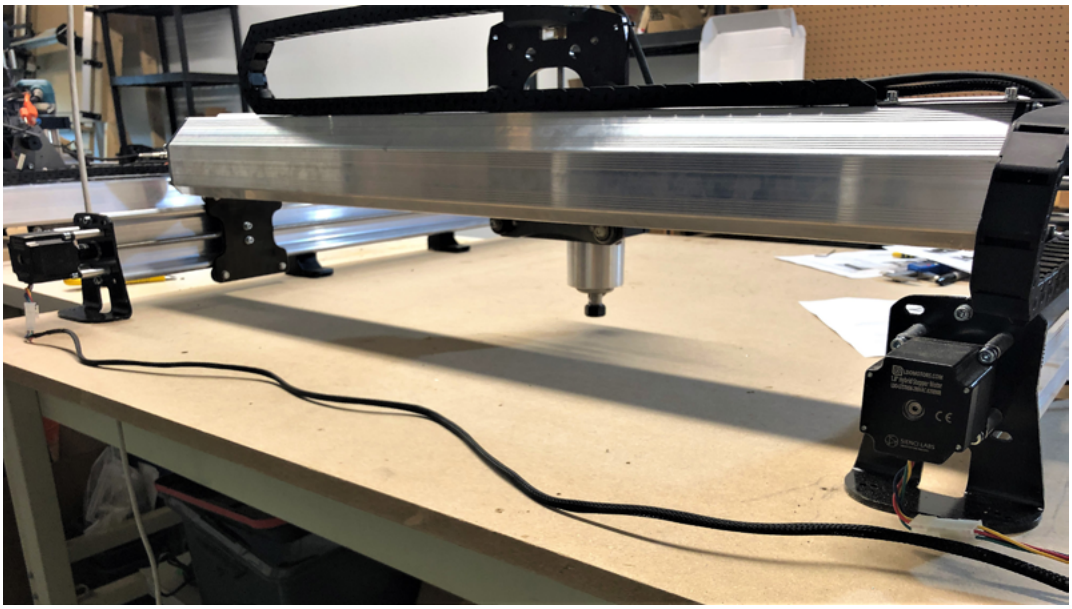
Attach a motor cable onto the X-axis NEMA 23 stepper motor.



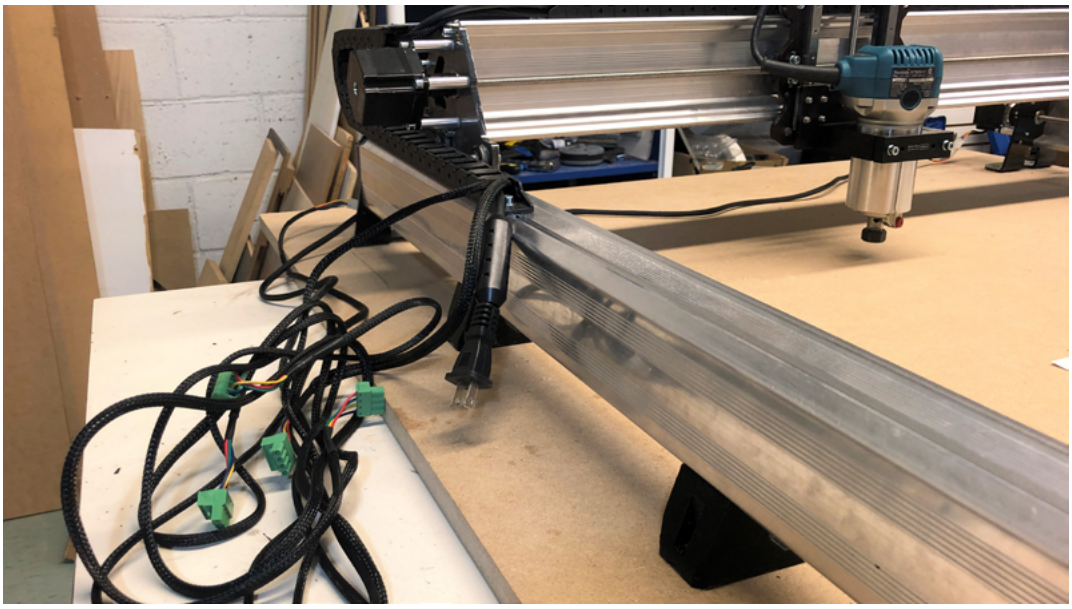
Take the cable from the X-axis and Z-axis NEMA 23 stepper motors as well as the router cable and insert it into the Y-axis drag chain. Again keep in mind to use the right end of the drag chain, then attach the chain on and clip the clips in to secure the wires.



Bring the other end of the drag chain around and attach it onto the other end link on the Y-axis rail. Pull the wires through and off to the left side of the rail.

