ShopBot®

PRS5 Alpha Z14

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Safety

Learn and understand safe use of the machine. Do not allow untrained individuals to operate the machine without supervision. Be aware of the location of the Emergency Stop switch at all times.

Eye and ear protection MUST be worn by the machine operator as well as any bystanders or observers. Flying sawdust, material chips, and other debris can cause serious eye injury.

Wear closed-toe shoes at all times.

Make sure that your material is properly secured before cutting, and be aware of any small parts that may come loose after being cut. If a small part catches the edge of a spinning bit, it can be thrown forcefully in any direction, causing injury or damage.

Never place your hands on the rails of the ShopBot. Be aware that the machine may move unexpectedly in any direction, which can cause serious injury if your hands are in the path of movement.

Never wear gloves while operating the machine. As with any power tool, a glove can get caught in moving or spinning parts and pull your hand into the machinery.

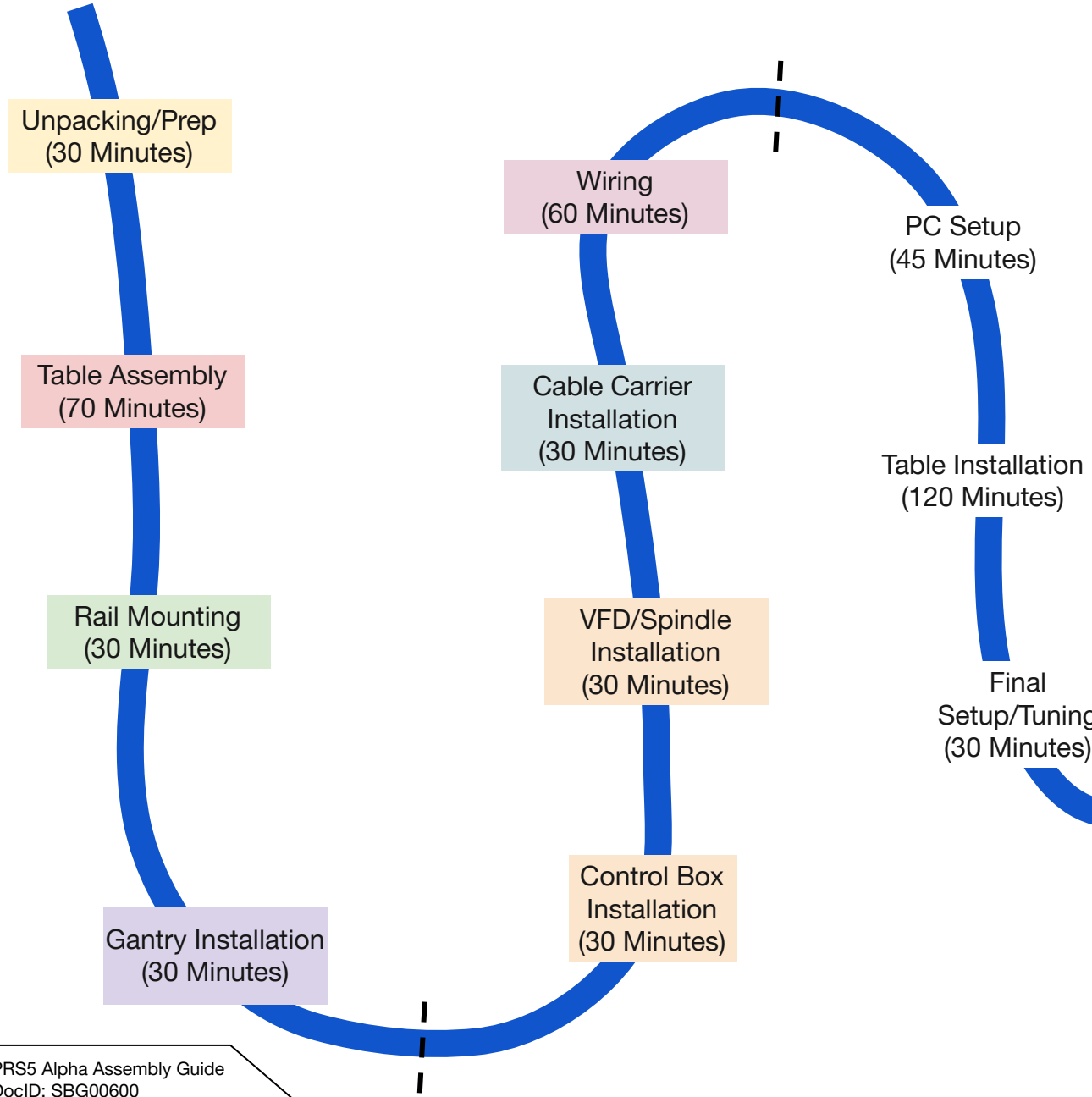
Never leave a machine running and unattended. Understand that a spinning tool generates friction and heat, creating a risk of fire. This risk is minimized by using correct chip load, using sharp bits, and by always double-checking your files before cutting. Be prepared to pause or stop the cut if something seems incorrect or unsafe.

Keep a working fire extinguisher within reach of the machine, for the reasons listed above.

General Safety and Precautions

This safety summary contains general safety warnings that should be understood during operation of this machine. Refer also to General Power Tool Safety Warnings found in the User Guide. Failure to observe these precautions could result in injury.

Assembly Process



Planning Your Assembly

We've provided some estimates of the time required for each step in the assembly process for someone who has never built a ShopBot before. There's a lot to learn, and it can help to break up the assembly into multiple days; the black dashed lines represent good "stopping points" for a 3 day build process.

Precautions

A licensed electrician is required to complete the ShopBot setup. Connecting power to the control box is easiest when the tool is set up and in its final position. If the tool includes a high frequency spindle and/or a vacuum blower, these will also need to be connected by an electrician. Wiring diagrams and specifications are located inside the control box door.

Other Electrical precautions:

Ground Wire: Your ShopBot electrical connections must include a ground wire. Lack of proper grounding can result in poor machine performance, damage to electrical components and injury or death due to electrical short circuit.

Motor Connections: DO NOT connect or disconnect motor cables while power is on to the control box. This can damage or destroy the motors or drivers.

Induced Currents: AVOID moving axes by hand when the control box is powered off. If it is unavoidable, do so very slowly. Spinning the motors can generate an electric charge and damage drivers or other electronic components.

Static Discharge: Follow all wiring and grounding instructions - electronic circuits are very sensitive to static and power surges. Avoid vacuuming around the machine before it is properly grounded, as vacuums can generate a large amount of static electricity that can damage the control box.

WARNING: RISK OF ELECTRIC SHOCK

The control box must be connected to electrical service by a licensed electrician, who has experience with industrial equipment. Personal injury or damage to the machine may occur if an unlicensed individual performs this job.

Use caution when lifting boxes and assembled components out of the crate. Having an assistant will make things much easier – particularly when unpacking the crate and lifting the gantry onto the table rails. Do not attempt to lift the gantry without assistance.

Unpacking the Crate

ShopBot components arrive in two packages: a large wooden crate and a long box. Contact the shipping company if either piece is missing, or if they do not arrive together.

The components are packaged to avoid shifting during shipping. Use a large screwdriver to pry off the clips on top of the crate, and a Phillips head screwdriver to uncrate the components. It will require two people to lift out some of the heavier pieces.

Read through the assembly directions, and sort the components by their function to help organize the assembly process. Sort hardware by size to reduce the amount of time searching for the correct bolts, nuts and washers for a given stage of the assembly.

Many components of the machine come pre-assembled to reduce the number of assembly steps. In many places, bolts or hardware may be loosely fit in place to show their intended location. Remove this hardware prior to fitting the applicable component into place.

Missing any parts?

Try to leave your machine parts in your crate until they are called for in the assembly instructions. The parts have been packed so that the parts you need first are on top! Unpacking the whole crate prior to assembly can lead to misplaced parts and will make assembly more difficult.
If you think that you are missing a part that you need for assembly; contact ShopBot support right away and we'll get things straightened out for you.

Long Crate: (Table Sides, Rails – 2 crates for 14 and 26" Z Axis Machines)

1+...

Main Crate: (Gantry, Table Steel, Electronics, Spindle, Accessories)

1

Need Help?
https://youtu.be/TXIspYO5VhA

Tools for Assembly

Your ShopBot will arrive with a kit of tools that will be helpful in assembling your machine. Some of these tool are also useful for installing optional machine upgrades that you may choose to add at a later date; so don't discard these tools after your assembly is complete!

Power Tools

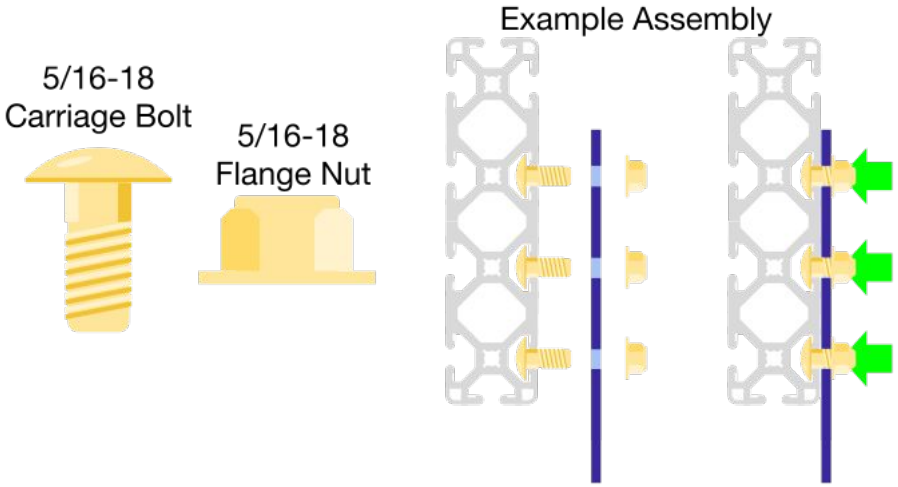
If you have an impact driver or battery drill; use it! Power tools can make the assembly process go much more quickly.

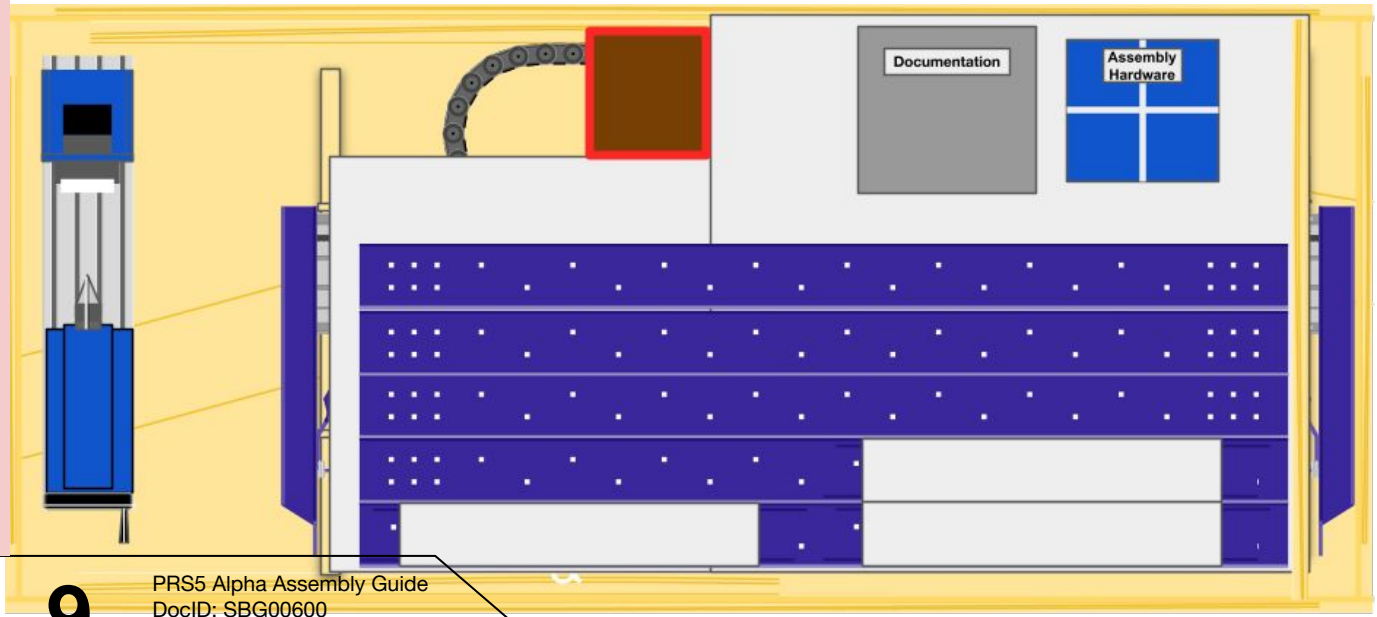
Base Table Assembly

Start by opening the main crate. The lid is held on using “klimps”; these can be removed by prying them upwards from the top using a screwdriver. Remove all of the klimps and carefully lift the lid off of your crate.

Your machine components are packed in layers with the base table components on top. Leave all components in the crate until they are called for in the assembly instructions.

The PRS5 table is assembled using carriage bolts. The square portion of the bolt locks into either a square hole in the steel table components or the t-slot of the table side. A flanged nut is then tightened onto the bolt to lock the joint.

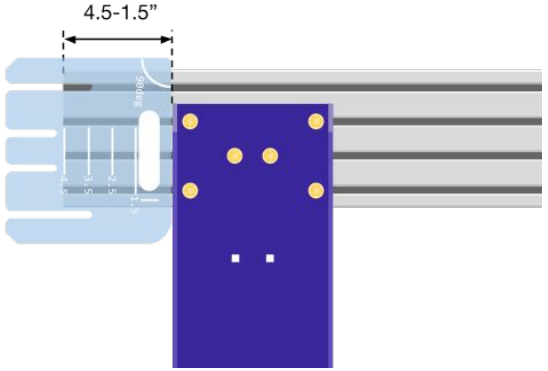


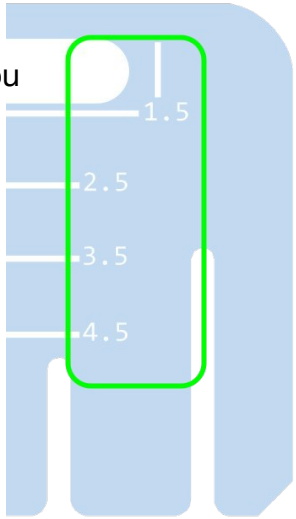


Start by locating the colored box labelled “Assembly Hardware”. This box has been screwed to the wooden platform inside the crate; so don’t try to lift it up! Simply cut the tape on the box and open it up to get access to your assembly hardware.

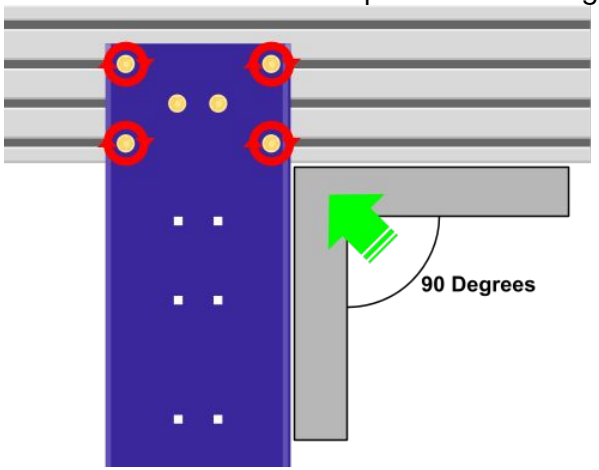
Attaching the Leg Supports

Next, we will set the position of all of the table legs. First, the left-most table leg must be positioned precisely in order to guarantee full travel for your machine. Refer to the table drawing included with your machine for the exact measurement. The jig that was used to align your bolts has a scale engraved in it that can help you with this measurement.

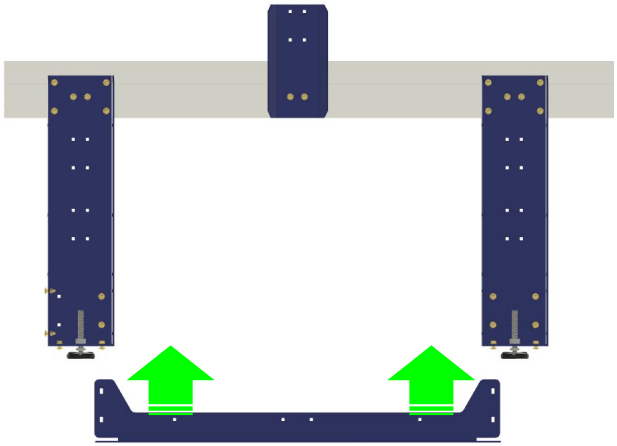




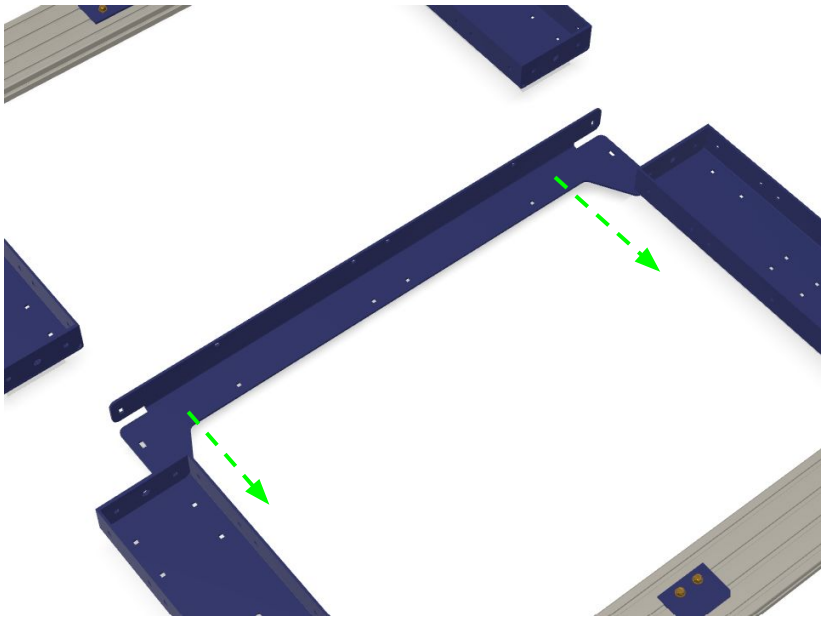
Use a square to confirm a right angle between the table side and the table leg – then tighten the 4 outer nuts to lock the position of the leg.



To set the position of the next leg, we will attach the first lower side support. Slide the lower side support under the first pair of table legs and align the mounting holes.

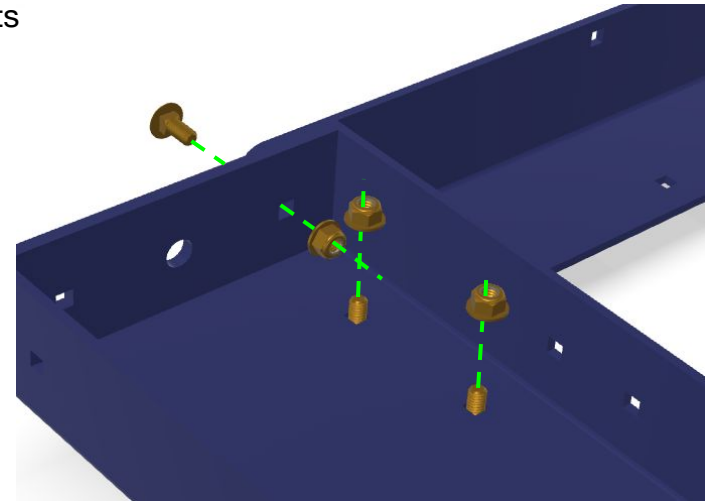


The lower side support will slide under the table legs.

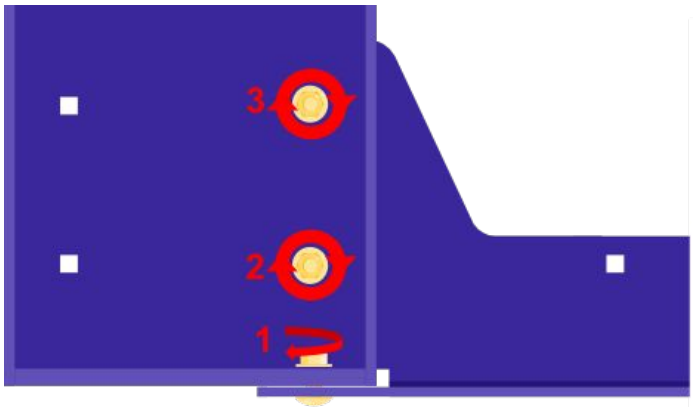


Attaching the Leg Supports (Cont)

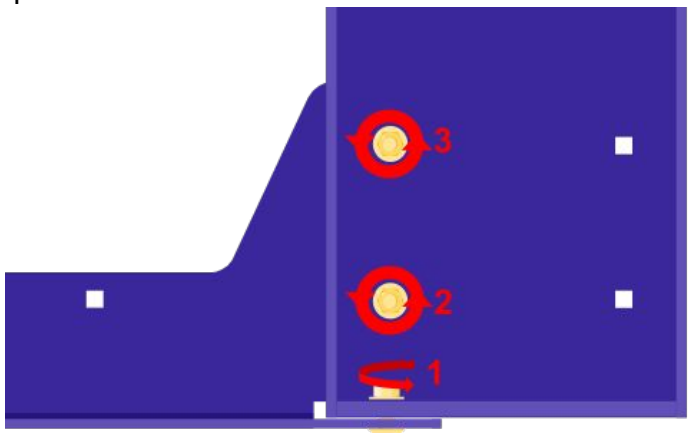
Insert carriage bolts from below into the holes highlighted below, with the threaded portion of the bolt sticking up towards you. Loosely finger tighten flange nuts onto these bolts



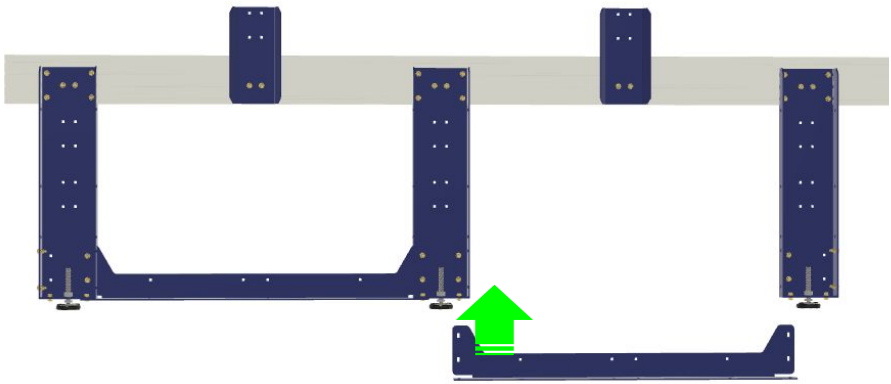
Tighten the nuts on the bolts in the order indicated by the numbers in the diagram below.



Tighten the bolts on the opposite end of the leg support in the same order.

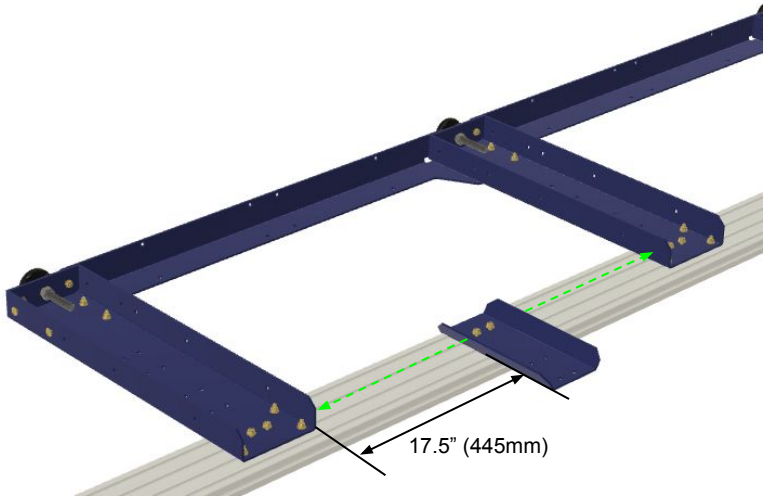


Continue to add lower side supports to connect the remaining legs on the table side. If your machine has a 120” or 168” X axis, you will have one shorter lower side support to connect the last set of table legs on this table side.

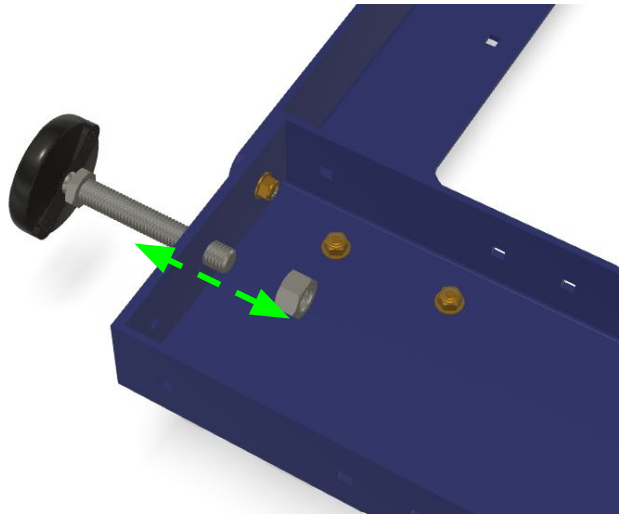


Supports and Levellers

Roughly set the spacing for the spacer plates halfway between the two table legs on either side.

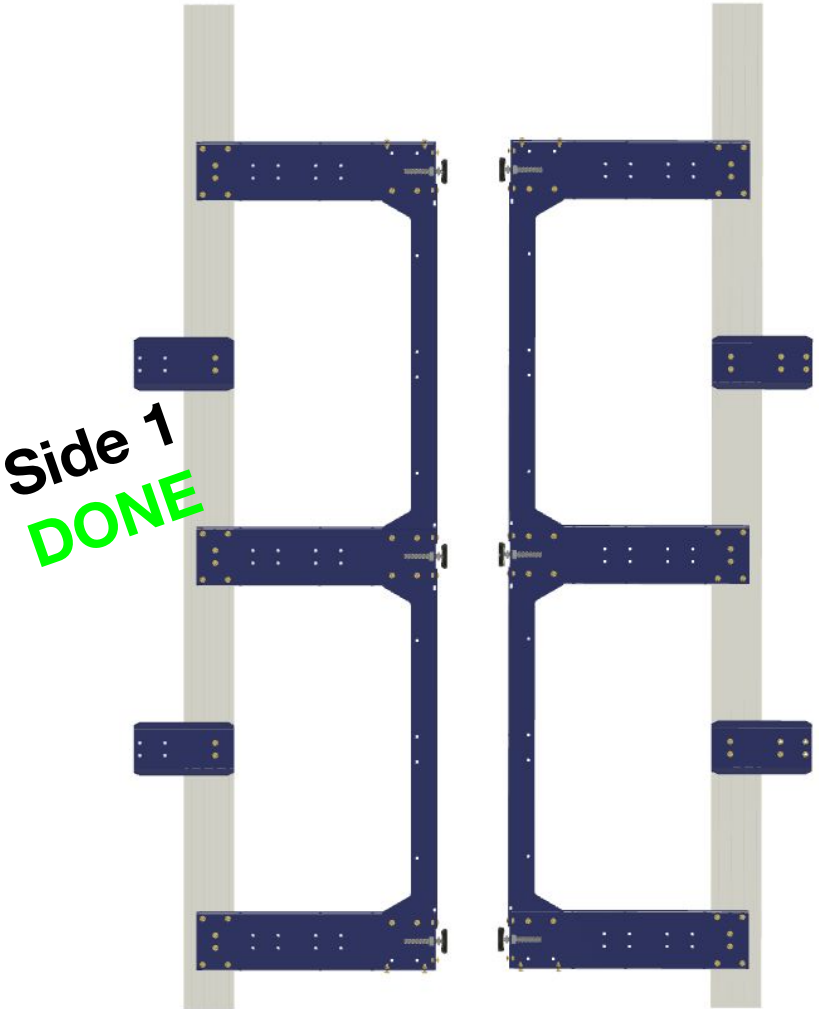


Thread a leveller foot into each of the table legs. Spin the threaded stud all the way in to its last thread. Loosely attach a ⅝-11 hex nut to the stud.



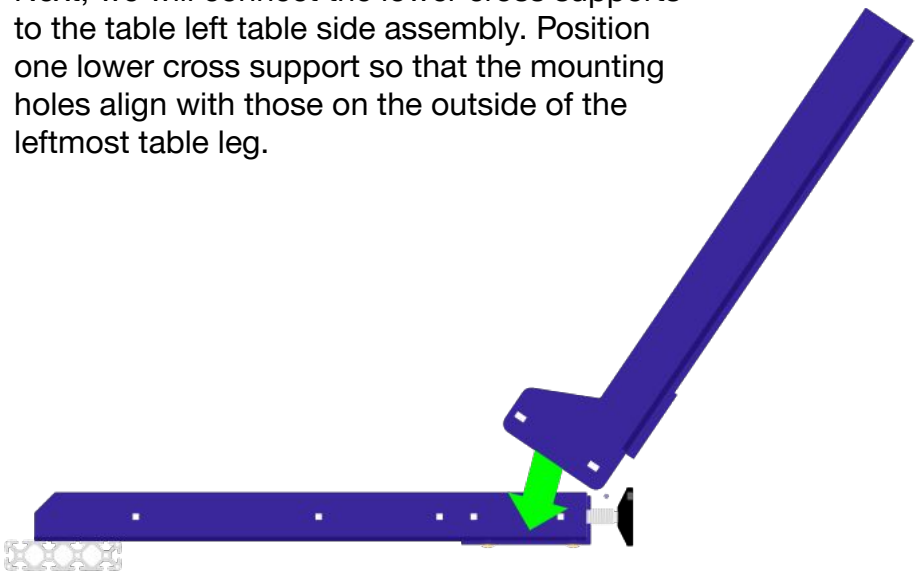
Back to the Start

That’s one side of your table! Now we need to build a mirror image of the first side to complete your two table sides. Start from the beginning of this process to build your opposite side

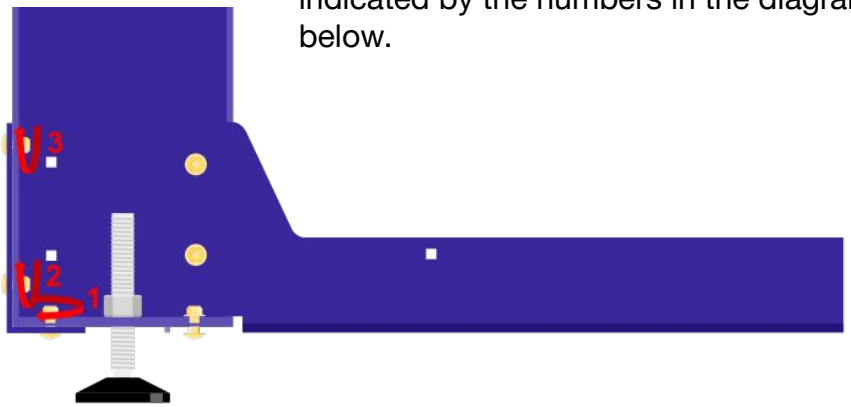


Lower Cross Supports

Next, we will connect the lower cross supports to the table left table side assembly. Position one lower cross support so that the mounting holes align with those on the outside of the leftmost table leg.

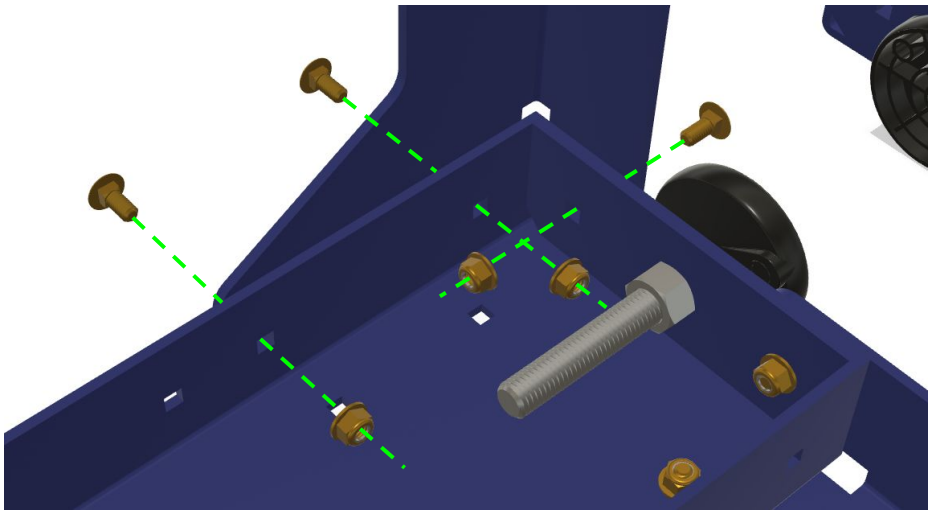


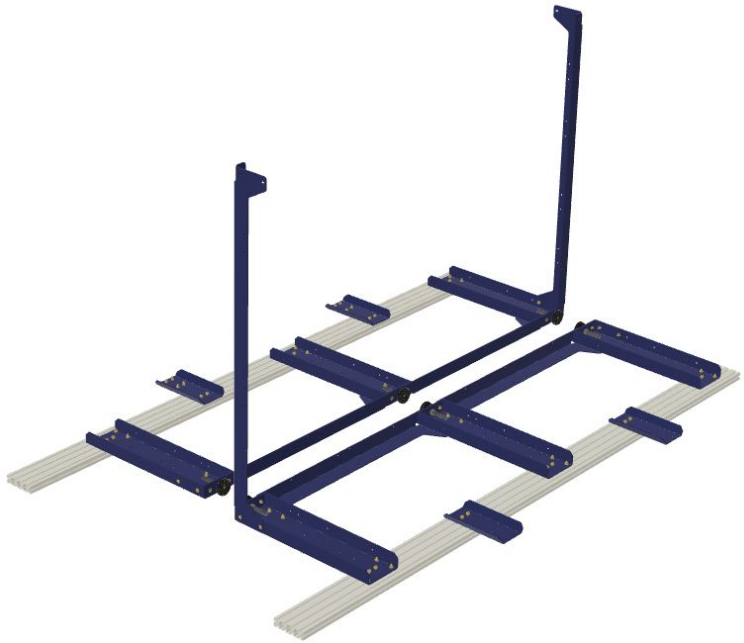
Tighten the nuts on the bolts in the order indicated by the numbers in the diagram below.



The Lower Cross Supports will be used to support our table side assemblies when we stand them up. Attach the second Lower Cross Support to the opposite side of your other table side assembly.

Insert 3 carriage bolts through the 3 mounting holes on the lower cross support.

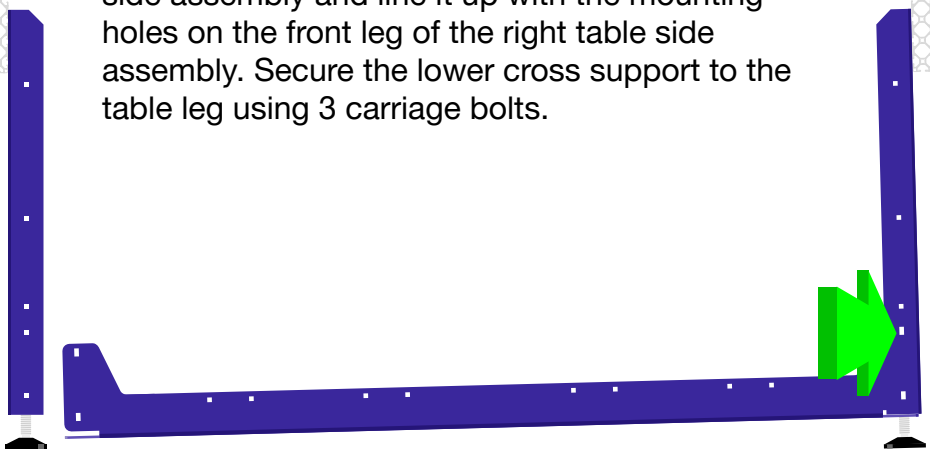




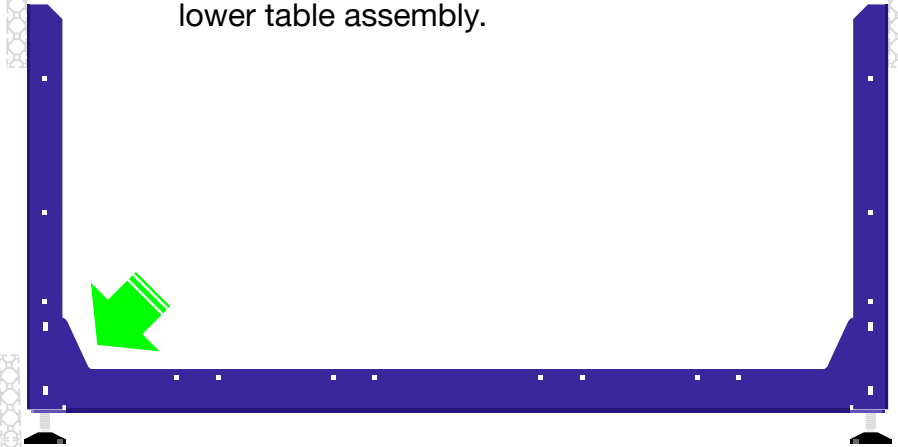
Connecting the Two Tablesides

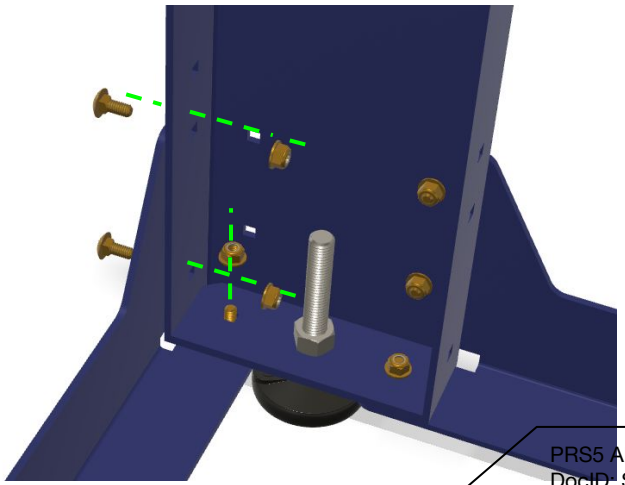
It will now be possible to stand both sides of your table up and allow the lower cross support to rest on the ground opposite the table legs.

Pull the two table side assemblies together. Lift the lower cross support on the left hand table side assembly and line it up with the mounting holes on the front leg of the right table side assembly. Secure the lower cross support to the table leg using 3 carriage bolts.

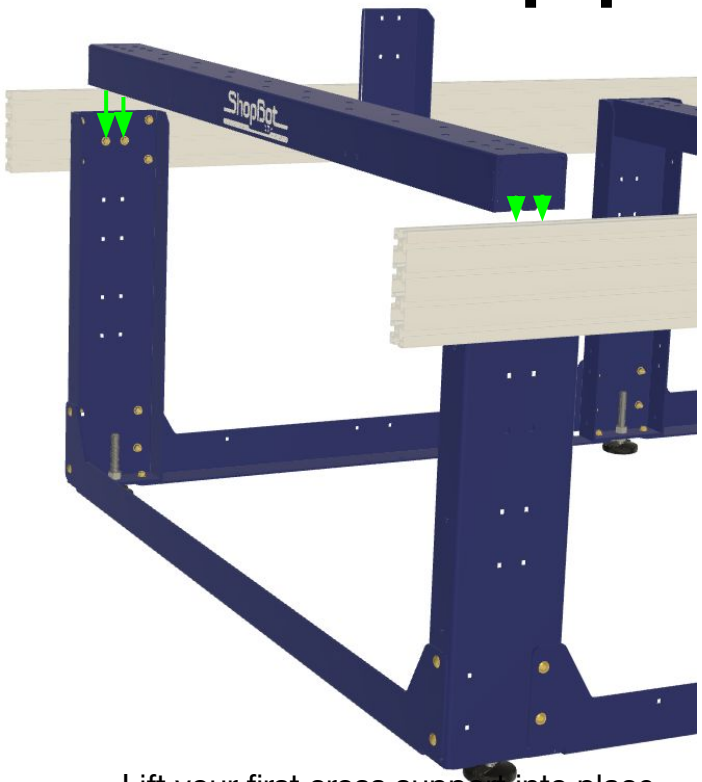


Secure the rear lower cross support to the rear leg of the left table side assembly using 3 carriage bolts to complete the lower table assembly.



