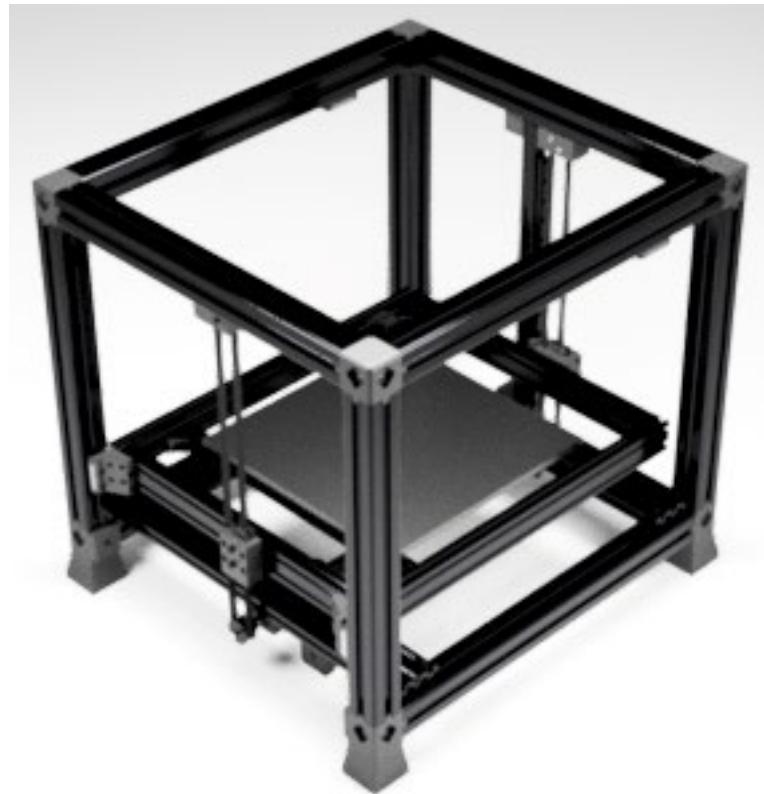


# **Blackbox CE Mechanical Assembly:**

## **03. DIY Heated Bed**



### **Change Log**

Version	Description
1	Initial release for Blackbox Refresh.
1.1	STL kit contained extra model.

### **Tools**

- Hex Wrenches
- Reamers
- Electric Drill
- Metric Tape Measure
- Carpenters Square
- Blue Painters Tape
- Soldering Iron with Heatset Insert Tip Installed
- Medium Strength Thread Locker (Blue Locktite)

- Small Hand Vise or Small Arbor Press
- M3 Tap
- Hand Tap Wrench

## Parts

QTY	Description
2	T-Slot_20x20mm_Nut6_373mm_CE
8	20x20_Corner_Bracket
26	Tnut_20Series_M4
24	DIN125_M4_Washer
16	ISO7380_M4_8mm_BHHS
2	T-Slot_20x40mm_Nut6_470.5mm_CE
2	T-Slot_20x40mm_Nut6_373mm_CE
8	Tnut_20Series_M3
8	DIN912_M3_14mm_SHCS
4	DIN912_M3_10mm_SHCS
4	DIN912_M3_35mm_SHCS
8	M4_6x5mm_Heat_Set_Insert
8	DIN916_M3_6mm_Set_Screw
4	DIN912_M4_6mm_SHCS
4	DIN912_M4_40mm_SHCS
4	DIN7991_M4_25mm_FHHS
4	DIN7991_M4_25mm_FHHS
4	DIN7991_M4_35mm_FHHS
4	DIN912_M3_50mm_SHCS
2	DIN912_M4_8mm_SHCS
2	GT2_434t_Belt_9x868mm_(1.52mm)
0	Dummy_Plate_300x300

## Printed Parts

QTY	Description	Version	Link
1	DIY Heated Bed STL Kit (includes all models listed below)	1.1	<a href="#">Link</a>
4	Print_Bed_Level_Alignment_Jig_(50)_CE	6	<a href="#">Link</a>
2	Print_Standarded_Bed_Frame_Alignment_Jig_(61.5)	2	<a href="#">Link</a>
2	Print_Standarded_Bed_Frame_Alignment_Jig_(69)	1	<a href="#">Link</a>
1	Print_Z-Axis_Belt_Tensioner_Installation_Tool_(158.986)_CE	4	<a href="#">Link</a>
1	Print_Z-Axis_Bracket_Rear_CE	12	<a href="#">Link</a>
1	Print_Z-Axis_Bracket_Front_CE	8	<a href="#">Link</a>
1	Print_Z-Axis_Belt_Tensioner_Left_Part_01_(1.52mm_Belt)_CE	21	<a href="#">Link</a>
1	Print_Z-Axis_Belt_Tensioner_Left_Part_02_(1.52mm_Belt)	10	<a href="#">Link</a>
1	Print_Z-Axis_Belt_Tensioner_Right_Part_01_(1.52mm_Belt)	25	<a href="#">Link</a>
1	Print_Z-Axis_Belt_Tensioner_Right_Part_02_(1.52mm_Belt)	16	<a href="#">Link</a>
1	Print_Z-Axis_Belt_Tensioner_Right_Part_03_CE	25	<a href="#">Link</a>
1	Print_ZChainMount_Top	4	<a href="#">Link</a>
2	Print_Z-Axis_Left_Bed_Frame_Installation_Tool_(3.5)_CE	2	<a href="#">Link</a>
1	Print_Z_Chain_Mount_Top_Installation_Tool_(170.25)_CE	3	<a href="#">Link</a>
8	Print_2020_Corner_Bracket_Lock_Part_01_CE	3	<a href="#">Link</a>
16	Print_2020_Corner_Bracket_Lock_Part_02_CE	2	<a href="#">Link</a>

## Step 1 – Preparation

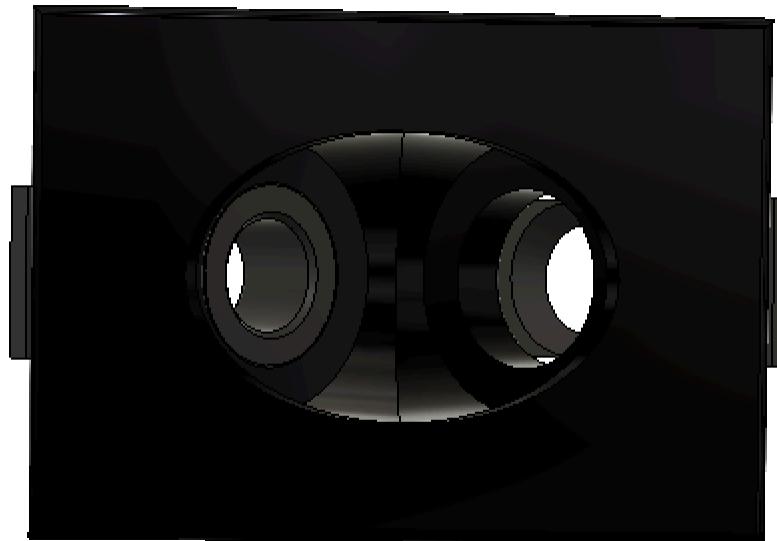
Find a flat surface which will be large enough to hold your bed frame. The assembled bed frame dimensions are 470.5mm x 413mm. Lay out all the remaining 2020 and 2040 extrusions for identification. There are two 2040 lengths: 470.5mm (x2) and 373mm (x2). The 2020 extrusions are also 373mm. The 470.5mm extrusions will define the front (and back) of the machine. For the bed frame section, the Installation Tools, the Alignment Jigs, and the Alignment Blocks may be printed in a less expensive material such as PLA. You will be securing your MGN12 Cartridges installed to the vertical linear rails to the bed frame. In all three instances, the MGN12 cartridge can easily slide off the linear rail at the bottom and become damaged. It is recommended that additional blue painters tape be wrapped around each vertical linear rail and the extrusion it is mounted to near the bottom. There is lots of different types of hardware used in this guide. It is best to lay out all the required hardware identified in each step. The profiles of the 2020 and 2040 rails are somewhat delicate. Do not overtighten any hardware going into a roll-in nut installed to a 2020 or 2040 extrusion to prevent deformation. The lengths of hardware are not substitutable, and a shorter length will prevent proper hold strength while a longer length will deform the 2020 or 2040 profile. You must request or acquire the proper hardware specified in the guide. Hardware going through printed parts can be substituted only with adjustments made to the associated printed part. The printed leveling blocks and printed installation tools are necessary for the proper alignment of the Z-Axis. The printed Bed Alignment Jigs are not always necessary and may not be suited for the bed you are planning to install. The kit frame extrusions are electrically conductive, and you may need to install a provision for providing grounding of the bed frame to prevent electrocution depending on your bed setup. It is also recommended to install a thermal switch to the bottom of your bed plate heater. This will be discussed at the end of the guide.