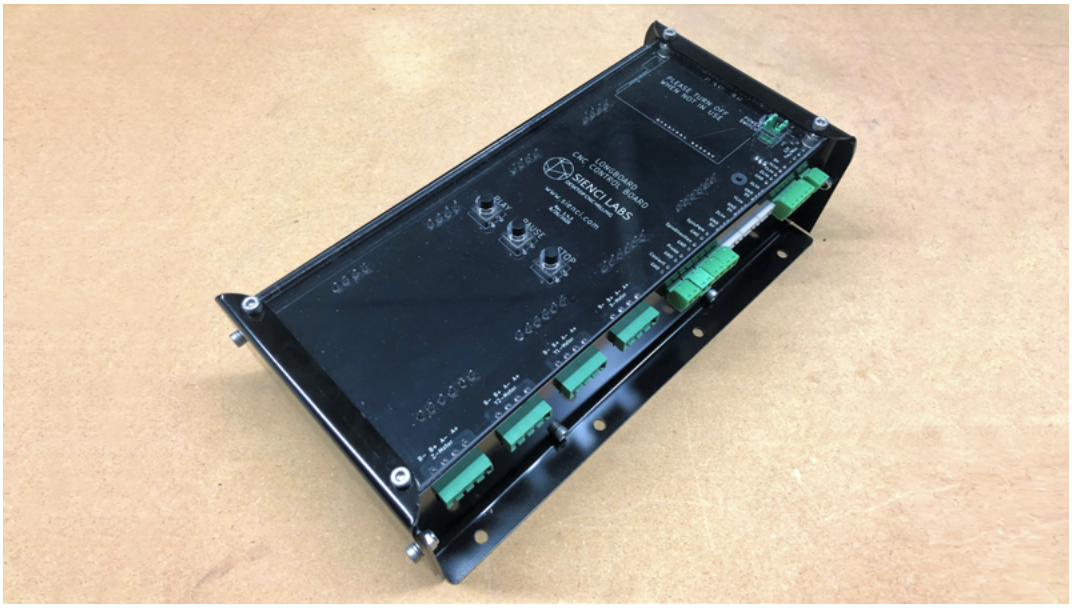


Lastly plug in the cables for the motors on the two Y-axis NEMA 23 stepper motors.

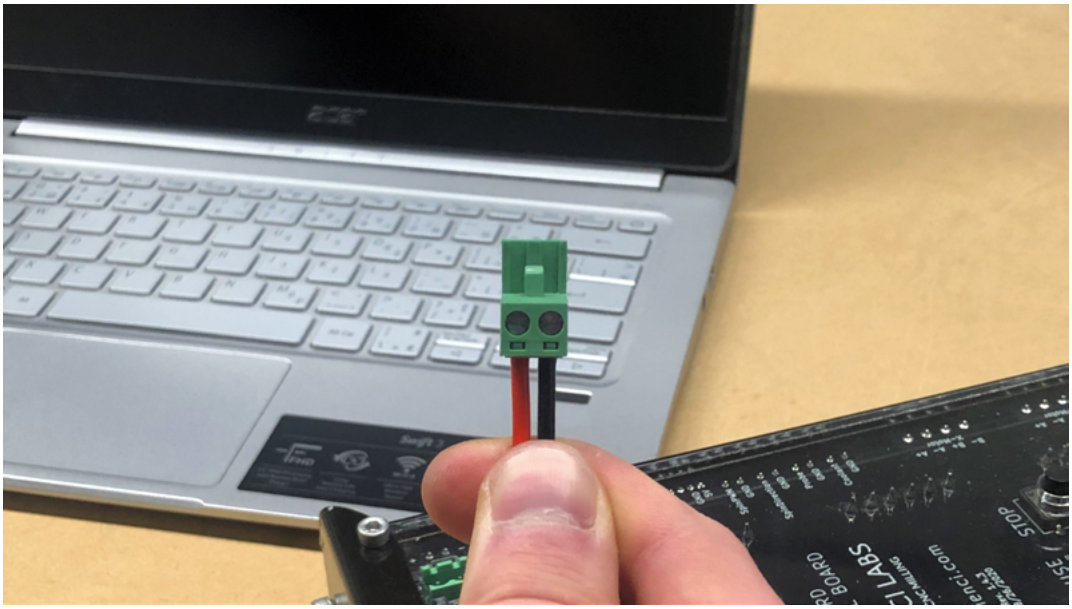


Bring the cables around to the left of the machine so they're now all bundled together (pictured). You'll be plugging the motors cables into the control box shortly but otherwise the machine wiring is now complete!

Checks & First Moves



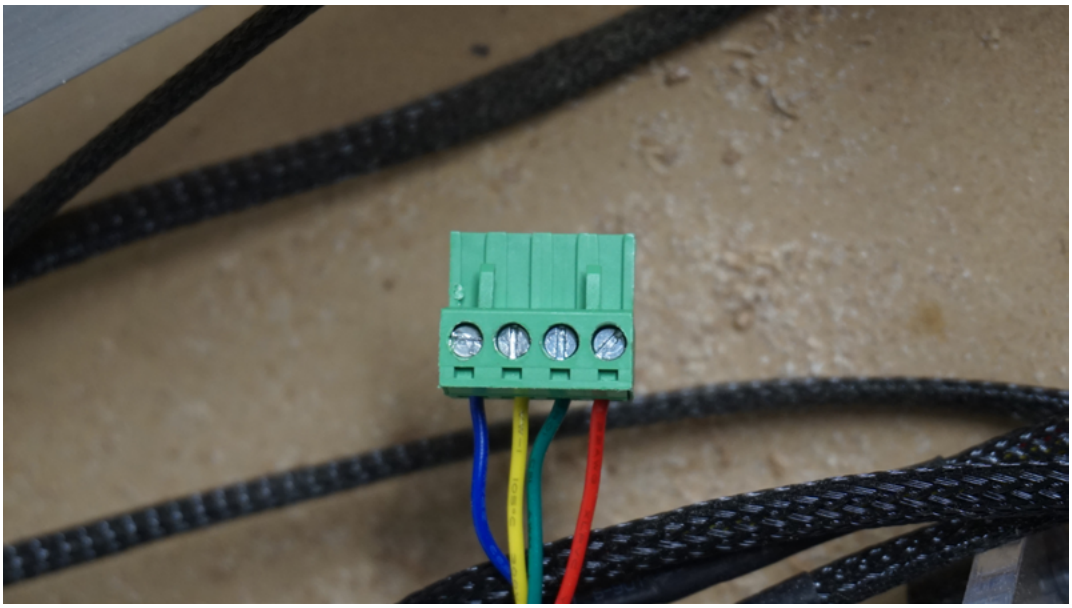
The LongMill electronics come pre-assembled and are pretty much ready to go out of the box. However, we recommend double-checking a few things before powering-on.