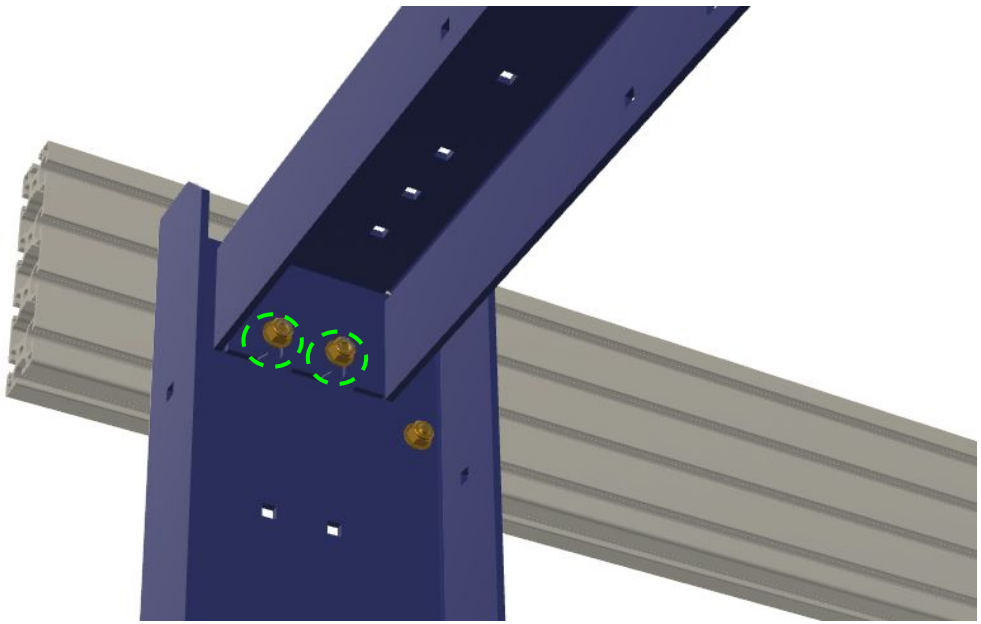


Inserting the Upper Cross Supports



Lift your first cross support into place between the first two table legs on your table assembly.

Each end of the cross support will slide onto the center two bolts that we left loose when attaching your table legs. Leave these bolts loose until all cross supports have been installed on the table assembly

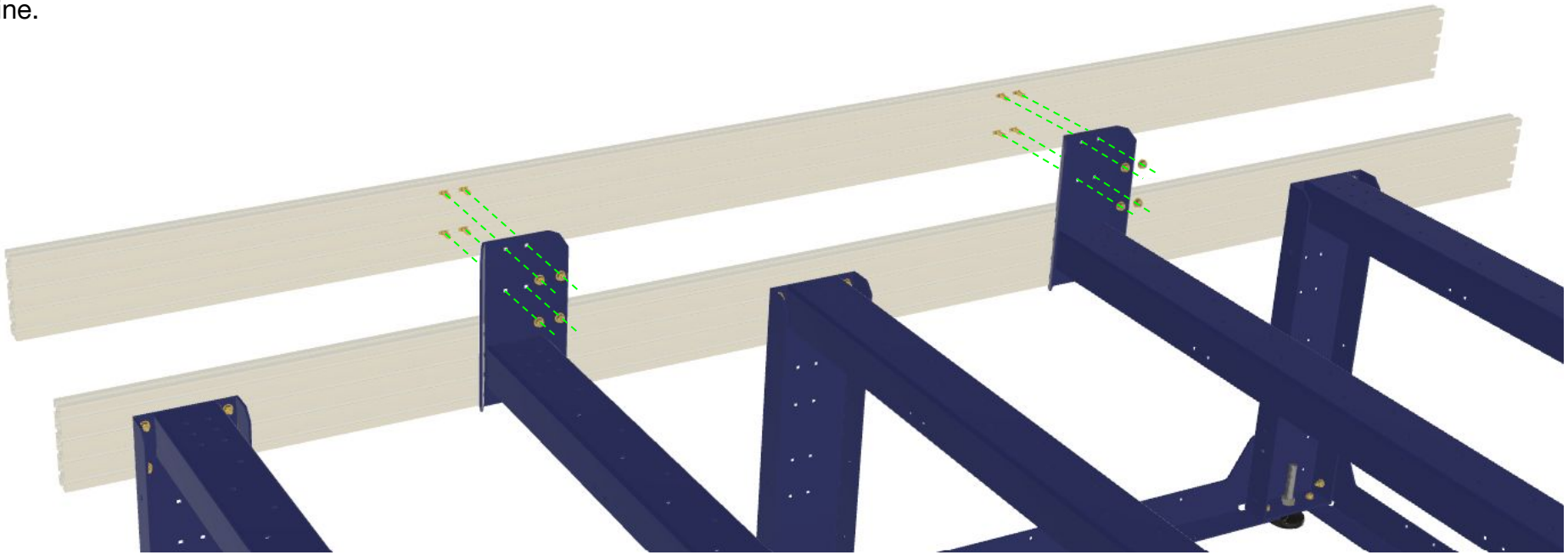


Attaching the Upper Table Side

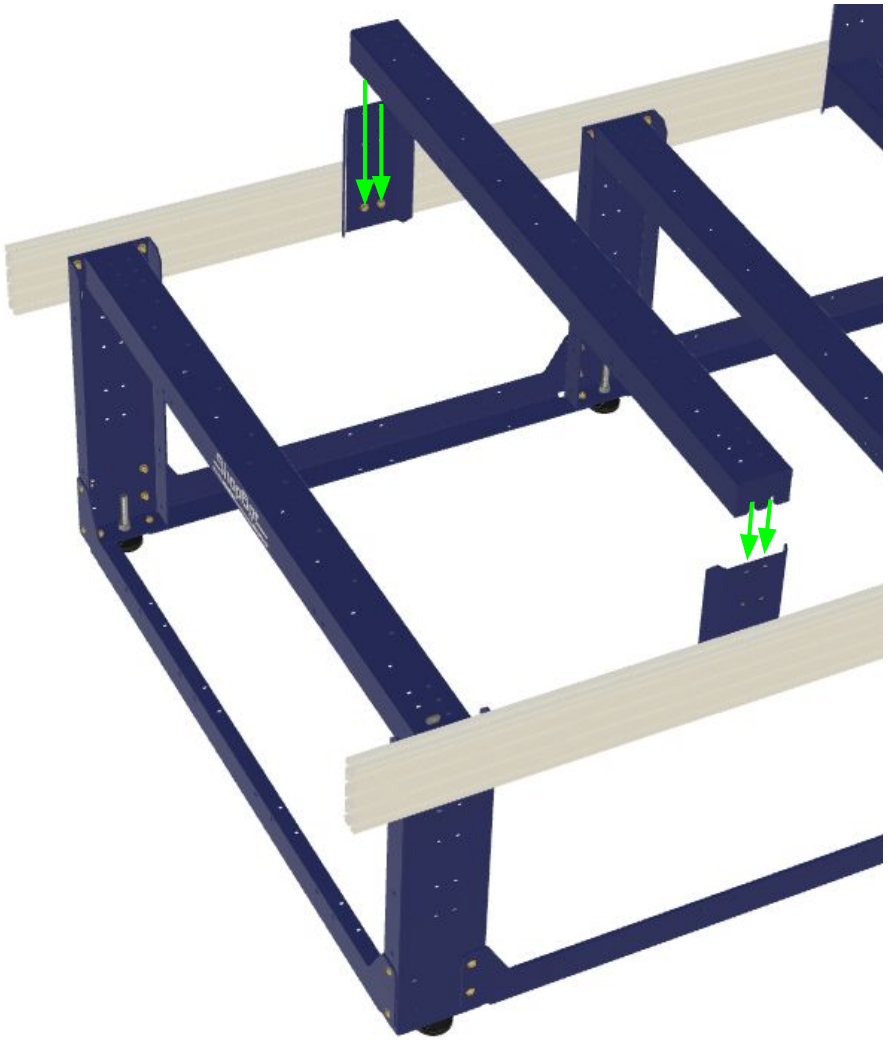
To raise the gantry high enough over the work area to take advantage of the extended z axis that you've purchase with your machine; we add a second set of table sides above the first.

The second set to tablesides attaches to the spacer plates that were inserted behind the cross supports on your table that were not aligned with a table leg.

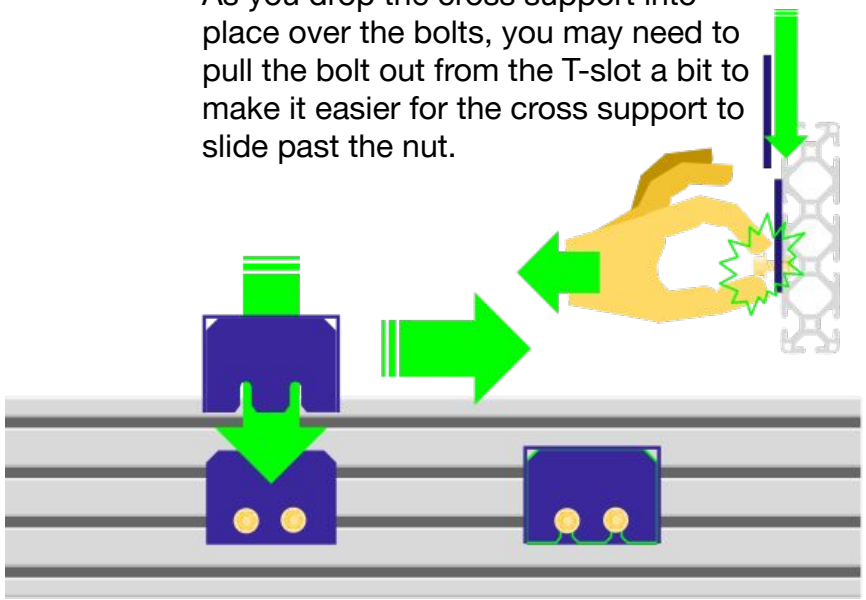
Use 4 bolts and nuts at each mounting point to attach the second table side to both sides of your machine.



Inserting Upper Cross Supports (Cont)



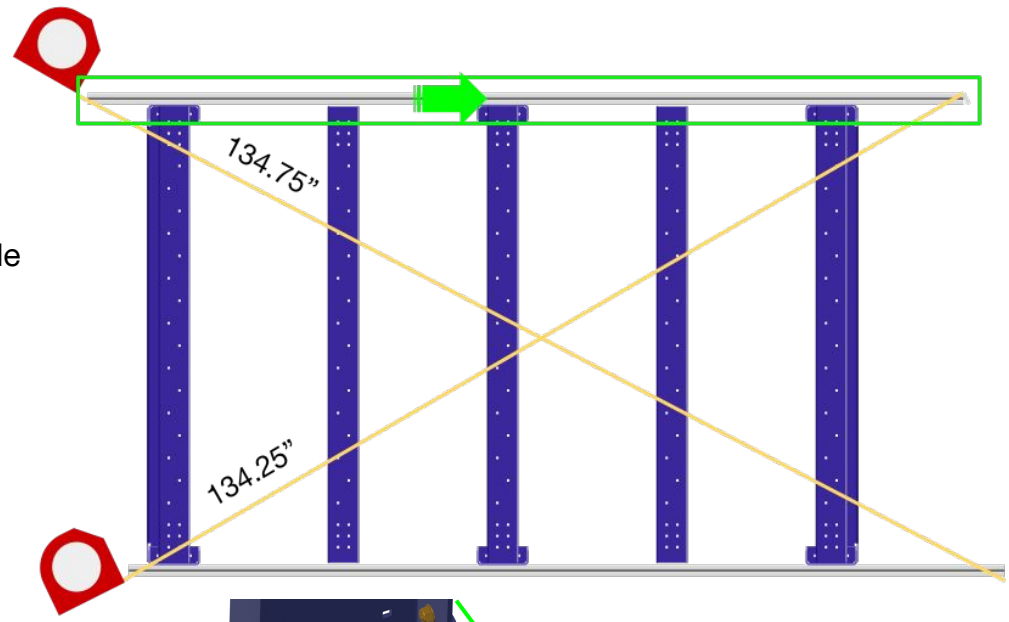
As you drop the cross support into place over the bolts, you may need to pull the bolt out from the T-slot a bit to make it easier for the cross support to slide past the nut.



Checking Table Squareness

With all the table components now in place, it is time to check that the table sides are aligned before tightening the bolts. Use a tape measure to check the corner-to-corner distance across your table.

If one of your measurements is more that ⅛” (3mm) longer/shorter than the other, you’ll want to adjust your table before tightening all of your bolts.

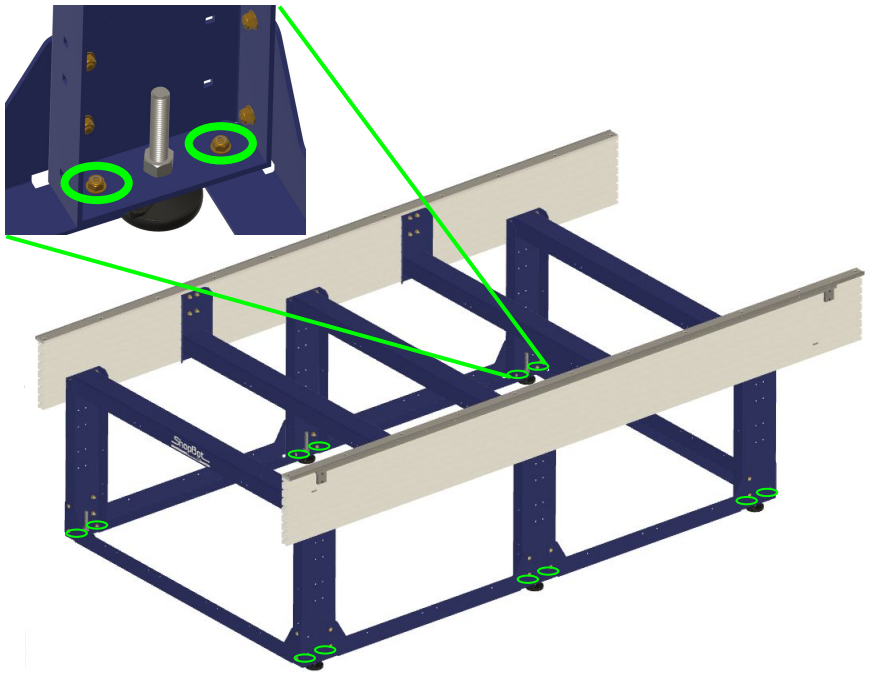


The side with the longer measurement will be the side that needs to be shifted towards the back of the machine to achieve a square table.

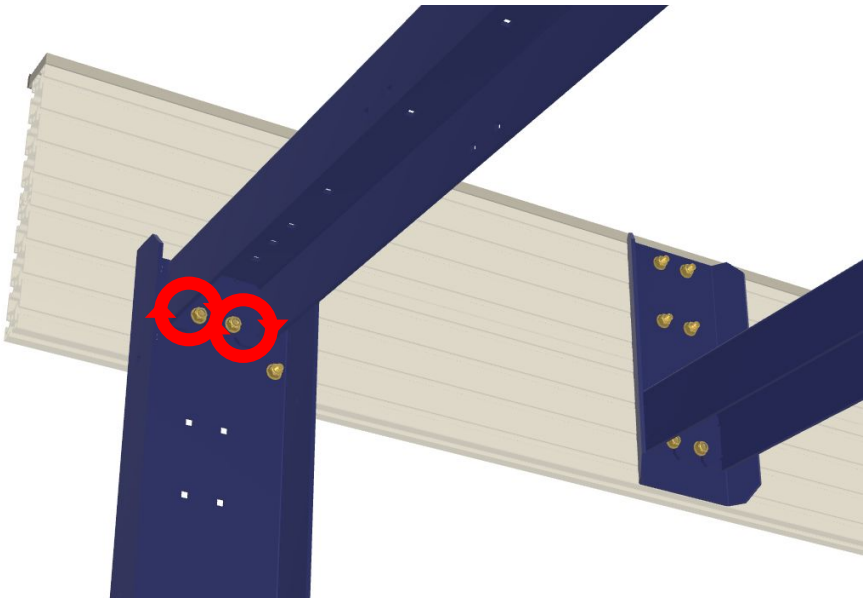
To make make it easier to adjust the squareness of the table, you can loosen the nuts at on the base plate of each of your table legs where they are connected to the lower leg and lower cross supports.

With the bolts loose; stand at one corner of your table and have someone else stand diagonal from you at the opposite corner to hold one corner stationary while you push or pull your corner to correct the alignment of the table.

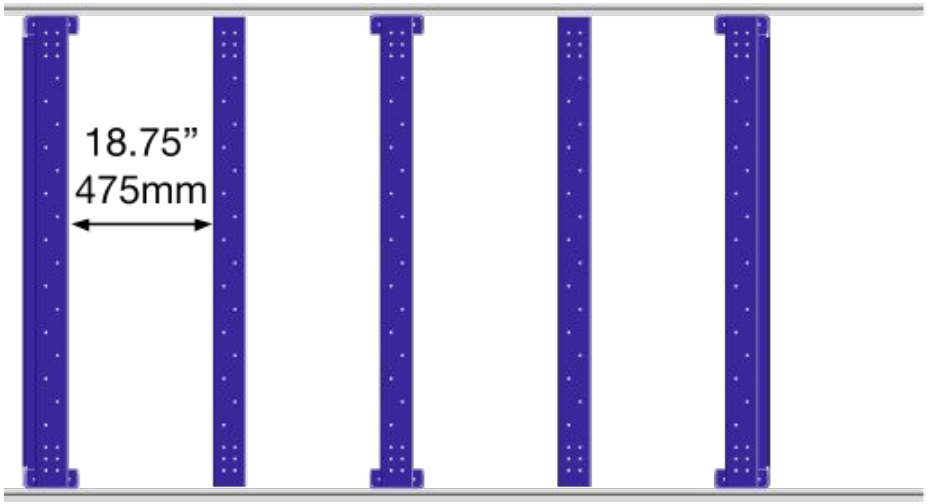
After making an adjustment check the squareness again. If your diagonal measurements differ by less that 1/16” (1.6mm) then you’re good to go! Retighten the bolts at the base of your table legs.



Checking Table Squareness (Cont)



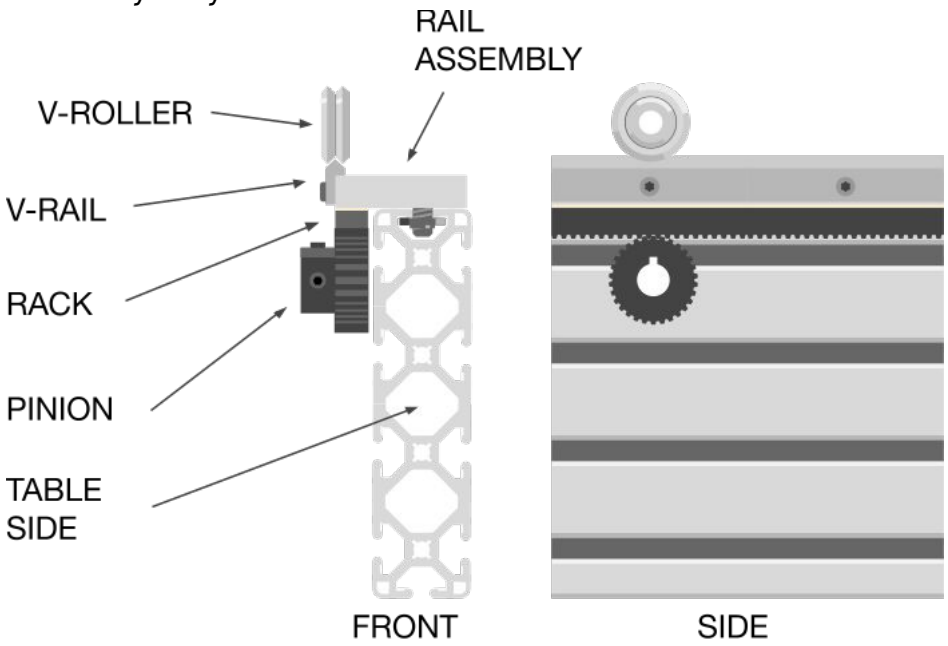
Once you've confirmed that your table is square, we can begin to tighten the bolts that secure the upper cross supports. Start with the front-most cross support that rests between the first set of table legs.



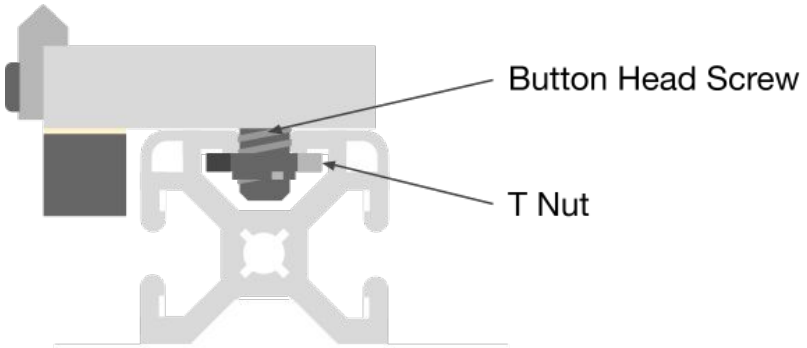
Before locking down the next Upper Cross Support, measure the gap between the first and second cross support; make sure that it is 18.75" (475mm) on each end, this should place it half-way between the first and second set of table legs. Work your way through the rest of the cross supports, checking spacing and locking down the bolts at each end.

Installing Rails

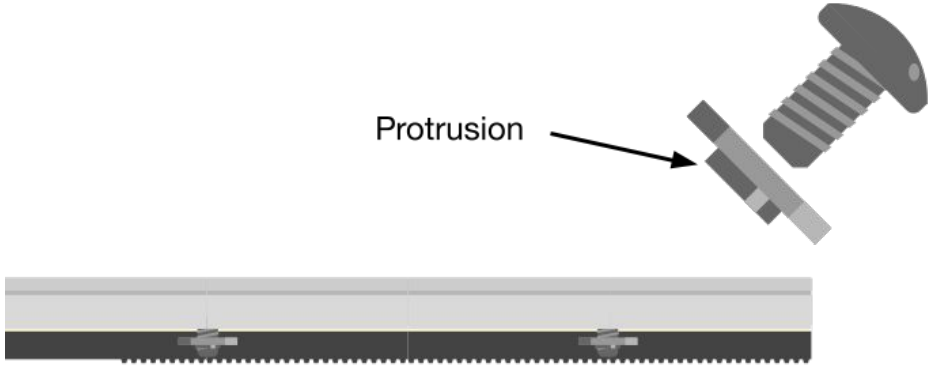
The ShopBot PRS5 makes use of V-Rollers paired with a rack and pinion drive system for the main table rails. This combination makes the drive system resistant to damage from debris or abrasive dust. It is also very easy to service.



Your rail assemblies are packed along with your table side extrusion in a long crate that arrived with the larger crate containing the rest of your ShopBot. The rail assembly will be attached to the table side using 5/16-18x¾ Button Head screws and matching T-Nuts.

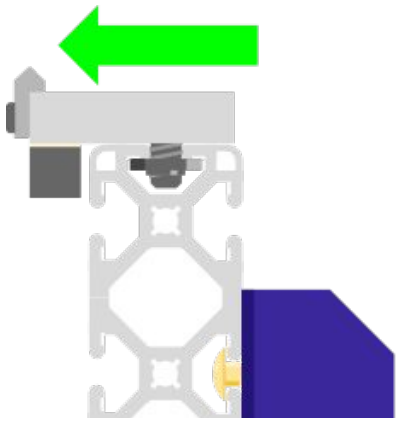


Before placing your rail assemblies onto your table sides, it is best to go ahead and insert all of the mounting bolts and loosely attach the t-nuts. You'll notice that one side of each t-nut has some extra material protruding from the body of the nut. For proper fit in the t-slot; make sure that this side of the nut is pointing "down"

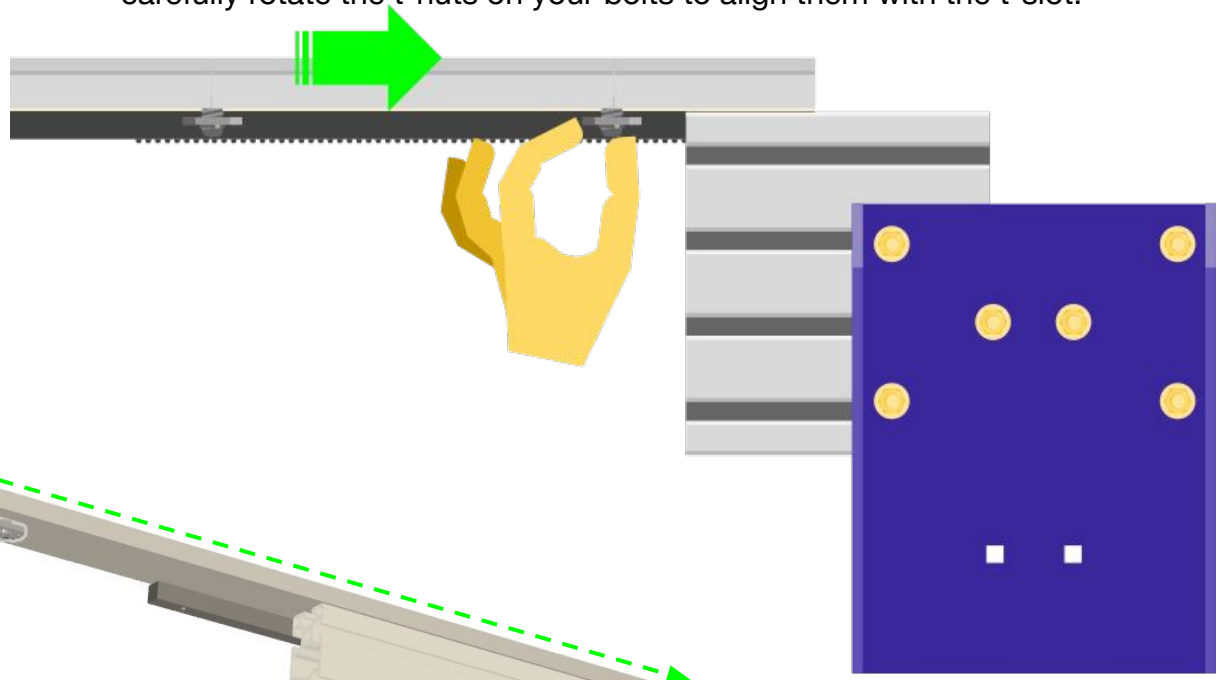


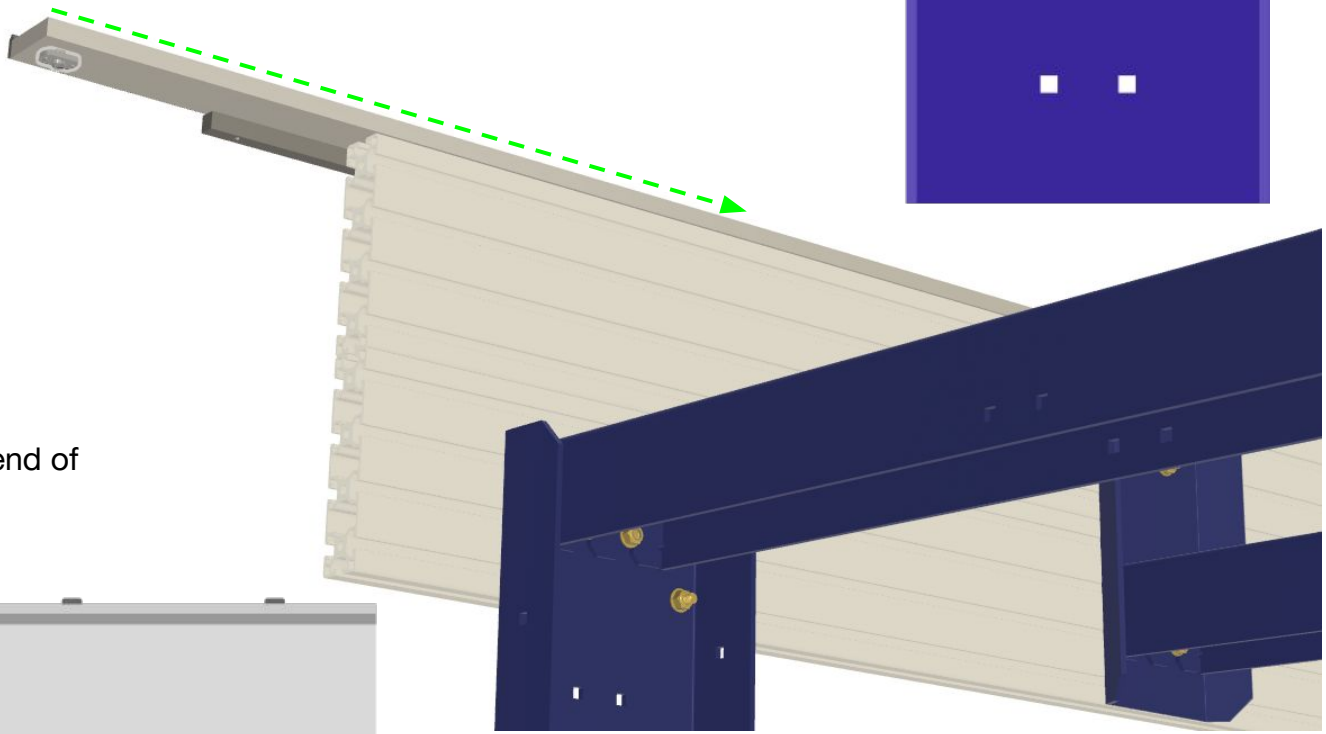
Installing Rails (Cont)

The v-rails on your rail assembly will face towards the outside of your table.



As you're sliding the rail assembly into the table side extrusion, carefully rotate the t-nuts on your bolts to align them with the t-slot.

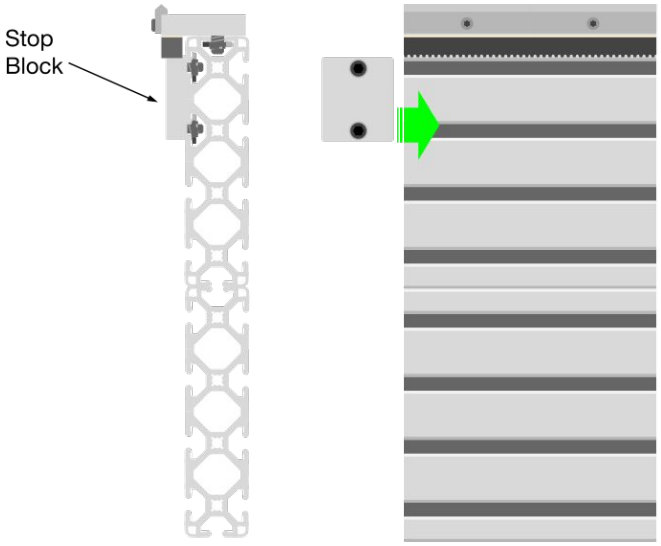


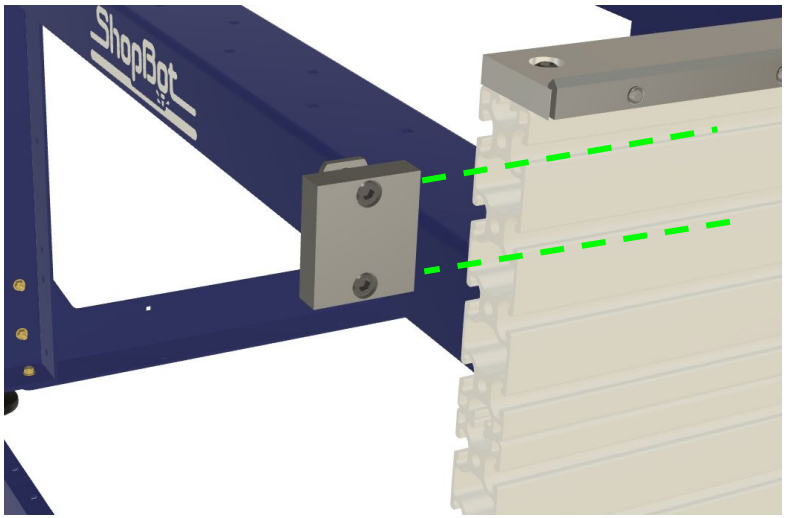


Make sure that the end of your rail assembly lines up closely with the end of your tableside extrusion.

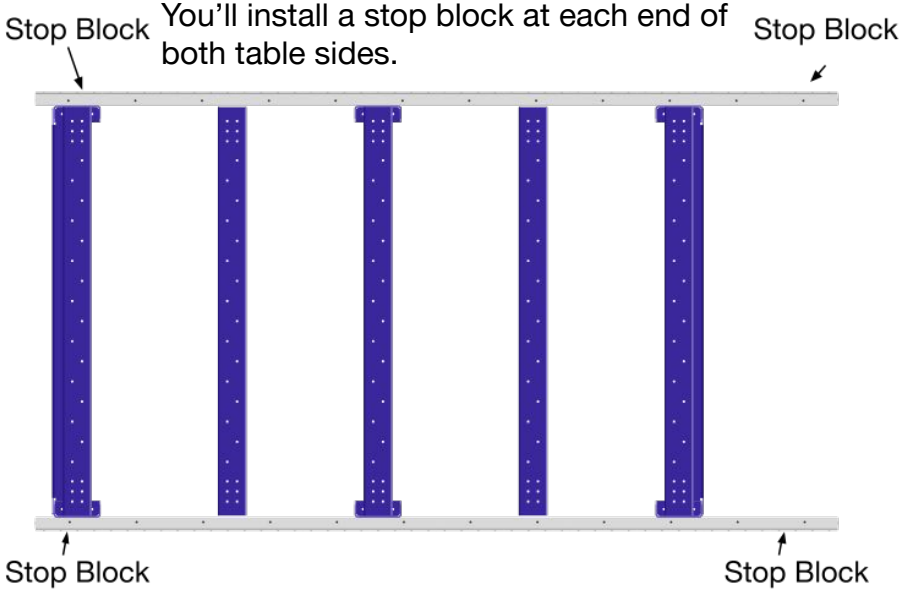
Installing Hard Stops

After sliding both rails into their respective table sides, we will install the hard stops on all 4 corners of the table.

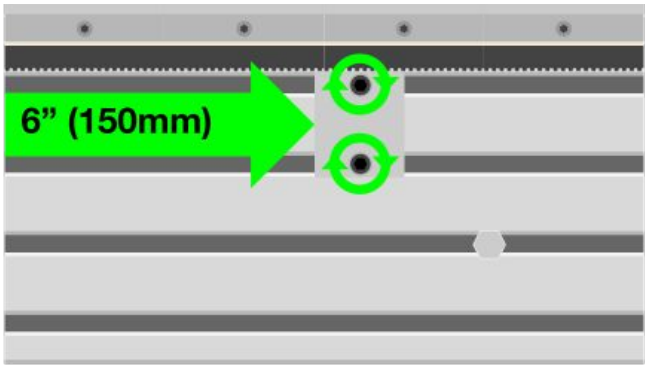




You'll install a stop block at each end of both table sides.

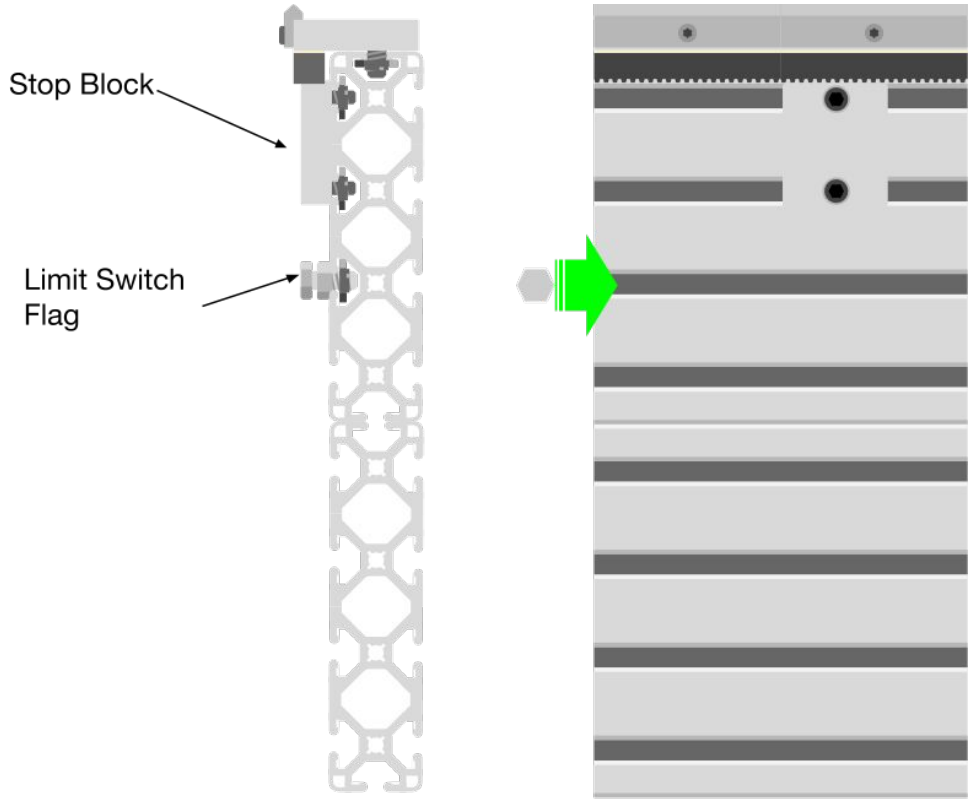


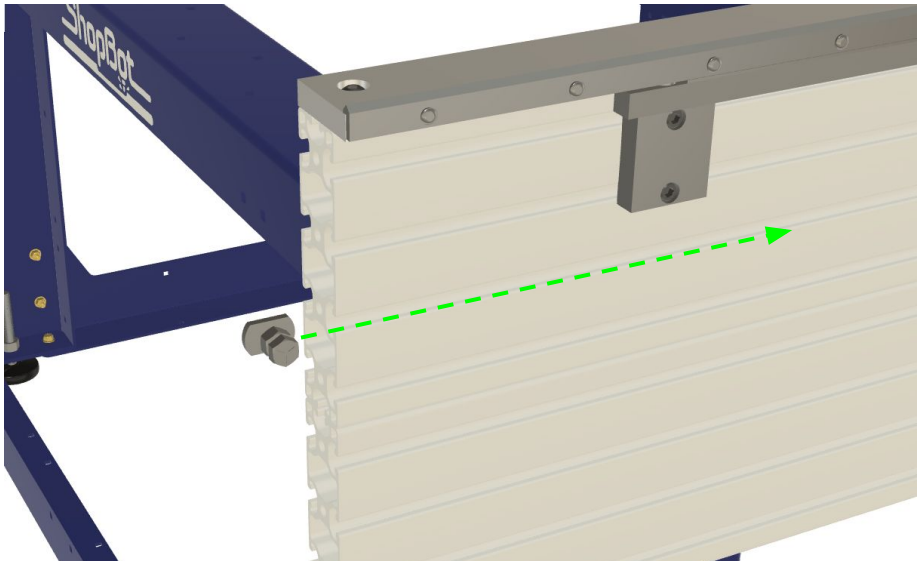
Each of the four stop blocks should be positioned 6"(150mm) from the closest end of their table side. Once the stop blocks are in position, lock them in place by tightening the two mounting screws. Having the stop blocks locked in place will make the gantry installation process more safe – we will set them in their final positions once the machine assembly is complete.



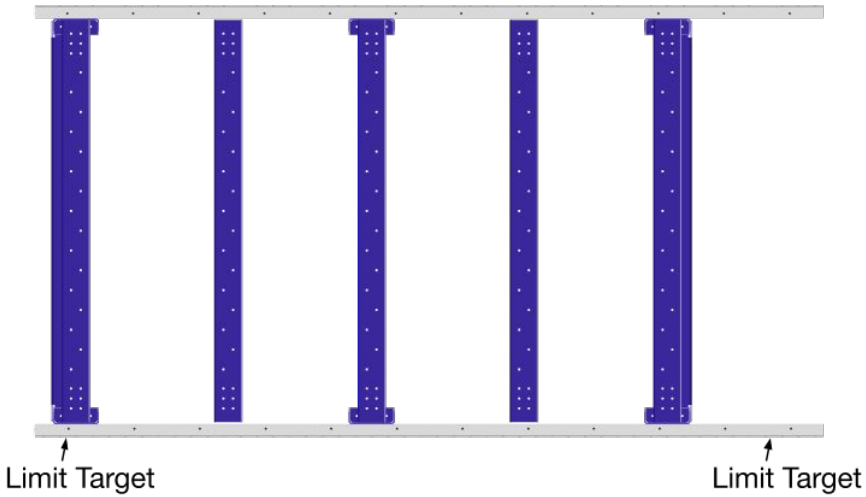
Installing Limit Targets

The limit switch targets will trigger your X-axis limit switch during the homing routine, they should be installed at both ends of the table side extrusion on the same side of the table as your control box.