## Step 2 – Outer Frame

Gather the eight 2020 Corner Brackets. Place Print\_2020\_Corner\_Bracket\_Lock\_Part\_01\_CE on the outside of a 2020 Corner Bracket as shown.



Now insert a Print\_2020\_Corner\_Bracket\_Lock\_Part\_02\_CE through one of the holes of the 2020 Corner Bracket until it is flush with the bracket and locked into the printed Part 01.



Repeat for the other hole of the 2020 Corner Bracket with another printed Part 02.



Repeat these steps for the remaining 2020 Corner Brackets. Start with a 2040 extrusion of 470.5 and install a M4 Slot 6 roll-in nut as show below.



Place a 2020 Corner Bracket on top of the 2040 extrusion to line up with the threaded hole of the M4 Slot 6 roll-in nut. Insert an M4x8 BHHS through a M4 washer and loosely install into the M4 Slot 6 roll-in nuts.



Repeat these steps at the other end of the same 2040 extrusion using another M4 Slot 6 roll-in nut, 2020 Corner Bracket, M4x8 BHHS, and M4 washer.



Perform the above steps on the other 2040 extrusion of 470.5mm using two M4 Slot 6 roll-in nuts, two 2020 Corner Brackets, two M4x8 BHHS, and two M4 washers. Locate one of the 373mm 2040 extrusions and place in front of you. Install two M4 Slot 6 roll-in nuts as shown below.



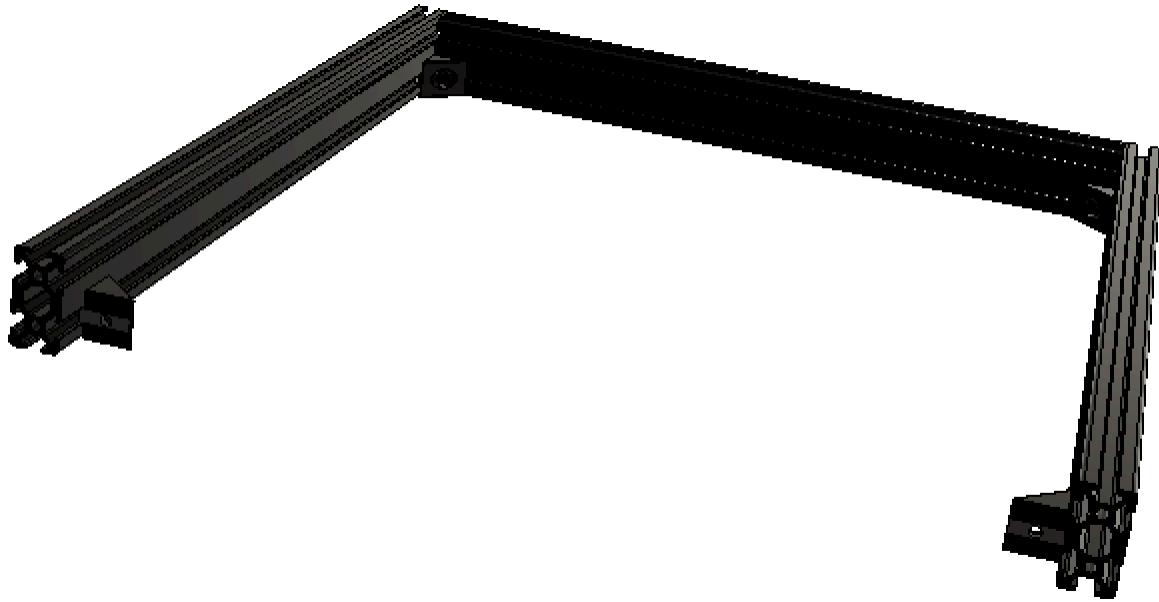
Repeat this for the other 2040 373mm extrusion with two more M4 Slot 6 roll-in nuts. Turn one of the assembled 470.5 2040 extrusion upright with the corner brackets closer to your work surface. Butt the end of one 373mm 2040 extrusion to the 470.5 2040 extrusion so the threads of the M4 Slot 6 roll-in nut of the 373mm 2040 extrusion line up with the 2020 Corner Bracket of the 470.5mm 2040 extrusion. You may need to move the M4 Slot 6 roll-in nut in the 373mm 2040 extrusion. Secure the two extrusions together via the 2020 Corner Bracket loosely using an M4x8 BHHS through an M4 washer.



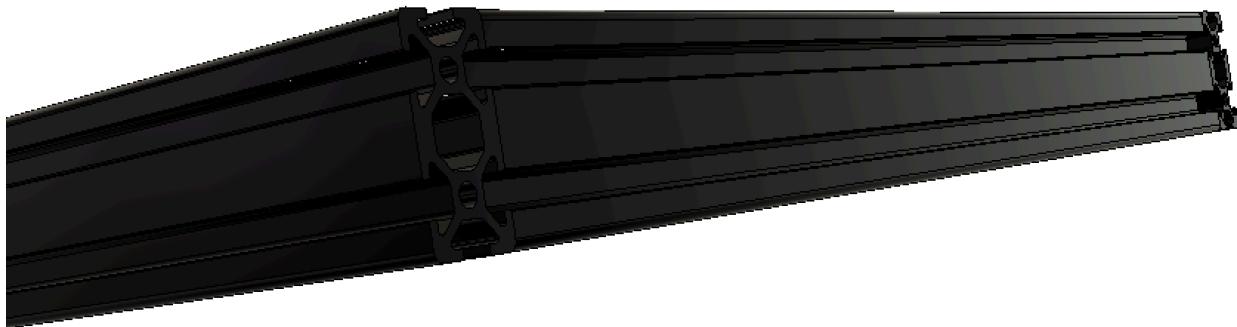
Be certain the outside face of the 373mm 2040 extrusion is flush with the end of the 470.5mm 2040 extrusion.



Secure the remaining assembled 470.5mm 2040 extrusion to the 373mm 2040 extrusion via the 2020 Corner Bracket loosely with an M4x8 BHHS through an M4 washer.