Power supply and E-stop connectors

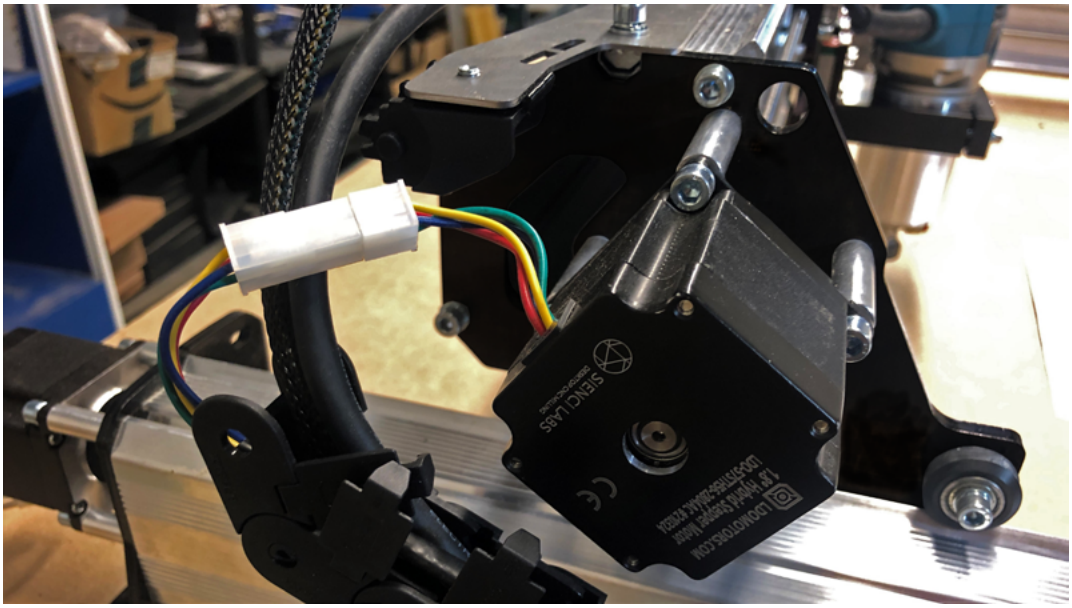
It's important that the connector coming from the DC power brick has a white or red wire on the left side and a black one on the right when the screw terminal is facing you (as pictured). Both this connector and the connector coming from the e-stop should have the wires attached very securely. The order of the wires going to the e-stop connector don't matter.

Check that the wires are connected appropriately by tugging on them. Secure them using the screw terminals and a flat head screwdriver if they're loose or disconnected.



Motor connector wiring

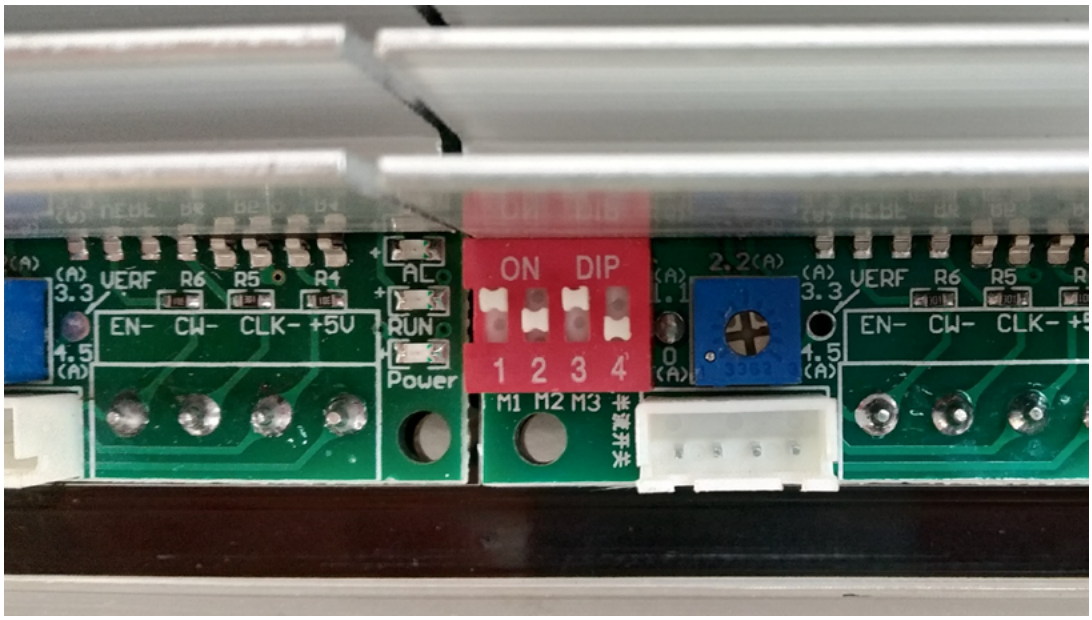
The wires, looking down from the side with the screw heads, should be, from left to right, BLUE, YELLOW, GREEN, RED (pictured). Check if the color pattern on all four of your motor wires is correct and re-arrange them if needed. As previously, also check that the wires are connected securely to the connector.



While you're at it, double check that the motor-side, white connectors on each axis are pushed all the way into the motor housing to ensure a good connection. If these connectors are sitting too loosely, then they can cause issues later on since the motor won't move as expected.