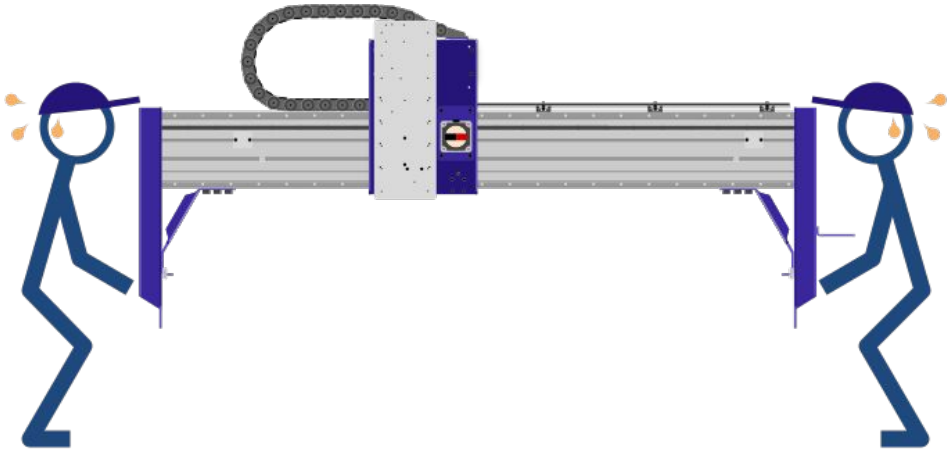


Don’t worry too much about the location of the limit targets for now; we’ll set their final position after we power up the machine for the first time.

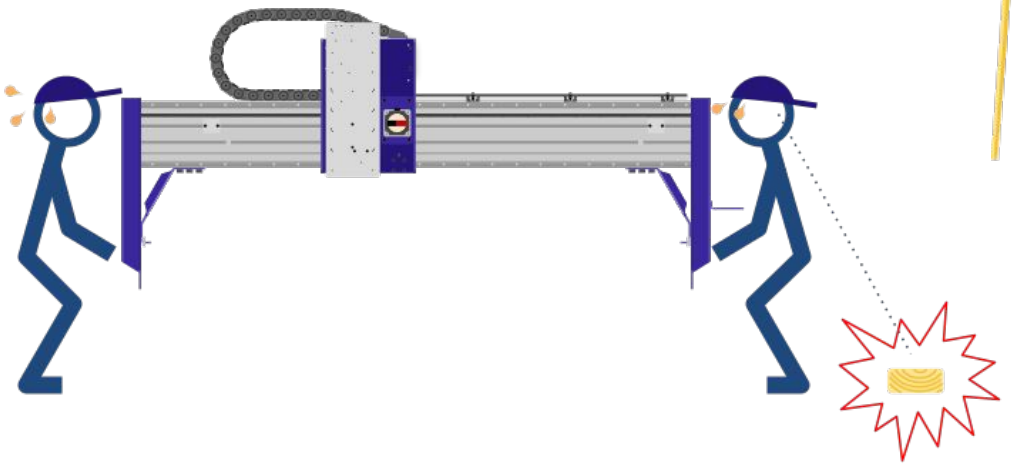


Mounting the Gantry

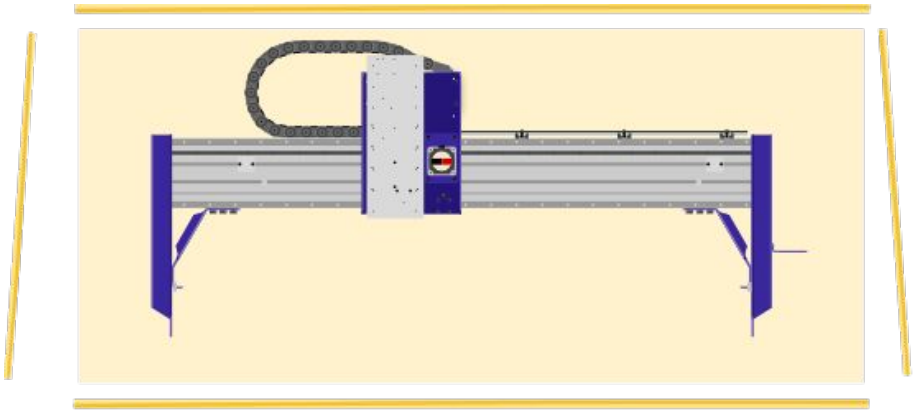
CAUTION! The gantry assembly can weigh over 150lbs (70kg) – you will need at least two people to lift the gantry out of the crate and place it onto the table assembly. Don't try to do this alone!



Make sure that you have cleared the path between your crate and table assembly of all obstacles that could pose a tripping hazard as you move the gantry to the table.

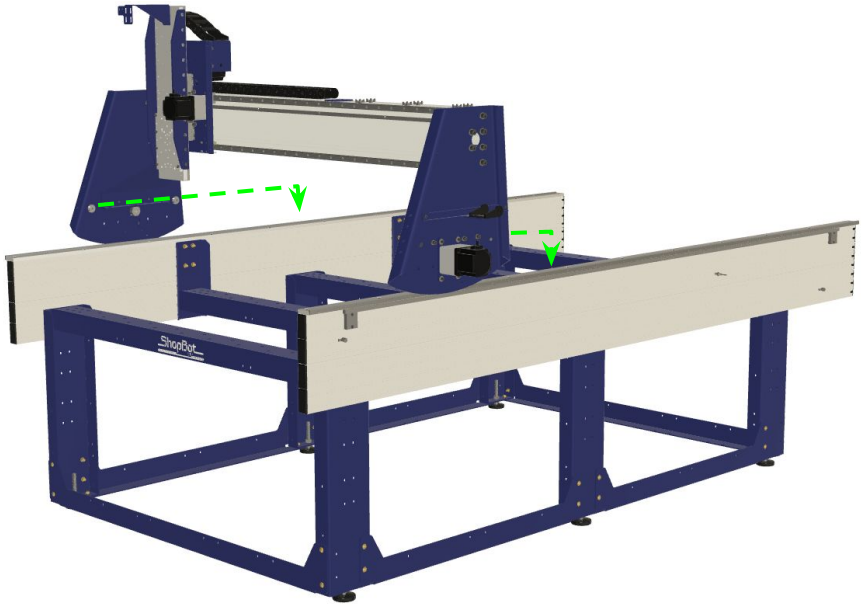


At this point it may be helpful to remove the wooden sides of the crate as well, for easier access to lift the gantry. Find screws along the sides and base of the crate walls and remove them, allowing the sides to be pulled away from the crate.

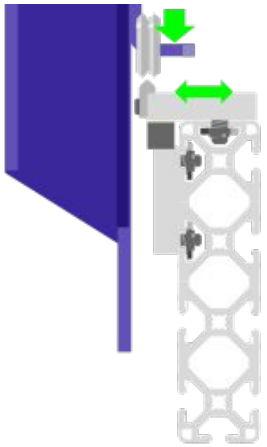


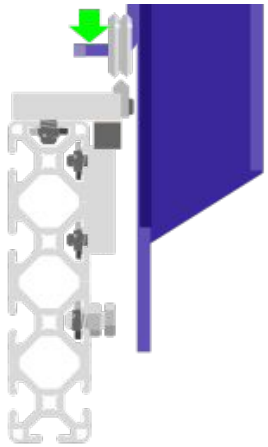
Mounting the Gantry (Cont)

Walk the gantry over to the table and lower it onto the two rails.



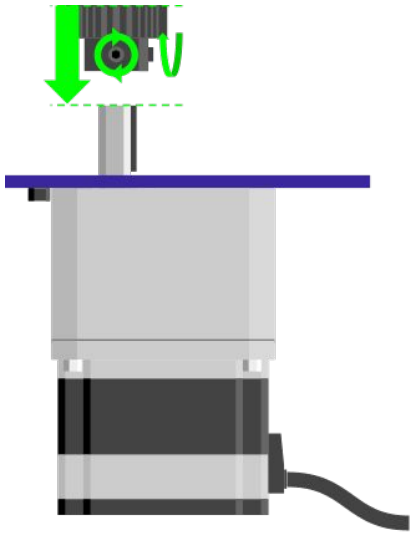
The V-rollers on your gantry should straddle the V-Rails on your table. First align one set of v wheels with the fixed rail – then shift the other rail into place under the v wheels on the opposite side of the gantry.





Mounting the X Motors

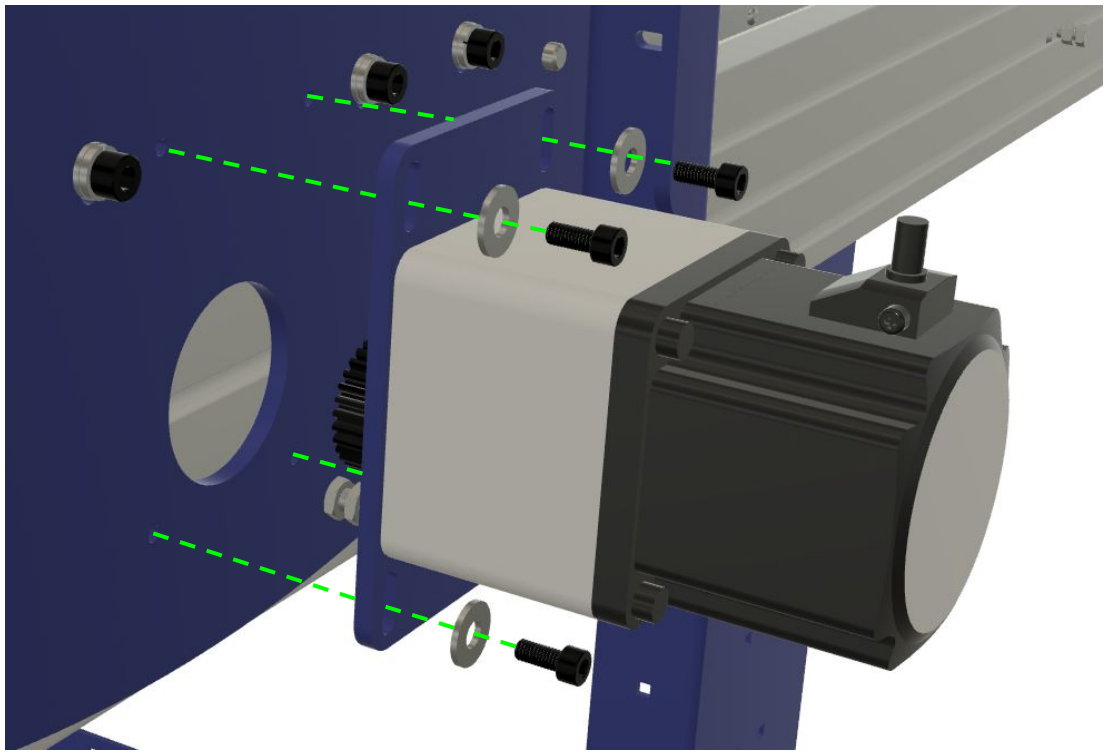
Your X Motors each use a 30 Tooth pinion. Slide the pinion onto the motor shaft so that the end of the shaft is coplanar with the top face of the pinion gear



Note that there are two set screws that must be tightened to secure the pinion on the motor shaft. Tighten both screws and twist the pinion with your hand to make sure that it is firmly attached to the motor shaft.

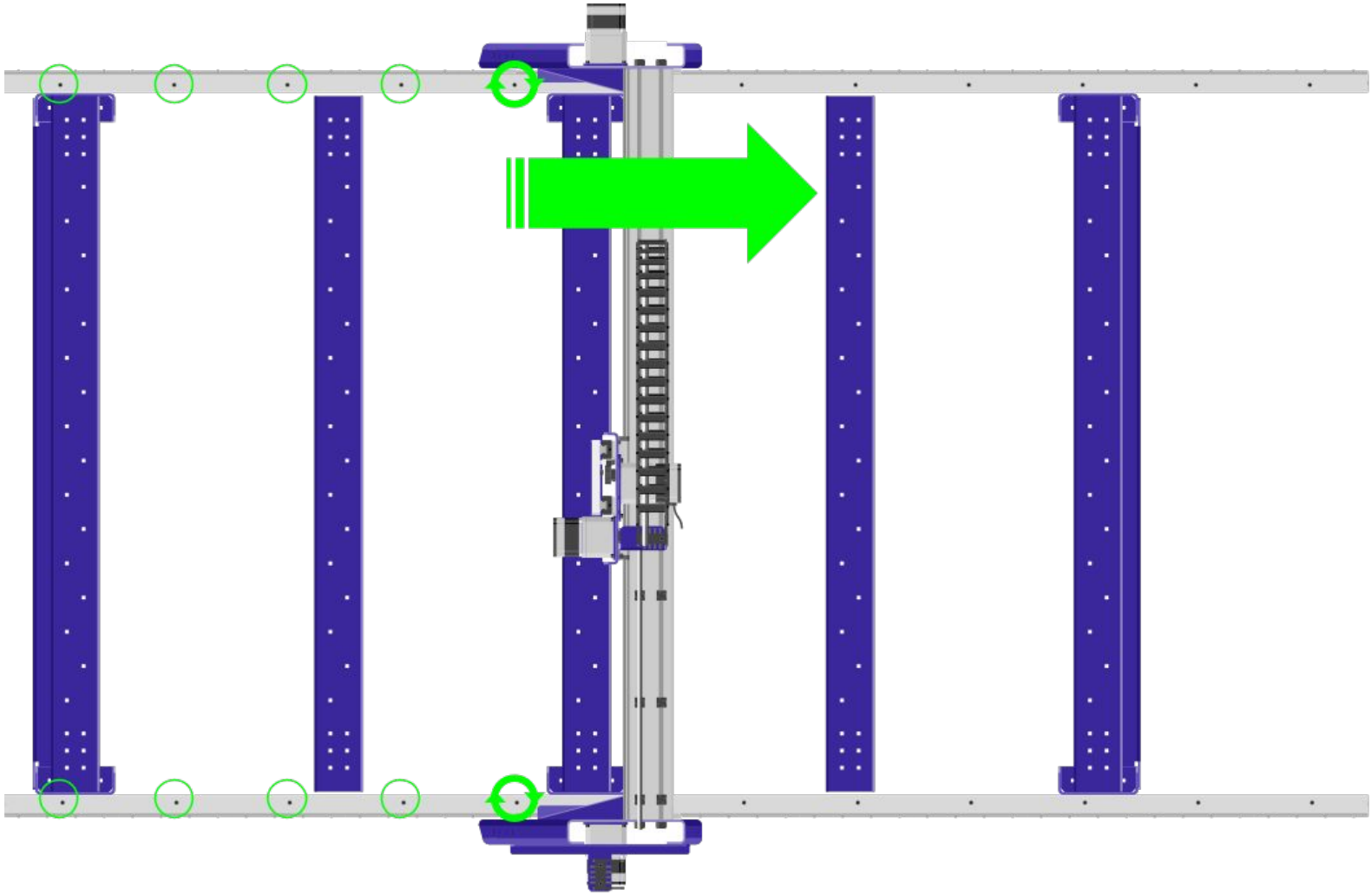
Attach one motor on either side of your gantry with the cable protruding from the motor body pointing up (the motors are identical so they can go on either side). Loosely insert the four mounting bolts with their washers. Leave them loose for now.

With the motors installed; your hard stops will prevent the gantry from rolling off the end of the rails during the rest of the assembly process. The hard stops work by blocking the pinion gears from rolling past the end of the gear rack mounted to the underside of your rails.



Finalizing Rail Placement

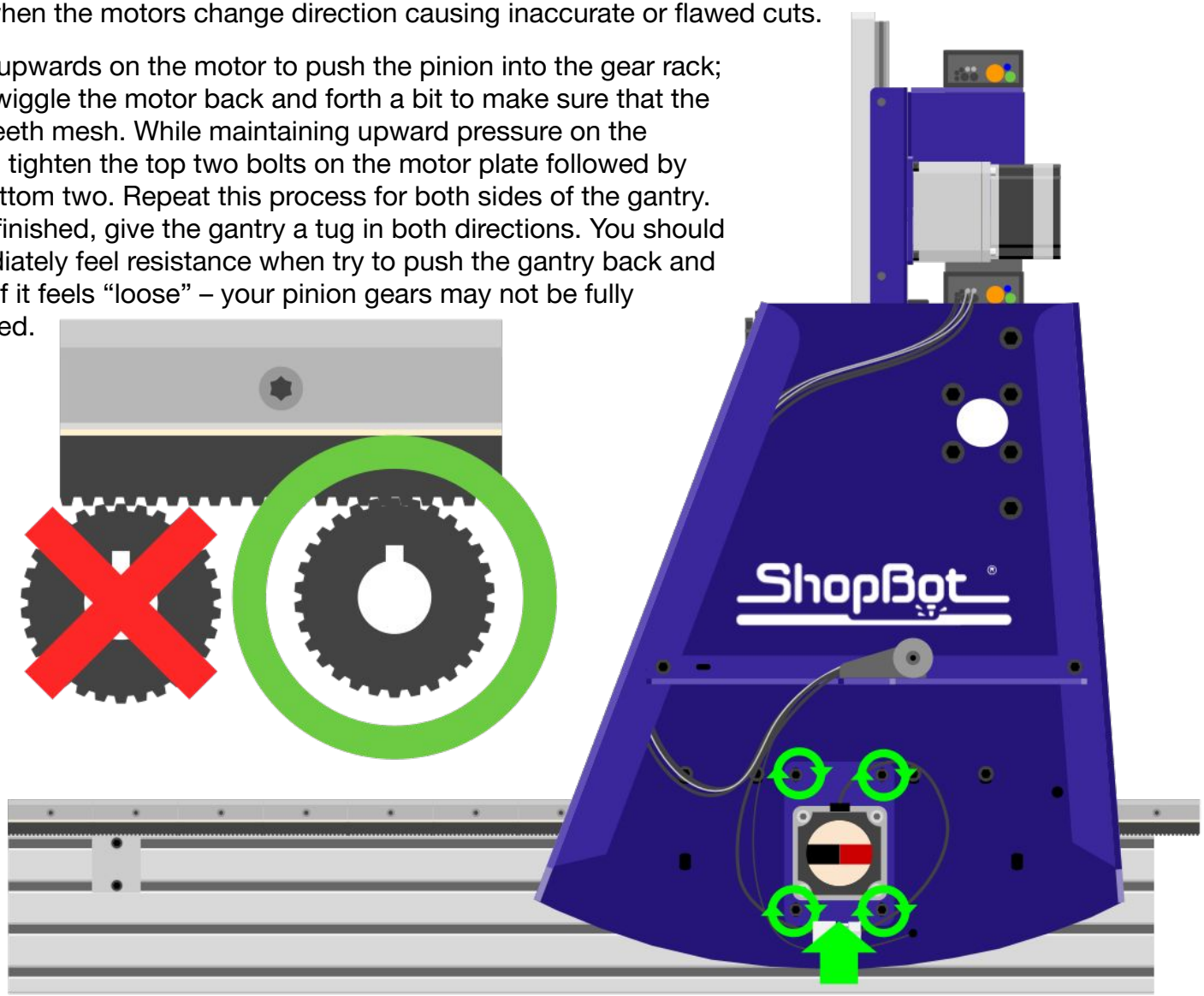
Starting from the front of your table; slowly roll the gantry towards the back. Tighten each bolt on your rails as the gantry clears the bolt. Working your way along the rail like this will ensure that your rails are parallel by using the gantry to space them precisely.



Eliminating Backlash

Once your rails are locked in place; it's time to seat the X Motors properly so that the pinion gears are fully engaged with the gear rack. Failing to fully engage the pinions will result in an effect called "backlash" where your pinions will briefly disengage from the rack when the motors change direction causing inaccurate or flawed cuts.

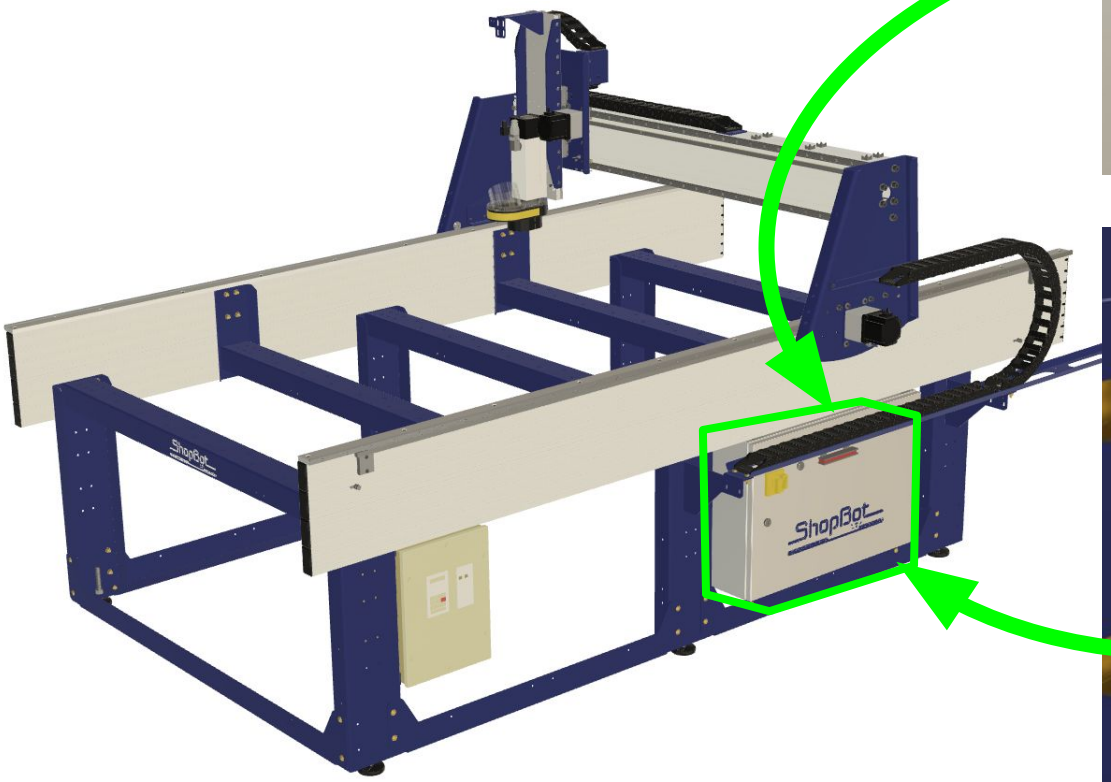
Press upwards on the motor to push the pinion into the gear rack; try to wiggle the motor back and forth a bit to make sure that the gear teeth mesh. While maintaining upward pressure on the motor; tighten the top two bolts on the motor plate followed by the bottom two. Repeat this process for both sides of the gantry. Once finished, give the gantry a tug in both directions. You should immediately feel resistance when try to push the gantry back and forth. If it feels "loose" – your pinion gears may not be fully engaged.

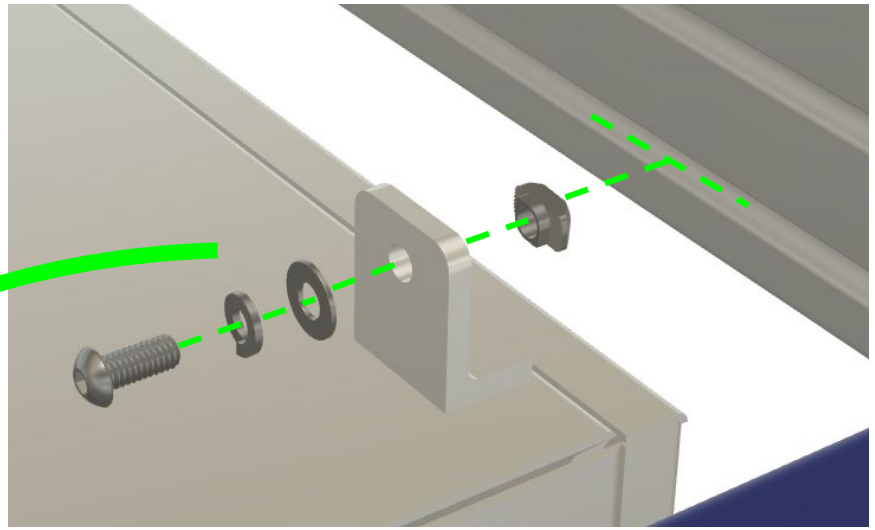


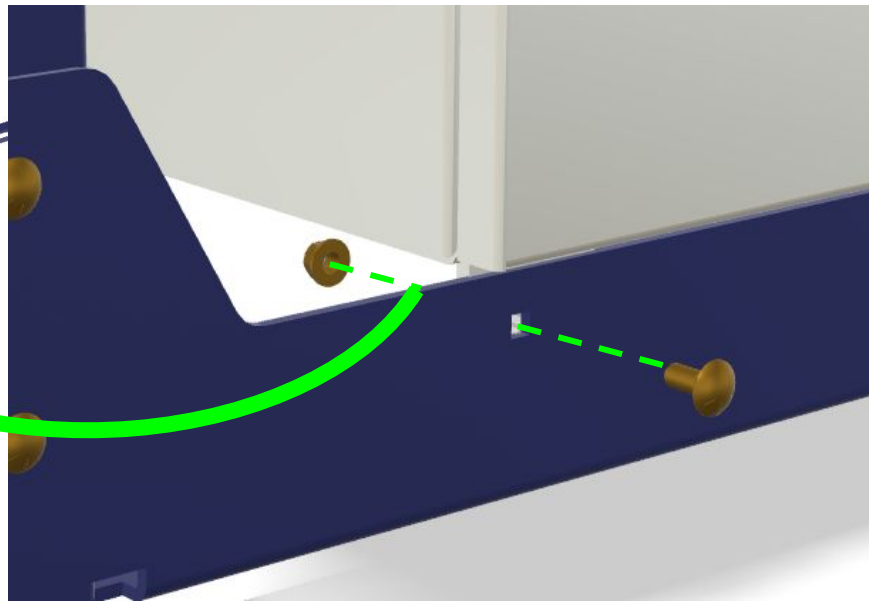
Mounting the Control Box

Your control box has 4 mounting “ears”. The top two mount to the inside face of the table side extrusion. Use the “Drop-In” T-nuts, bolts and washers to loosely attach your control box to the table side extrusion. You’ll need to slide it back and forth a bit to align it with the lower mounting holes.

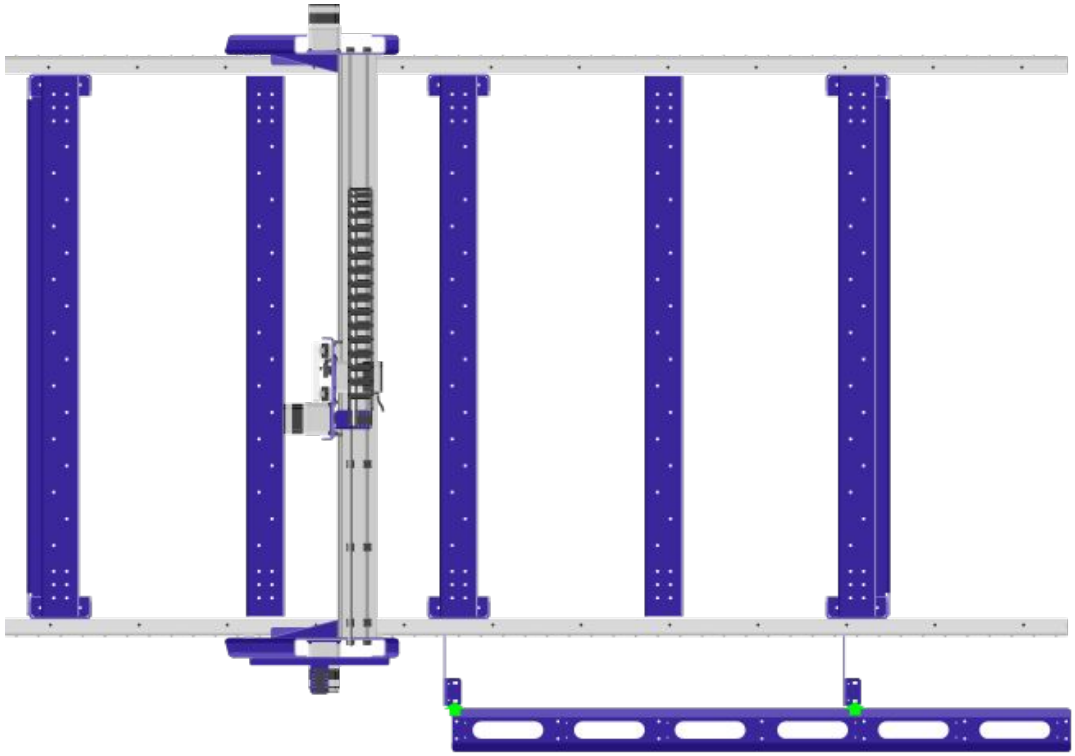
The lower “ears” attach to the blue steel leg support using carriage bolts and nuts. Once these bolts are inserted and tight; return to the top set and tighten them.

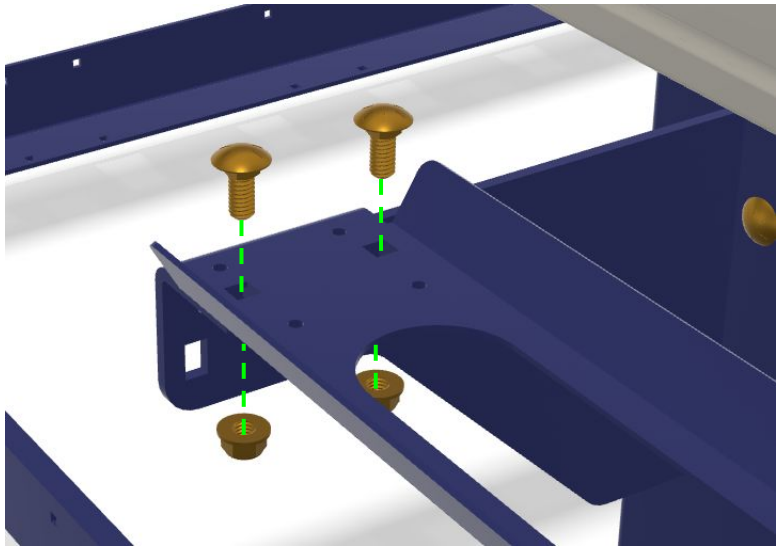


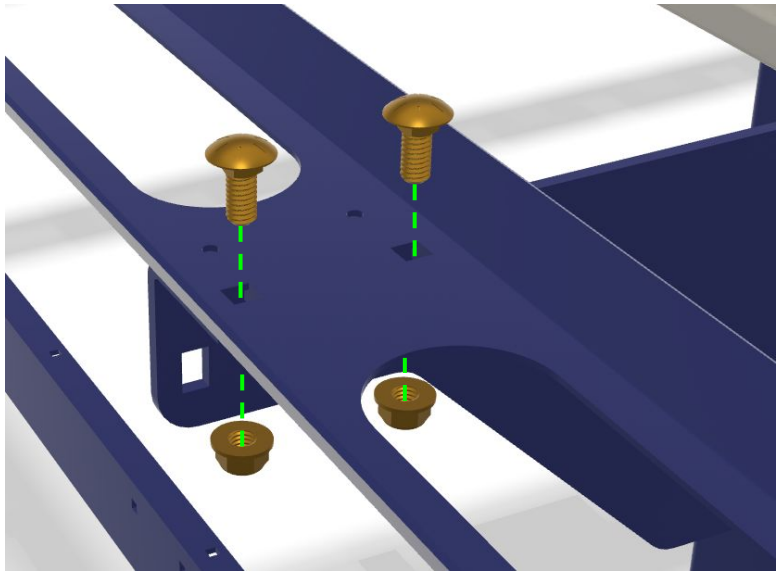




Mounting Echain Trough



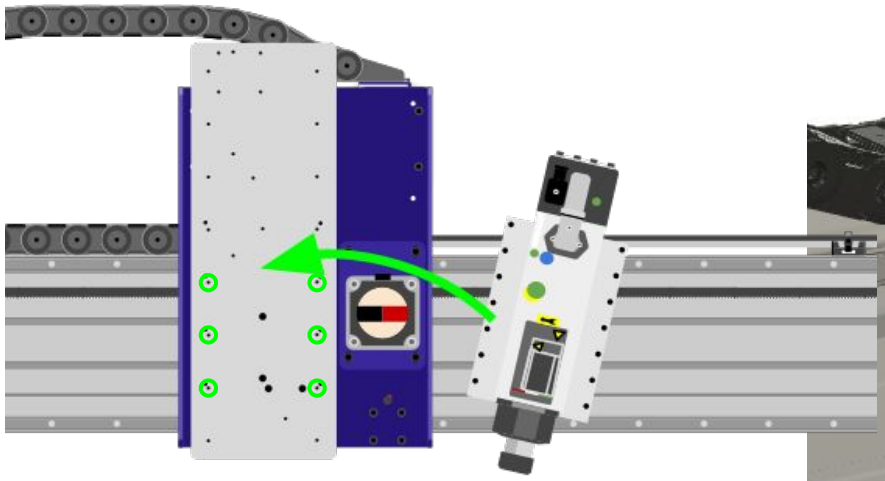


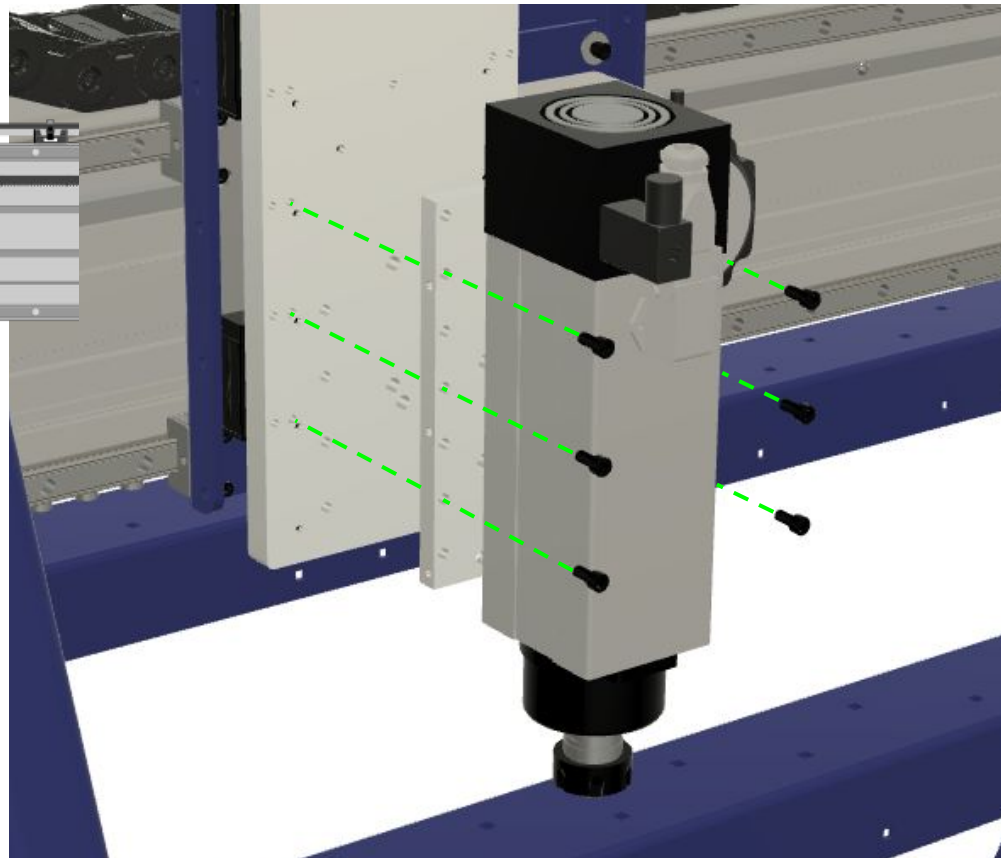


Position the echain trough on top of the two trough support brackets. Secure in to the support brackets using carriage bolts and nuts.

Mounting the Spindle

Note: If you have purchased a router instead of a spindle; keep on going to the next page where we'll discuss the process for mounting a router on your ShopBot.

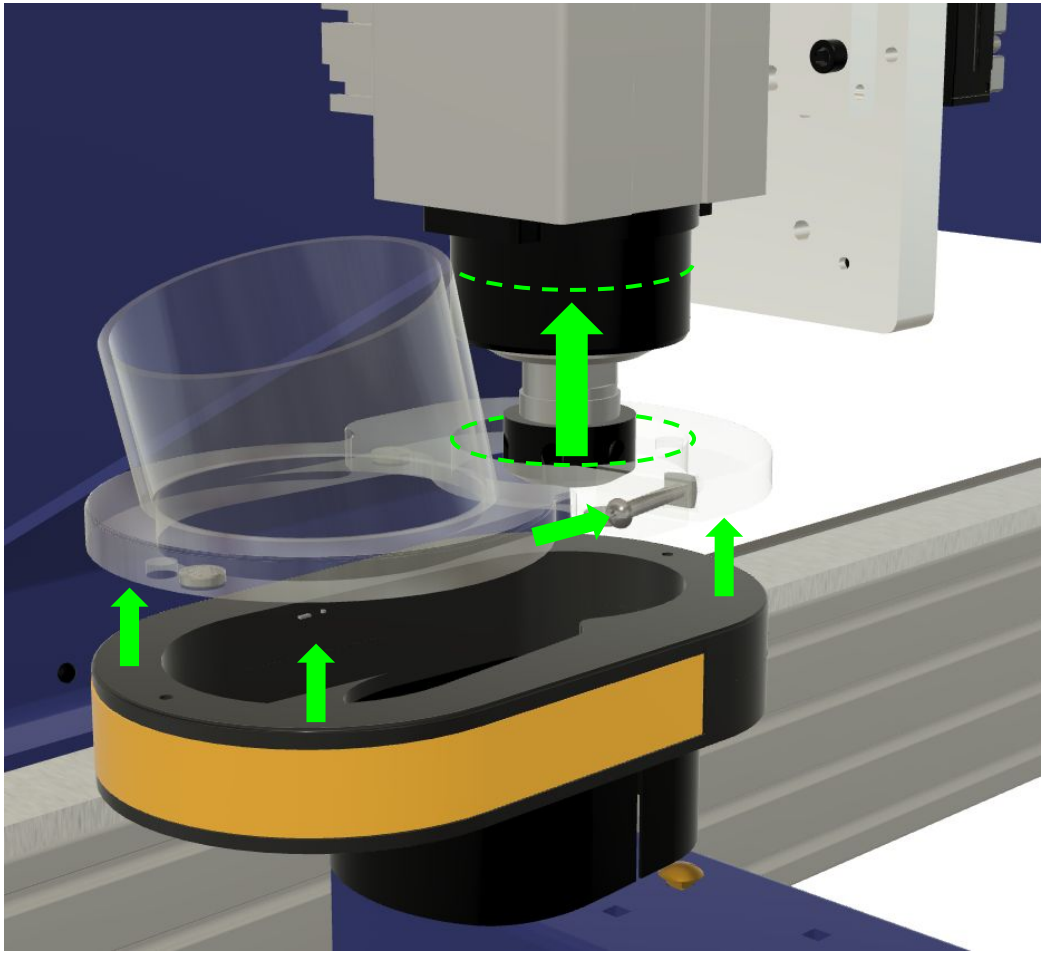




You'll find your spindle already attached to an aluminum mounting plate. Use the included bolts to attach the spindle to the Z Axis plate. You'll notice that there are two sets of holes on either side of the Z Axis plate. Use the inner set of holes as shown in the diagram to the right.

During our final checks before starting your first cut; we'll verify that the spindle is "trammed" correctly – verifying that the bits held in the spindle are going to be held perfectly perpendicular to your cutting surface. This check is vital for ensuring high quality cuts with your ShopBot.

Mounting the Spindle (Cont)

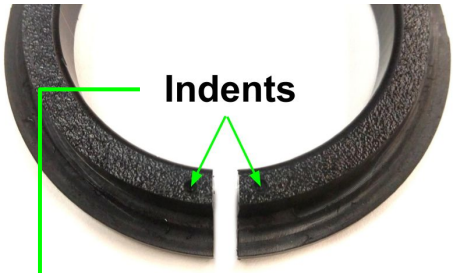


Your spindle kit will include a dust foot designed to fit your specific spindle (make sure to mention your spindle type if you ever call ShopBot to order a replacement dust foot!).

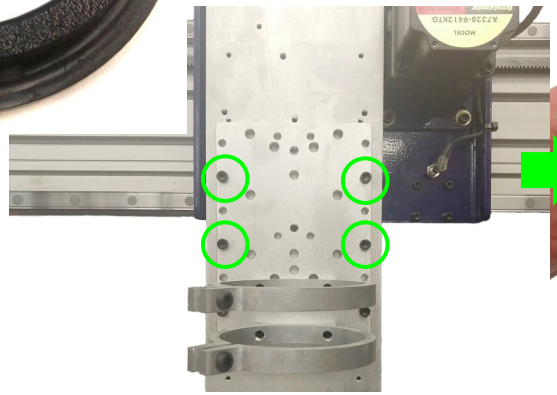
The upper portion of the dust foot attaches to the metal cylinder at the base of your spindle. Slide it on and use the phillips head bolt to tighten the collar around the spindle body.