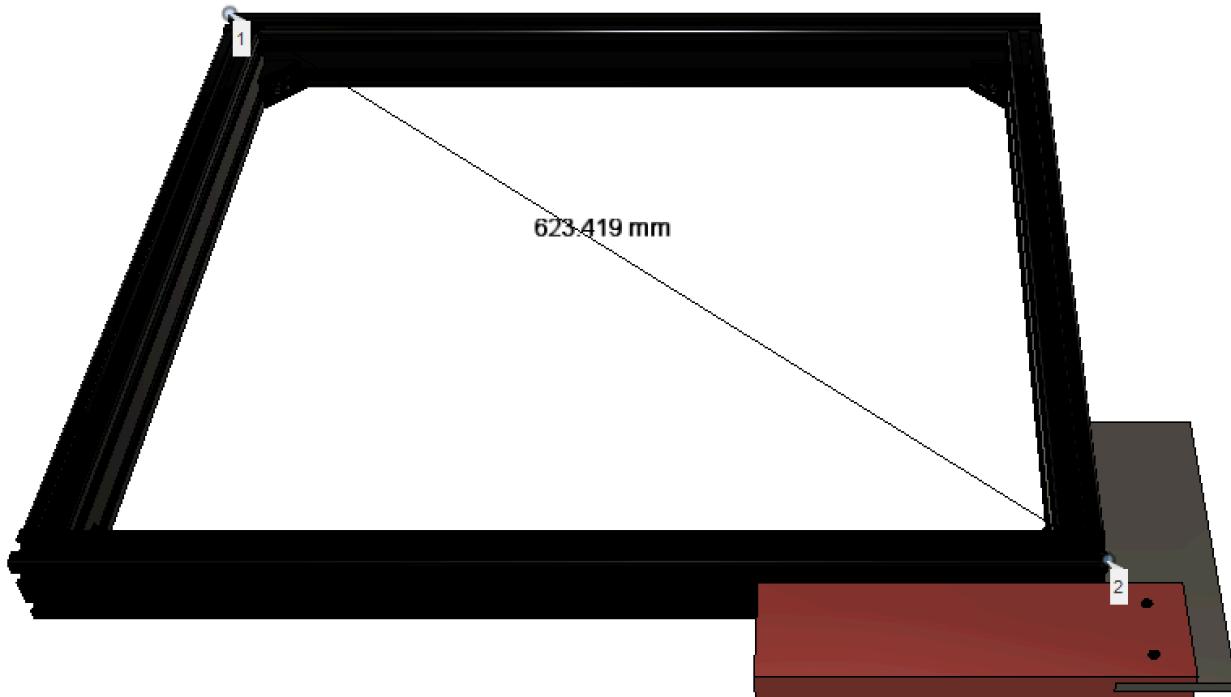
Again, be certain the outside face of the 373mm 2040 extrusion is flush with the end of the 470.5mm 2040 extrusion.



Secure the remaining 373mm 2040 extrusion to the bed frame via the two 2020 Corner Brackets loosely by using an M4x8 BHHS through an M4 washer at each end.



Using a carpenters square, check that each outside corner of the bed frame is 90 degrees and the 373mm extrusion is flush with the 470.5mm extrusion. Fully tighten the M4x8 BHHS as you move from corner to corner. Also measure the outermost opposing corners of the bed frame and check that the distance between them is 623.419mm. (Whatever value you manage to measure needs to be the same when you measure the other two opposing corners).

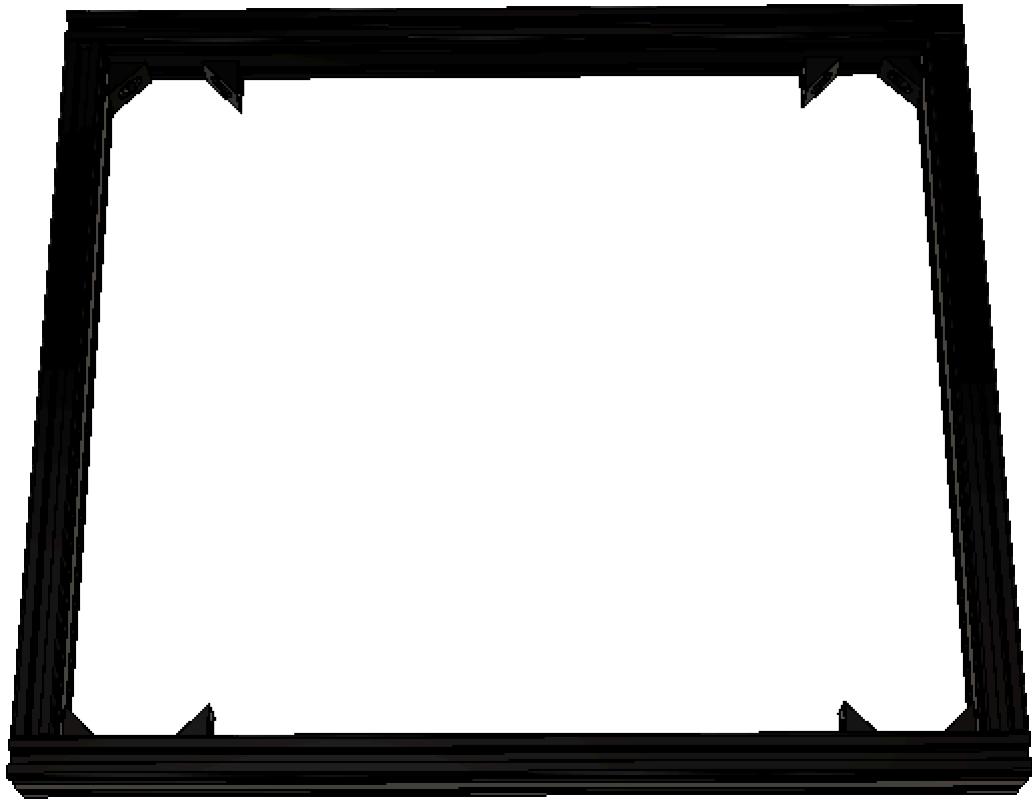


### Step 3 – Bed Supports

Install two M4 Slot 6 roll-in nuts into the rear 470.5mm 2040 extrusion as shown.