Properly seated DIP switches

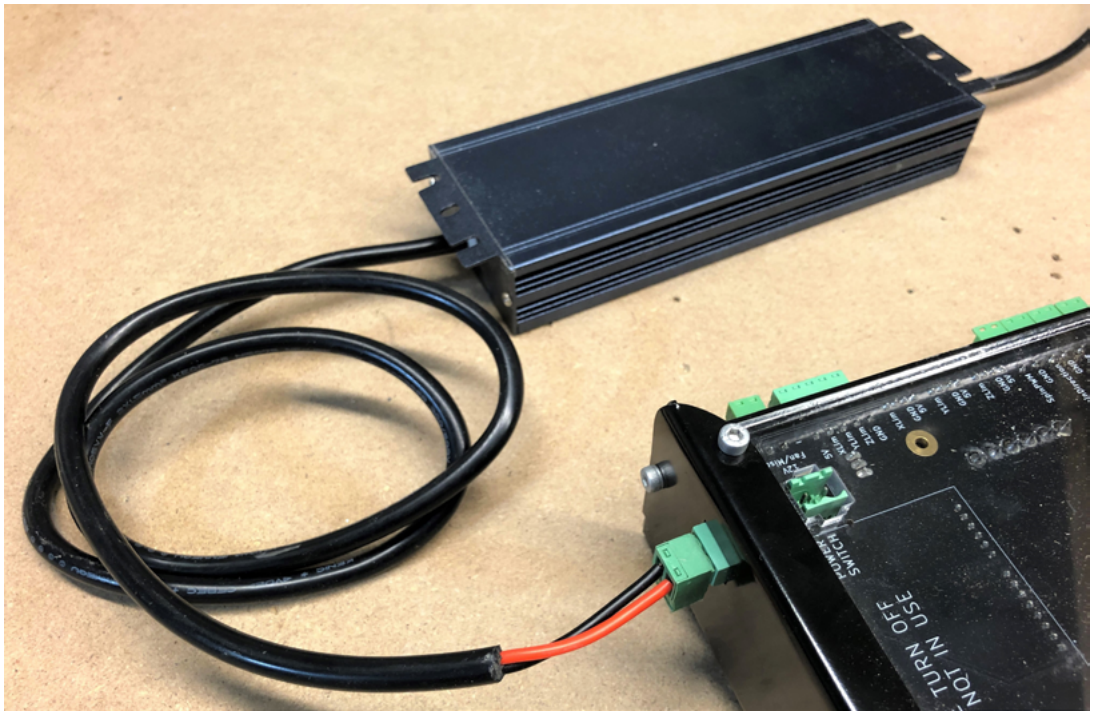
Looking at the underside of the control box, you should notice four red switch blocks on the circuit board through the slots in the steel (pictured). These are a way of toggling how the motors are controlled by their respective motor controllers, where the slots in the steel have been made wide enough so that you can reach in with a small flat head screwdriver or an Allen key to adjust these switches without dissembling anything.



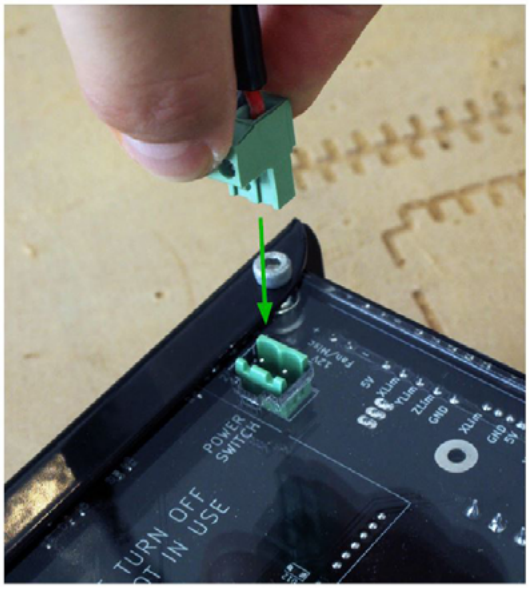
These DIP switches normally look like they've been properly switched when in reality they're 'floating' between the up and down positions, as is the case for switch 2 in the picture below. Because of this, it's a good idea to push every single switch into it's correct position before moving on to the next step, putting switches 1 and 3 into the 'up' position and switches 2 and 4 into the 'down' position (pictured).

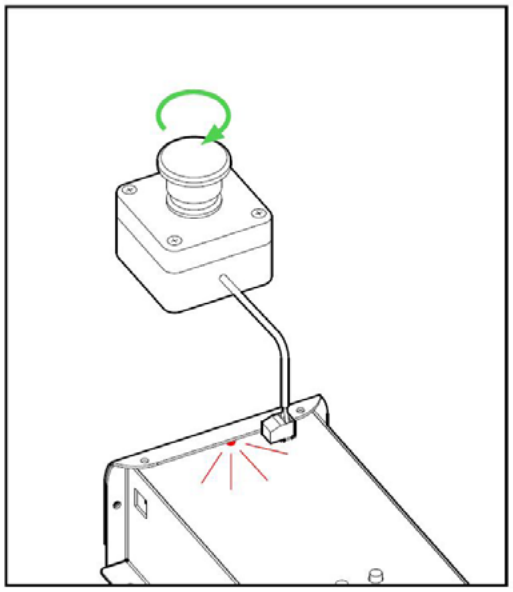
Plugging in the motors and power supply

With these checks done, start by connecting the motors. Track each cable from each motor to its corresponding green connector and connect it to the board. The fit of these connectors is tight but you need to be sure to push them ALL THE WAY in so that there is good contact between the plug and the connector. Each plug on the board is labelled on the top (note that there isn't a difference between the Y1 and Y2 plugs, the Y-axis motors can be connected to either of them).



Next, plug the connector coming from the power brick into the rear of the LongMill's control box (pictured); wait until after it's plugged in before plugging the other power supply cable into the wall. A green LED on the power supply brick should light up to indicate that it's receiving wall power.