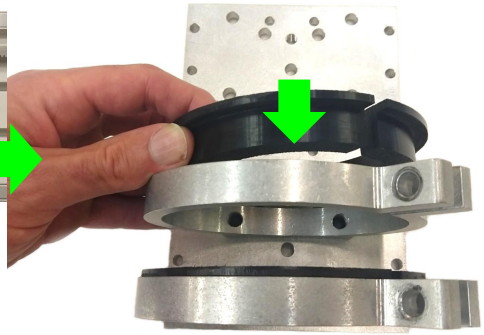
The lower portion of the dust foot with the brushes clips onto the upper portion magnetically; this makes it easy to remove the dust foot for tool changes or when the dust foot is not needed.

Mounting a Router

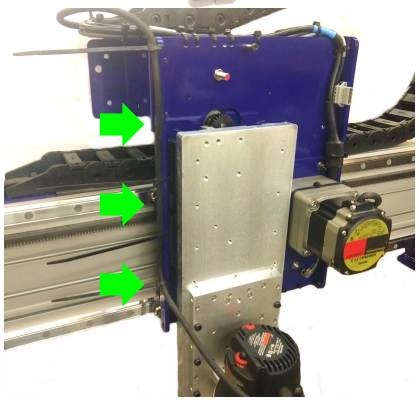


Your router kit will include three plastic rings; one of these will have two indents cut near the opening in the ring. Set this ring aside for use with the dust foot.





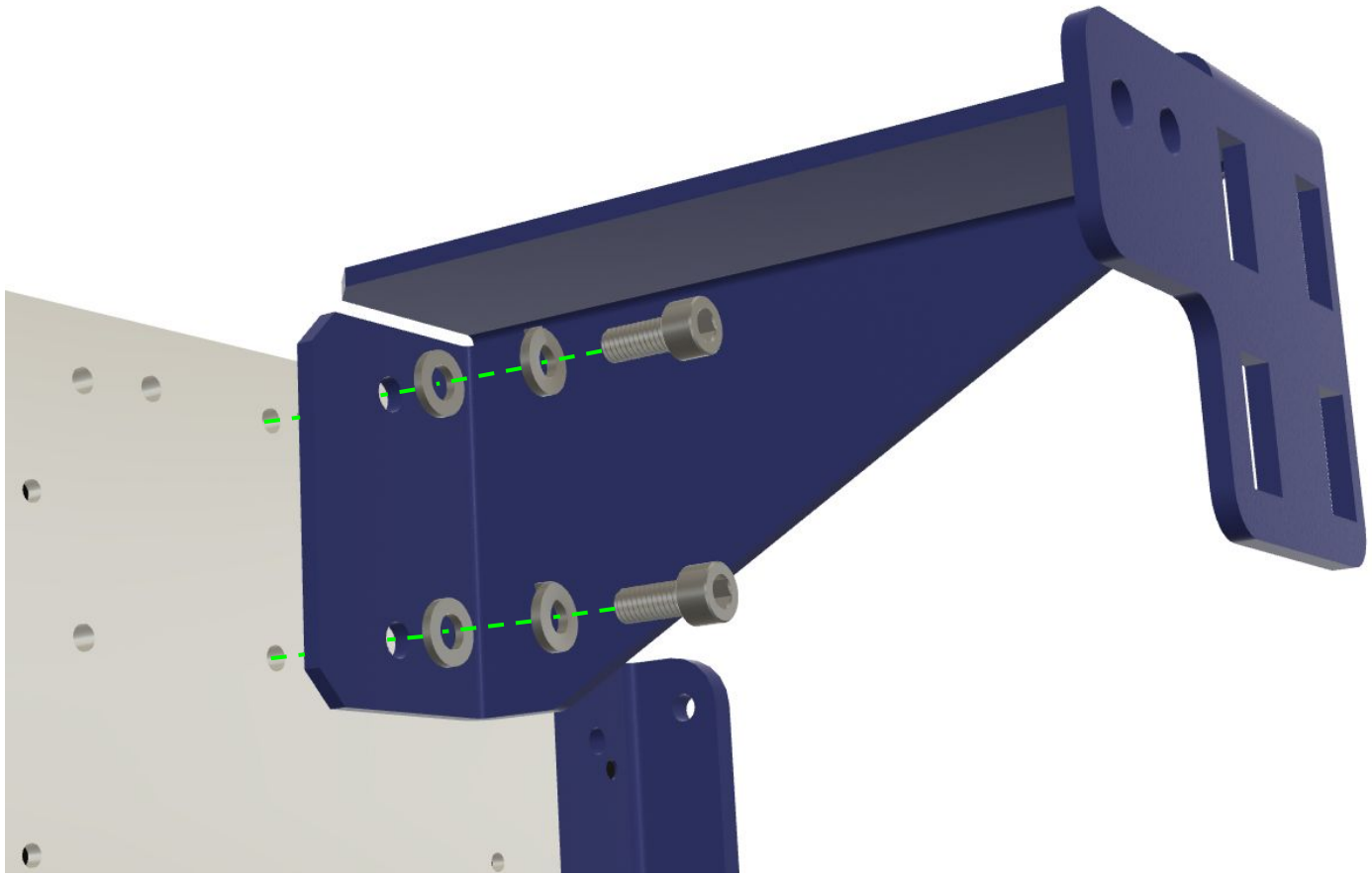
Start by mounting the router plate with its pre-attached router rings to your Z Axis plate using the hardware included. The holes in the router plate will line up with the inner set of holes on your Z Plate. Take the to plastic rings without indents and slip them into the router bracket. This will allow the router itself to be dropped into place inside the rings and secured by tightening the bolts on the router rings. Use zip ties to secure the router power cable to the blue steel Y/Z Carriage plate to keep the power cable clear of the moving components of the Z Axis.



The remaining plastic ring will fit into the dust foot opening. This will allow the dust foot to fit snuggly around the base of the router. Slide it onto the router and lock it in place using the phillips head bolt on the right side of the upper dust foot bracket.

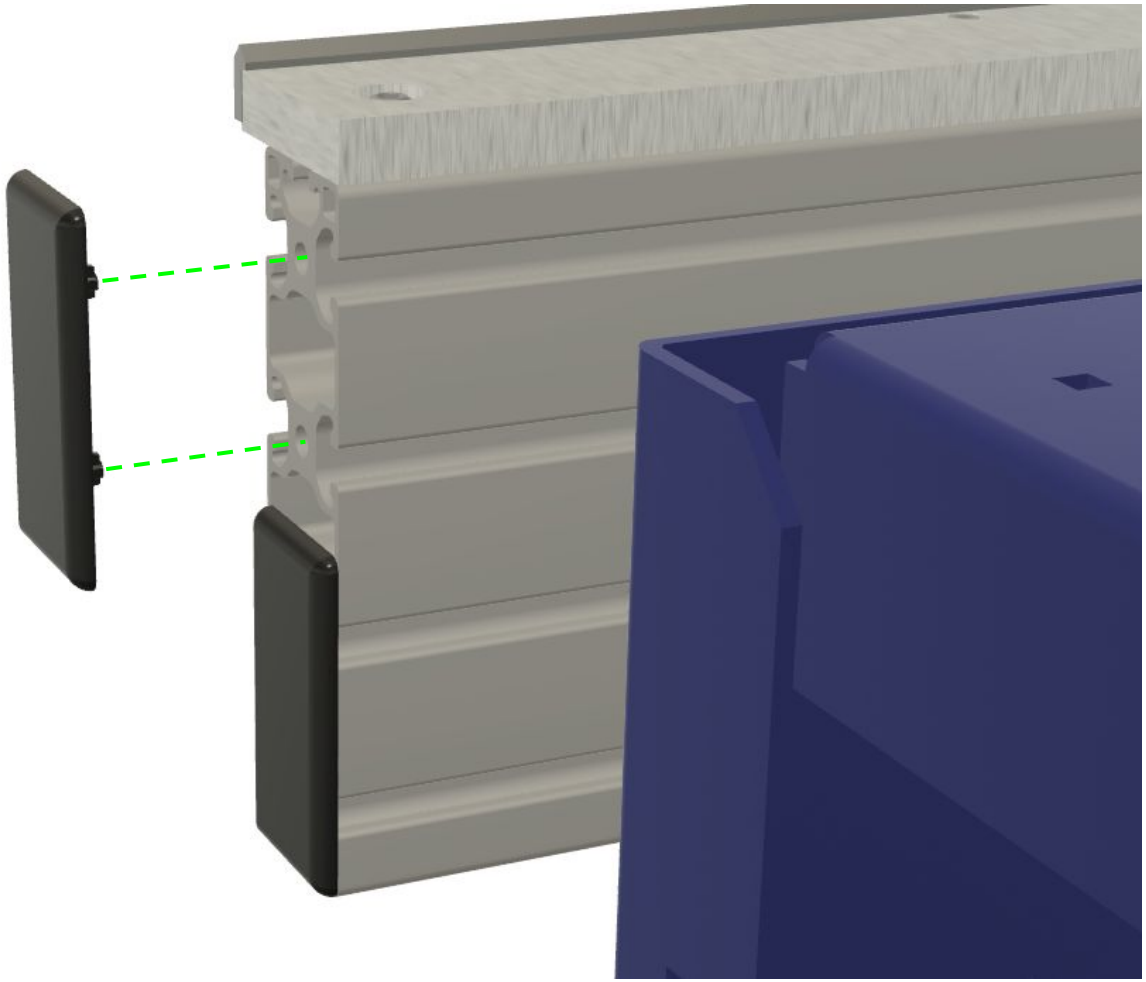
Mounting the Dust Hose Bracket

The dust hose bracket mounts to the top center of the Z Plate using a pair of M6 bolts with washers and split lock washers. You'll also find a set of three hose clamps included with your dust hose bracket. Two of these are meant to be passed through the rectangular holes on the front of the dust hose bracket to clamp onto your dust hose. The third clamp can be used to compress the hose where it slides over the dust foot to create a better seal around the hose.

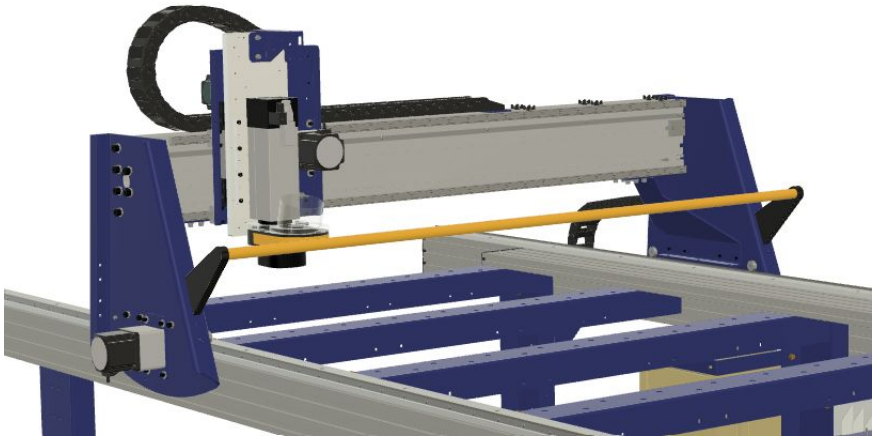


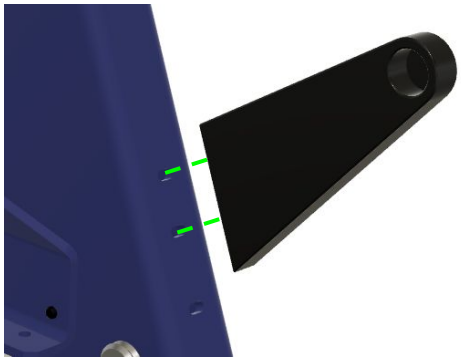
Installing End Caps

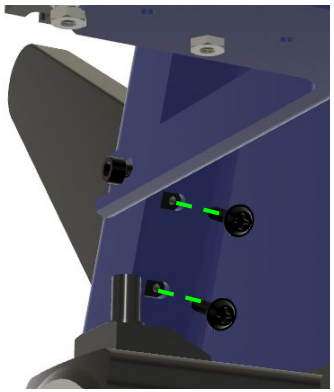
Extrusion end caps give a finished look to the your tableside extrusion and also guard the sharp edges of the table sides. Install the end caps by lining up the two posts on the underside of the endcap with the holes in the extrusion; use a mallet to pound them into place.



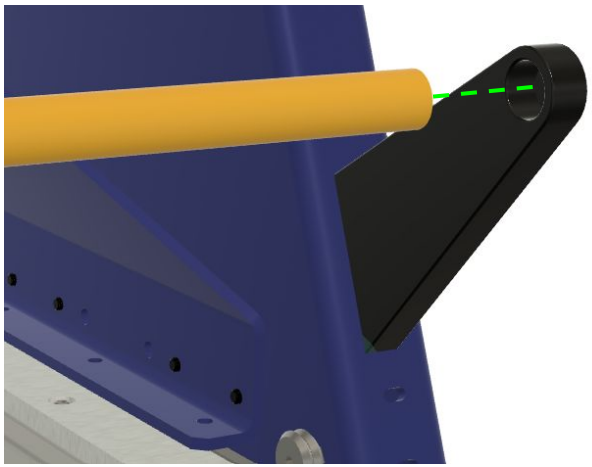
Installing Push Bar



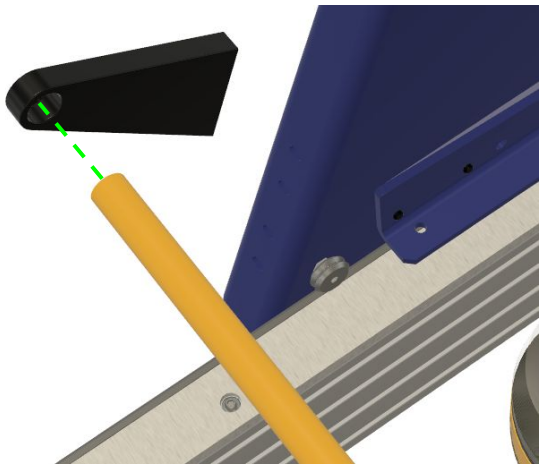


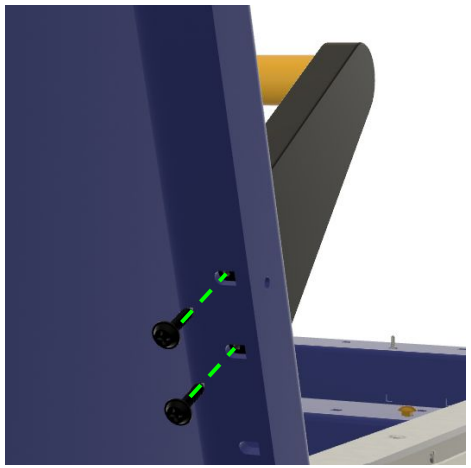


The “pushbar” is an safety feature on your ShopBot that helps prevent someone from accidentally coming close to the spindle while the machine is running. The pushbar held by two plastic brackets the mount to the gantry. To attach the first bracket, find the slotted holes on the front face of the gantry end plate. Insert two of the screws through the top set of holes and attach your first bracket with the circular pocket facing towards the center of the machine.



Set the other bracket and screws next to the gantry end plate at the other side of the machine. Press the yellow steel push bar into the cutout in the bracket that you’ve already mounted; then press the second bracket onto the opposite end of the pushbar. Secure this bracket to the gantry end plate using the two remaining screws inserted through the top pair of holes in the gantry end plate.



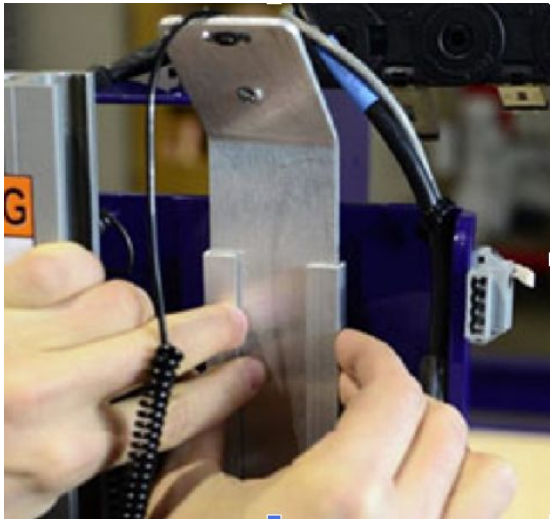


Mounting the Z Zero Plate

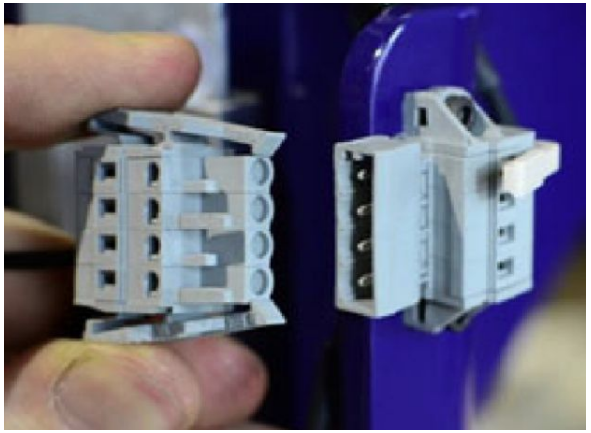
Your machine includes a “conductive Z Zero Plate” this plate will be connected to a sensor input inside your control box. The copper clip is connected to electrical ground. When the plate comes into contact with any electrically conductive material to which the clip is attached, the control system will detect that contact. This is used to set the height of your cut by placing the plate on your material and the clip on your bit – then using an automated routine to touch the bit off on the plate.

The installation kit includes the plate, clip and their wiring ,some rubber bumpers and two pieces of aluminum U-channel with adhesive backing that will be used to create a holder for your z zero plate.

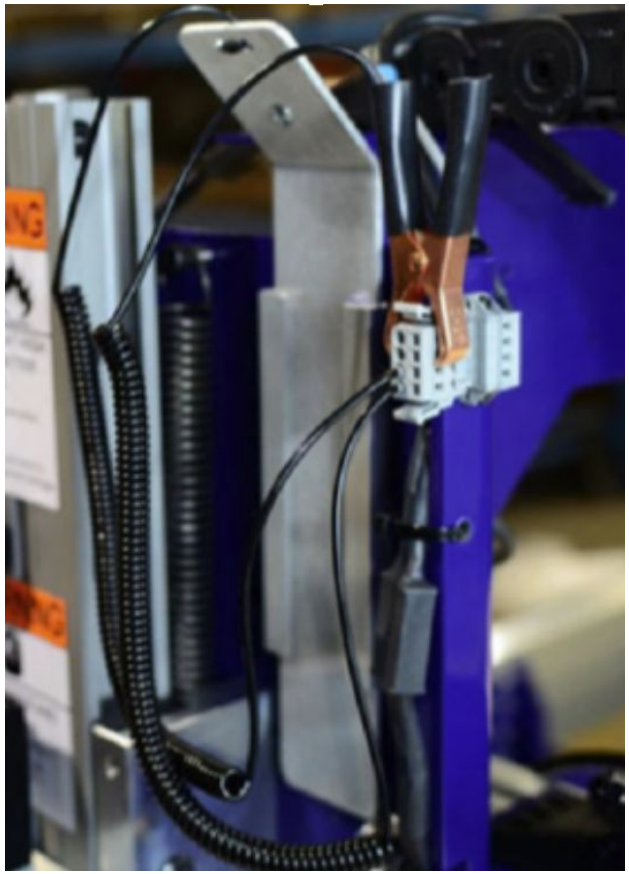
Slide the z zero plate into the two pieces of U-channel and gently pinch them together with one hand. With the other hand, remove the paper backing of the adhesive on the U-channel. Using the z zero plate to set the spacing, press the two pieces of U-channel onto the bare painted metal surface above the Y Axis motor.



Find the grey connector to which both the plate and the clip are wired and plug it into the socket on the right side of the Y/Z Carriage Plate.



Store the copper clip by clipping it to the plastic housing of the connector.

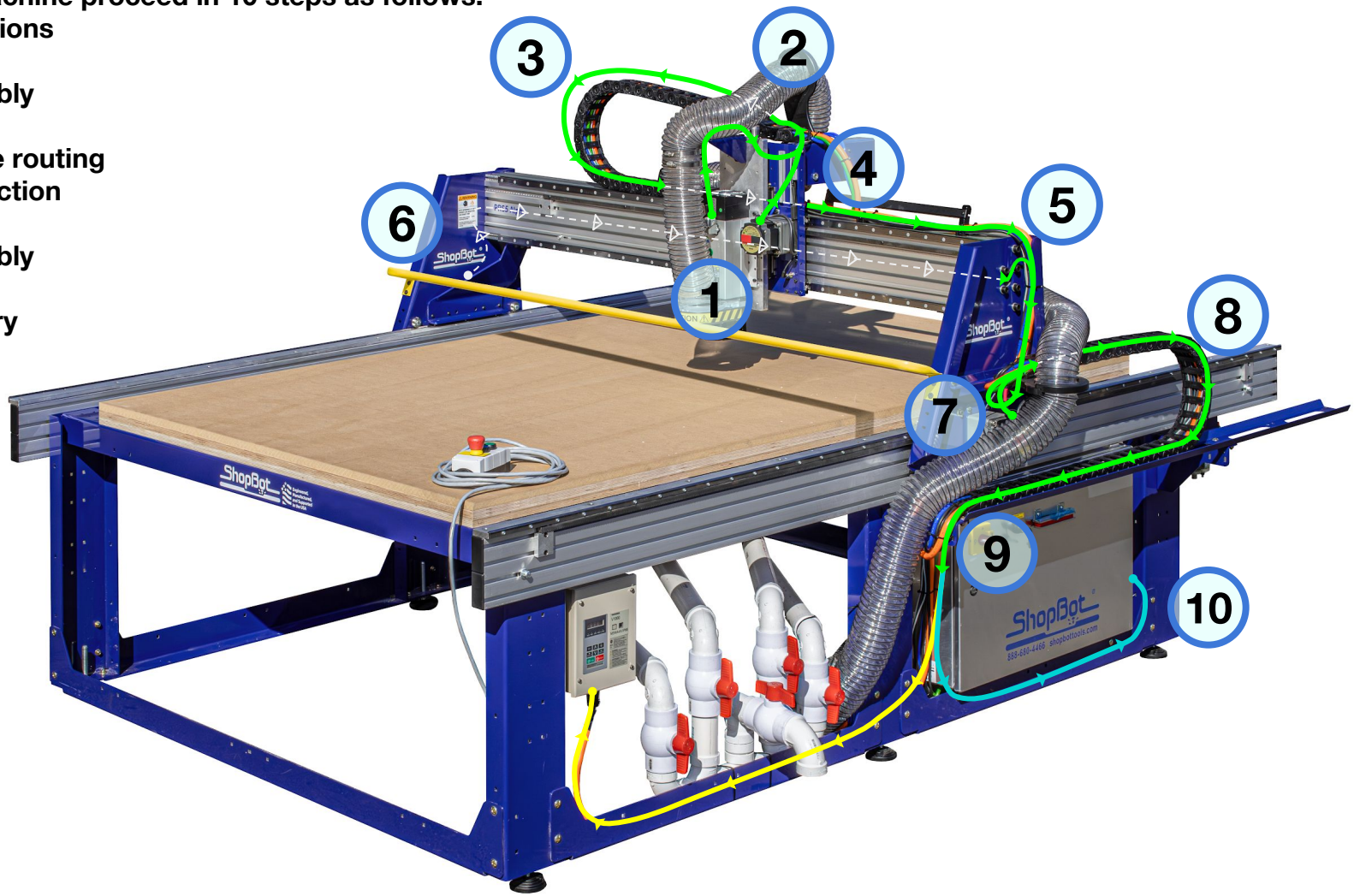


Wire Routing

The wires for your machine must be able to bend and move as the machine moves. We employ cable carriers (sometimes called E-Chains) to protect the wires during operation and make sure that they are not bent too much. You will need to route a few more wires through you E-Chains before making the final connections in your control box. It is easiest to work from the spindle – back to the control box with your wiring.

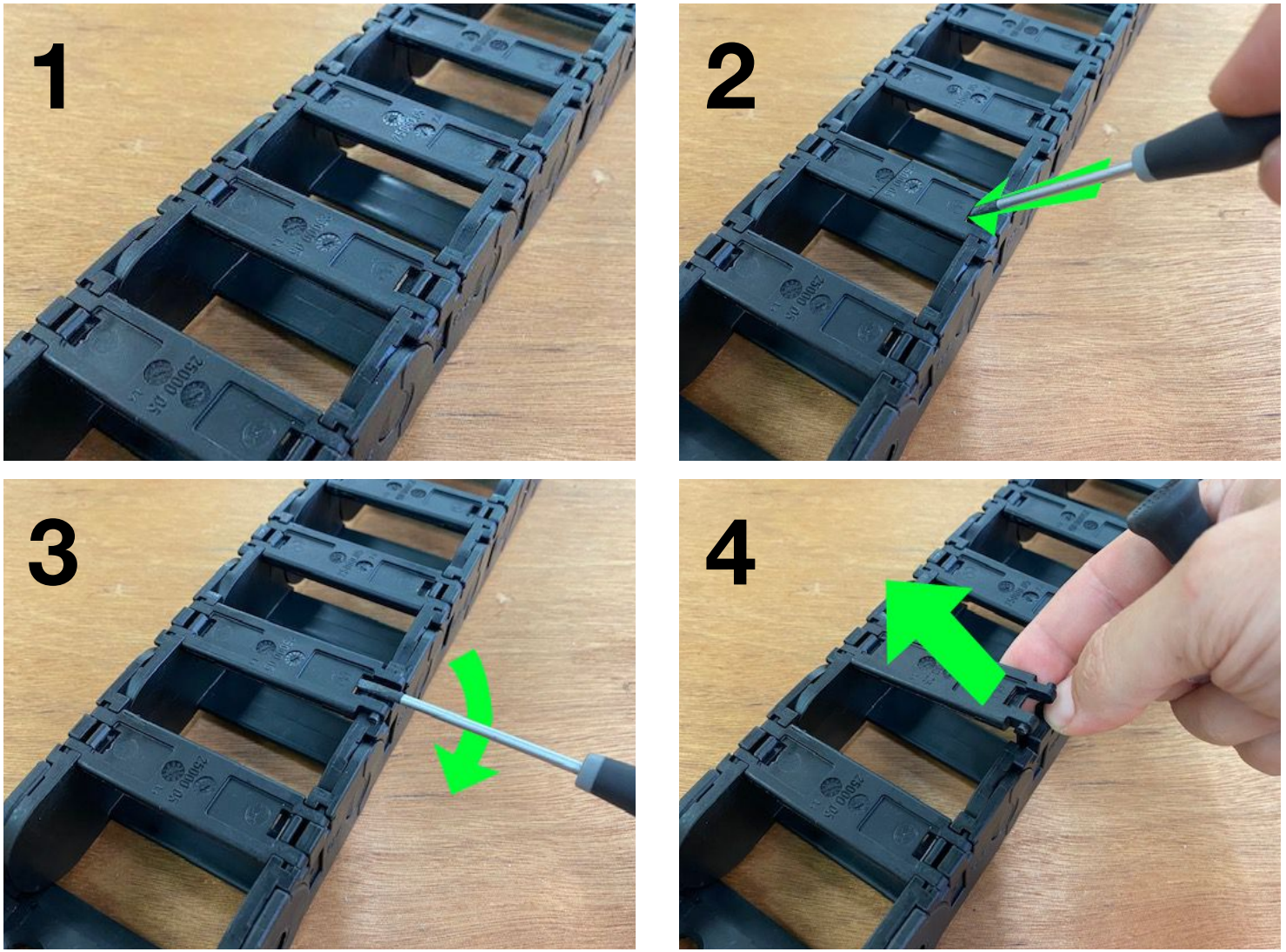
The wiring of every machine proceed in 10 steps as follows:

1. **Spindle connections**
2. **Y Echain entry**
3. **Y Echain assembly**
4. **Y Echain exit**
5. **Gantry end plate routing**
6. **X2 motor connection**
7. **X Echain entry**
8. **X Echain assembly**
9. **X Echain exit**
10. **Control Box entry**



Opening E-Chain Links

The links on your E-Chain can be opened with a flat head screw driver. Insert the tip of the screw driver into the opening at the edge of the link and apply some leverage to pop the link open. Once you're finished inserting cables, the links will snap closed with a bit of pressure. If one of covers completely pops off – don't worry, it isn't broken, simply snap it back into place with pressure on both ends of the cover.

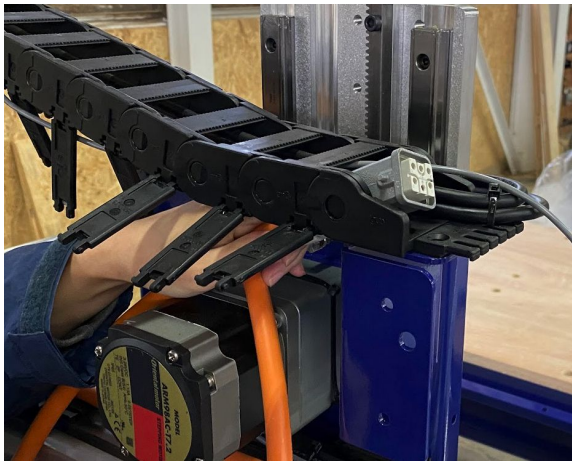


Wire Routing (Y-Axis)

Most of the wires are already partially installed on your machine at this point. A coil of wires will already be connected to the base of your VFD. Cut the zip ties on these wires and unwrap them. Find a clear space to lay them out flat, making sure that there are no kinks in the wires.



Route the orange spindle cable (this will also include a bright green cable for ATC systems) and the fan cable (this is integrated into the spindle cable for 5HP and ATC systems) through the X axis echain bracket and through the underside of the Y axis E-Chain entry near the Z axis. Drape the cables over the Z plate to position them for connection.

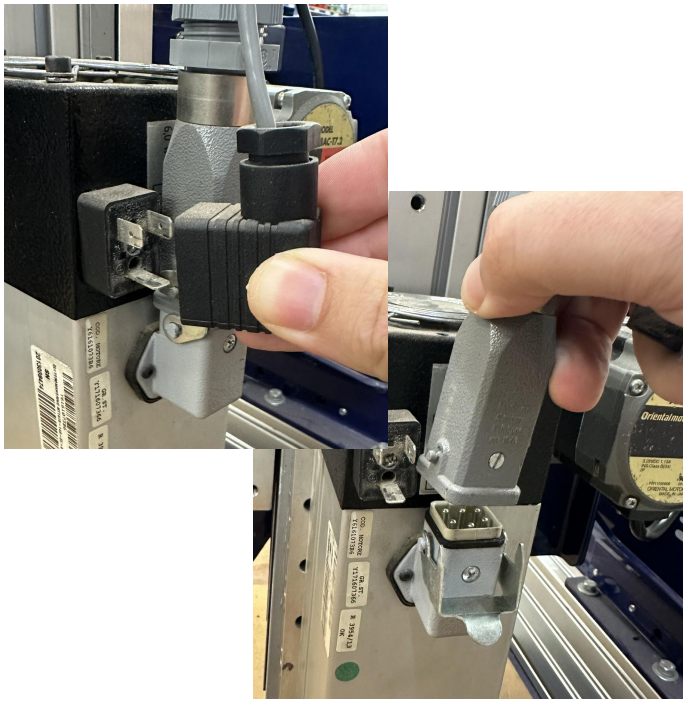

Wire Routing (Y-Axis) (Cont)

We'll start by making the final connections at your spindle. Spindle connections vary in size and shape depending on the type of spindle that you've purchased with your machine. 2.2HP and 4HP HSD spindles will have one large orange power cable along with a smaller grey cable that supplies DC voltage to the cooling fan on the spindle. 5HP Manual Toolchange (Colombo) spindles have the fan power integrated into a heavier gauge orange power cable. Finally, 5HP Automatic Toolchange spindles use two large cables, one orange power cable and one green I/O cable that terminate in a single large connector.

Regardless of what connector type your spindle uses, it is best to start by connecting your power and fan cables to the spindle before routing the spindle cables through the cable carrier. The images below show the various connections for the different spindle types that can be installed on the PRS5 Alpha system.

5HP (Colombo) Spindle Connection

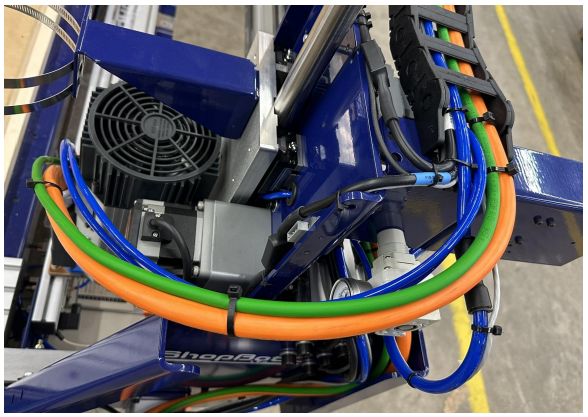
2.2/4HP (HSD) Spindle Connection

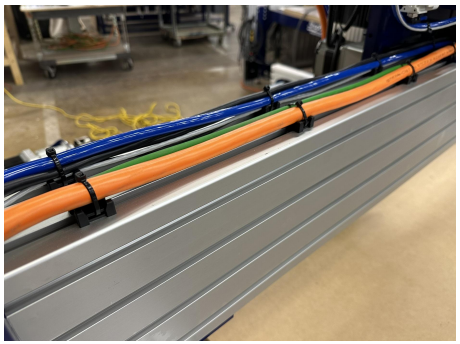


5HP ATC (HSD) Spindle Connection

Wire Routing (Y-Axis) (Cont)

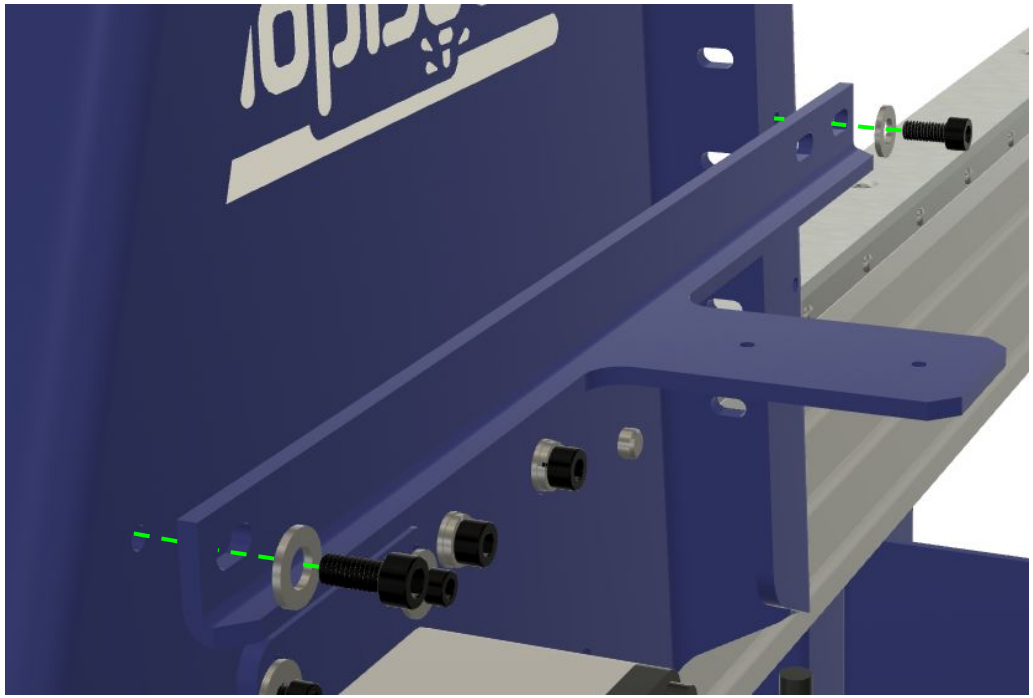
Your cables will be secured to the machine at a number of locations using the zip-ties that were included with your assembly kit. Before starting to lock your wires in place, lower the Z axis of your machine to its lowest point – this is to ensure that there is enough slack in your wires to allow the full range of motion for your machine.
We also need to open your Y axis cable carrier so that new wires can be inserted. Using a flat head screwdriver, disconnect the cable carrier from the black plastic end bracket that is bolted to the blue steel cable carrier mounting bracket on the back side of your Y/Z carriage.
-With your Z axis lowered, start by securing all wires/tubes coming from your spindle to the dust hose bracket using a zip tie inserted through the two holes on the left side of the bracket.
-Next, guide the wire bundle in an arc from the dust hose bracket to the cable carrier end bracket. Lay the wire bundle flat on the end bracket and secure them to the end bracket using a pair of zip ties.
-To reconnect the cable carrier to the end bracket, you'll need to open the first 5 links of the enchain using your flat head screwdriver to gently pry open the snap on cover on the bottom face of each link. Reconnect the cable carrier to the end bracket, making sure that all of your wires are inside the cable carrier.
-Continue down the cable carrier, opening each link, pressing the wires into the cable carrier and eventually closing each link until you have routed the wires all the way to the opposite end of the cable carrier.
-Secure the wire bundle to the lower end bracket of the cable carrier using a pair of zip ties.
-Next, we'll route the cables along the top of the gantry beam towards the X Axis cable carrier. You'll find a set of zip tie anchors attached to the top of your gantry beam. Pull your wire bundle tight across the top of the gantry and secure it to each of the open zip tie anchors.
-Finally, take all of the wires coming off the side of the gantry and lay them against the side of your gantry end plate.



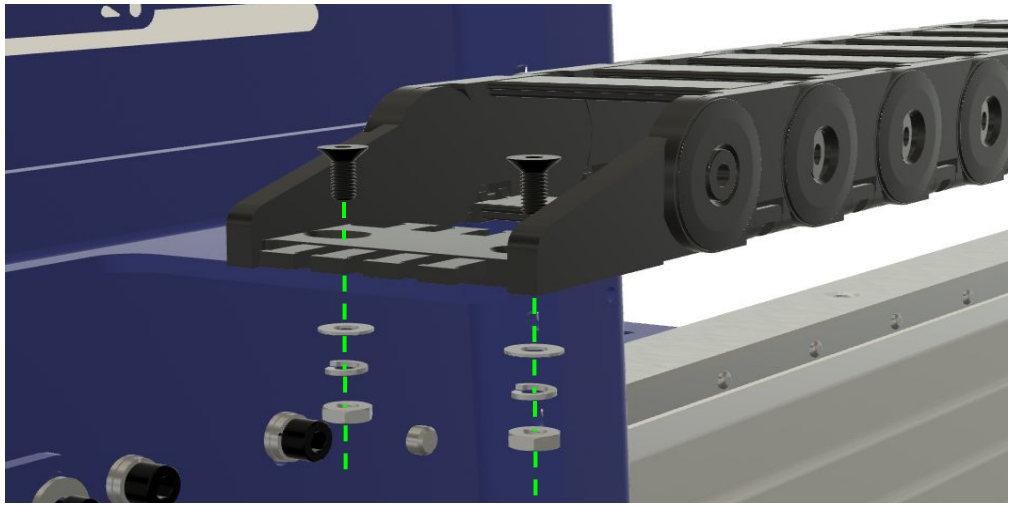


Attaching X Echain

Connect the X Echain Bracket to the Gantry End Plate on the same side on which your Echain Trough is mounted.