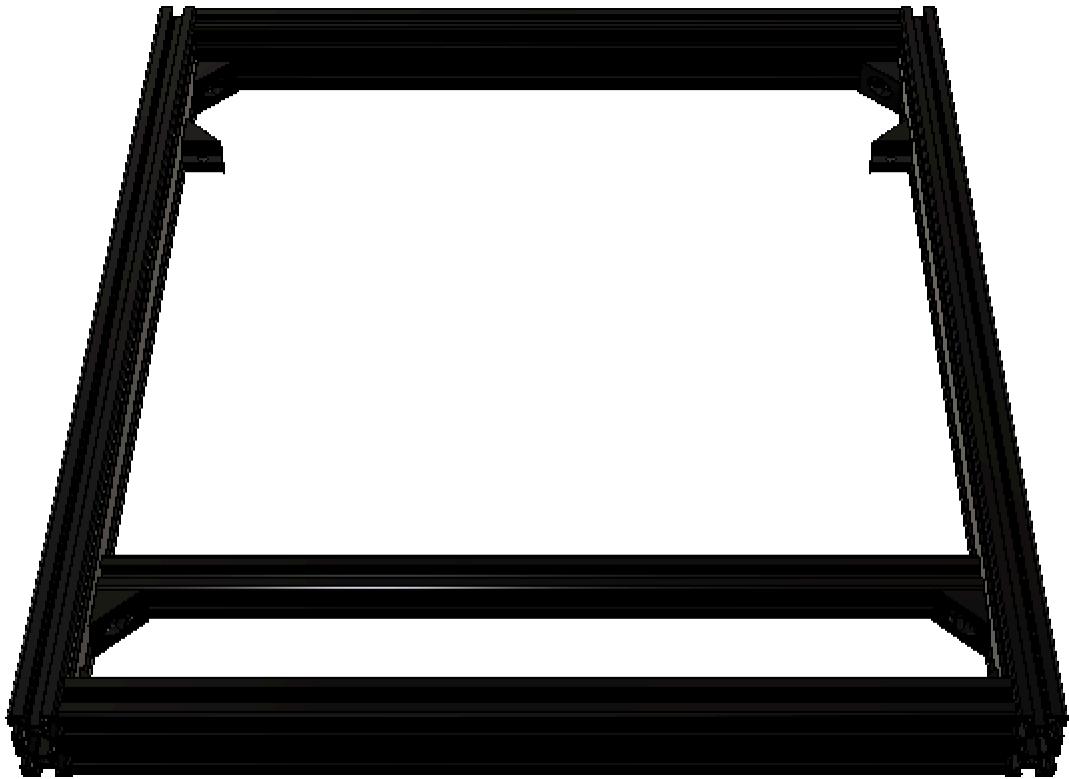
Repeat this for the front 470.5mm 2040 extrusion with two additional M4 Slot 6 roll-in nuts. Place a 2020 Corner bracket over each installed M4 Slot 6 roll-in nut and align with the threaded hole in the M4 Slot 6 roll-in nut. Loosely secure each 2020 Corner Bracket with an M4x8 BHHS through an M4 washer.



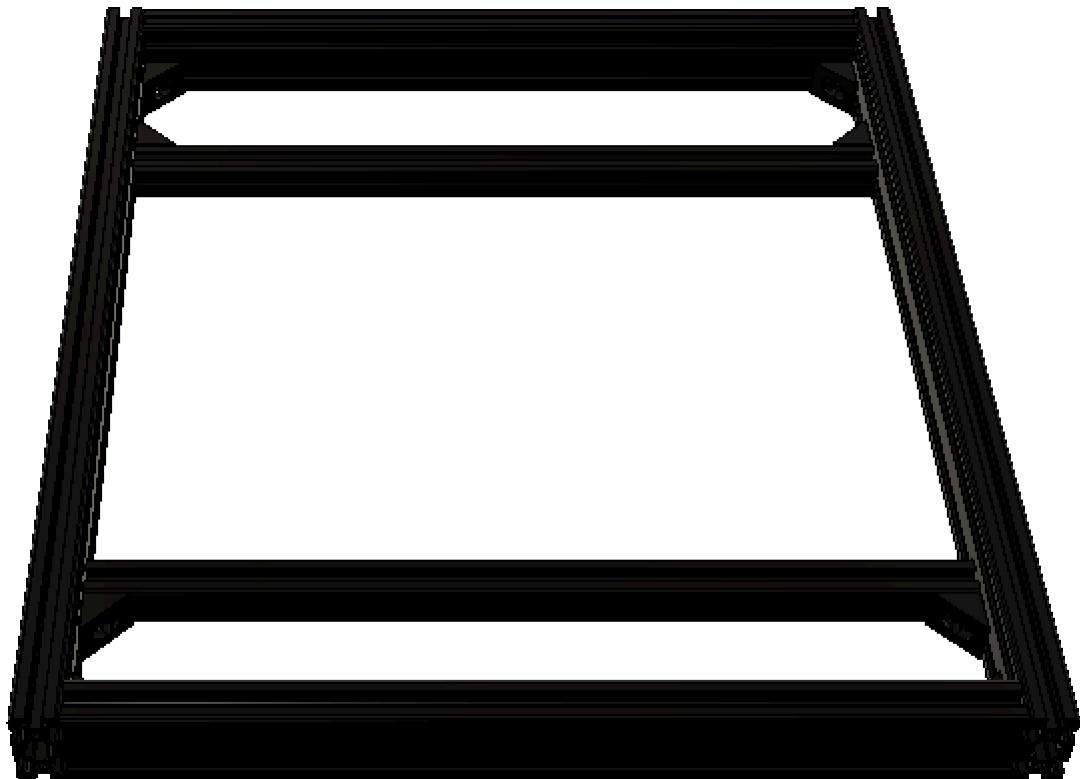
Place a 2020 extrusion of 373mm in front of you. Install two M4 Slot 6 roll-in nuts as shown.



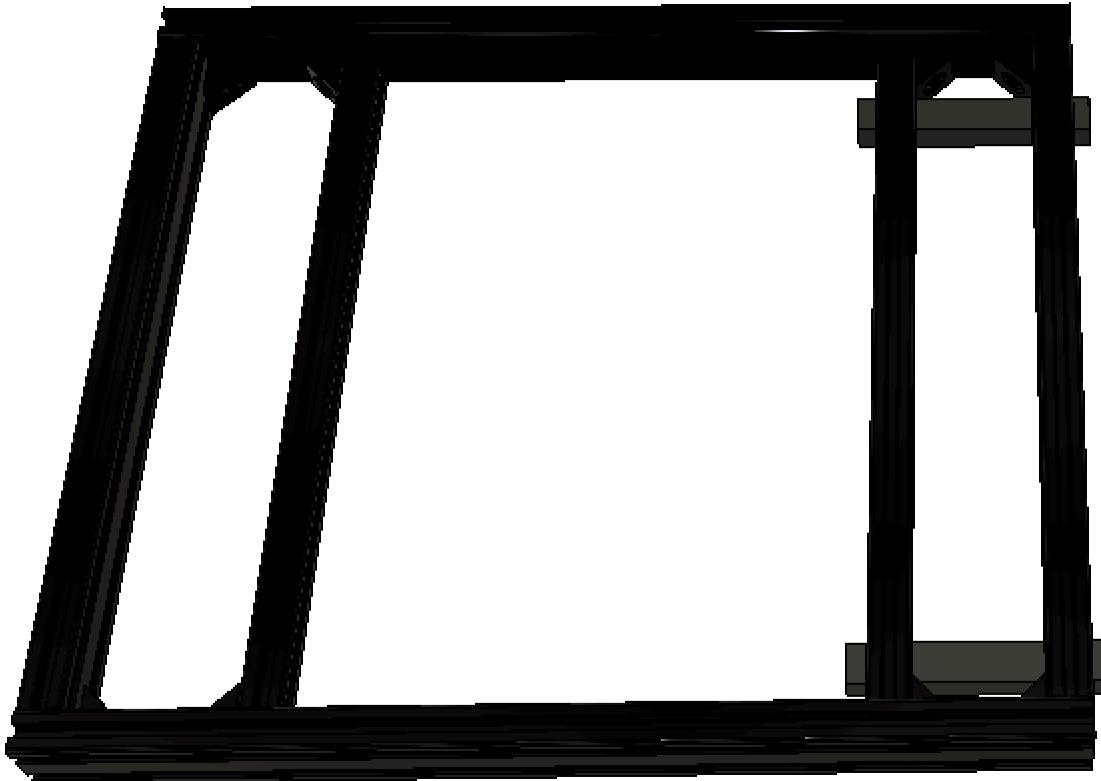
Repeat this for the remaining 373mm 2020 extrusion. Place one assembled 2020 extrusion so the side with the M4 Slot 6 roll-in nuts line up with the 2020 Corner Brackets in the bed frame. Fully secure the 2020 extrusion to the bed frame via the 2020 Corner Brackets using an M4x8 BHHS through an M4 washer at each end.