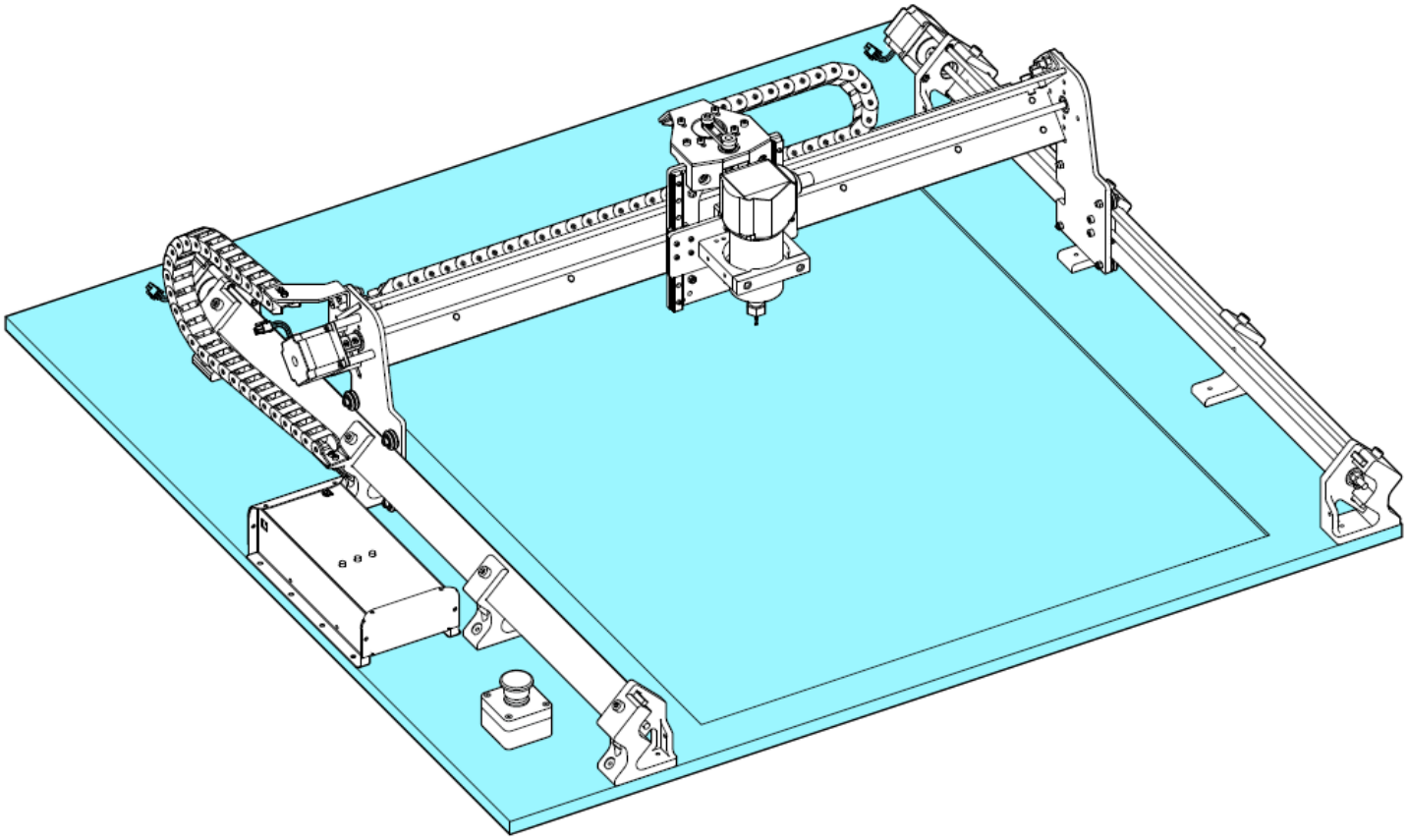
Now, connect the emergency stop button to the control box via the connector on the top. You should be able to find your e-stop button (pictured on the right) in a bubble wrapped bag the #3 top carton. Turn it on by rotating the button clockwise. You should see a red light on top of the box light up to confirm that everything is receiving power.

Once you've checked that the lights are turning on, press the e-stop button to turn it back off.

A note on the control box is that it will be limited in it's placement due to the length of the Z-axis motor cable. If you don't think you'll be using the on-board control buttons feel free to mount the box out of the way – the basic operations can be controlled via a USB cable and the e-stop. If you wish to place it further from the machine, extending the wires for that cable is quite straightforward either through the use of a soldering iron or through crimp-able wire extenders.

Part 5

Table Mounting



The LongMill is designed to be mounted to a flat surface which is provided by the user. This could be as simple as a single sheet of material, or as intricate as a multi-piece torsion table with t-tracks and threaded inserts. This helps to:

1. Save on the cost of shipping. For example, a 4'x4' piece of 3/4" MDF shipped often costs over a hundred dollars in shipping and is very easy to damage during transit. Instead, you can usually find a full 4'x8' sheet of 3/4" MDF for under $60 at your local lumber or hardware store.
2. Give users flexibility to choose the size and material of the wasteboard to match their needs.

Suitable wasteboard & Table

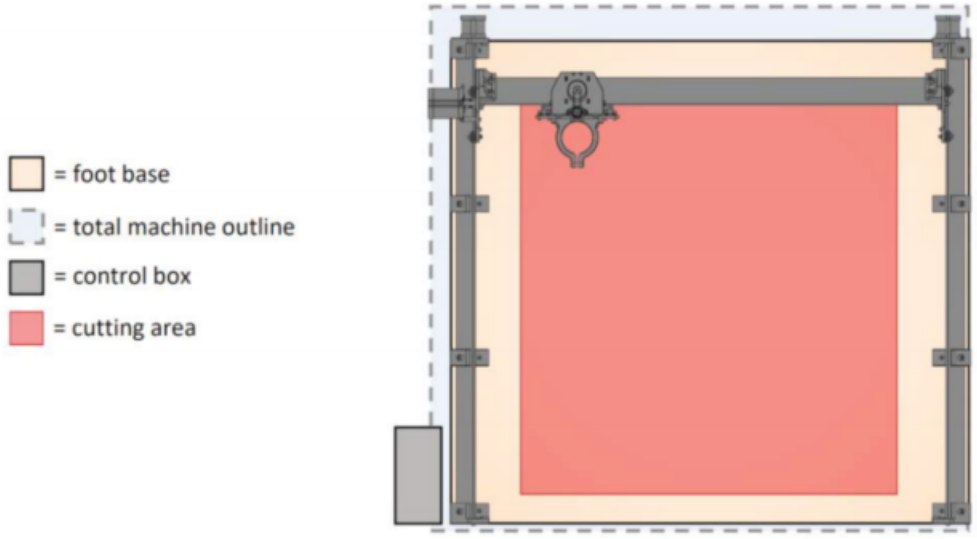
There are two factors to consider for your setup:

1. The table / mounting surface itself: this needs to be relatively flat to properly mount the machine to and it should be relatively sturdy as well
2. The wasteboard: this is the cutting area of the machine that you place material within and will get worn out over time. This will get flattened and occasionally re-flattened by your LongMill to ensure any material you cut is parallel to the machine. Ideally this should be removable. If you want to pass larger material through the cutting area you should also ensure the wasteboard is the same size as the machines cutting area otherwise it'll leave a lip when you flatten it out

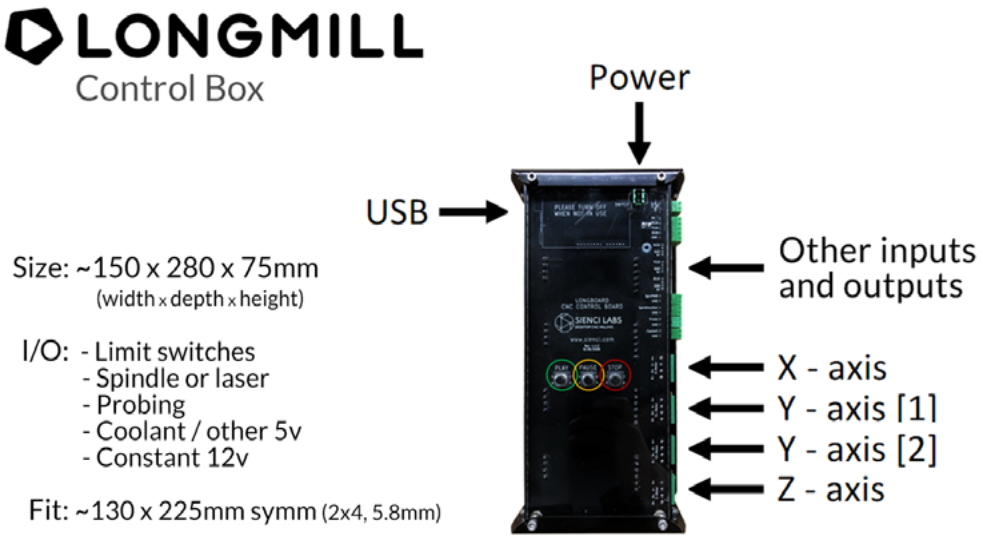
The easiest setup that we recommend is a flat, clean piece of 3/4" MDF to act as both your mounting surface and your wasteboard. This is because 3/4" MDF is quite stiff and is readily accessible in 4'x4' and 2'x2' sizes from most big- box hardware stores or a lumber store. Any similar piece of thick, flat material would also suffice; you can choose at your own discretion.

A higher-quality setup will have both a flat surface that your machine mounts to as well as a removable surface that you can cut away at to 're-flatten' after it starts to show some wear. Some inspirational examples of flashier setups by some of our community members' can be found here: https://sienci.com/dmx-longmill/community-table-builds/

Machine Dimensions



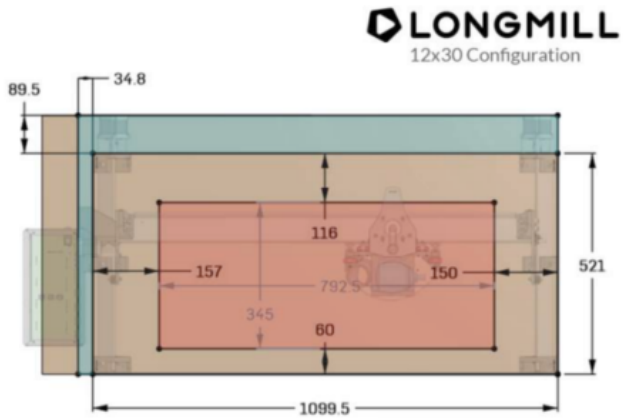
When getting ready to mount your LongMill, the most important dimensions you'll need to know are the size of its foot base and the total outline of the machine. As long as your mounting surface is at least the size of the foot base and you've left enough space around your mounting surface to account for the total machine outline, then your setup will be suitable.

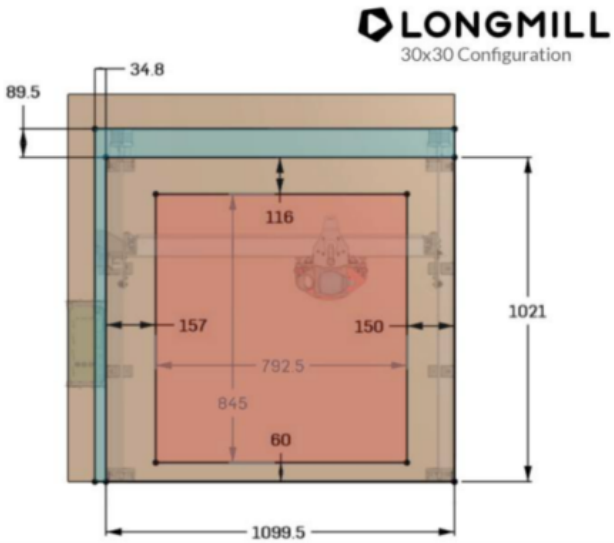


The control box is also something you should plan for, as the design of the machine favours placing the control box on the left side of the machine whether it's sitting on the table or mounted to the side or underside of the surface. The control box has buttons on the top which can Play, Pause, and Stop the machine's motion so some prefer to keep it mounted in an area that's accessible. It has a USB input on the left side, motor and other outputs on the right side, and the power input on the back side, so make sure to keep some space around it for cable management.