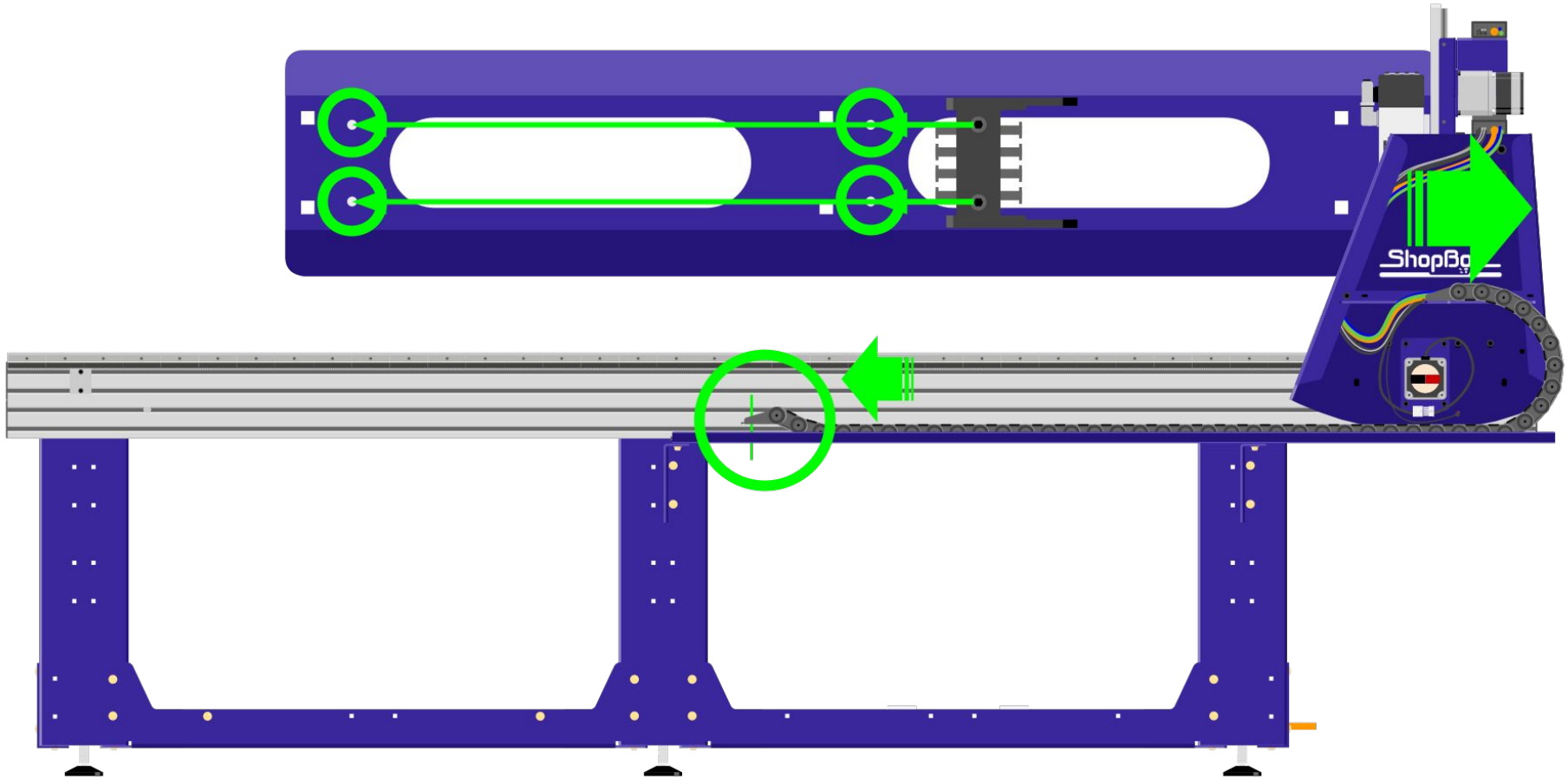


The end of your Echain may already be attached to the bracket; but if for some reason we were forced to remove it while packing your machine; attach the Echain to the bracket using the included hardware.

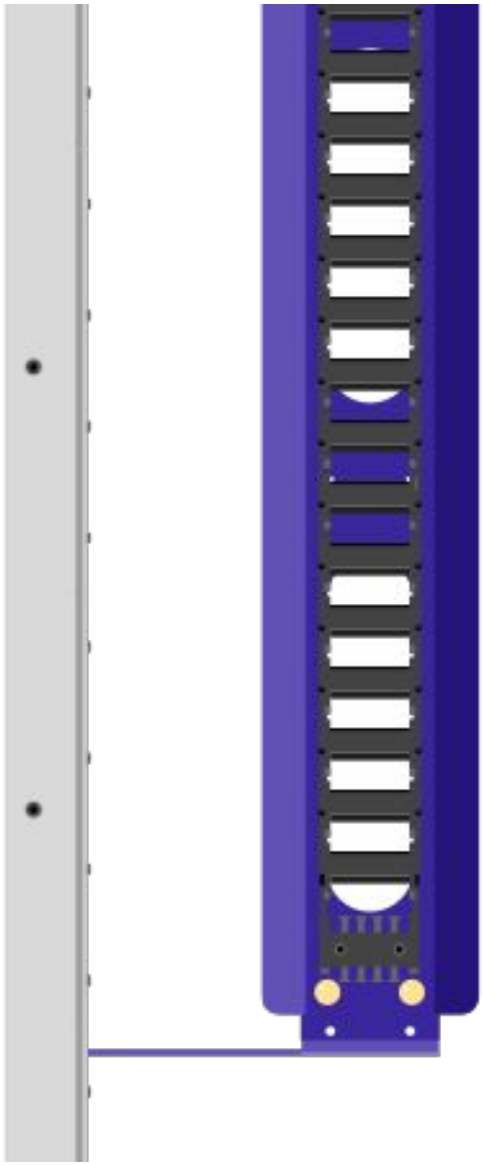


Attaching X Echain (Cont)

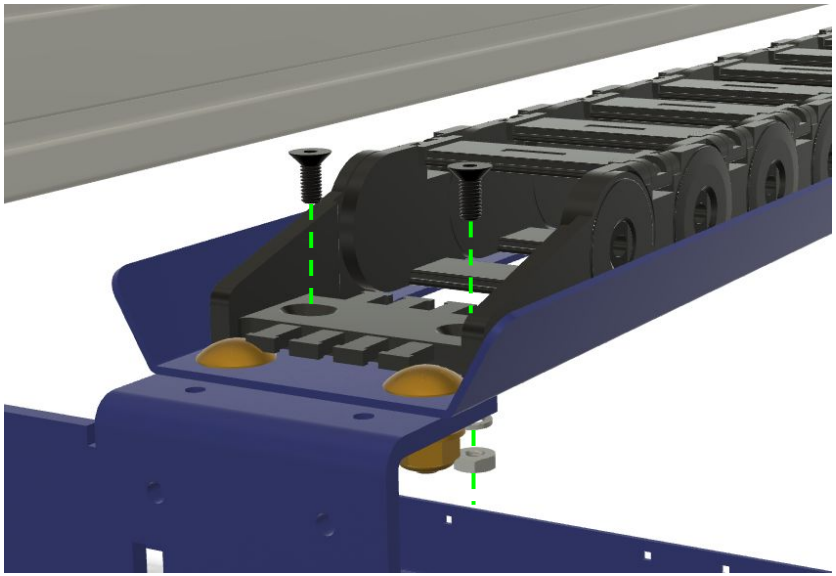
There are multiple locations where it is possible to attach the exit end of your X E-Chain. To make sure that your machine will have the full range of travel, start by moving the gantry all the way to the back end of your machine table. Then pull the E-Chain exit as far towards the front as possible. The frontmost reachable set of holes will be the ideal attachment point for your E-Chain exit.

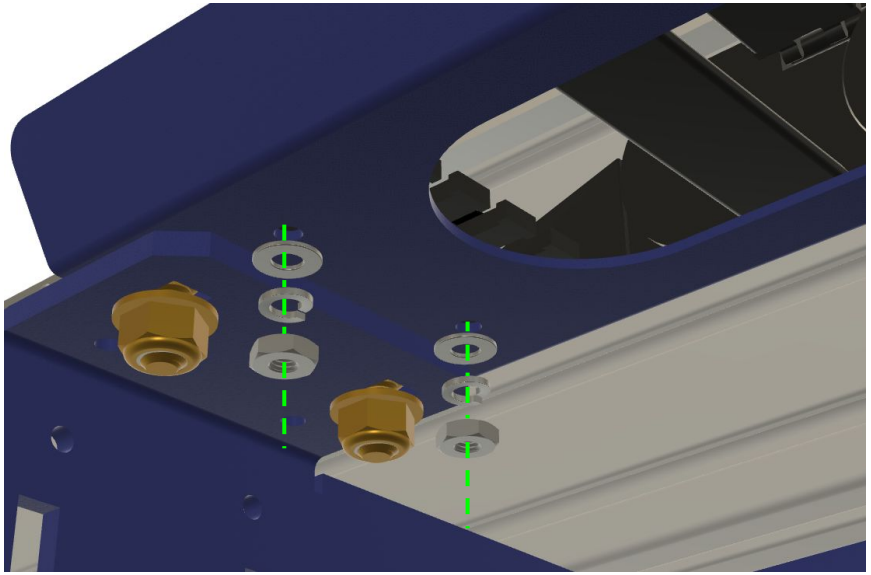


Attaching X Echain (Cont)



The opposite end of the Echain will be attached to the Echain trough. Use the 10-32 Flat Head SHCS along with washers, split washers and nuts to secure the end of your Echain.





Wire Routing (X-Axis)

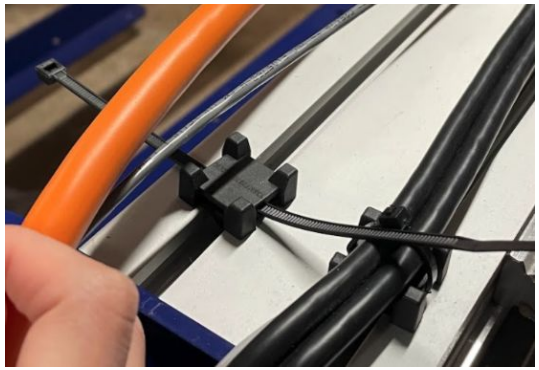
The bundle of wires coming from your gantry should now be contained behind the X Axis echain bracket at the side of the gantry end plate. To continue routing your cables, first make sure that the x axis cable carrier is disconnected from the end bracket that is attached to the X Axis echain bracket. Just like with the Y Axis cable carrier, we'll open a few links on the underside of the cable carrier.

-Split the bundle of cables into two groups, with the motor cables and sensor cables in one bundle and the orange spindle power cable along with any pneumatic tubing in another bundle.

Wire Routing (X-Axis) (Cont)

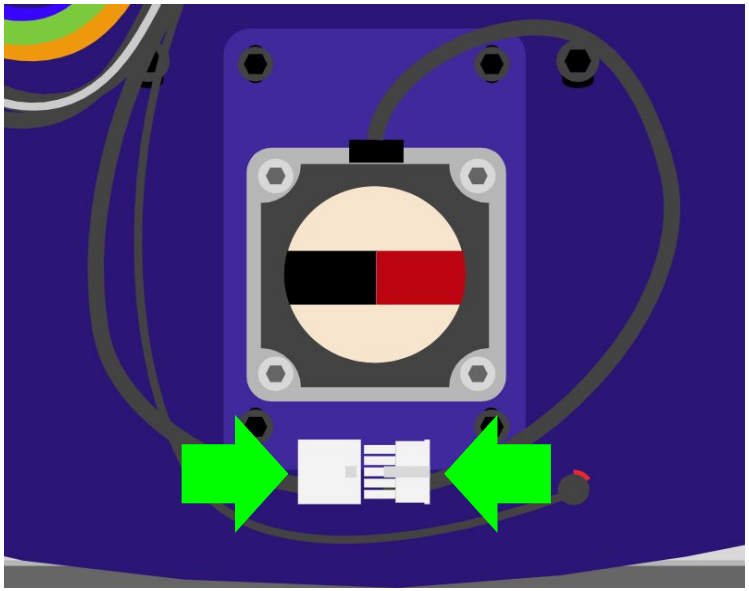
Work the cable bundle down the length of the echain, opening and closing links as you go until the cables are routed to the opposite end of the cable carrier. Once your cables are completely routed through the X E-Chain, it is time to secure the cables with zip-ties. On top of the gantry beam, you'll find zip tie anchors to with you can attach the spindle cables.

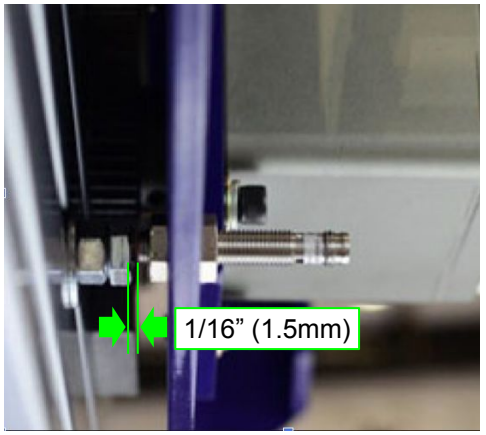
At either end of your X E-Chain, using the mounting points to secure the cables with zip ties.



Connecting X Motors/Sensors

Each X Axis motor will connect to a motor cable that will be run back to the control box. Locate the large black wire with the white connector on the end of it. Connect the two halves of the connector.





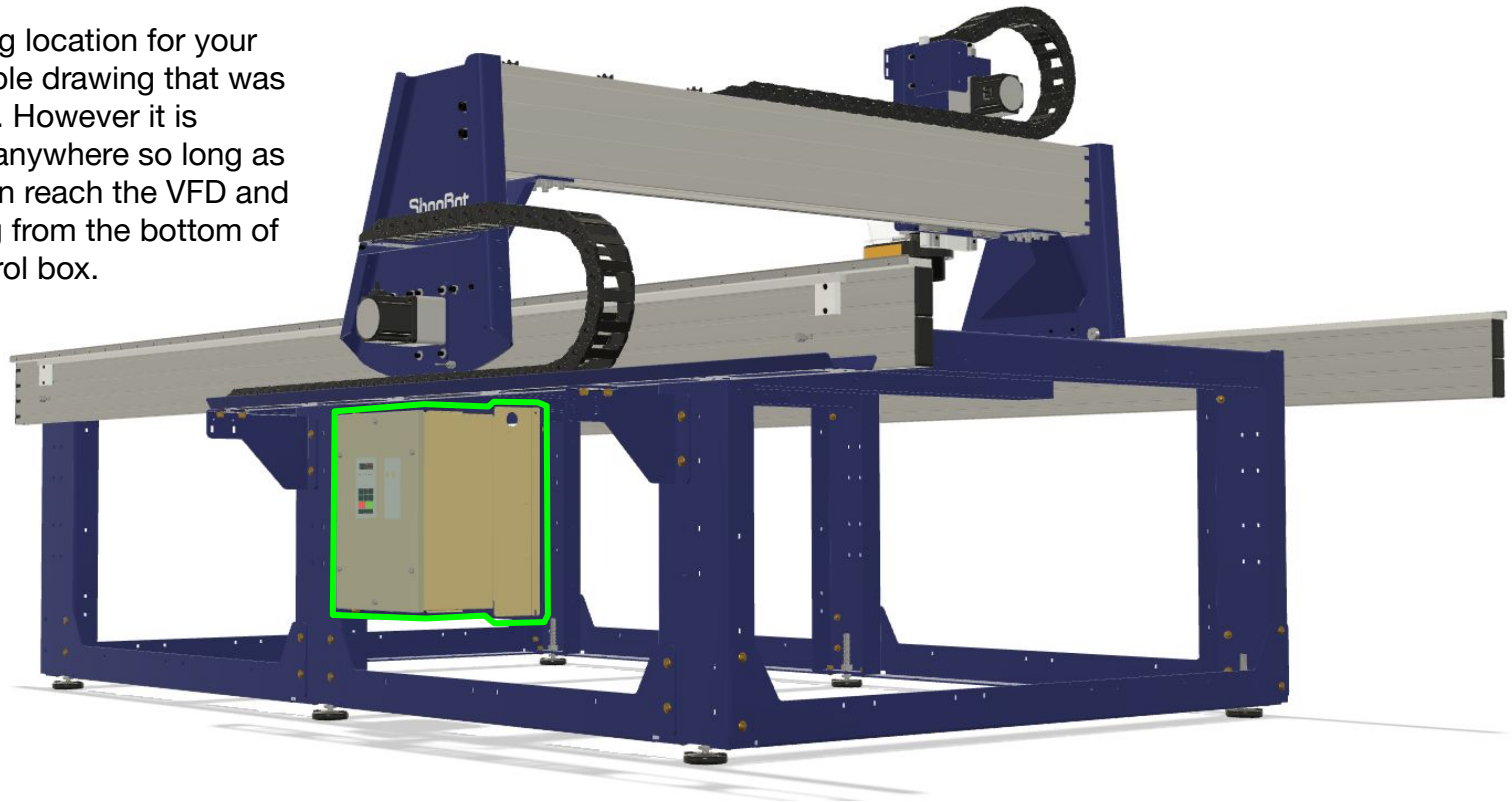
The X axis limit switch does not ship pre-installed, to prevent damage to the switch when moving the gantry from the crate to the machine. The limits switch is a attached by threading it through the hole to the bottom right of the X motor on the side of the machine with the echain. Two lock nuts are included with the switch, use one on either side of the switch barrel to secure it in place. The switch will detect the limit targets that you installed on your table sides. Roll the gantry over to the limit target and thread the switch in until there is a roughly 1/16” (1.5mm) gap between the tip of the switch and the top of the bolt head on the target.

The smaller loose cable near the x motor connects to the open end of the switch. Line up the three pins on the switch with the three holes in the connector; press it onto the switch and then rotate the knurled ring on the connector to thread it onto the switch body.

Mounting the VFD

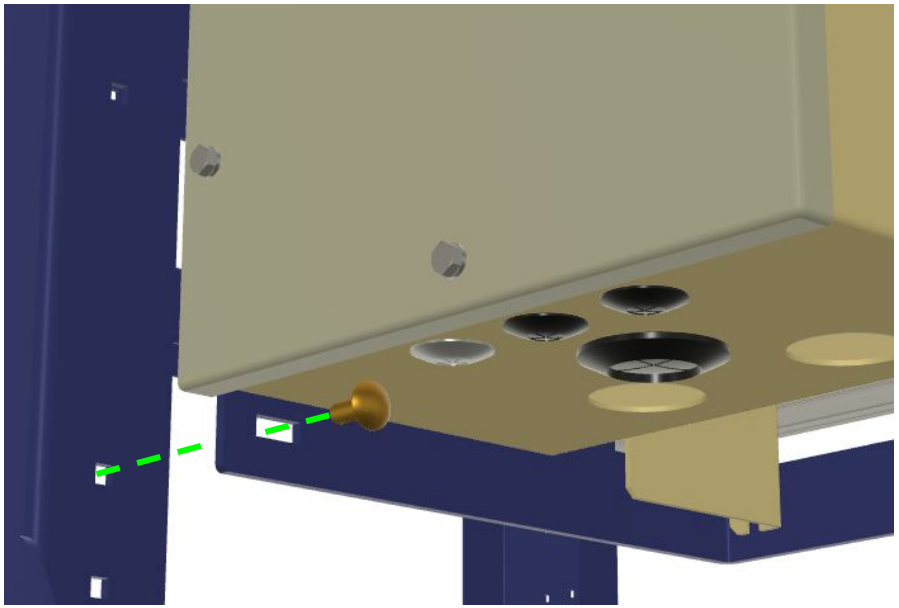
If your machine uses a spindle (and not a router) it will come with a VFD (Variable Frequency Drive). The VFD takes the power that you've connected to your machine (either single-phase or three-phase power) and outputs 230V 3-Phase Power to run your spindle. The VFD is also capable of modulating the frequency of the AC Voltage that it is outputting to control the rotation speed of your spindle. Depending on your spindle's rated Horsepower (kW) and the supply voltage that your shop has; your VFD can vary in appearance and size; however, the installation process is the same for all systems.

The recommended mounting location for your VFD will be shown in the table drawing that was included with your machine. However it is possible to mount the VFD anywhere so long as the orange spindle cable can reach the VFD and the Black S/O cable coming from the bottom of the VFD can reach the control box.



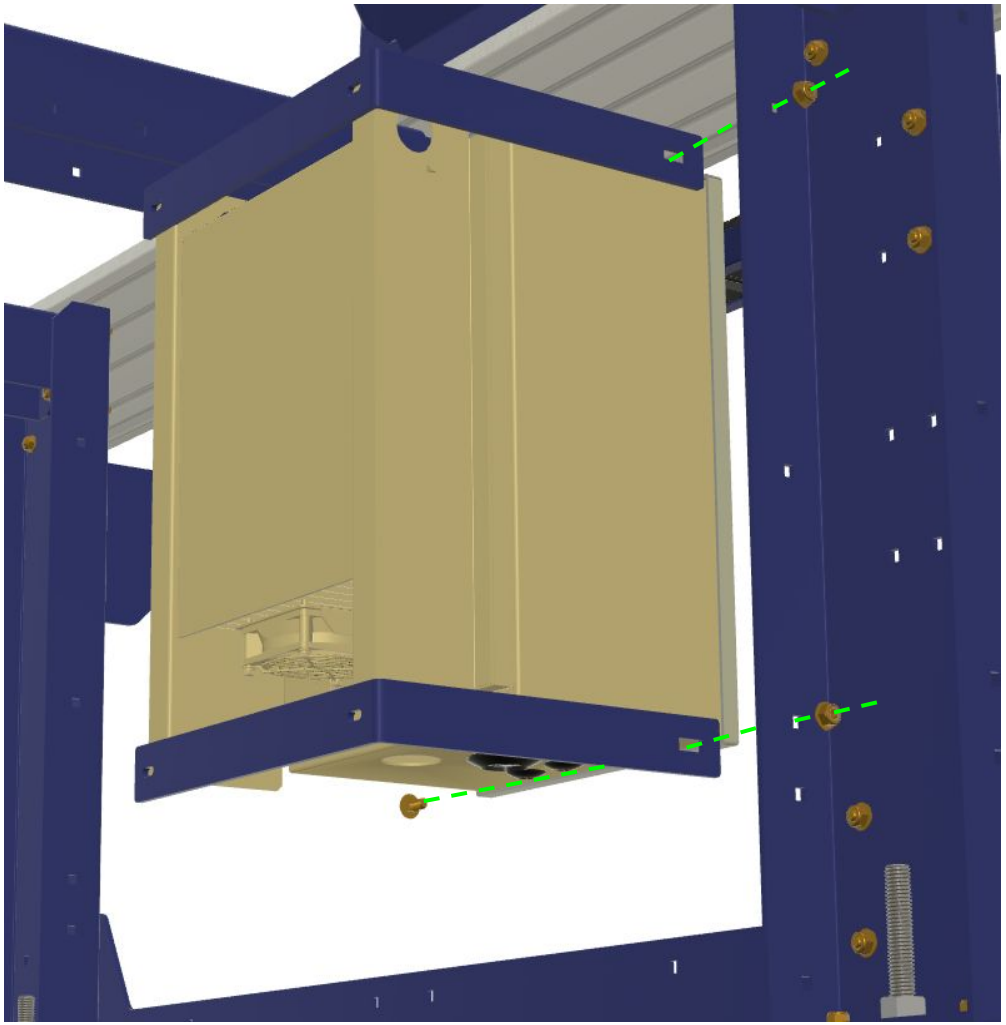
The mounting brackets for your VFD should already be attached to your VFD when it arrives. Only two bolts should be required to attach the VFD to your table.

Mounting the VFD (Cont)

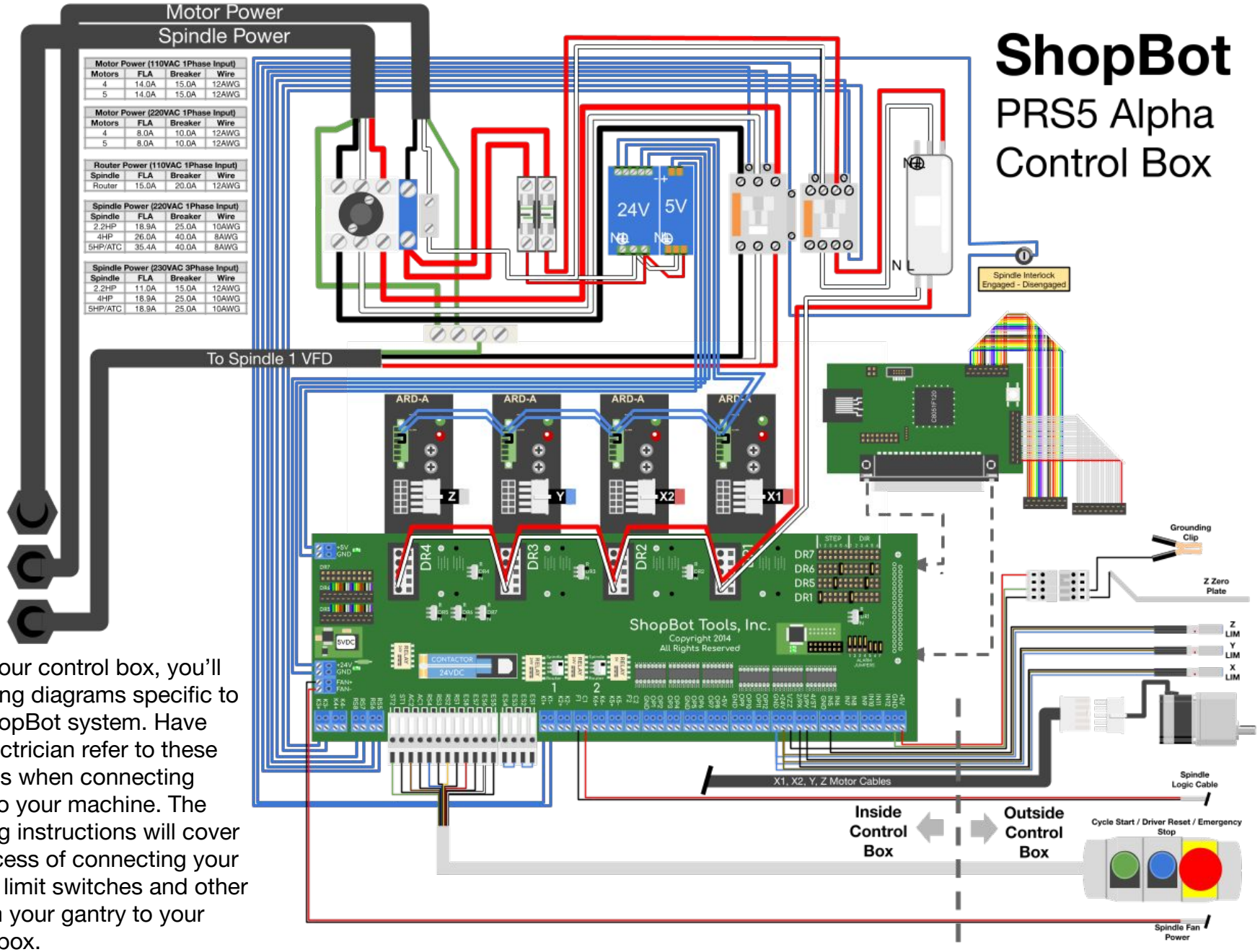


Find the top mounting hole for your VFD near the top of the table leg where the table leg meets the table side extrusion. Insert a screw and secure it with a nut. The bottom bracket of your VFD will line up with one of the holes lower down on the table leg, depending on the size of your VFD.

Once you've got both screws inserted; tighten down the nuts to hold the VFD in place.



Control Box Wiring



Inside your control box, you'll find wiring diagrams specific to your ShopBot system. Have your electrician refer to these drawings when connecting power to your machine. The following instructions will cover the process of connecting your motors, limit switches and other I/O from your gantry to your control box.

Control Box Wiring (Cont)

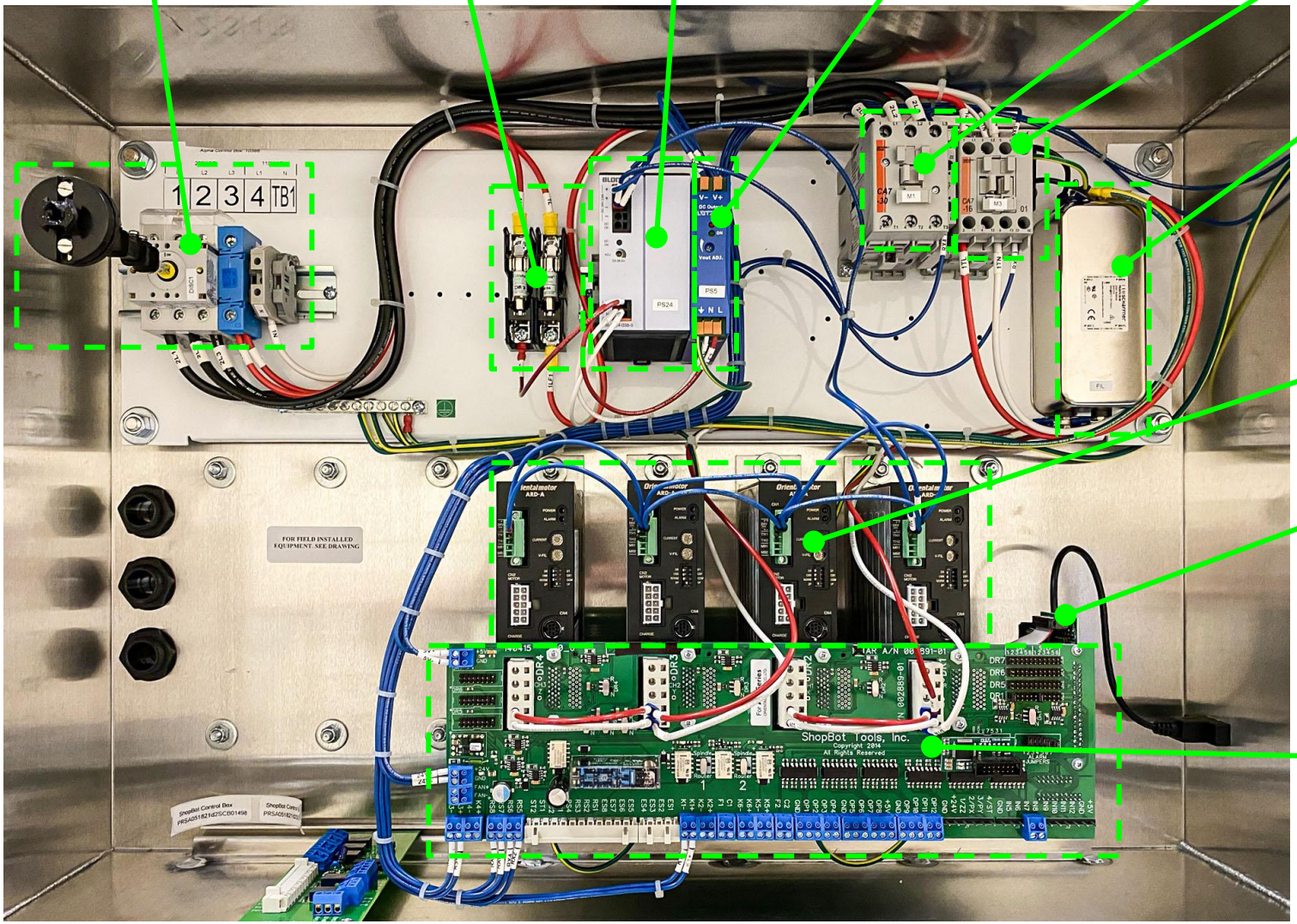
Power Disconnect
Controls both spindle and motor power

Fuses
Protect DC power supplies and filter

24VDC Supply
Supplies power for interface board

5VDC Supply
Supplies power for interface board

Spindle Contactor
Controls power supply to VFD



Motor Contactor
Controls power supply to motors

Power Filter
Prevents noise in electrical connection from affecting motor drivers

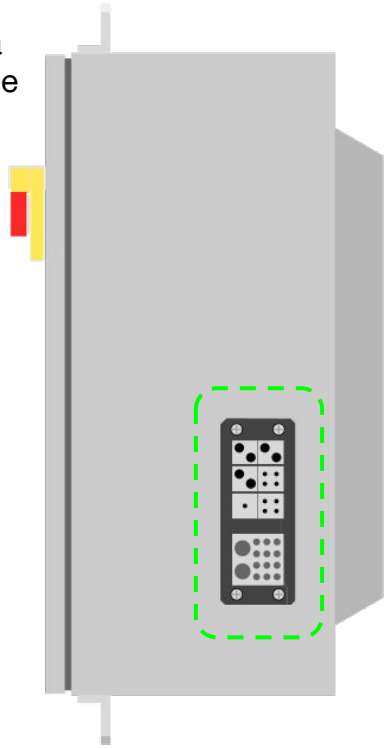
Motor Drivers
Convert pulses from control system into motion in motors. Interpret motor encoder signals

Controller Card
Interfaces with PC control software, reads I/O, issues movement commands to drivers

Interface Board
Connects all systems in control box.

Control Box Wiring (Cont)

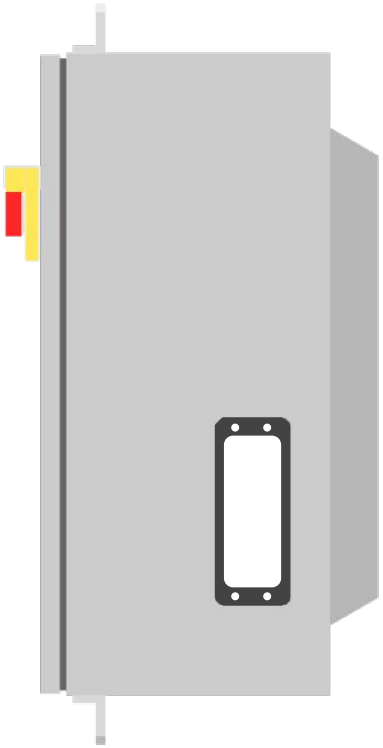
The Alpha control box uses a cable gland to seal around the cables that pass into the control box. This prevents dust and cutting debris from getting into the control box where it can cause malfunction.



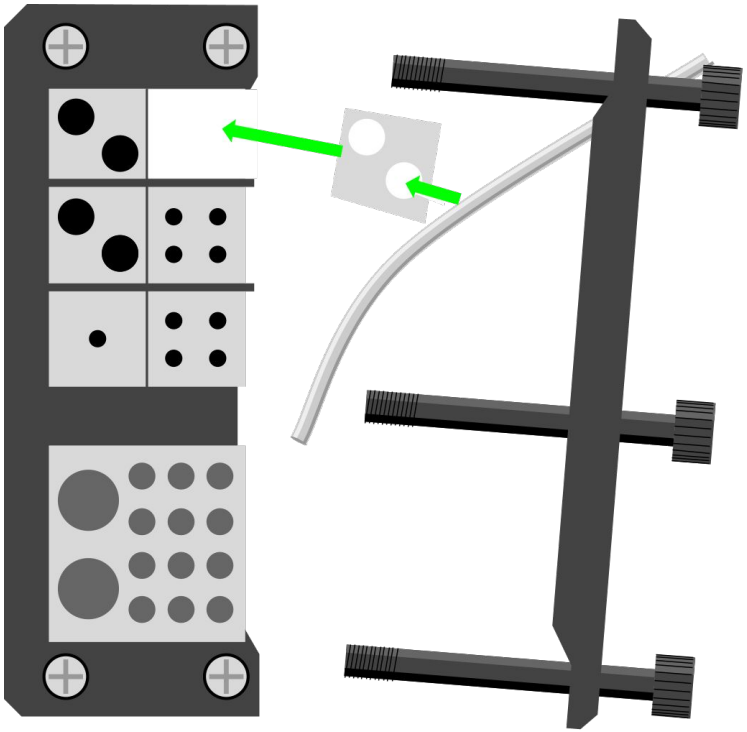
The cable gland includes rubber inserts with holes of various sizes, chosen to match the cables that need to be inserted into your control box. The lower section includes one large rubber insert with sealed holes that can be punctured to accommodate additional cables for accessories.

To insert cables into your cable gland, remove the bracket from the side of the cable gland by loosening the three screws holding it in place. After it is pulled out of the way, you'll be able to slide your rubber fittings into the frame after filling them with your wires.

Once you've inserted all of your wires into the cable gland, clamp the rubber fittings in place by reattaching the side bracket.



When you're ready to attach your cable gland to the control box, first affix the adhesive backed seal around the opening the in the side of the control box. Then screw the cable gland into the side of the control box using the screws included with the kit. There will be several white plastic rods that can be used to plug any unused holes in the cable gland to prevent dust from entering through these openings.

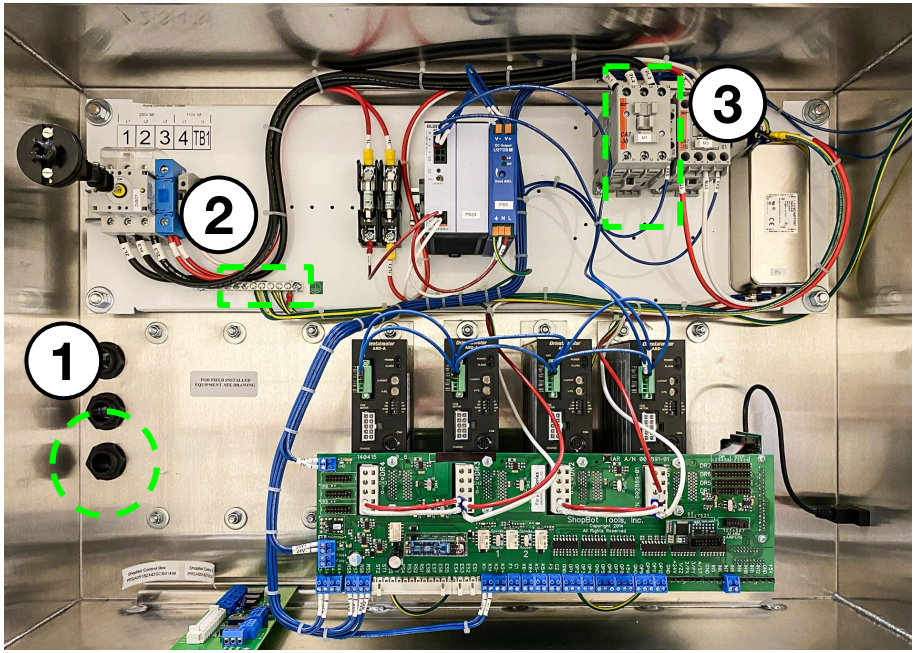


Connecting the S/O Cable

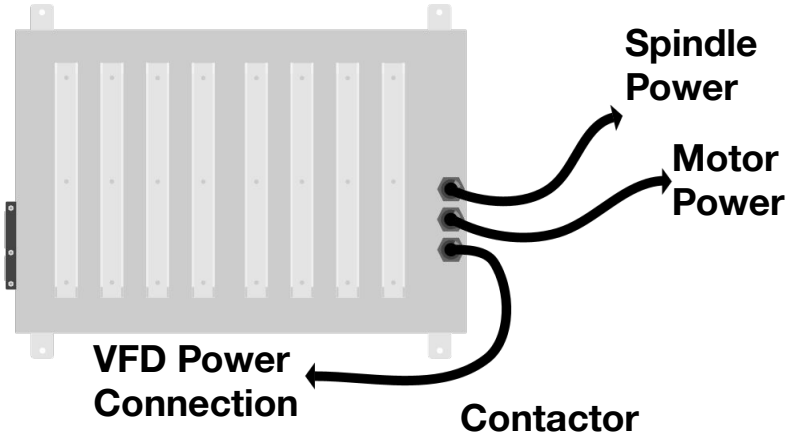
WARNING: RISK OF ELECTRIC SHOCK

Make sure that your control box is disconnected from any external power source before working on wiring inside of the control box.

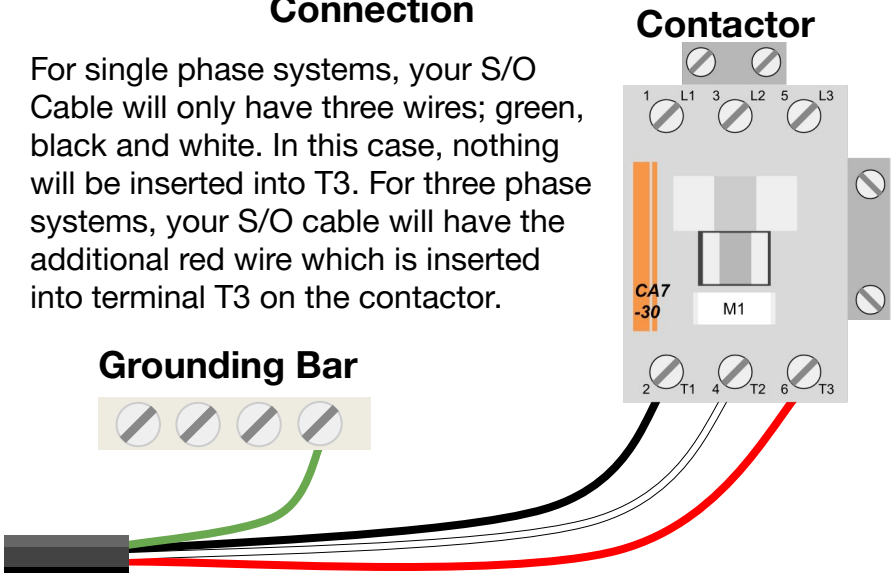
With the S/O Cable inserted through the cord grip in your control box; first connect the green ground wire to the grounding bar, located near the power disconnect. You'll see all of the other ground wires for your control system connected to the same bar. The 2 (or 3 depending on your power source) remaining wires in your S/O cable will be connected to the output of the contactor.



Your control box will have three openings in the back of the case. Each of these openings will be sealed with a "cord-grip" that can be tightened to seal around the cable inserted through the hole. Two of these openings will be used for the power supply to your motors and spindle. The third will take the cable from your VFD (S/O Cable) so that it can be connected to your spindle contactor inside the control box.