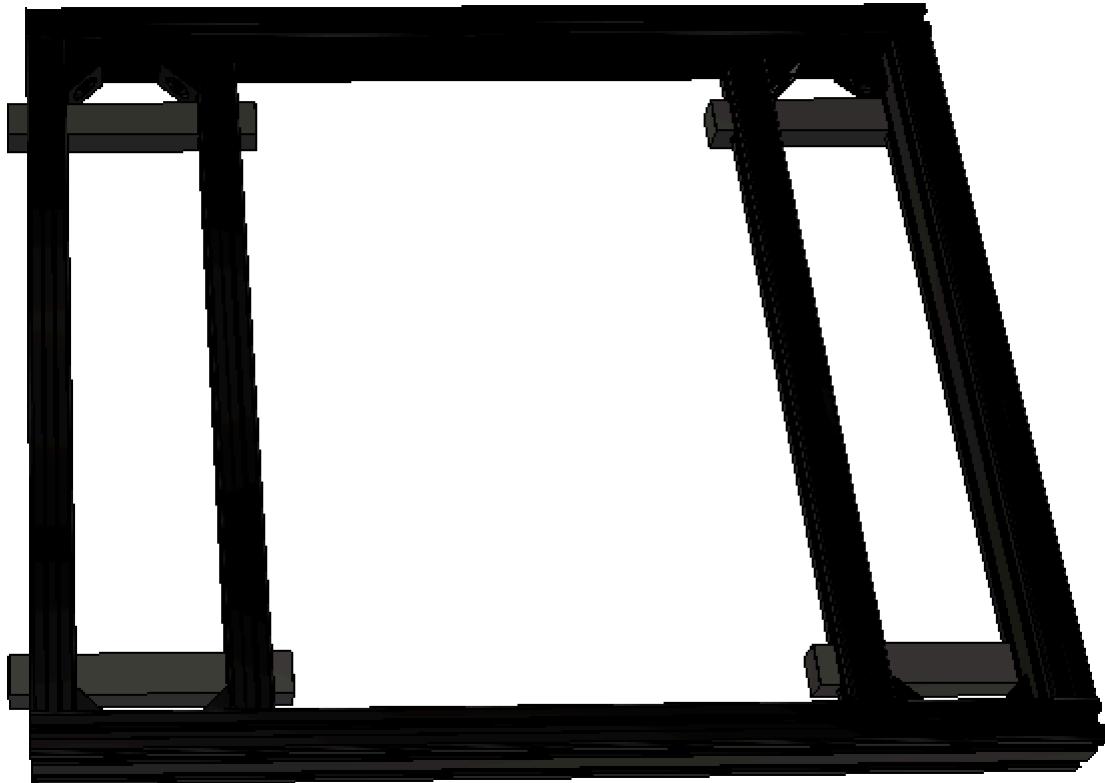
Repeat these steps with the remaining assembled 373mm 2020 extrusion using two M4x8 BHHS and two M4 washers.



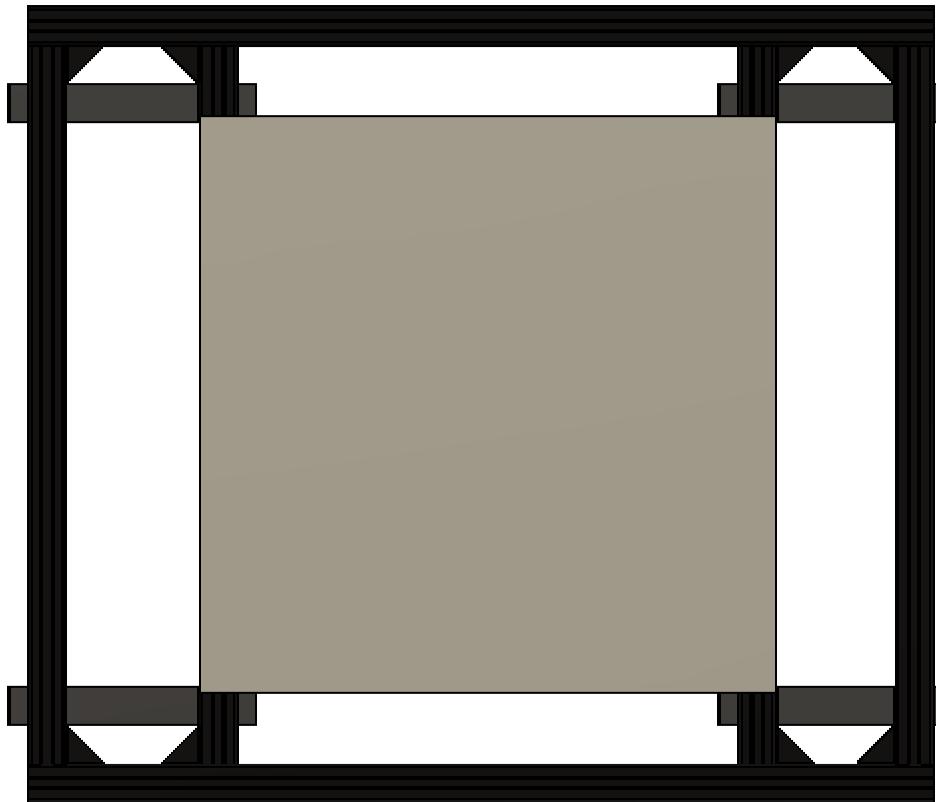
These 2020 extrusions will be the supports for your Heated Bed. The Printed Bed Frame Alignment Jigs will set these 2020 extrusions at the proper locations to support a square 300mmx300mm heated bed. You may need to adjust the positions of these extrusions to properly support the bed you are installing. Some bed layouts may need additional 2020 supports for proper function (such as a three point leveling bed). To begin to determine the proper positions of the 2020 extrusions for your bed, install the two Printed Bed Frame Alignment Jigs (61.5mm) on the underside of the bed frame at the right side. Move the rightmost 2020 extrusion until it lines up properly in the slots of the alignment jig.



Install the Printed Bed Frame Alignment Jigs (69mm) on the underside of the bed frame at the left side. Move the leftmost 2020 extrusion until it lines up properly in the slots of the alignment jig.



Now place your heated bed onto the frame in a similar fashion to the 300x300 Dummy Plate below.



The Dummy Plate as placed above represents the maximum reachable area of the nozzle in the current FDM tool. This makes the maximum printable area of the machine 300mmx300mm. The larger gap between the frame and the Dummy Plate on the left needs to be maintained to allow for clearance of the Tool Dock. The gap between the frame and the Dummy Plate on the right needs to be maintained to clear the Cable Chain (wiring harness). The Cable Chain has a minimum bend radius that is represented by this gap. If your bed is larger than these dimensions, you will want to have your bed centered with the desirable printable area within the area designated by the Dummy Plate above. Check the mounting mechanism for your heated bed. If the mounting mechanism is attachable to the 2020 extrusions as they currently rest, then remove the heated bed plate and fully tighten the four remaining M4x8 BHHS to secure the 2020 extrusions. If you need to adjust one or both 2020 extrusions, remove the associated Printed Bed Alignment Jigs and move the 2020 extrusion(s) in a fashion to keep the heated bed plate relatively centered to the printable area shown above. If you moved a 2020 extrusion with the Printed Bed Alignment Jig removed, check that 2020 extrusion for perpendicularity with the carpenters square at each end. When you have everything properly lined up and square, be certain that all M4x8 BHHS are fully tightened. Remove all the Printed Bed Alignment Jigs.