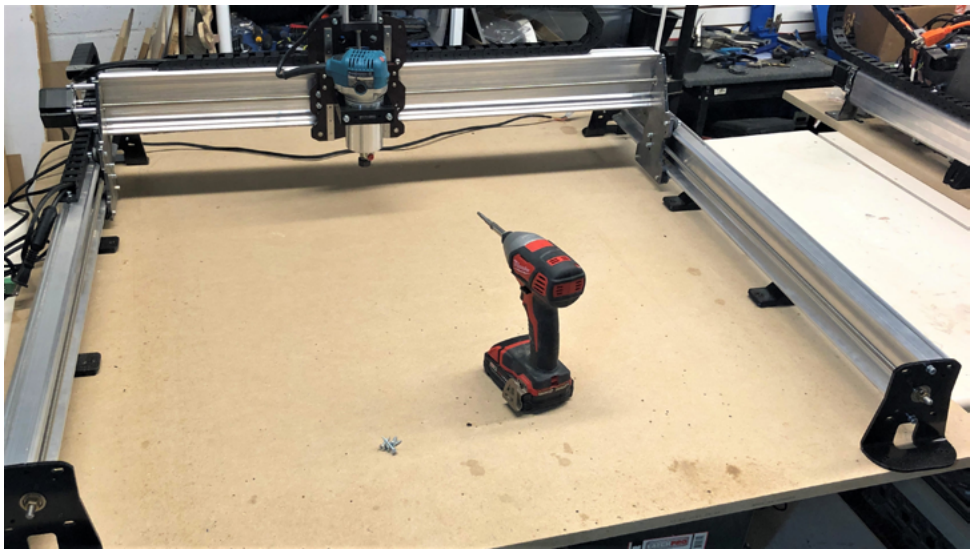
Once assembled, each LongMill MK2 model (12×30 and 30×30) is designed to generally fit on a 2×4□ and 4×4□ surface respectively. The diagrams below show a more detailed view for each model:

1. The **red area** inside the main box shows the cutting area as an offset from the foot base. It's based off the center-point of the router, thus you can plane an area larger than what's stated if you're using a large surfacing bit.
2. The **blue area** outside the main box shows the hanging parts as an offset from the foot base which makes up the total machine outline.
3. These diagrams have got a small buffer on the cutting area (i.e. it's been shrunk slightly) since each part has its own manufacturing tolerance and can come together differently in assembly so we want to ensure we're providing a reasonable guarantee on what can be expected from your machine.



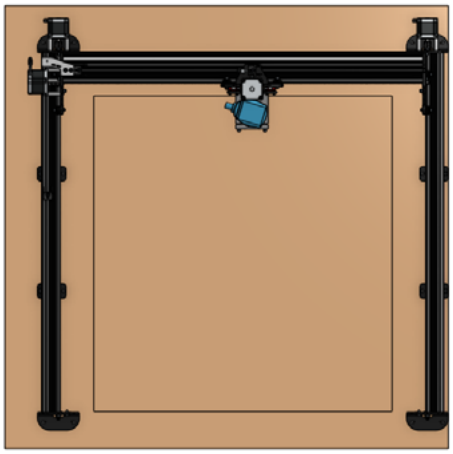


Mounting your LongMill



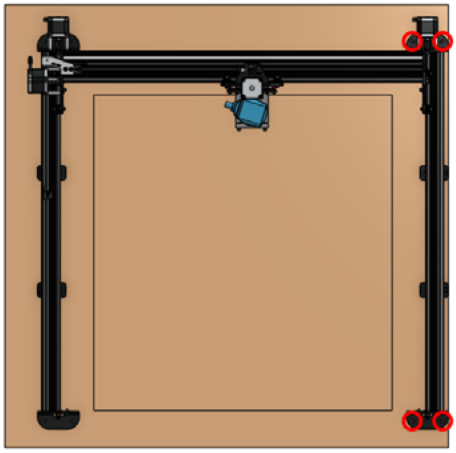
To ensure that your machine is mounted securely and accurately, we've created a series of steps that are easy to follow through. We highly recommend following these steps exactly, as the order of these steps matter. You'll need a computer to be connected to the machine in order to move it around between steps.

Gently place your LongMill on the mounting surface and shuffle it over roughly where you want it. In this case we're using a 4'x4' MDF sheet as a combination mounting surface and wasteboard which we had cut to 42 inches to better fit in a car. We'll be mounting it in the middle and have the electronics box sit off the material to the side.

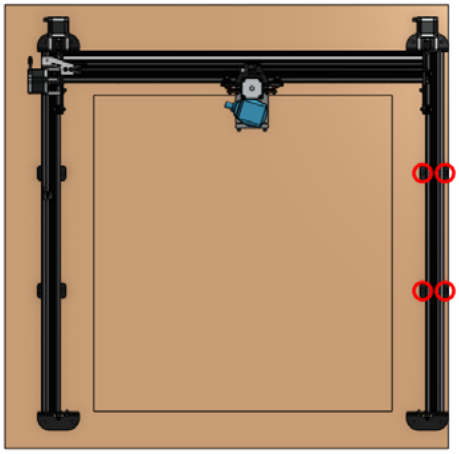


We'll start by mounting the right side of the machine. Using a drill with a long Robertson driver or a short one on a bit extender works best for driving in the screws so that you have the necessary reach. You can use the wood screws provided (#8 x 1"), or use your own mounting hardware depending on your material or its thickness.

Each foot has two holes for mounting. The steel end feet have an additional two holes that will enable you to shuffle the machine slightly if you initially place them incorrectly. This has been built in to add space for adjustments when squaring the machine up - use either the inner or outer pair initially and if you end up needing to shift the foot then alternate to the other set.