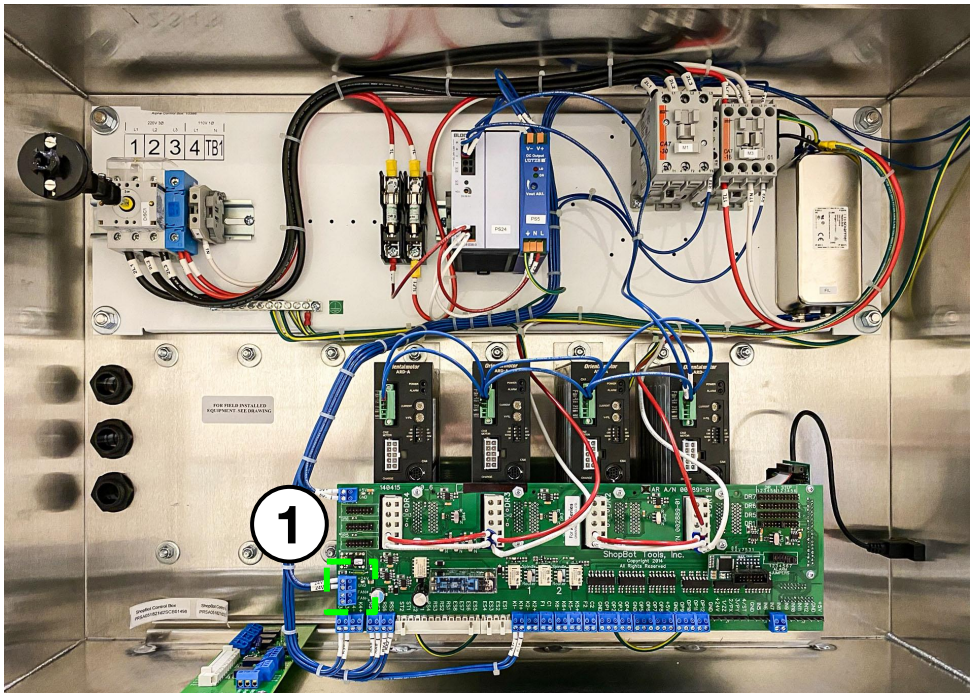
For single phase systems, your S/O Cable will only have three wires; green, black and white. In this case, nothing will be inserted into T3. For three phase systems, your S/O cable will have the additional red wire which is inserted into terminal T3 on the contactor.



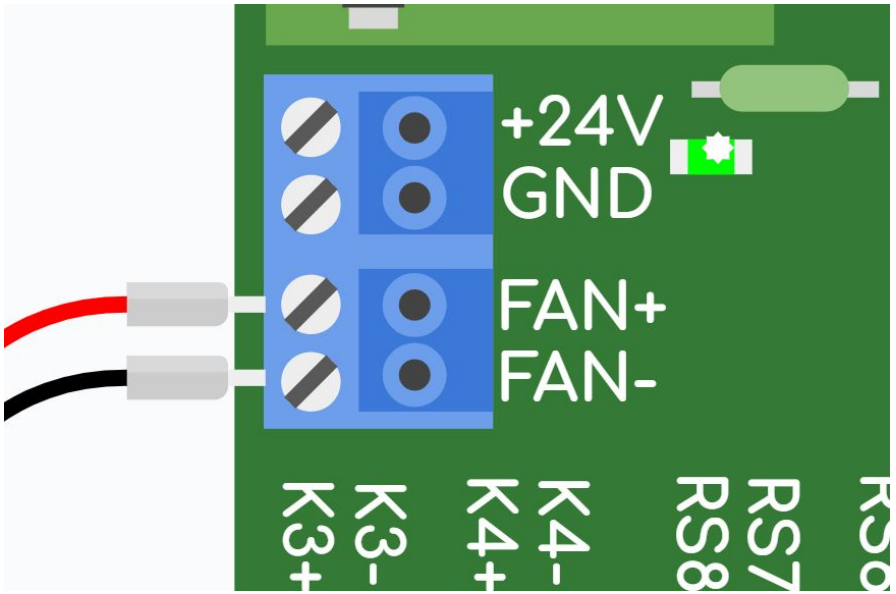
Connecting the Spindle Fan

All spindles supplied with ShopBot CNC machines are air cooled using fans mounted on top of the spindle. 2.2, 4HP and 5HP manual tool change spindle systems use a separate 24VDC power cable to power the fan, while the 5HP ATC spindle uses the same power as the spindle itself to power its cooling fan.
2.2 and 4HP spindle systems have an external connector on the spindle body where the spindle power cable must be attached to power the fan. The other end of this cable will be connected to a 24VDC power source inside the control box.

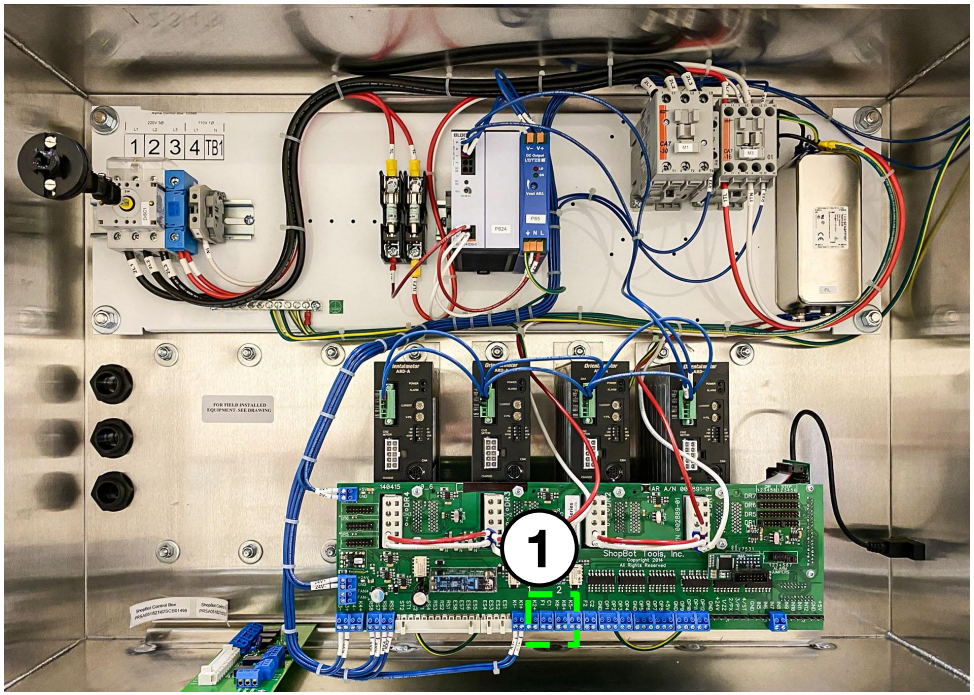
Shown to the left, the power cable plugged into the port on the 2.2 or 4HP spindle frame. The plug is secured by a screw passing through the center of the plug. Make sure this is plugged in before you use your ShopBot for the first time!



If your spindle system requires 24VDC, you'll find a terminal on the bottom left corner of your main interface circuit board labeled for FAN power. Connect the black wire from your fan cable to the terminal labelled FAN+ and the red wire to FAN-

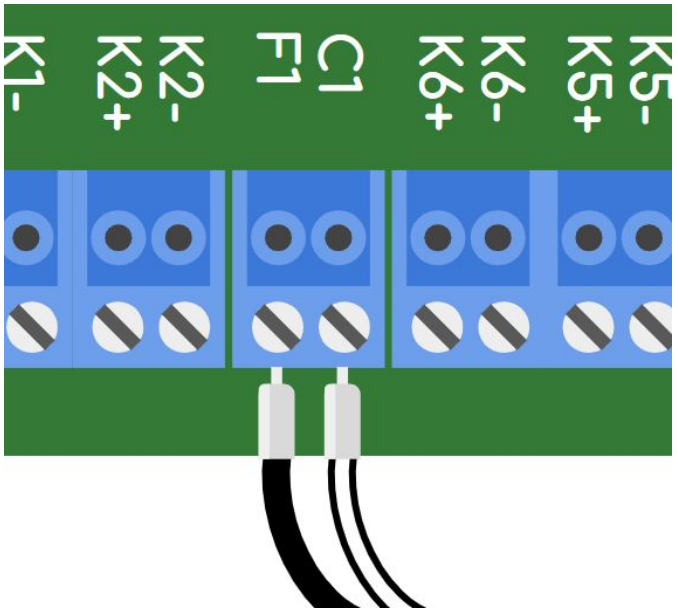


Connecting the Spindle Logic Cable

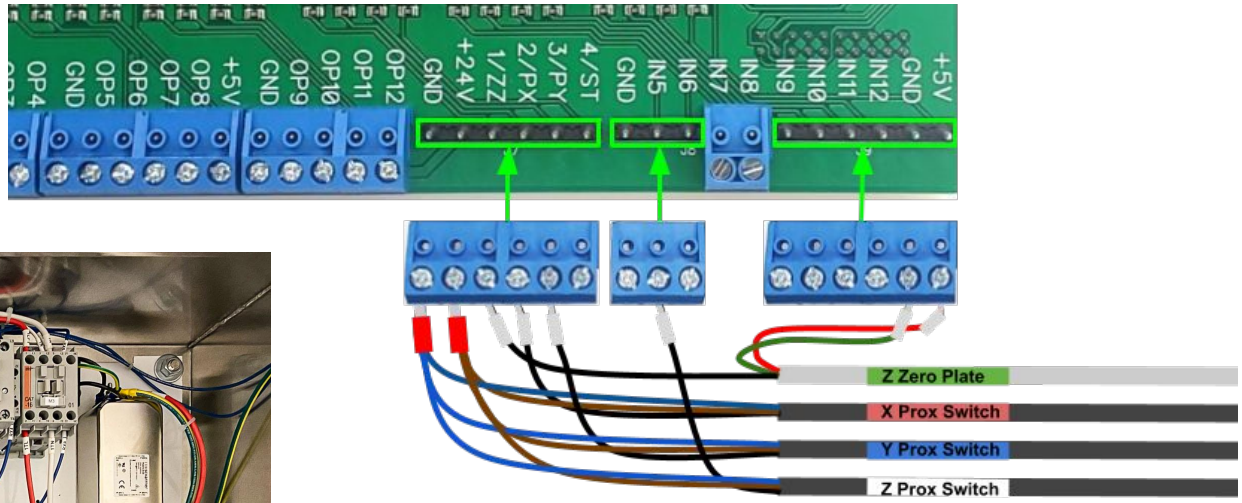


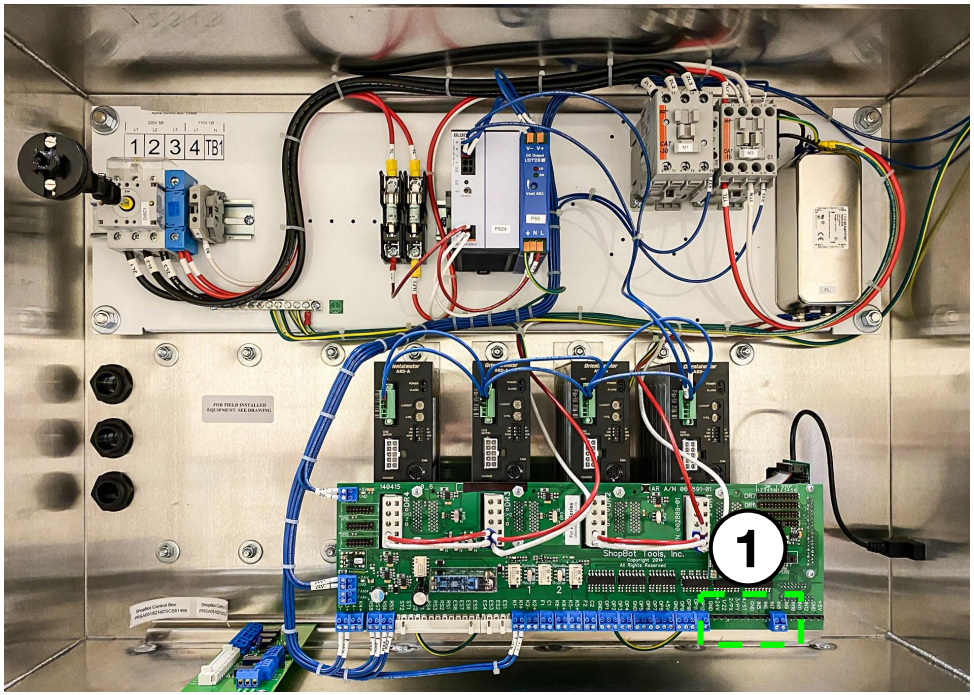
The spindle logic cable is used to communicate the spindle start signal from your control box to your VFD. This two wire cable will be connected to the terminals labelled F1/C1. In this case, it does not matter which color cable is plugged into each of the terminals – just that this pair of wires is connected to F1/C1.

For ATC systems, the spindle logic cable will instead be run through the ATC interface board so that pressure sensor connected to that board can disable the spindle start command if there is not enough air pressure to retain the tool in the spindle.



Connecting the Limit Switches and Z Zero Plate



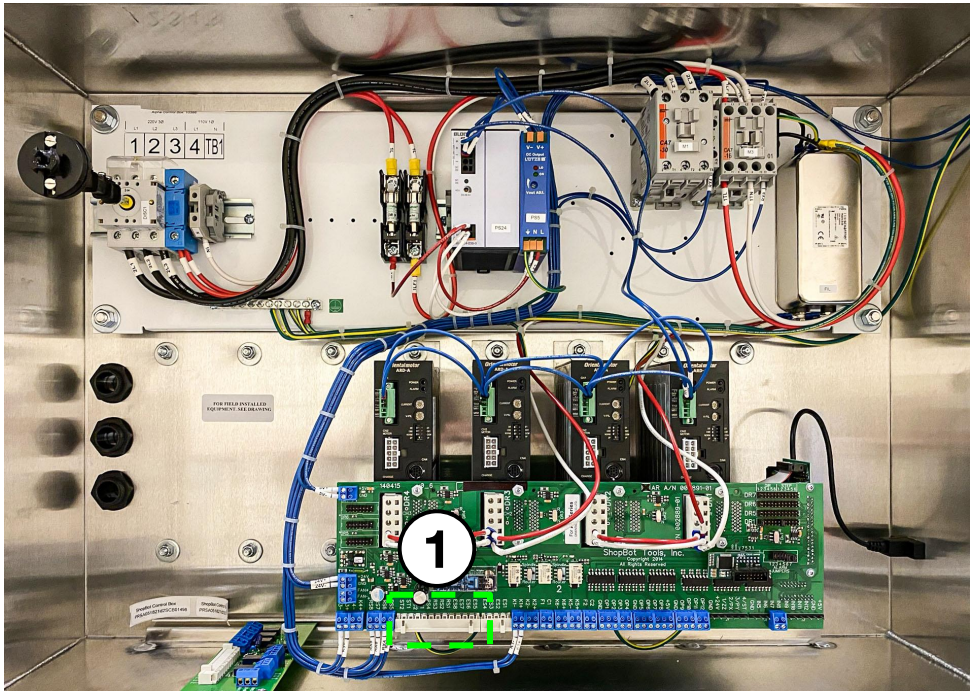


All sensors on your machine will be connected to the row of “input” channels along the bottom right edge of your main interface board.

Your Z Zero plate along with your X, Y and Z axis limit switches plate will be connected to inputs 1, 2, 3 and 5 respectively. The black wires designate “signal” wires. The z zero plate signal wire connects to the terminal labelled “1/ZZ”, the signal wire from the X Prox (limit) into “2/PX”, the Y into “3/PY” and the Z into “IN5”.

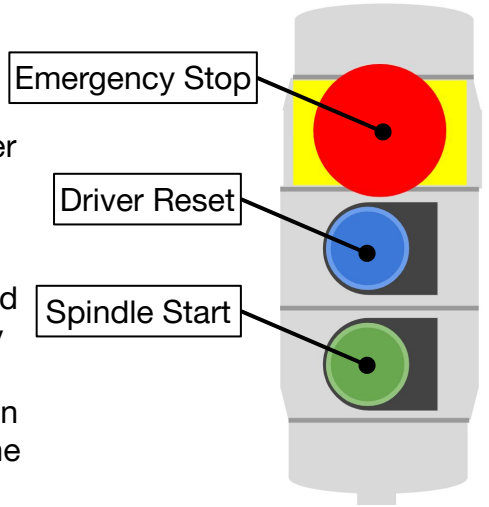
The limit switches on the alpha system require 24 volts to operate and their power and ground wires are all connected to the adjacent GND and +24V terminals. The Z Zero cable also connects to the 5V line on the interface board to supply power to accessories like the laser pointer and probe.

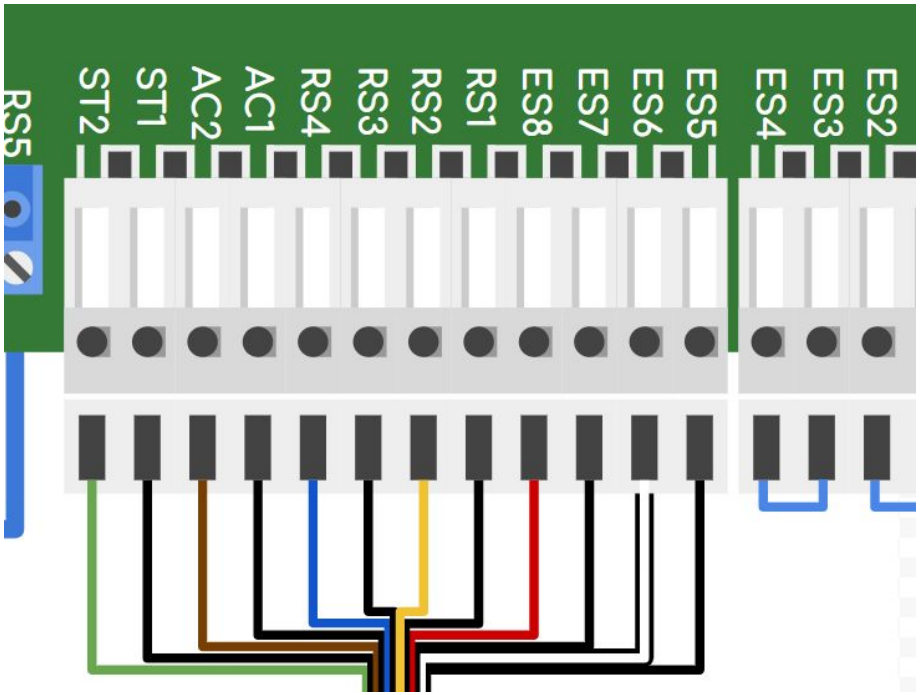
Connecting the Remote Pendant



The connector for the remote pendant plugs into a socket on the bottom left edge of the main interface board. The socket is quite tight, so you may need to apply careful pressure to force the connector into the socket. Without this pendant in place, it will not be possible to power your drive motors or your VFD/Spindle.
Any time that power has been disconnected and restored to the machine, or your have received a message in your software indicating that a motor fault has been detected, you will need to press the blue reset button to clear the fault and restore power to your motors.

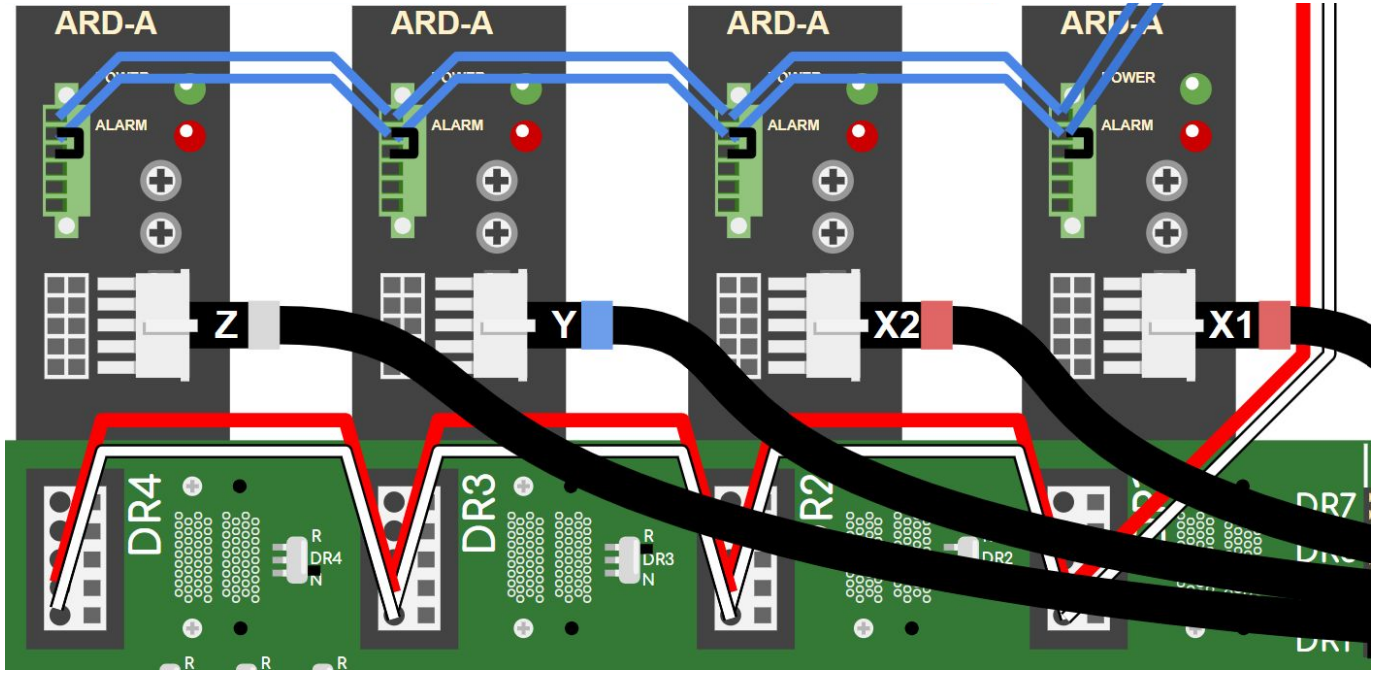
Your Alpha control system includes a remote pendant equipped with an emergency stop button that cuts all power to the motors and spindle; a reset button that is used to reset the contactor that powers your motor drivers and clear motor faults should they occur; and a spindle start button that must be pressed in order to start the spindle at the beginning of each cut.

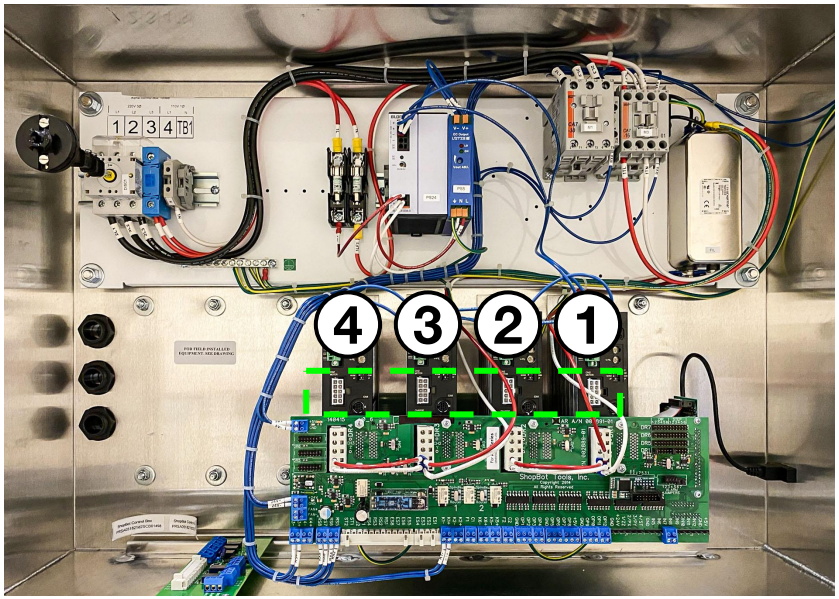




Connecting the Motor Cables

A typical Alpha control system will use 4 motors and drivers, 1 each for the Y and Z axes and a pair of motors for the X axis. Additional motors and drivers can be added to use accessories like rotary indexers or secondary z axes.
The two X motor cables should be plugged into the white sockets on the first two motor drivers. Y and Z are plugged into the 3rd and 4th driver from the right, respectively. You'll feel a "click" when the connector is fully engaged with the socket.





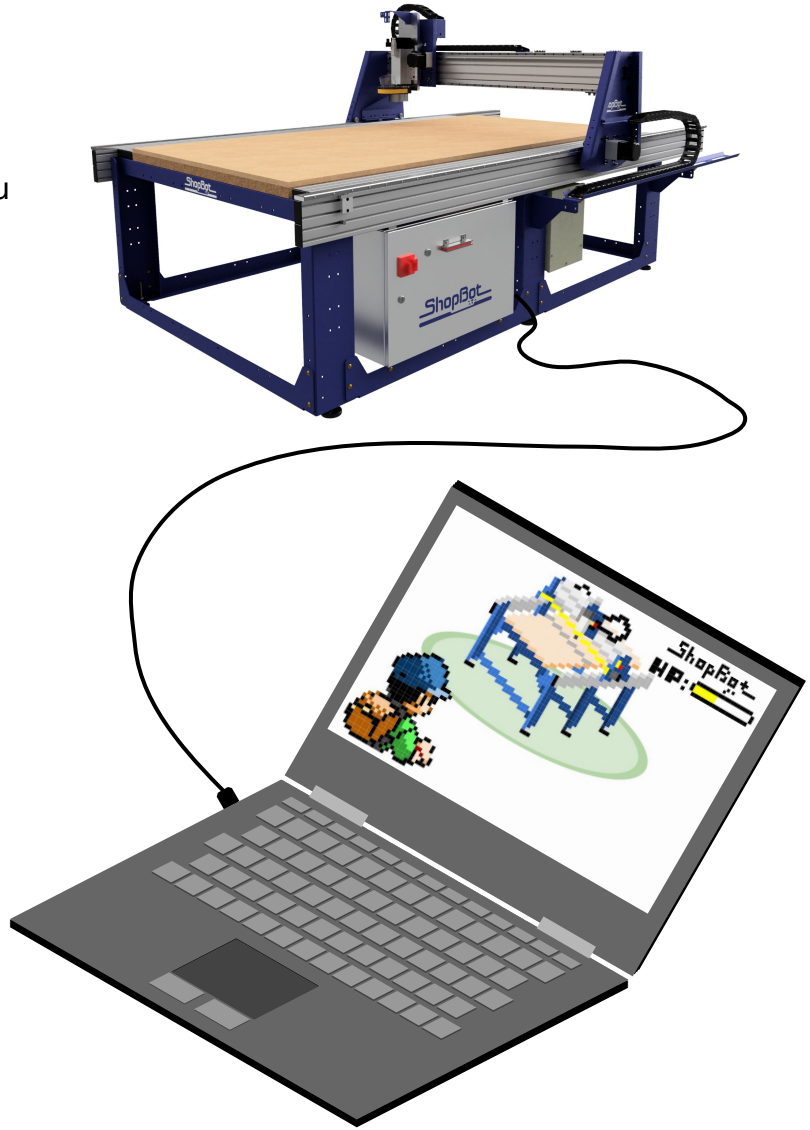
If any of the motor cables are unplugged or not fully inserted; the associated motor driver will register a motor fault which will be communicated to the user through the software interface.
If you ever experience unexplained motor faults that cannot be cleared using the blue reset button on your remote pendant; inspect the motor connections inside your control box.

Setting Up Your Control Station

ShopBot's control software, ShopBot 3 (SB3 for short) is free to download from our website and can be installed on as many PCs as you would like at no cost. The software runs only on Windows PCs.

We recommend that you dedicate a PC for running your ShopBot and nothing else! The PC is your control console, an extension of your machine; you want to make sure that it is properly set up to get the best performance out of your ShopBot.

If you don't want to look for another PC, or are having trouble getting your own PC set up to control your ShopBot; **we sell laptops that are pre-configured to work with the ShopBot control software.**



RECOMMENDED PC SPECS:
Operating System: Microsoft Windows (XP and beyond).
Processor: Dual Core 1.3GHz or better.
RAM: 4GB or higher.
Hard Drive: 65MB for software, 2GB additional free space.

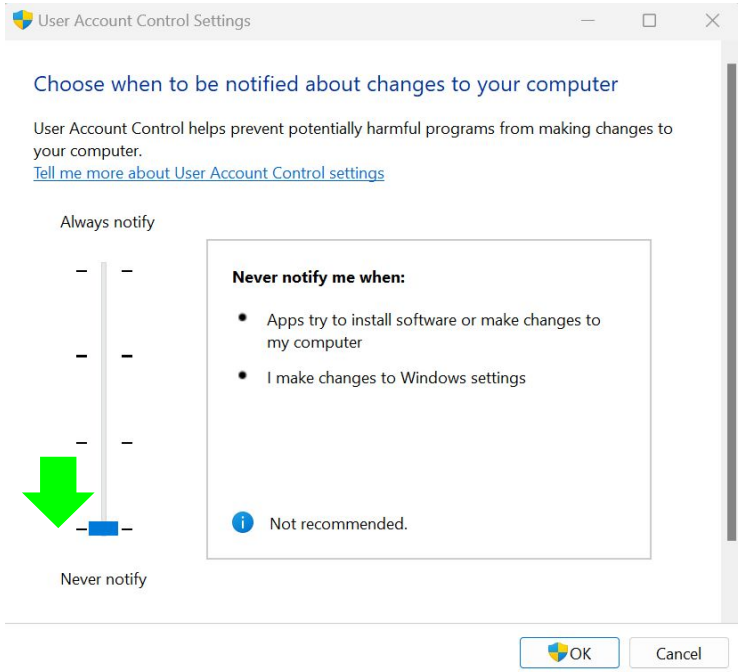
PRE-INSTALL CHECKLIST(details on next page)

1. ☐ **Log into your PC as administrator**
2. ☐ **Set User Account Control to "Never Notify" (N/A to Windows XP)**
3. ☐ **Set power options to never go to sleep, never turn off monitor**
4. ☐ **Disconnect PC from the internet**
5. ☐ **Uninstall any unneeded applications**
6. ☐ **DO NOT plug ShopBot USB cable into PC yet!**

PC Setup

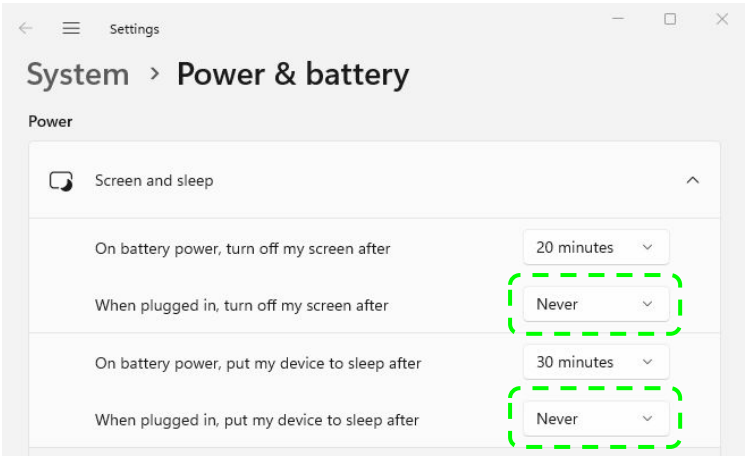
(2) Set User Account Control to “Never Notify”

The first process to change is User Account Control. This can be found by performing a search from the Start Menu in Windows 7 & 10, or by swiping in from the right edge of the screen and selecting the “Search” icon in Windows 8. Then, type “User Account Control” or “UAC” into the search box and press Enter. This will bring up the User Account Control Settings window, containing a slider. You should ensure that this is set to “Never Notify”, as it will prevent popups from interrupting software.



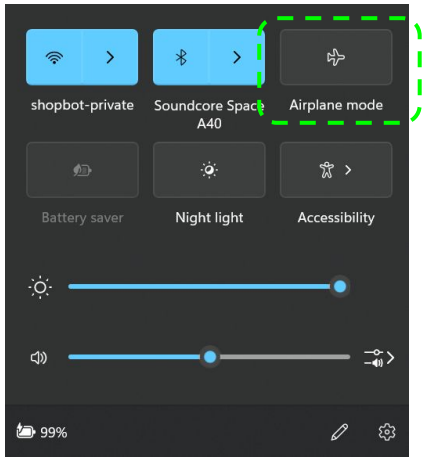
(3) Set Power Options

Open your power options menu and set the laptop to never “go to sleep” and never “turn off my screen” when plugged in. This will prevent disruptions to your cut.

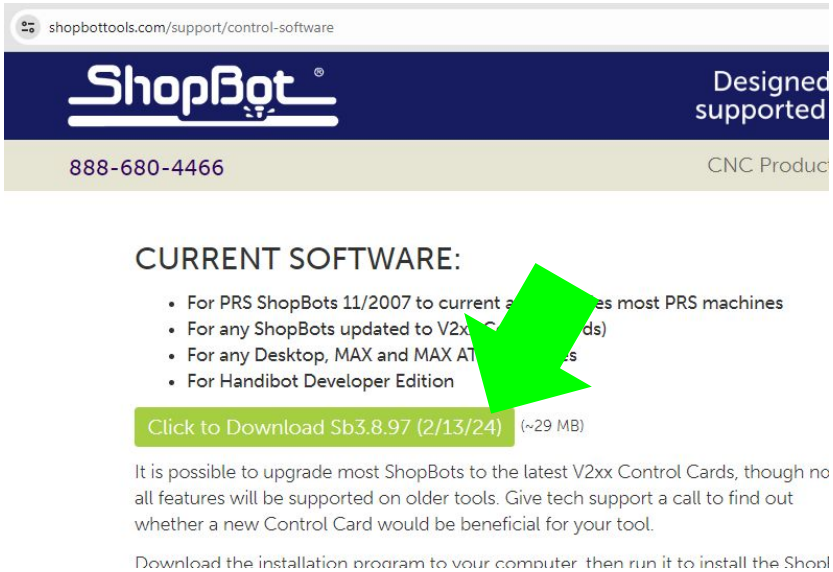


(3) Disconnect your PC from the Internet

Disconnecting your PC from the internet will prevent online applications from disrupting your cuts and prevent windows from starting updates without your permission. The easiest way to do this on modern PCs is to select “Airplane Mode” from your system controls.

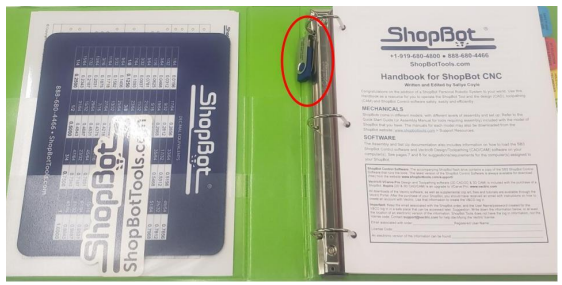


Installing SB3

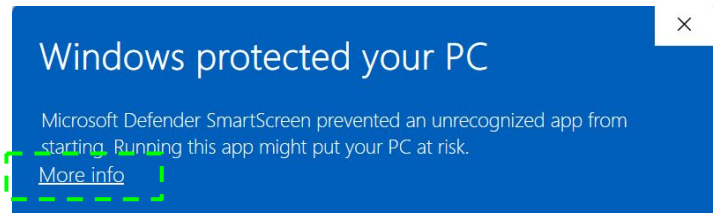


The latest version of the ShopBot control software that was available on the date your machine shipped will be included on a USB drive clipped inside your green ShopBot Handbook. ShopBot releases regular software updates; so it is always a good idea to check at shopbottools.com/support/control-software to see if there is a newer version available.

If you have an older version of the ShopBot software loaded on your PC, follow the normal steps for uninstalling an app to remove the old version from your PC before installing the newest version. Once you're ready, find the installer and double click to being the installation.

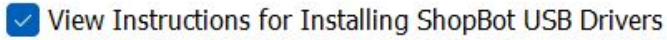


When you start the installer; Windows may inform you that it has "protected your PC" from the ShopBot software. This message will need to be bypassed to continue the installation. Click "More Info"



Click "Run anyway" to continue the installation.

USB DRIVERS
At the conclusion of the install process; you'll be presented with instructions for loading the USB drivers for your ShopBot. Follow these instructions to set up the USB connection to your ShopBot.



Powering On your Machine

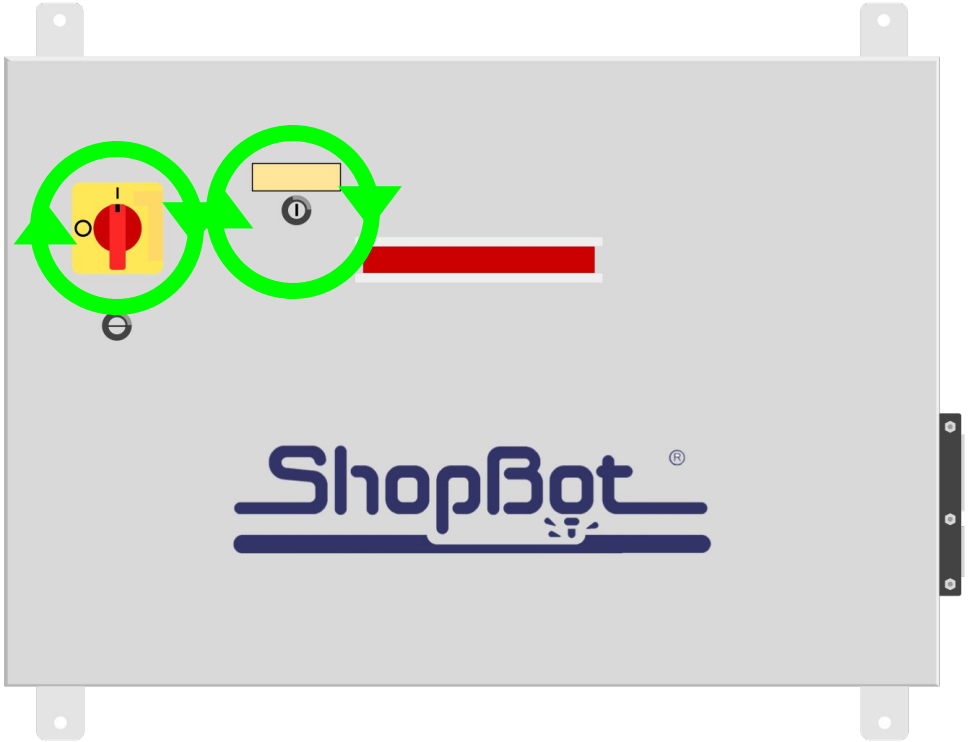
To power your machine on and prepare it for running; first make sure that the main power from the wall to your machine is switched on.

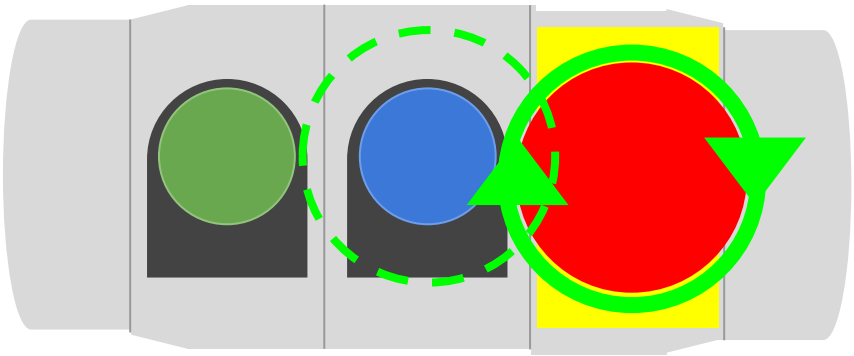
To connect power to the controls, turn the red disconnect handle on your control box clockwise. Next, insert the key for your interlock and turn it clockwise to “engaged”; turning this switch to “disengaged” will disable your spindle.

Next, on your remote pendant, twist the emergency stop “mushroom” button clockwise to make sure that it is not depressed.

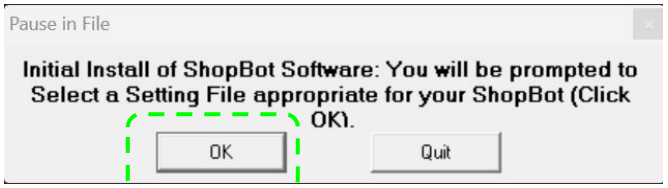
Finally, press the blue “reset” button on your pendant. Pressing this button will engage two contactors inside your control box, connected power to both your motors and your VFD.