## Step 4 – Z-Axis Belt Tensioners

If your Z-Axis Belts are not pre-cut, then cut two lengths of 9mm GT2 belt to at least 868mm. The belts used in the guide are exactly 868mm with 434 usable teeth. It is not recommended to cut the belt shorter, as this will make tensioning the belt difficult. If the belt is too long, then proper tension may

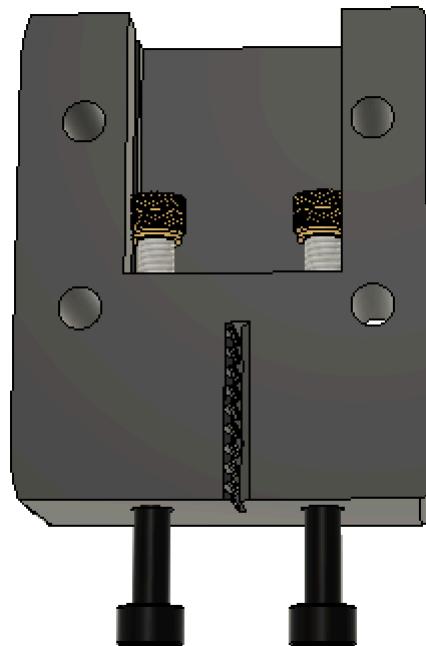
not be achievable, and the problematic belt will need to be shortened by a tooth or more. It is better to have the belt too long. Install two M4 Heat Set Inserts into the Printed Belt Tensioner Right Part 01 as shown.



Install two M4 Heat Set Inserts into the Printed Belt Tensioner Left Part 01 as shown.



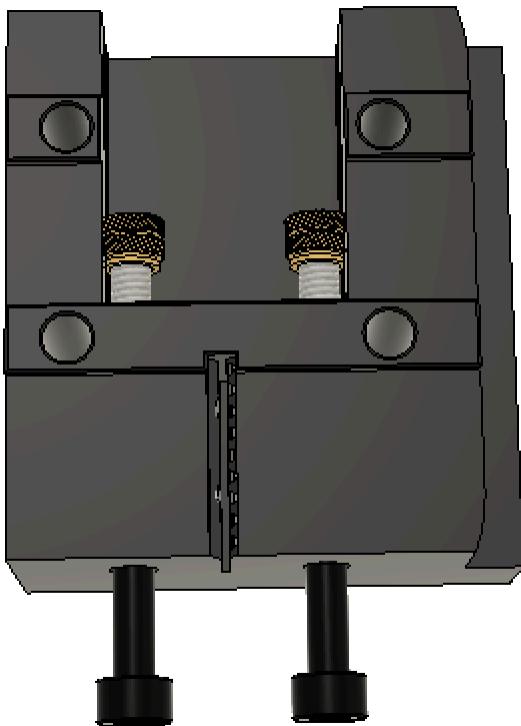
Install two M4 Heat Set Inserts into the Printed Belt Tensioner Right Part 01. You will need to hold the Soldering Iron at an angle to install the heat set inserts into this area (to prevent the Soldering Iron from melting the sides of the printed part). It is helpful to have an M4x40 SHCS inserted through the bottom of the printed part and partially screwed into the M4 heat set insert. Set up the process as shown below.



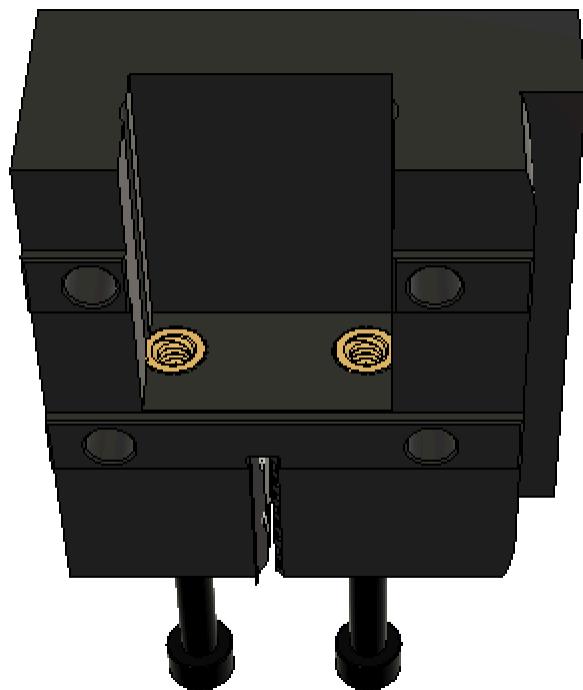
Now install the M4 Heat Set Inserts into the printed part with the Soldering Iron angled to prevent unwanted melting of the printed part. After one insert is pressed in, use the attached M4x30 SHCS to properly align the M4 Heat Set Insert until it cools. Repeat for the other M4 Heat Set Insert.



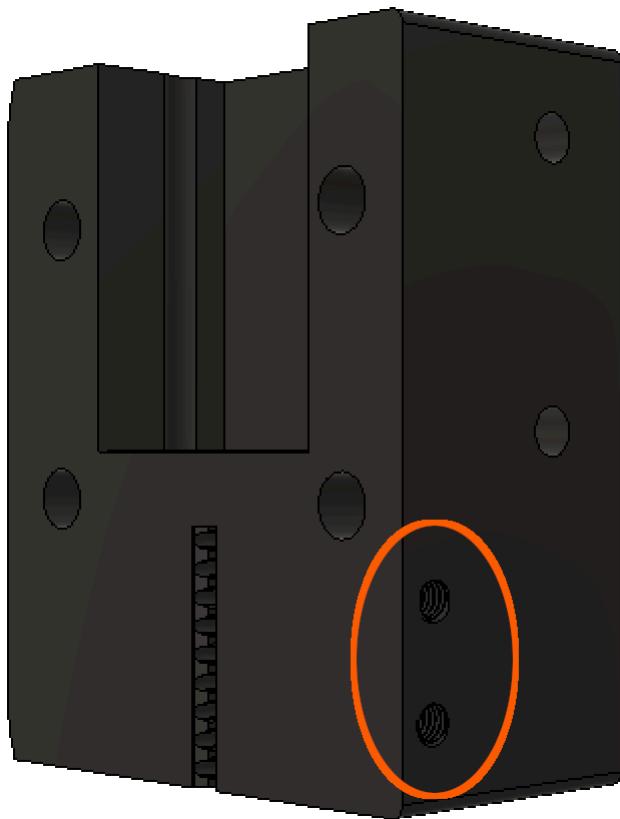
When both M4 Heat Set Inserts are cool, remove both M4x30 SHCS. Set up Printed Belt Tensioner Left Part 01 with two M4 Heat Set Inserts and two M4x30 SHCS inserted through bottom of printed part and partially threaded into M4 Heat Set Inserts.