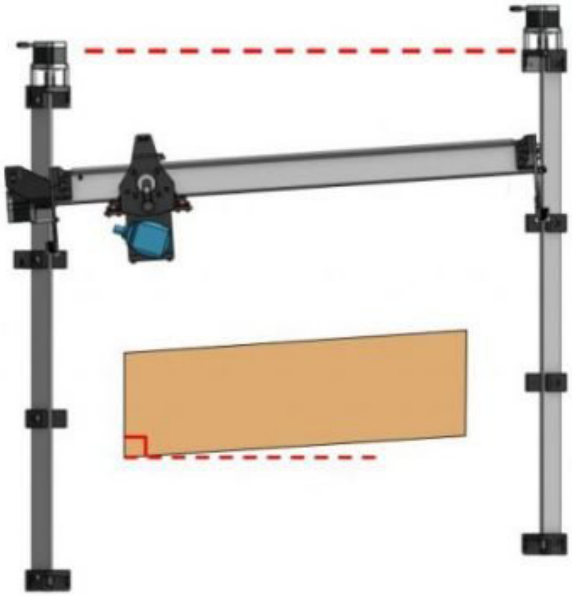


Alright, starting off we'll be simply mounting the whole right-side of the machine where we want it to go. Begin by moving the machine a couple of inches forward and mount the ends of the right side Y-axis using 2 screws per foot. Align this to an edge or an inset line you draw on your table, whatever best suits your setup. If you'd like to pre-drill the holes to avoid shifting around that's an option as well.



Next, we'll screw in the middle feet on the right side.

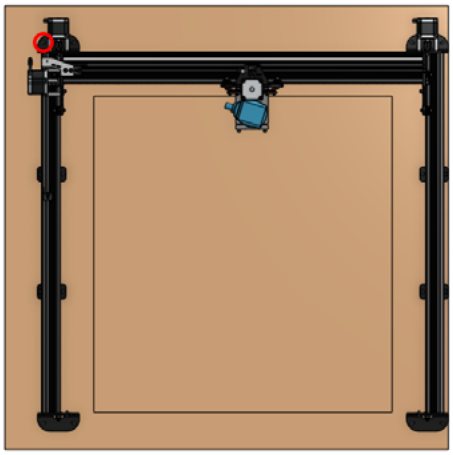
Y-axes aren't parallel to each other
(causes machine stress)



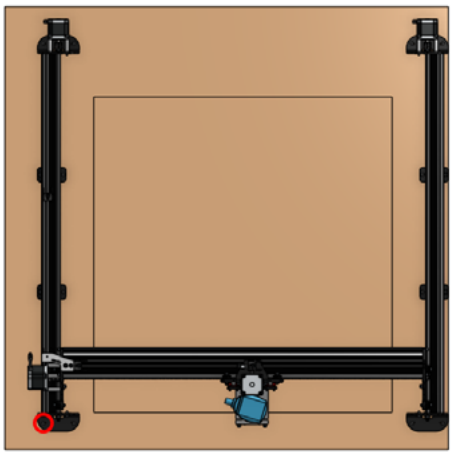
Back feet not aligned
(causes skewed cutting)

At this point the right side of your machine will be fully secure. When mounting the left side, we'll want to ensure it's mounted parallel to the right side and also that the back feet are aligned to each other. You can see in the diagram below why mounting the rails both parallel and in-line is important to ensure the CNC isn't overly stressed and also cuts how you'd expect it to.

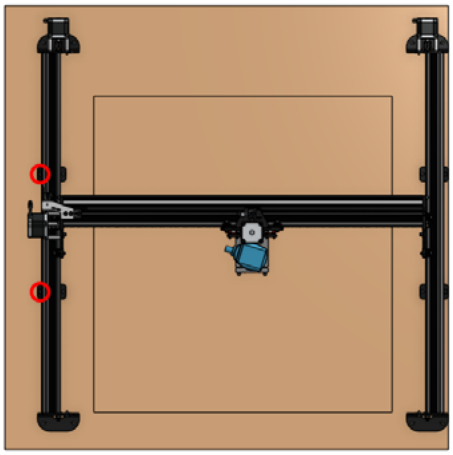
To combat this misalignment, first you'll want to start with the back, left foot on its outside hole (circled). Before attaching this screw, you should be able to double-check your machine alignment using a combination of a measuring tape and a straight edge (level, carpenters square, etc.) - you can even butt the table up against a wall and space off the wall if need be. You'll notice that the steel end feet on the LM have notches in them which will also enable you to measure the diagonals from the top left to bottom right and top right to bottom left. If these measurements are equal then that'll ensure your machine is mounted square.



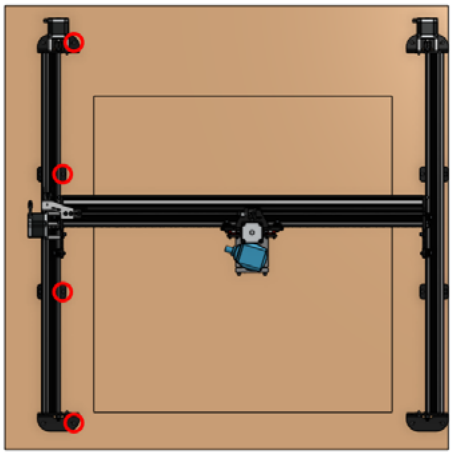
Once you feel confident in the foot placement, drive this first screw into place.



To complete parallel alignment, you'll be moving the machine towards the front so that it's right next to the front left foot and then driving in another screw:



Move it to roughly the middle and secure one screw on each middle foot:



Now finish off mounting the feet by attaching each foot down with a second screw.

Your machine should now be fully secure and square to its mounting surface. An easy squareness check is to tape a pencil or marker to your router mount and draw a large L or box shape manually by using the X and Y movements on your computer. You'll be able to use this in combination with a carpenter's square or measuring a 3-4-5 triangle to confirm that your machine has been aligned properly.

From this point, you should be ready to begin cutting your first job! If you've got the touch plate, dust shoe, or t-track add-ons alongside your machine, you'll see the guide on how to utilize these and put them together after the "Starter Projects" page.

The rest of this Assembly section also contains information on how to surface your wasteboard, ways to get started making more projects, machine maintenance, and a page on troubleshooting in case you happened upon any issues during assembly or during the Starter Projects.