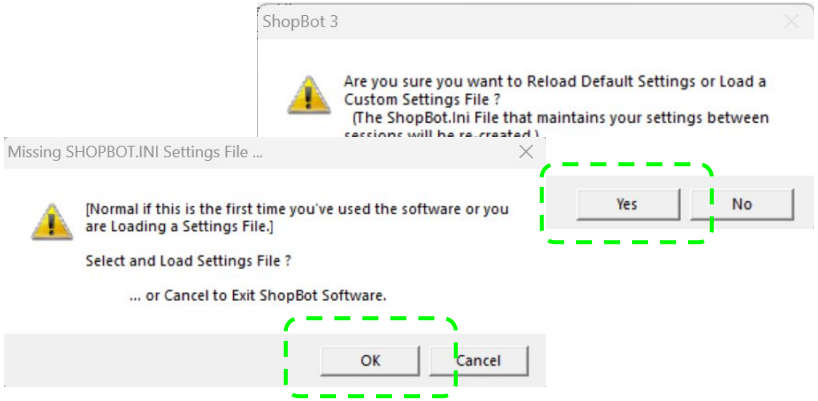
Now that you’re ready to run your software – first make sure that you’ve plugged the USB cable into the port next to the cable gland on your control box and connected the other end to the PC that you will use to control the ShopBot.



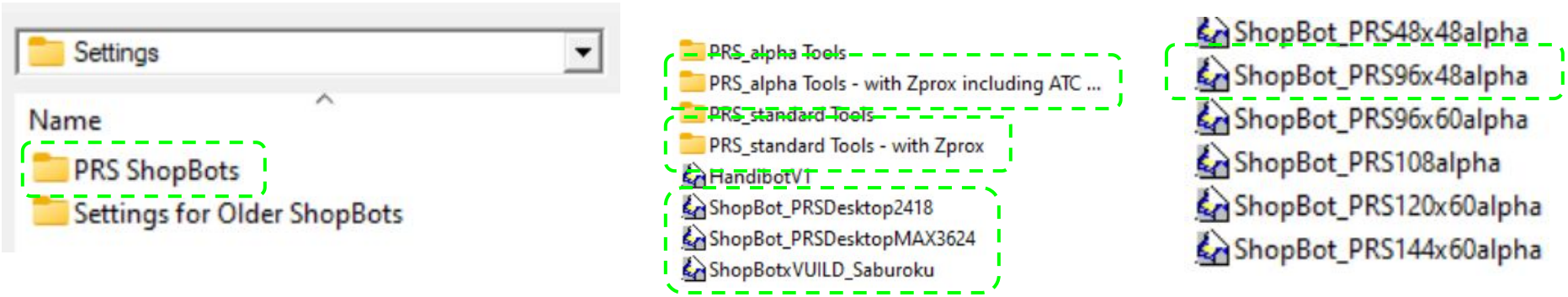


Launching SB3





Find the Sb3 icon on your desktop and double click to launch your software for the first time. You'll be presented with some dialog boxes about loading the settings file for your ShopBot. Don't worry, this setting can be changed if you think you've chosen incorrectly at a later time. For now, click "OK" on the first message, and "Yes" and "OK" on the subsequent messages until your file browser loads to let you search for your settings file.



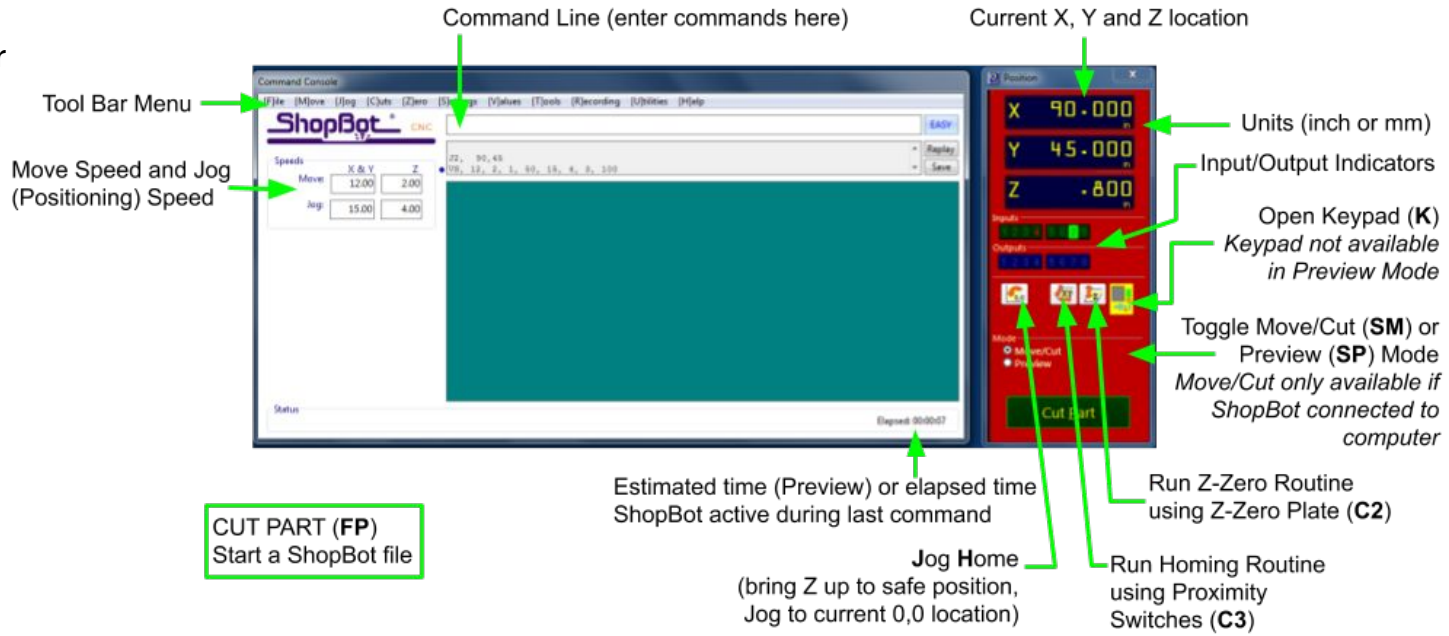
In the file browser, open the folder labelled "PRS ShopBots". If your machine is a Desktop or a Max (or the Saburoku; a version of the ShopBot sold in Japan), select the settings file that matches your machine here. If you have a alpha or standard gantry machine; open the folder for your machine type. All modern ShopBot machines have a ZProx so select the folder with that option. Inside the folder, find the machine size closest to the size of your machine.

Setting up your User Interface

Once your software launches, find the “digital readout (DRO)” also known as “The Red Position Window (TRPW)” and click on the blue “?” button

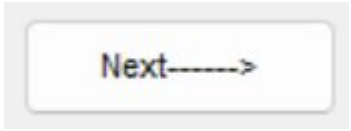
Switch your software to “Full” mode to access all of the controls and menus.

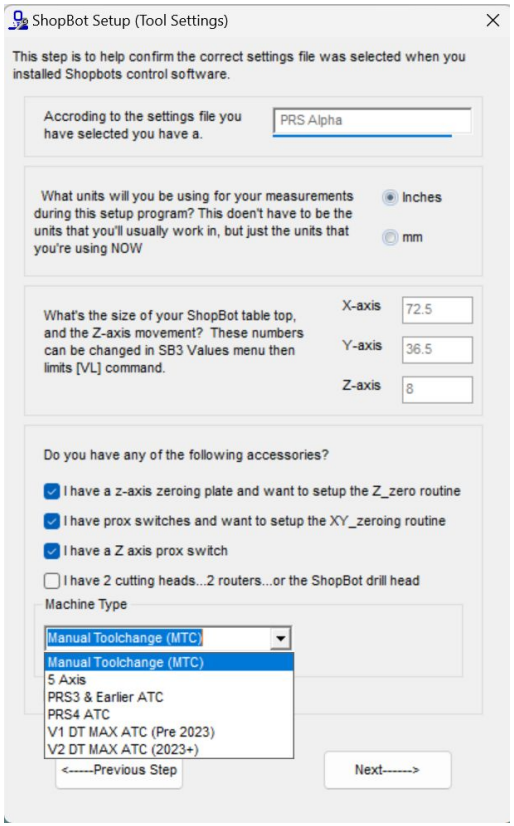
More details about the user interface and setup of your software are contained in the ShopBot handbook. Shown here is a brief overview of some of the main functions that you’ll be using on a daily basis in your software.



Running ShopBot Setup

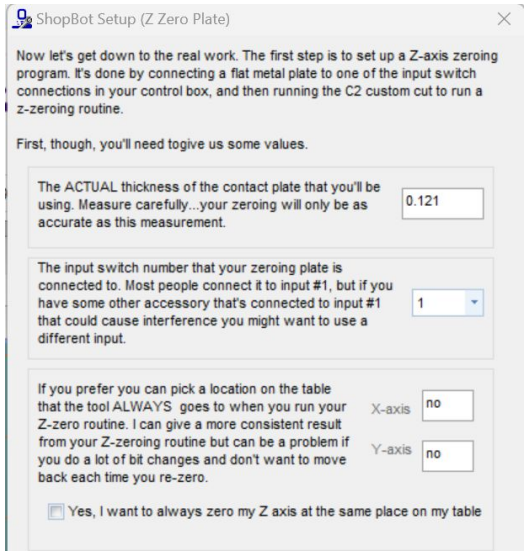
The ShopBot Setup app will help manage many of the customized settings for your machine. Open the app by clicking on the “Tools” menu and selecting “ShopBot Setup”



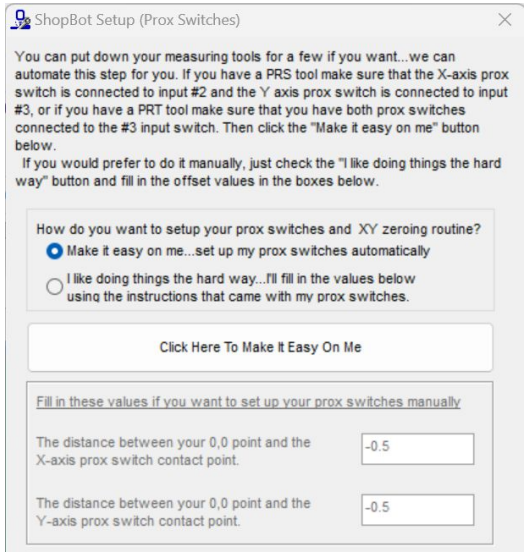


The setup app will take you through a number of steps; click the “Next” button at the bottom of each page to continue. Note: your settings will not be saved until you have clicked through all of the screens and pressed the “I’m Done” button.

On the “Tools Settings Page”, you’ll be able to select the units that you want to use for your position readout. You’ll also need to check the box next to “I have a Z axis prox switch” (older models did not have this sensor, but **all** modern ShopBots have a Z axis prox switch). Finally, here is where you’ll tell the software that your machine is an ATC if you’ve purchased an Automatic Tool Change package. Select PRS5 ATC from the list if you are building an ATC machine.



The next page contains your Z homing settings. The default values here will be automatically added to match your machine. You may need to change these settings if you’re using certain accessories, but the documentation for those accessories will instruct you on the necessary changes.



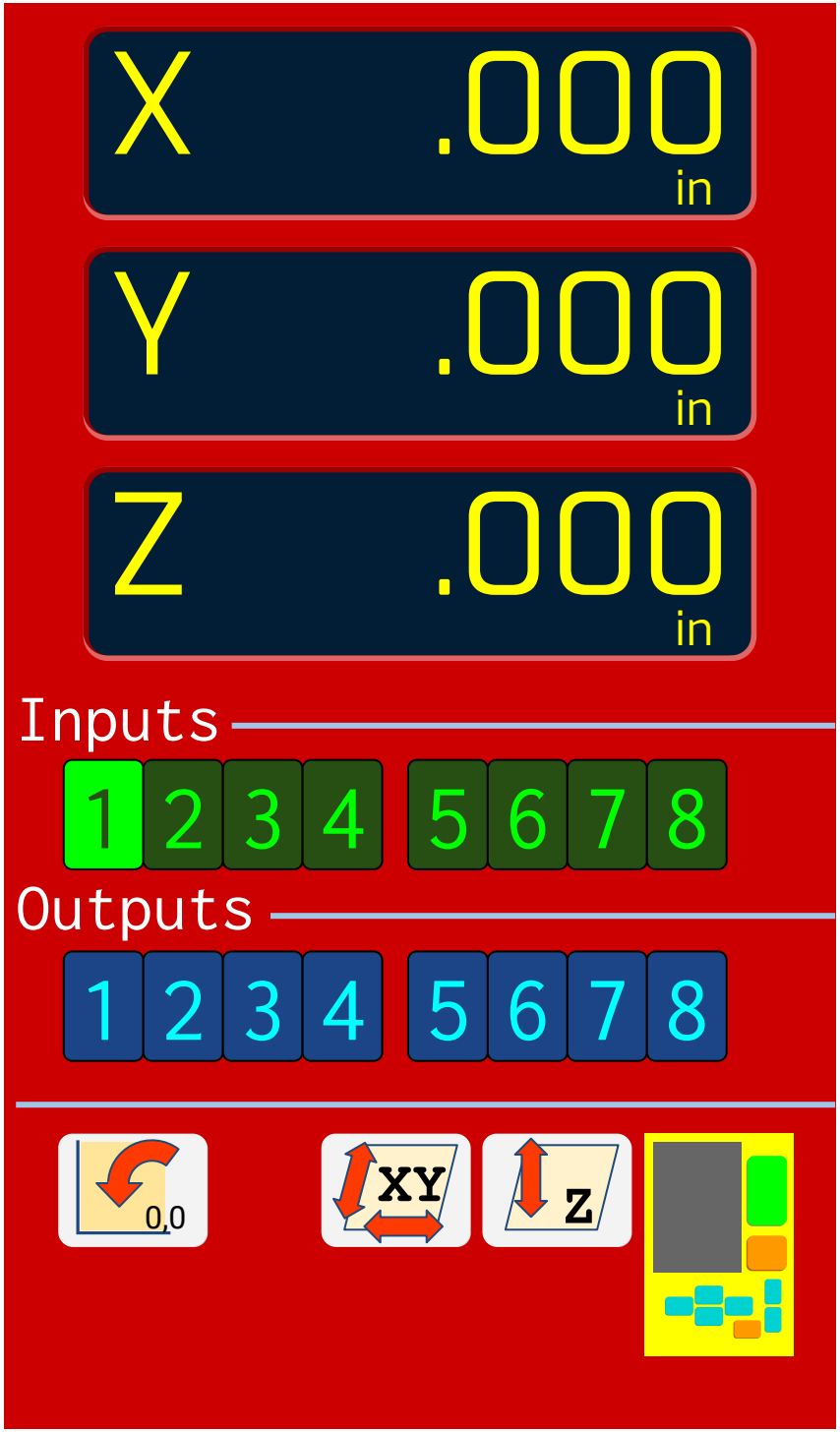
Next you’ll be presented with the settings for your X and Y axis homing. If this is your first time setting up a ShopBot; click the radio button labelled “Make it easy on me…”

Then click on the large button below to start the routine to set up your X/Y home position. On the next page we’ll walk through this routine to set up your home position.

Input/Output

Inputs Mapping		
Input Number	*Function*	*Lights up when…*
1	Z Zero Plate	Grounding clip (attached to bit) touches Z Zero Plate
2	X Axis Limit	The X Axis limit switch passes in front of the X Axis limit target
3	Y Axis Limit	The Y Axis limit switch passes in front of the Y Axis limit target
4	Stop	The machine is stopped due to a motor fault
5	Z Axis Limit	The Z Axis limit switch passes in front of the Z Axis limit target
6	Toolbar (ATC Only)	The toolbar is raised and ready for toolchanges
7	Tool Present (ATC Only)	A toolholder is present in the spindle
8	Drawbar Open (ATC Only)	The ATC Spindle drawbar is open

Outputs Mapping		
Output Number	*Function*	*Lights up when…*
1	Primary Spindle On	Grounding clip (attached to bit) touches Z Zero Plate
2	Secondary Spindle On	The X Axis limit switch passes in front of the X Axis limit target
3	-	-
4	Spindle Armed	The machine is stopped due to a motor fault
5	Air Drill/Knife	Lowers Air Drill or Knife Assembly for use
6	Air Drill/Knife	Turns on Air Drill or Knife
7	Air Drill	Lowers second Air Drill Assembly for Use
8	ATC/Air Drill	Opens ATC Spindle drawbar or turns on second Air Drill



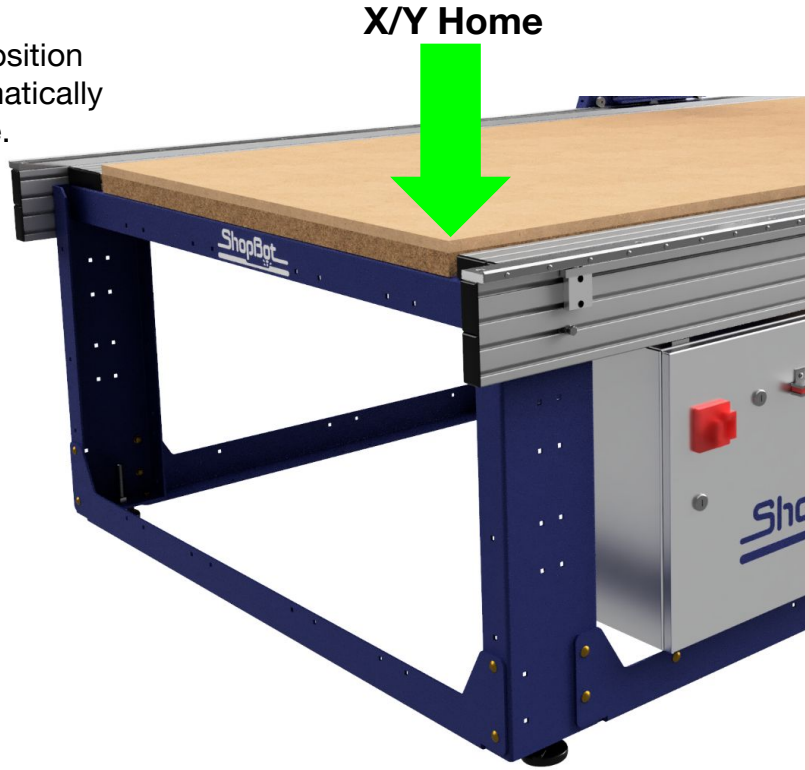
Homing your X and Y Axes

The “prox switch setup” routine will guide you through setting your home position according to your X and Y limit switches. You’ll first be asked if you want to open the manual control keypad to move to your desired home position; select “Yes”.

A window with a yellow background will appear on your screen – this is the manual control KeyPad; it allows you to move your machine in all axes using the arrow keys (page up/down for Z axis) on your keyboard or by clicking the buttons on your screen.

Use this control to move towards the X/Y Home corner of your table. Once you have the spindle centered over the home position (it helps to put a pointed bit in the spindle). Close the manual keypad.

You’ll be asked if you want to set your home position here, select “Yes”. The machine will then automatically touch off on your limit switches to record home.



Once this routine is finished, you’ll return to the ShopBot Setup App. Click “Next” to proceed to the final screen where you’ll click “I’m done” to save you settings.

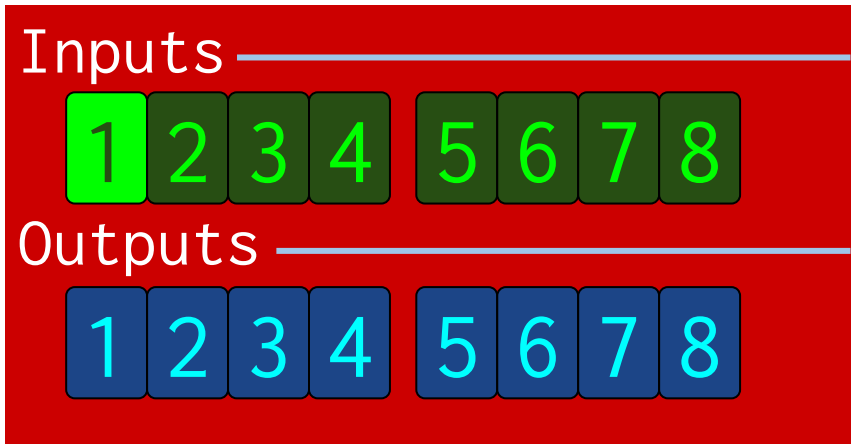
Now that you Home Position is set, you can always find it again by pressing the X/Y Home button on your position window, or by entering the keyboard command “C3” in your command console.

Homing your Z Axis

Your Z Axis Home position is set using your “Z Zero Plate”. The Z Zero plate works by detecting when any grounded surface on the machine comes into contact with the thin aluminum plate. The copper clip is connected to ground, so it can be clipped to your bit or collet nut to ground the tip of your bit. The Z axis will move down until it detects contact, record the position and deduct the thickness of the Z Zero plate to set your “Z Zero”.

To start the Z Zeroing routine, move your bit over the material to which you want to zero the z axis. Click the “Z Zero” button on the position window; or enter the command “C2” in the command console. You’ll see a prompt telling you to attach the grounding clip to you bit/collet nut and to place the z zero plate under the bit. To verify that your Z Zero plate is connected correctly; gently tap the Z Zero plate against the tip of your bit – you should see the number “1” input light up on your red position window.

Once you’re ready, click OK to start the routine. The Z Axis will descend, touch the plate once, lift up, then descend more slowly to touch the plate again for a precise reading. Make sure that there is no debris underneath the Z Zero plate when you take your measurement to ensure an accurate reading.

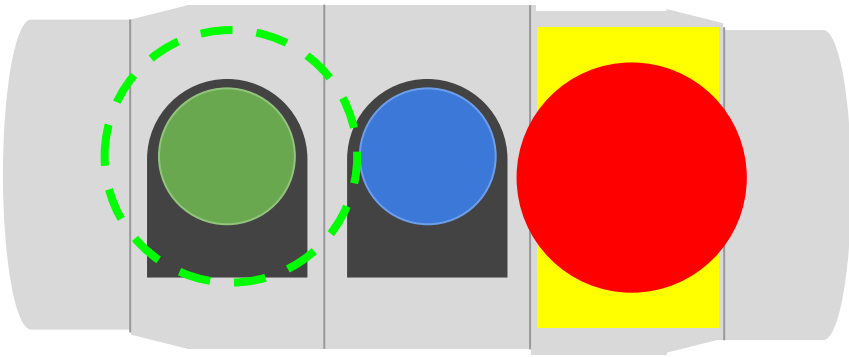


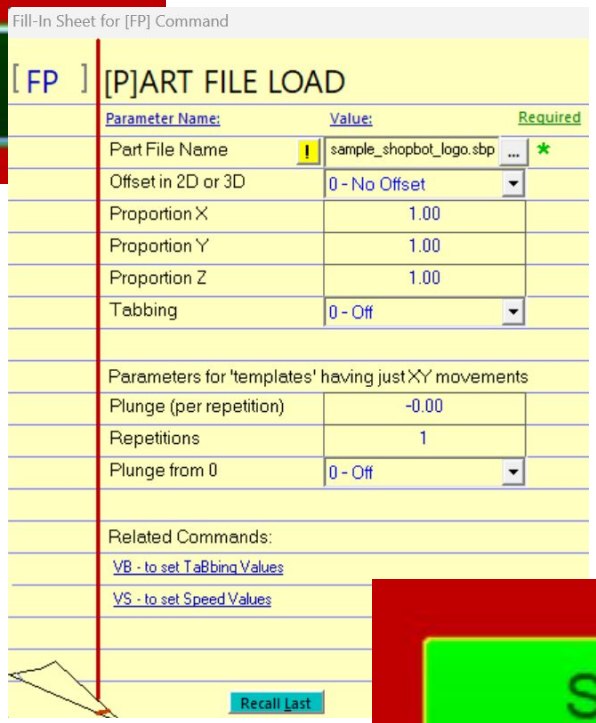
The next time that you home your machine, you’ll be asked if you want to restore the previous Z Zero measurement. If you answer yes, the Z axis will lift up to find the Z limit switch and restore the previous z zero point based on the offset recorded during the last z zero measurement.

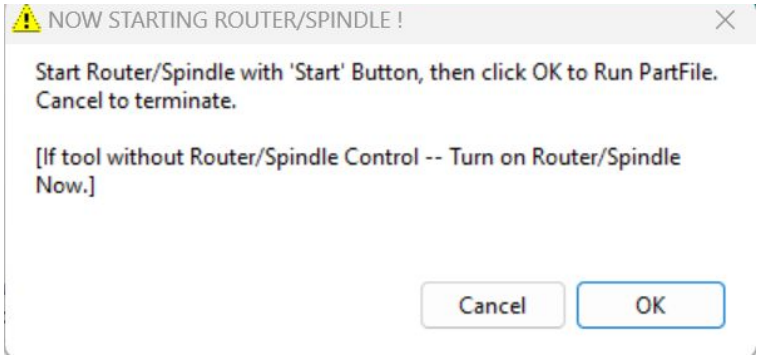
Starting a Cut File

To load a cut file into the ShopBot software, press the “Cut Part” button in the red position window; or enter the keyboard command “FP” in the command console. A file browser will appear – select your cut file (cut files have the extension “.sbp”). A yellow notepad sheet will appear – this fill in sheet provides some details about your file. To start running the code press the “START” button in the red position window or press the “Enter” key on your keyboard.

The code will begin to scroll past in the command console as the file starts up. When the file reaches a spindle start command, you’ll see a prompt on the screen warning you that the spindle is about to start. When you see this prompt, press the green button on your remote pendant to start the spindle. Once the spindle is running, click “OK” to begin cutting!





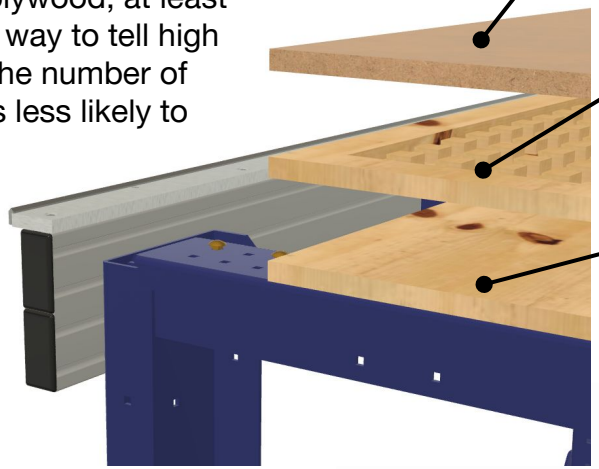


Building Your Machine Table

All machines have a “sacrificial” layer of material on which material to be cut can be placed and held down using screws, clamps, glue or vacuum. This layer is typically made from MDF for a handful of reasons. First, MDF is inexpensive and readily available in any hardware store. Second, MDF is soft enough that it will not damage your bit even if you cut through your material slightly and into the layer below. Finally, MDF is porous and when a vacuum pump is connected from below, it can pull air through the MDF and create a powerful holding force on your material.

All machines will also need a rigid base layer to support the sacrificial MDF layer. This layer should be made of high grade plywood, at least ¾” (20mm) thick; 1” (25mm) is even better. The quick way to tell high grade plywood from low quality plywood is to count the number of layers – more layers = better, stronger plywood that is less likely to warp over time.

If you’ll be using a vacuum pump with your machine to create a vacuum table you’ll need a third layer, referred to as a “plenum”, between the sacrificial layer and the base layer. The plenum acts as a diffuser to allow air to flow through the MDF layer and into ports located at the center of each vacuum “zone”



MDF Spoil Board (aka Waste Board, aka Bleeder Board for Vacuum Tables): Consumable surface on which the material you are cutting will rest.

Plywood/MDF Plenum (aka Waffle Grid): Only used on Vacuum Tables, distributes air flow through MDF to Vacuum Pump

Plywood Base Layer: Supports Spoil Board and Plenum (if present).

If you’re building a vacuum table, you’ll find designs for your plenum and base board in the “Vacuum Tables” folder in C:/SbParts on the PC that runs your ShopBot control software. How will you cut the plenum pattern into this layer of your table? Luckily you’re now the owner of a nearly complete ShopBot CNC! You can use the machine to prepare its own table.

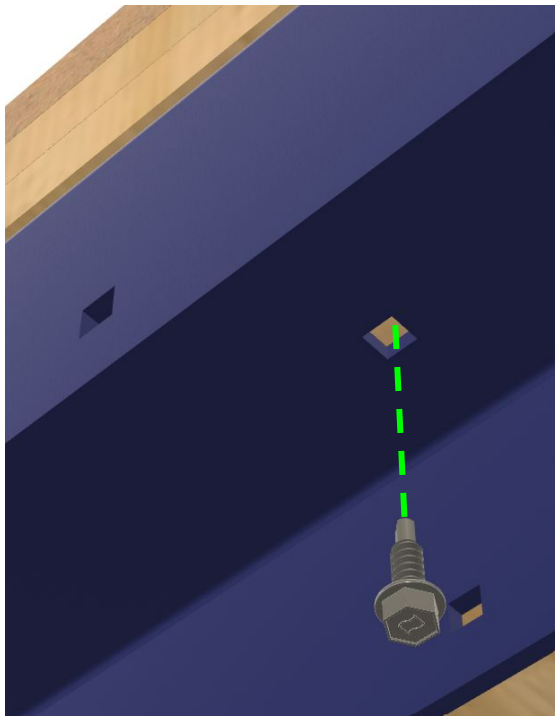
Attaching the Base Layer

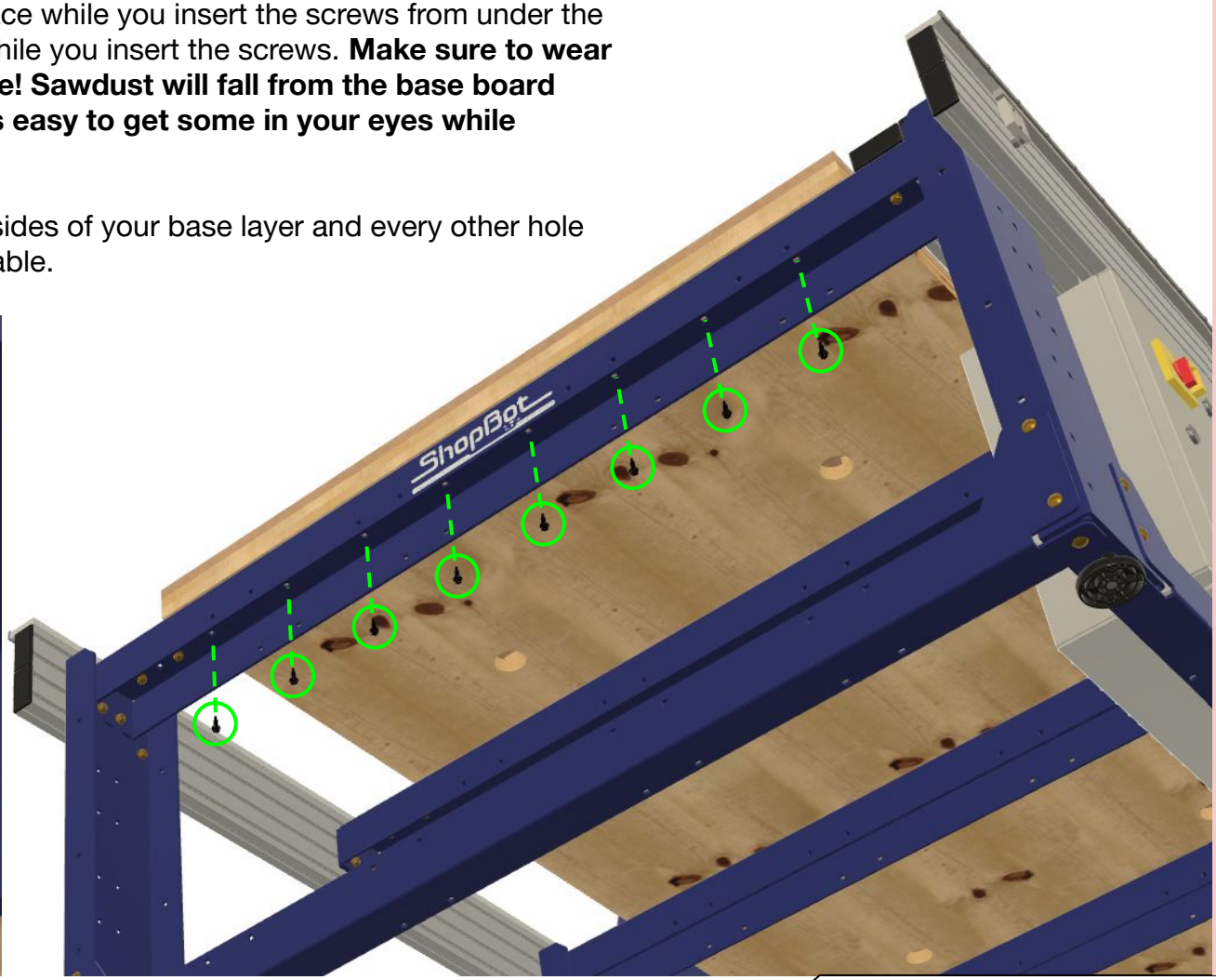
The base layer is secured the to the table steel using screws inserted from the underside of the cross support steel.

Place the base layer with the front edge lined up with the front edge of the cross support nearest your X=0 end of your table. Align the adjacent edge of the base layer **6.75” (170mm) from the inside face of the table side on the Y=0 side of your table**.

Use clamps to hold the base layer board in place while you insert the screws from under the machine; otherwise the base layer may shift while you insert the screws. **Make sure to wear eye protection while working under the table! Sawdust will fall from the base board while the screws are being inserted and it is easy to get some in your eyes while looking up at the screw you’re inserting!**

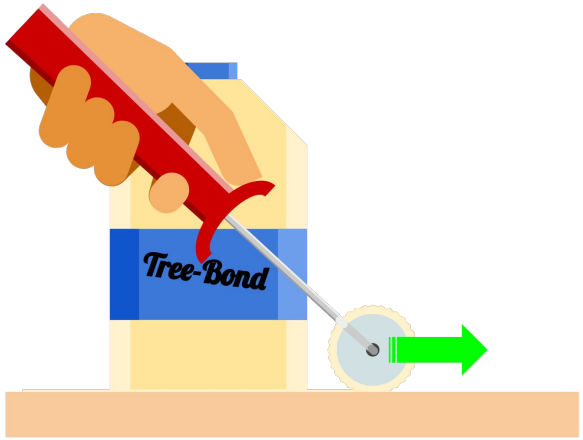
Insert screws in holes nearest the edge on all sides of your base layer and every other hole along the cross support in the center of your table.



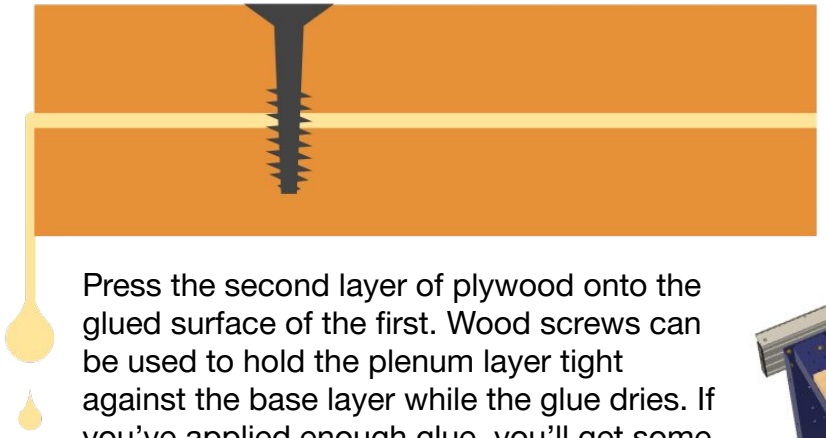


Building your Plenum

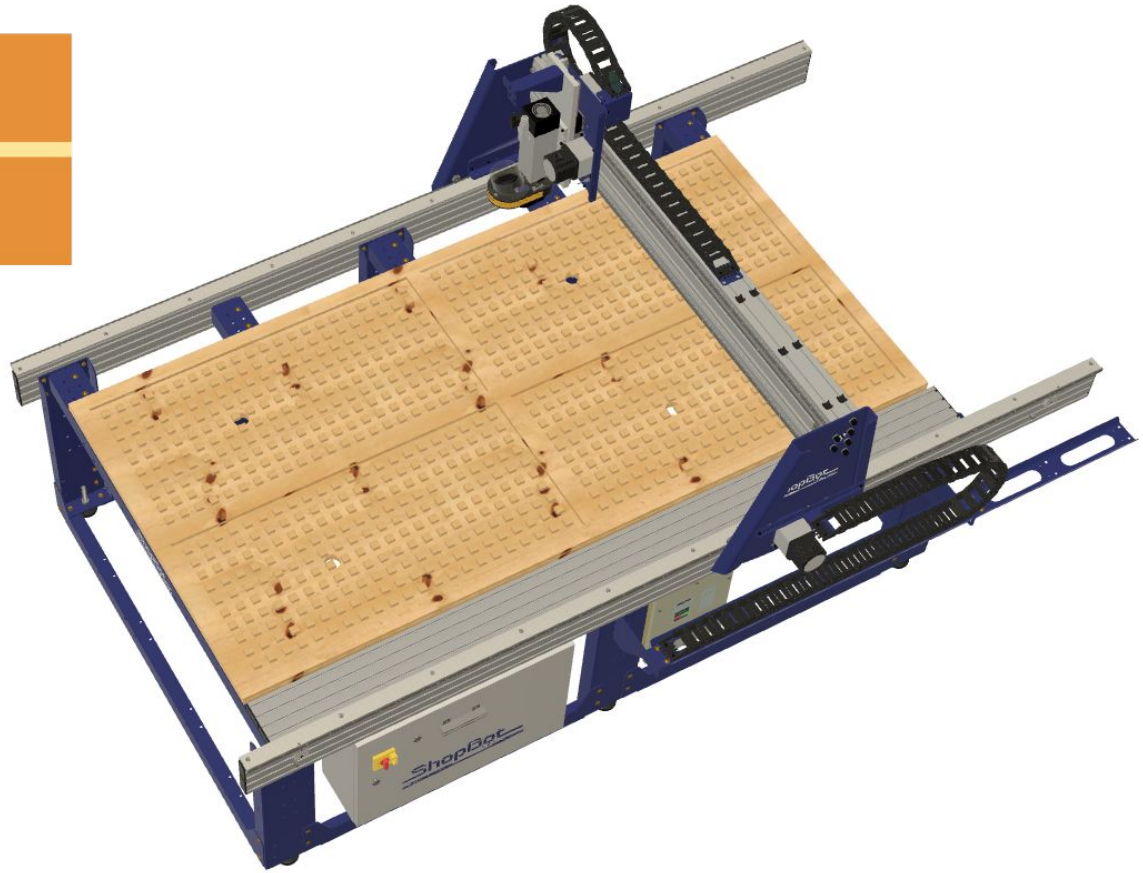
If you are building a vacuum table, the plenum layer is the "distributor" of air flow from the vacuum ports on the base of the table to the MDF "bleeder board". It is important that the plenum layer not be made of porous material – you'll need to either use cabinet grade plywood or if you are using MDF for you plenum; apply a polyurethane seal to the plenum after it is cut.



Before cutting the "waffle grid" pattern, the plenum layer should be bonded to the base layer using a generous application of wood glue. **A paint roller and a gallon of glue** will be what you need to cover an entire sheet of plywood adequately to secure the layer on top of it. Don't skimp!