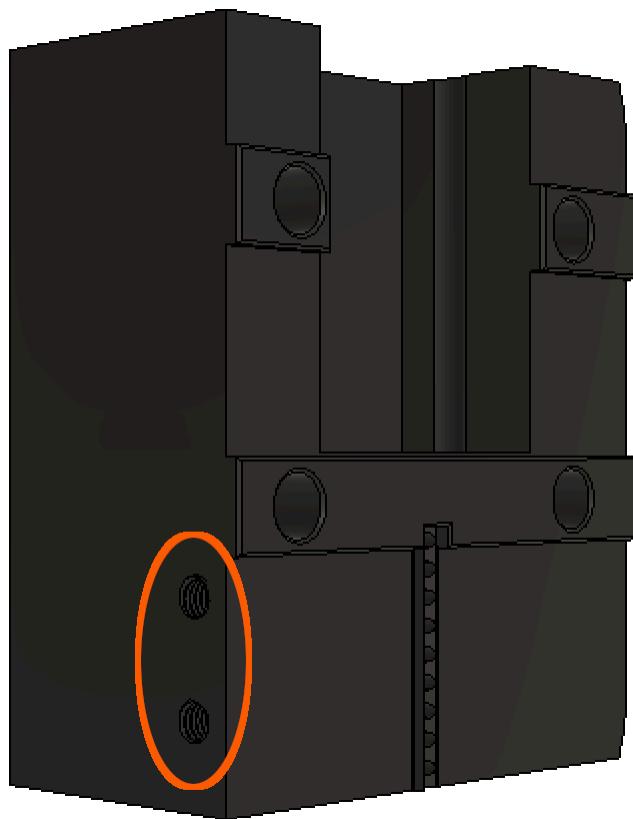
Now install the M4 Heat Set Inserts into the printed part with the Soldering Iron angled to prevent unwanted melting of the printed part. After one insert is pressed in, use the attached M4x30 SHCS to properly align the M4 Heat Set Insert until it cools. Repeat for the other M4 Heat Set Insert.



When both M4 Heat Set Inserts are cool, remove both M4x30 SHCS. Install an M3 Tap into your Hand Tap and proceed to tap M3 threads into the two holes in Printed Belt Tensioner Right Part 01 as shown below.



Tap M3 threads into the two holes in Printed Belt Tensioner Left Part 01 as shown below.



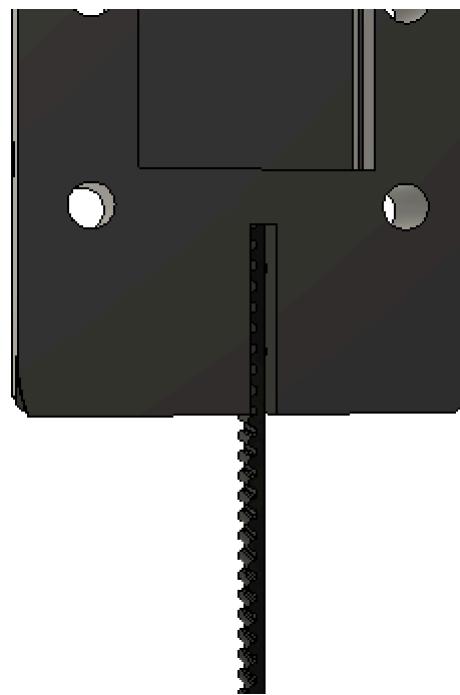
Tap M3 threads into the two holes in Printed Belt Tensioner Right Part 02 as shown below.



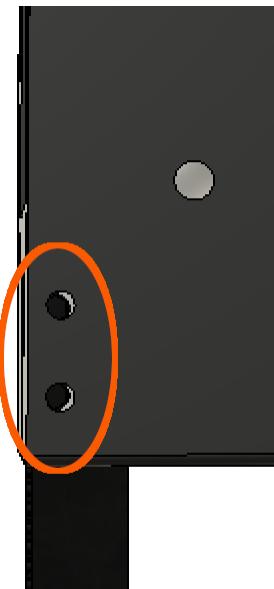
Tap M3 threads into the two holes in Printed Belt Tensioner Left Part 02 as shown below.



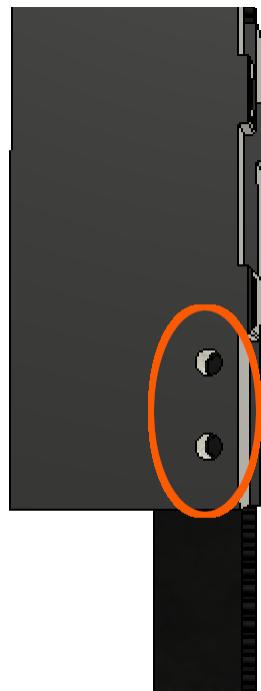
Insert one end of a GT2 Z-Axis Belt into the profile of Printed Z-Axis Belt Tensioner Part 01 as shown below.



If the material you chose to print the tensioner blocks in can withstand medium strength thread locker without compromising strength, then coat two M3x6mm Set Screws with medium strength thread locker. Install the two M3x6mm Set Screws into the holes you threaded earlier in Printed Z-Axis Belt Tensioner Part 01 and tighten until each Set Screw is snug against the installed GT2 Belt.



Repeat these steps on Printed Z-Axis Belt Tensioner Left Part 01 with another GT2 Z-Axis Belt, two additional M3x6mm Set Screws, and medium strength thread locker (if applicable.)



Orient the bed frame with the right side facing you and place four M4 Slot 6 roll-in nuts into the 373mm 2040 extrusion as show below.



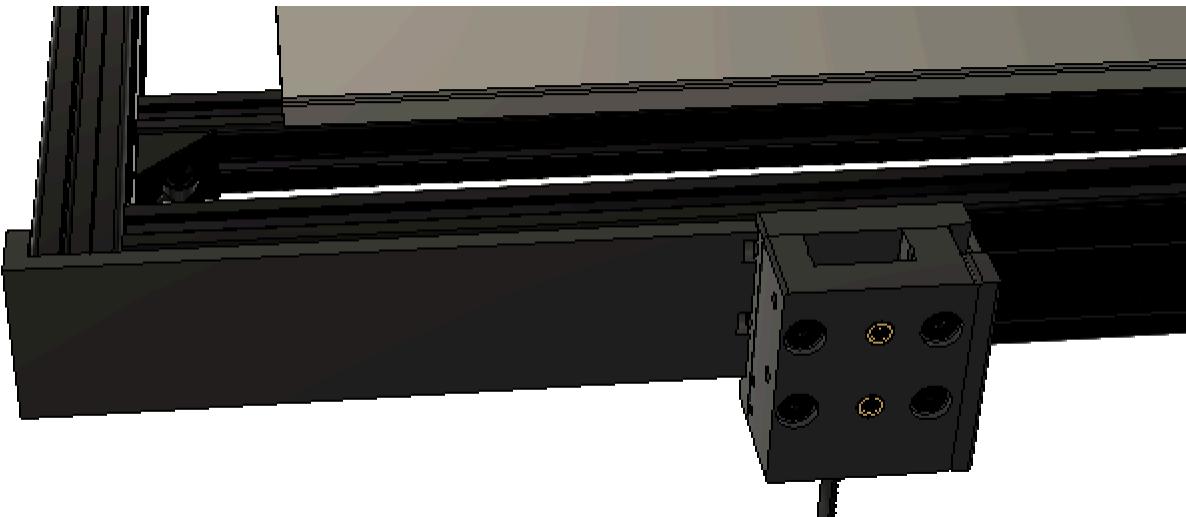
Place Printed Z-Axis Belt Tensioner Right Part 03 onto the 373mm 2040 extrusion so the holes in the printed part line up with the holes in the M4 Slot 6 roll-in nuts. You may have to move one or more of the M4 Slot 6 roll-in nuts for proper alignment.