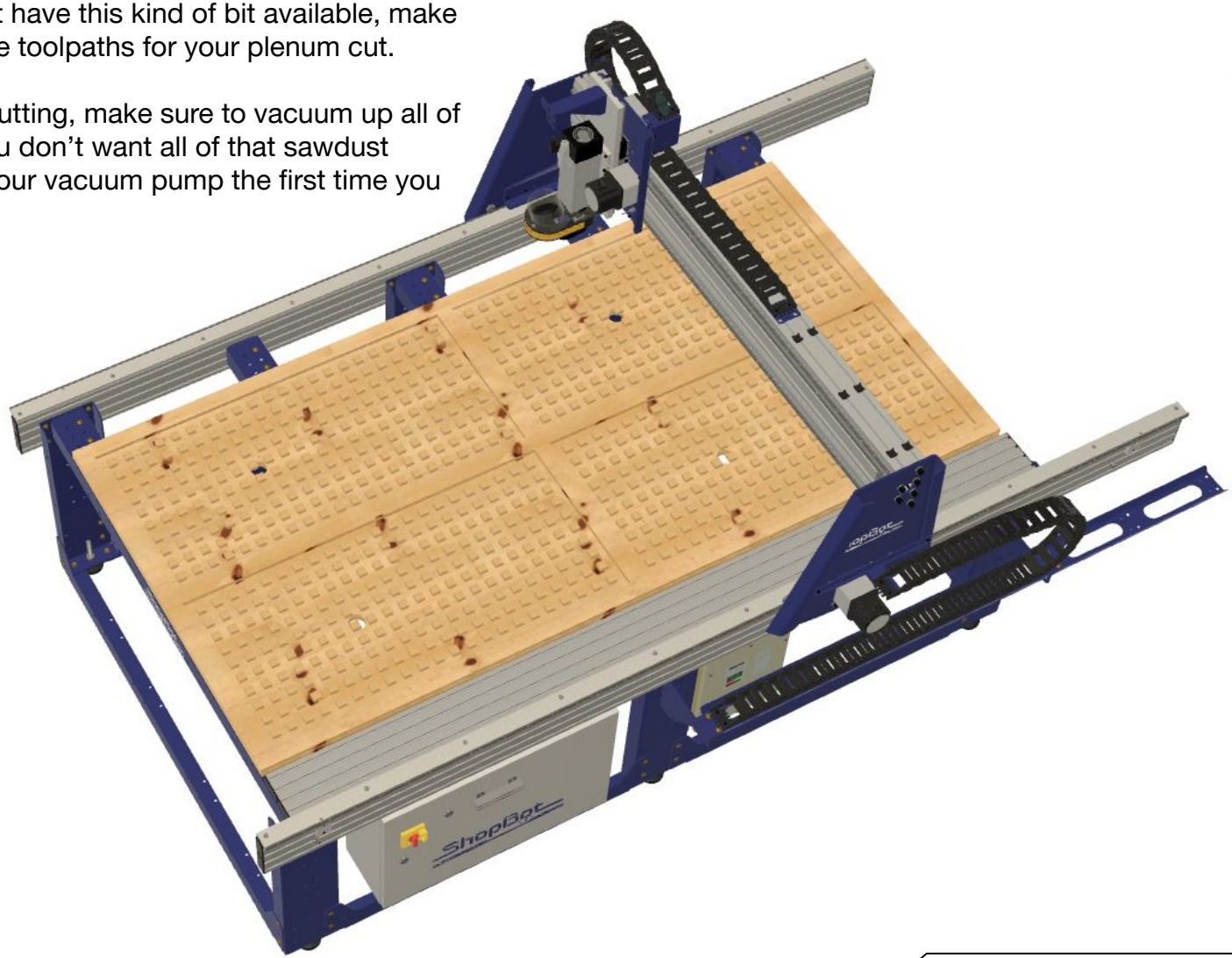
Press the second layer of plywood onto the glued surface of the first. Wood screws can be used to hold the plenum layer tight against the base layer while the glue dries. If you've applied enough glue, you'll get some drips coming from the sides of the wood. The glue is water soluble so a wet rag or paper towel will work well to clean up the mess.



Building your Plenum (Cont)

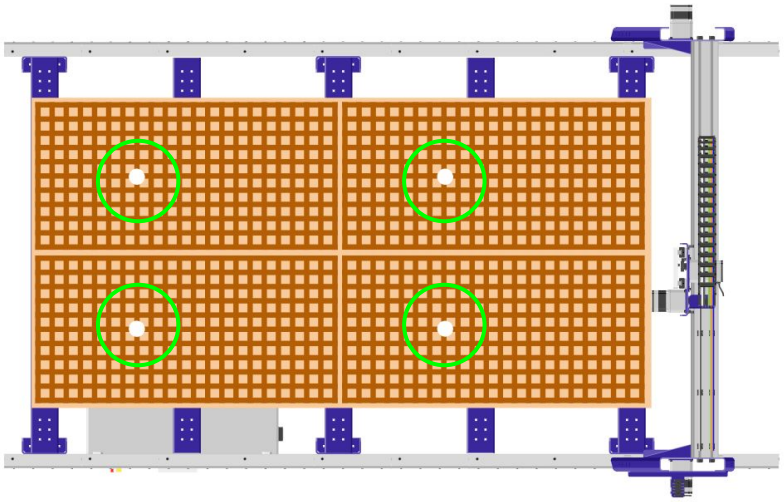
Once the glue has dried, remove the wood screws (so that you don't accidentally hit one while cutting out the air channels and vacuum ports on your plenum). Find the design file that matches your table size in the Vacuum Tables folder located in C:\SbParts\ on the PC where your control software is installed. Open the .crv file in VCarve. The recommended bit to cut your plenum is a 0.5" down cut or straight flute end mill. If you don't have this kind of bit available, make sure to adjust the bit choice in the toolpaths for your plenum cut.

Once your plenum has finished cutting, make sure to vacuum up all of the sawdust from your table – you don't want all of that sawdust getting sucked into the filter on your vacuum pump the first time you turn it on!



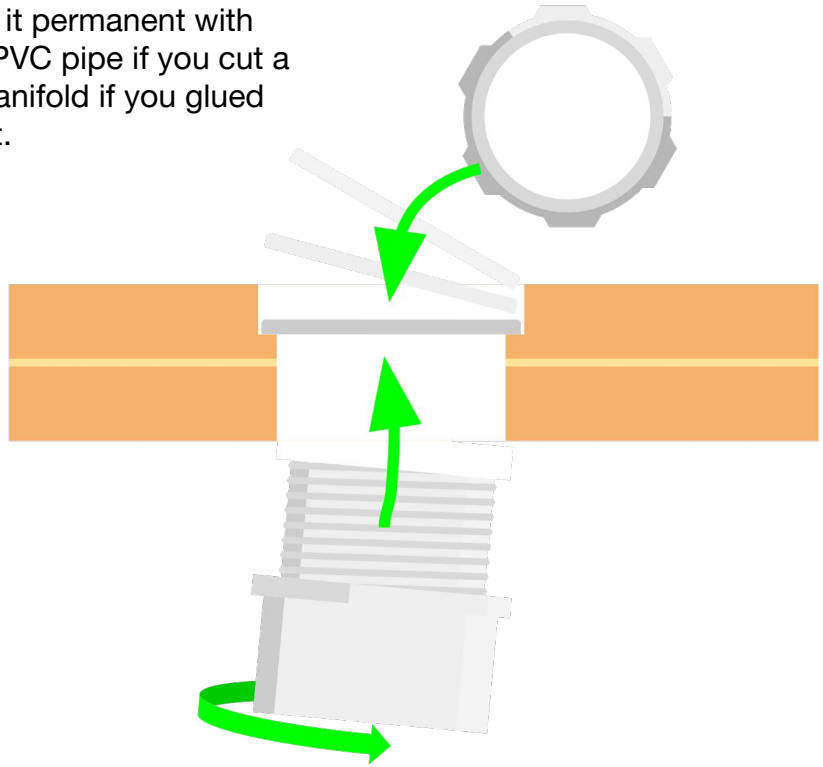
Plumbing your Vacuum System

If you purchased a vacuum system with your machine, you most likely also purchased a vacuum manifold. The vacuum manifold is an assembly of pipes that splits the inlet of your vacuum into multiple lines that will be connected to the different “zones” of your vacuum table. Each line can be turned on or off using the ball valve in line with the zone connection.



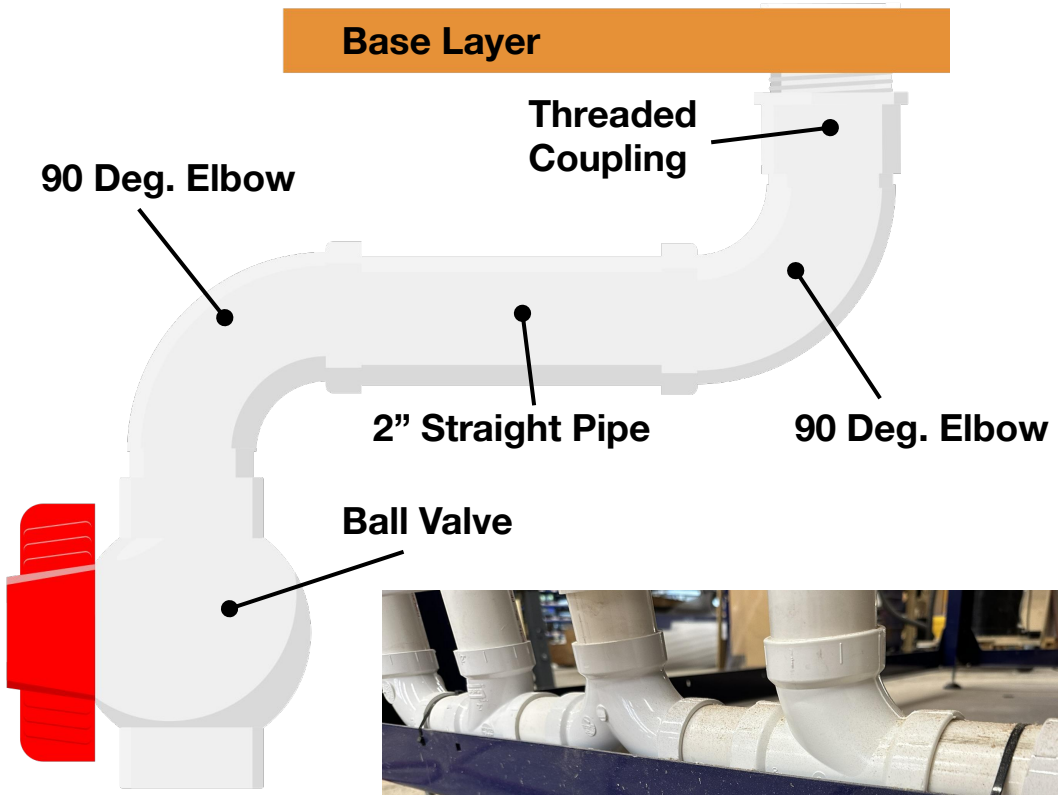
To install your manifold, start by dropping the threaded “nuts” into the cutouts on the top of your plenum. The protrusions on the edges of the nuts will lock into the pocket cut in the wood.

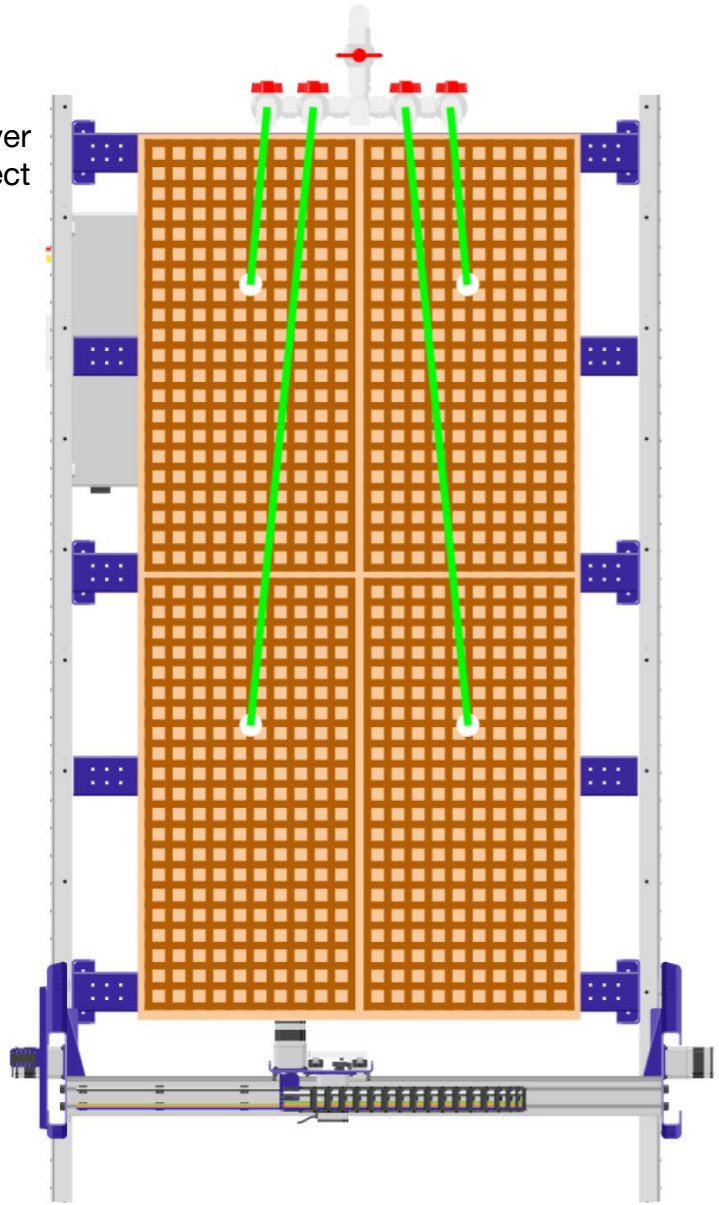
Apply teflon tape around each of the threaded PVC fittings included with your kit and screw them into the nuts from below the table. The rest of the vacuum system will be glued together using PVC cement; however it is important to “dry fit” all plumbing before making it permanent with cement. It is much easier to go out and buy more PVC pipe if you cut a piece too short than it is is to rebuild your entire manifold if you glued things before making sure the lengths were correct.



Plumbing your Vacuum System (Cont)

Attach the manifold to your table frame using zip ties – then insert elbow joints into the tops of the lines coming out of your manifold and the fittings threaded into the base layer of your table. Next, use a tape measure to measure the length of pipe needed to connect each line from the manifold to the inlets on the bottom of your table. Once you feel confident that you've got everything cut to the right length – begin applying cement to lock your vacuum plumbing in place.

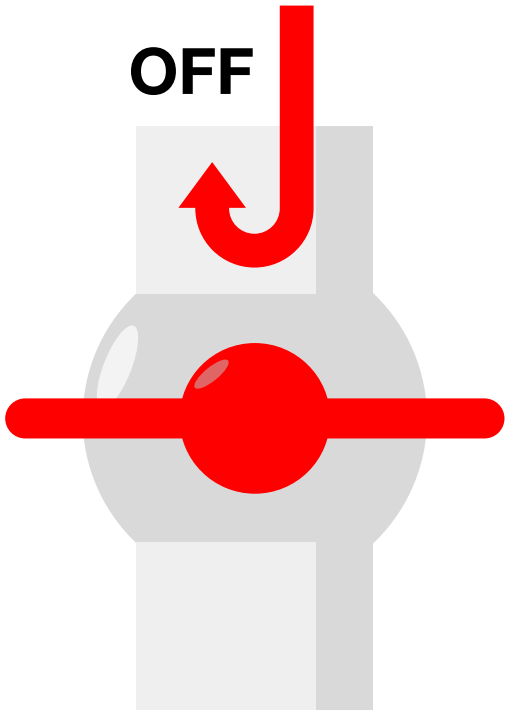


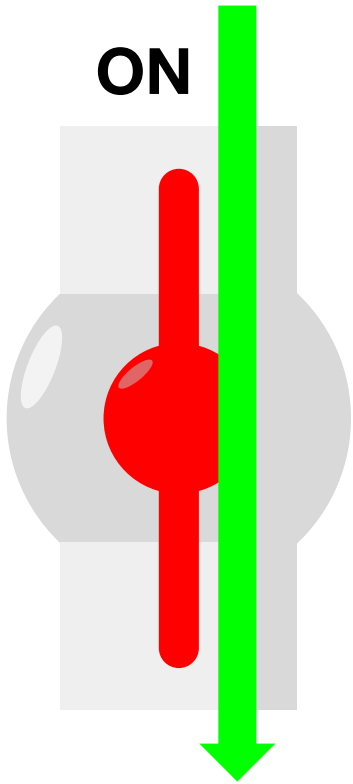


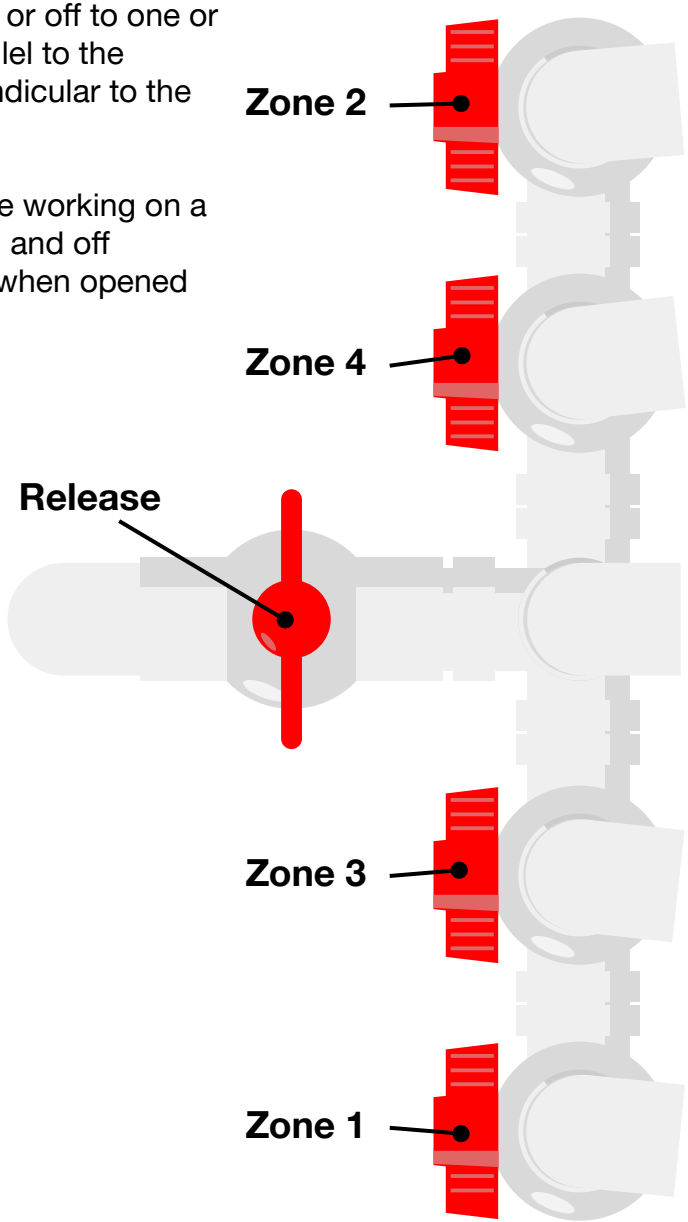
Adjusting your Vacuum Manifold

The ball valves on your vacuum manifold can be used to turn vacuum hold down on or off to one or more zones on your vacuum table. Rotating the handle of the valve so that it is parallel to the direction of airflow will turn the zone on; while rotating the handle so that it is perpendicular to the direction of airflow will turn the zone off.

The lone valve in the center of the manifold is a pressure release valve. When you are working on a set of cuts, loading and unloading sheets; you'll want to avoid turning your pump on and off frequently – this pressure release valve will remove vacuum pressure from the table when opened so that the material can be easily removed and another sheet loaded.

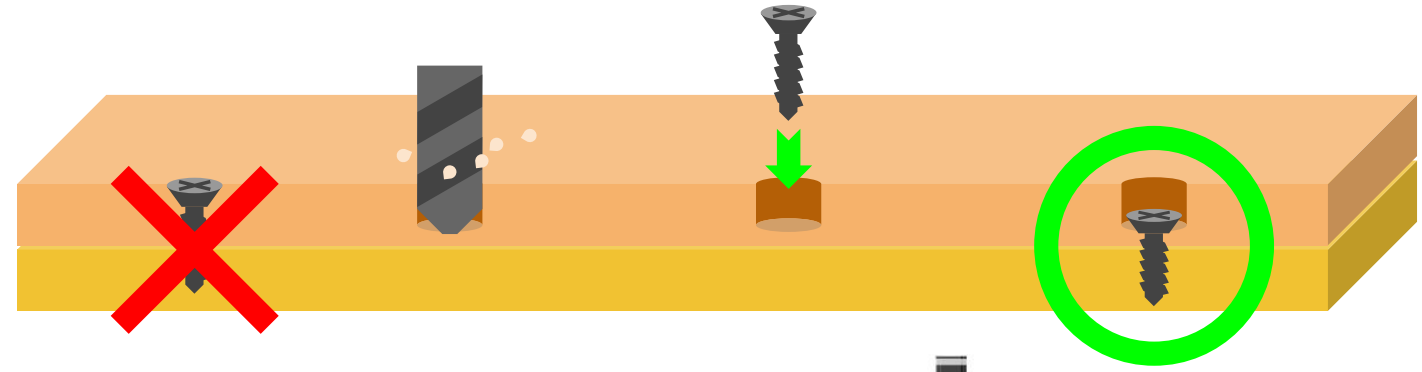


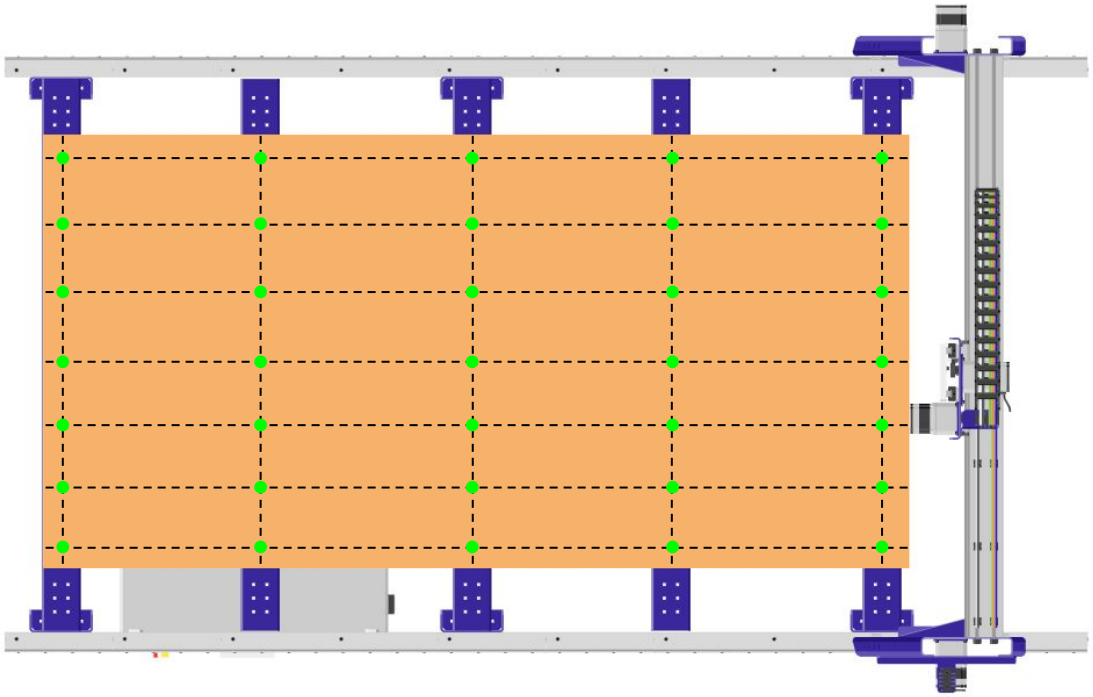




Attaching the Spoil Board

For non-vacuum tables, the spoilboard can either be attached by gluing a sheet of MDF to the base layer using a generous amount of wood glue – or the spoilboard can be screwed down onto the base layer using wood/drywall screws. Be sure to use a drill to counterbore your screw holes so that the heads of your screws sit well below the surface of your table top. This will prevent you from accidentally hitting screws when cutting – hitting screws causes a lot of sparks and a ruined bit.



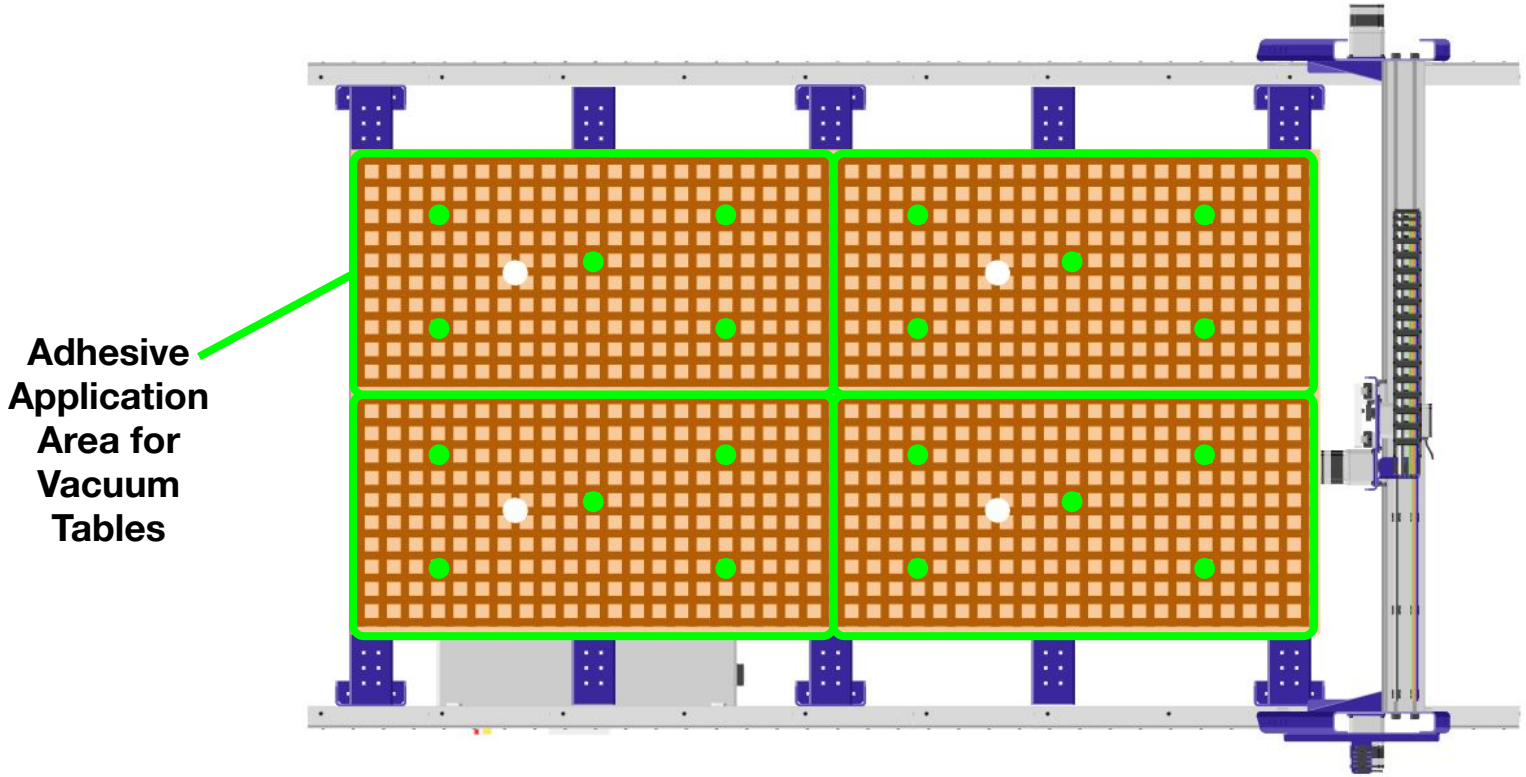


Attaching the Spoil Board (Cont)

if you're building a vacuum table, you can't cover the spoilboard with glue because that would block all air flow through the MDF – making your vacuum table quite useless!

Instead, use a construction adhesive like that can be dispensed from a tube and caulking gun; "Liquid Nail" is a commonly available example. Lay a bead of adhesive around the perimeter of your plenum layer and along the boundaries between your vacuum zones. Apply a few "dollops" of adhesive on 3 or 4 points in the central area of each vacuum zone. Then, carefully lower the MDF layer onto the plenum.

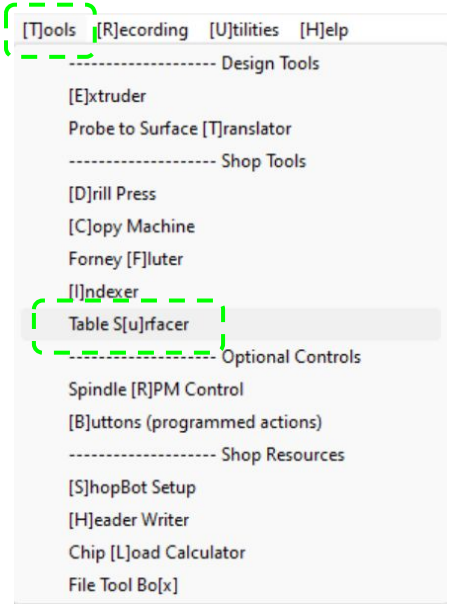
Once the MDF is in place for your vacuum table, open all the valves on your manifold (except the main bleeder valve at the center) and turn on your vacuum pump to pull the MDF down onto the plenum layer. Leave the pump running for at least 2 hours while the adhesive sets up.



Surfacing the Spoilboard

Make sure to wait for the adhesive holding your spoilboard to your plenum or base layer to dry before trying to surface your spoilboard. If the glue isn't completely set, the MDF spoilboard may peel up and be ruined during the surfacing process.

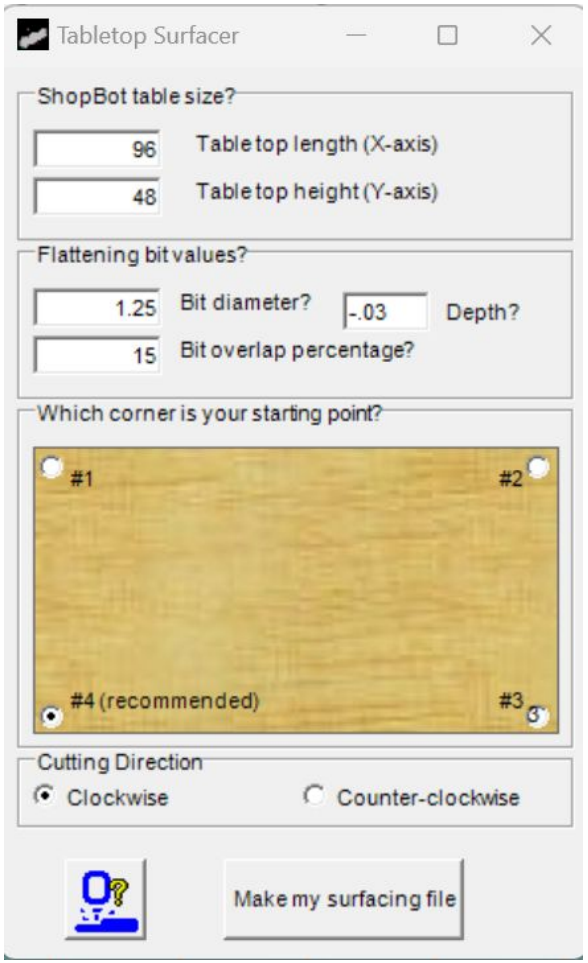
We've created a utility for surfacing your spoilboard which can be accessed through the ShopBot control software by opening the "Tools" menu and clicking "Table S[u]rfacer".



From the Table Surfacer interface, enter the information about your machine's table dimensions, the bit you'll be using and the depth of cut you want to make. The first time you surface your table, you may have to remove as much as 0.075" (2mm) of material to get a truly flat surface.

You'll know that you need to go deeper if there is a part of your table that is left untouched after the bit has gone over the entire table.

For a really fine surface, you'll want a "Bit overlap percentage" of 60 or higher. However, this first surfacing will be used to assess the alignment of the spindle; so keeping it at the more coarse 15% setting will make this assessment easier.

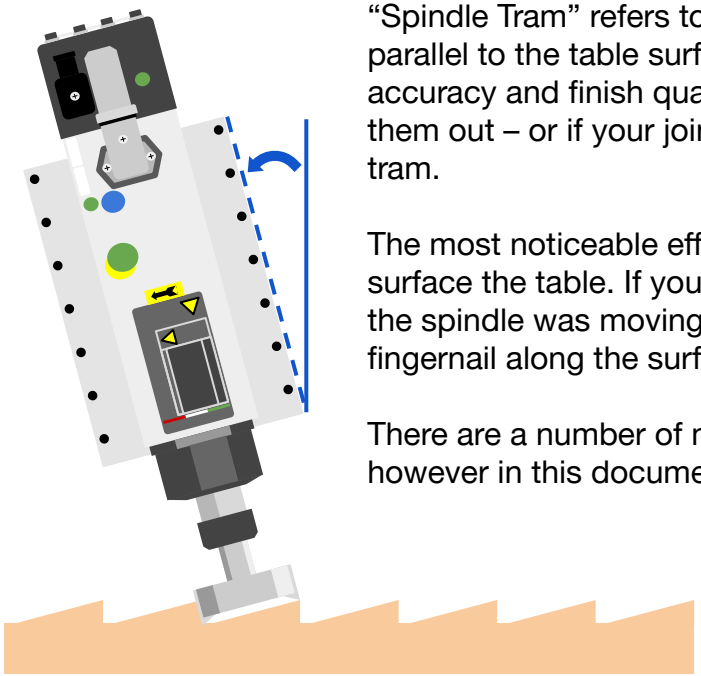


Once you've selected your settings; click "Make my surfacing file", click "Ok" on the next prompt to load the file explorer where you can save a cut file containing the code for your surfacing file.

Insert your selected bit into your spindle and run the Z Zeroing routine to home the bit to your table surface. Next, load your table surfacing cut file and start your cut. You'll be asked if you have zeroed your bit to your machine bed, answer "Y" to this question to continue. Follow the next prompts and start the cut.

If you notice that the bit is not touching the surface of your table at some points, go ahead and stop the file by clicking "STOP" on the screen or pressing the space bar on your keyboard; click "Quit" to exit your file – recreate your surfacing file with a deeper cut depth.

Checking Spindle Tram



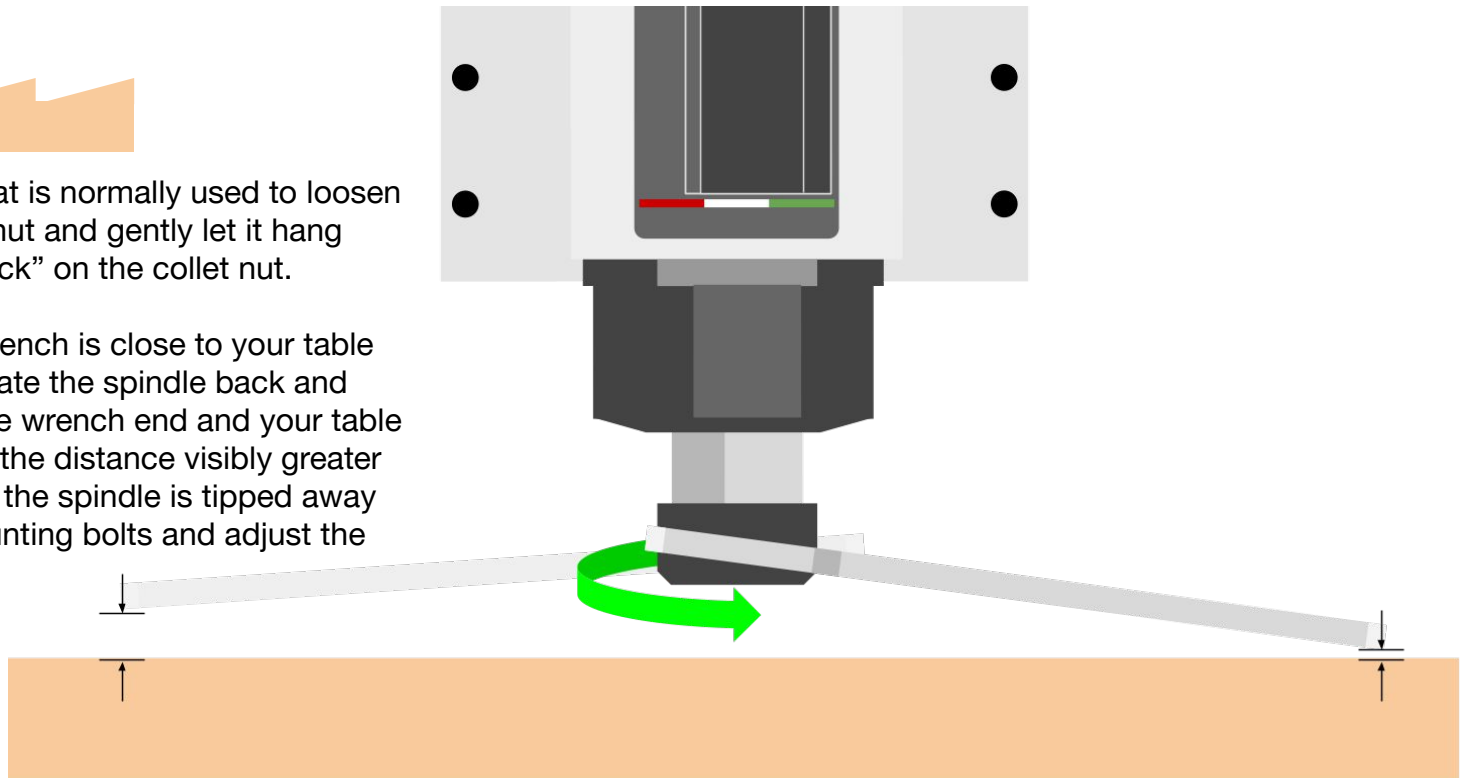
"Spindle Tram" refers to the alignment of the spindle rotation axis with a vertical line that is perfectly parallel to the table surface of your machine. Spindle tram is important because it will effect the accuracy and finish quality of your cuts. If you notice grooves on the sides of your parts after you cut them out – or if your joints aren't fitting properly – there's a good chance that your spindle is out of tram.

The most noticeable effect of an out of tram spindle will be ridges present in your spoil board after you surface the table. If your spindle plate is not attached straight, you'll notice grooves in the cuts where the spindle was moving in the X axis during surfacing. You can detect these grooves by running your fingernail along the surface of the table.

There are a number of measurement devices that can be inserted into a spindle to help with tramming – however in this document, we'll cover a way to do it with just the parts included with your spindle kit.

Take your spindle's spanner wrench that is normally used to loosen the collet nut – press it onto the collet nut and gently let it hang free; you should be able to get it to "stick" on the collet nut.

Lower the Z axis until the end of the wrench is close to your table surface. You should then be able to rotate the spindle back and forth to check the distance between the wrench end and your table surface on both sides of the spindle. If the distance visibly greater on one side than the other, that means the spindle is tipped away from that side. Loosen the spindle mounting bolts and adjust the spindle, retighten and check again.



Maintenance (Daily)

In order of importance…

1. **Spindle Warmup** – **Even if your machine is sitting idle between gigs;** to prolong the life of your spindle, run the spindle warmup routine by entering the command "**C5**" in the command console. This will keep your spindle well lubricated and free of internal corrosion; especially if you live near the ocean or in a humid area.
2. **Check bits and collets** - Bits wear out, they get dull and sometimes they break. Other than pushing a bit too hard for its diameter or flute count – the main reason bits break is poor collet grip. **Collets are consumables** they are good for 600-700 hours of cutting if well cared for. To keep your collets in good shape; make sure to remove any sawdust that became packed into the kerf cuts that must be able to compress in order to firmly grip the shank of a bit.
3. **Square your gantry** - Once your motors are powered on, the two motors that power the X axis will not come out of sync without issuing a warning to the user that a motor driver fault has occurred. To achieve the most consistent cuts, after you turn power on to your machine, you can quickly pull the gantry up to the X axis hard stops until the pinion gears on both sides of the gantry are resting against the hard stops – then press the reset button to power on the motors and lock the gantry alignment.
4. **Check pinion gears** - Your pinion gears are made from slightly softer steel than your drive rack; this is by design so that the relatively inexpensive and easy to replace pinion gears wear over time instead of the more expensive and difficult to replace drive rack. As the teeth on your pinions wear, you will occasionally need to re-engage the pinions with the rack to eliminate backlash and extend the life of your pinions. This is done using the same procedure that was outlined for attaching your X Axis Motors. Checking for backlash is easy; with the motors powered on (blue reset button pressed after powering on machine) try to push each axis back and forth – you should not be able to feel any movement; if you hear a "clicking" sound or are able to wiggle the axis back and forth slightly, it is time to inspect and adjust your pinions.

Maintenance (Long Term)

Every 3 Months (Heavy use 40+ hrs/week) to 6 Months(Light use ~ 20hrs/week)

1. **Apply grease to rack** – Apply a blob of grease to the teeth on your rack every 6”. Run the machine back and forth along the axis to which you applied to grease to spread it across each tooth on the rack.
2. **Clean your V-rails** - Sawdust and other debris can build up on the surface of your V-rails (X-Axis). This debris will cause small “bumps” in the motion of your X-Axis which could be noticeable as flaws in your cuts if you’re doing surfacing operations with a large diameter bit. Use a scotchbrite or other light abrasive pad to remove the stuck on debris without damaging the hardened steel V-rails.
3. **Check for software updates** - We’re always trying to be responsive to customer requests for new features and improvements in our software. Make sure that you’ve got the latest software loaded so that you can take advantage of improvements. If there are things you’d like to see in the software, let us know!
4. **Check spindle tram** - Using the same process that you used to tram your spindle during machine assembly; confirm that you spindle is trammed correctly.

Every 6 Months (Heavy use 40+ hrs/week) to 12 Months(Light use ~ 20hrs/week)

1. **Replace all pinions** – Contact ShopBot for a set of replacement pinions for your machine. Replace all pinions at the same time (just like tires on a car).
2. **Replace frequently used collets** - Worn out collets will affect cut quality and potentially cause broken bits. A new collet is a lot cheaper than a new bit!