Place the assembled Printed Z-Axis Belt Tensioner Right Part 01 on top of the Printed Z-Axis Belt Tensioner Right Part 01 and loosely secure the printed parts to the 373mm 2040 extrusion using four M4x35 FHHS.



Place the Printed Z-Axis Belt Tensioner Installation Tool at the right front corner of the bed frame as shown. Move the right Z-Axis Belt Tensioner assembly so it is flush to the printed installation tool and the printed installation tool is flush to the corner of the bed frame. When properly aligned fully tighten all the M4x35 FHHS in the right Z-Axis Belt Tensioner assembly.



Remove the printed installation tool. Place an M4x6 SHCS through an M4 washer and loosely install into the right face of the right Z-Axis Belt Tensioner Assembly. Repeat for the other hole with another M4x6 SHCS and M4 washer.



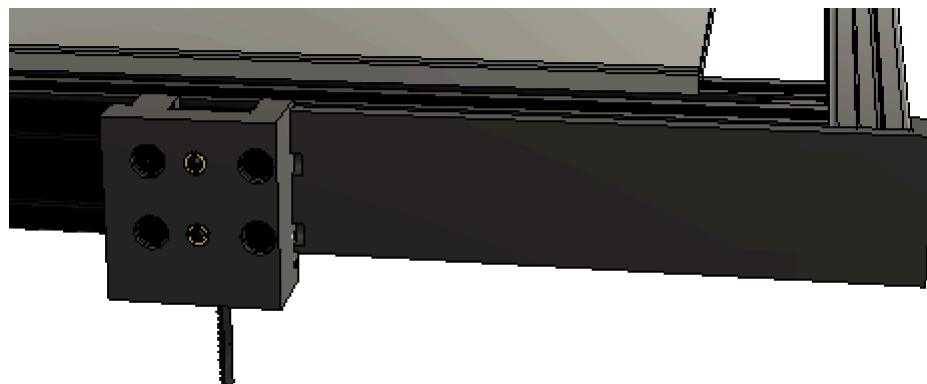
Turn the bed frame around so the left side is facing you and place four M4 Slot 6 roll-in nuts into the 373mm 2040 extrusion as show below.



Place the assembled Printed Z-Axis Belt Tensioner Left Part 01 onto the 373mm 2040 extrusion so the holes in the printed part line up with the holes in the M4 Slot 6 roll-in nuts. You may have to move one or more of the M4 Slot 6 roll-in nuts for proper alignment. Loosely secure the printed parts to the 373mm 2040 extrusion using four M4x25 FHHS.



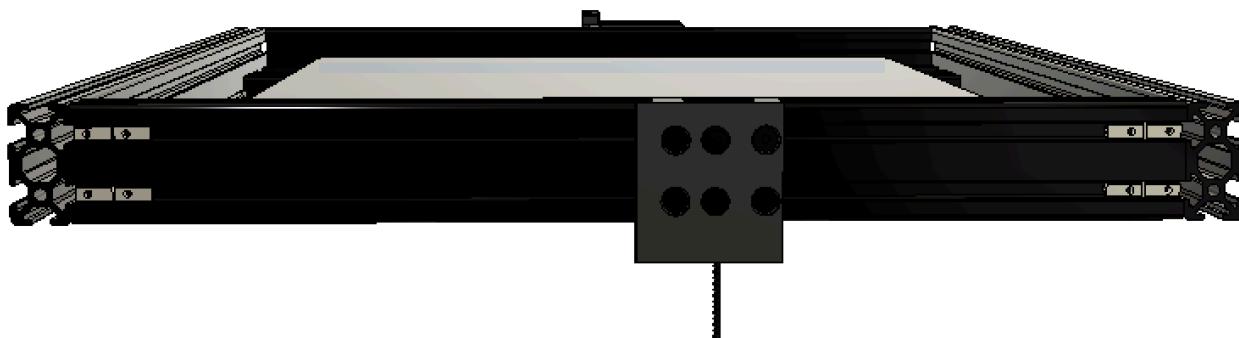
Place the Printed Z-Axis Belt Tensioner Installation Tool at the left front corner of the bed frame as shown. Move the left Z-Axis Belt Tensioner assembly so it is flush to the printed installation tool and the printed installation tool is flush to the corner of the bed frame. When properly aligned fully tighten all the M4x25 FHHS in the left Z-Axis Belt Tensioner assembly.



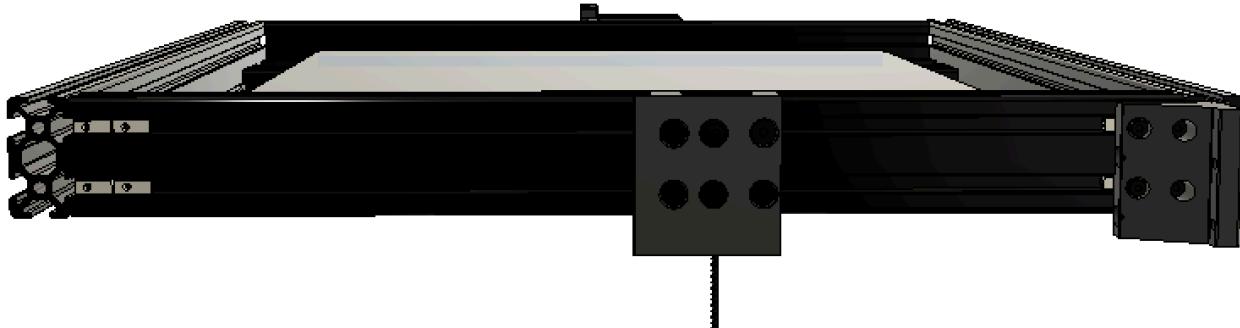
Remove the printed Installation Tool.

## Step 5 – Left Bed Frame Mounts

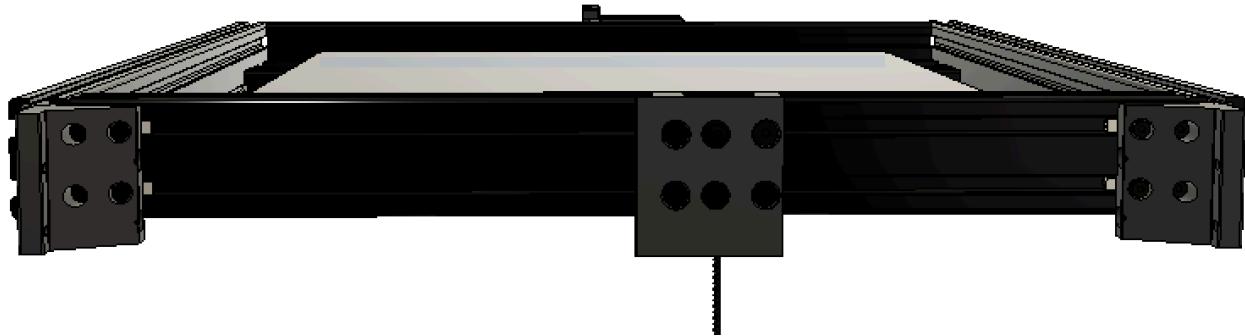
Orient the assembled Bed Frame with left side facing you. Place eight M3 Slot 6 roll-in nuts into the 373mm 2040 extrusion as shown below.



Place the Print Z-Axis Bracket Front on the 373mm 2040 extrusion at the front end (right in perspective of picture) and line up the holes in the printed part with the threaded holes of the M3 Slot 6 roll-in nuts. You may need to move one or more M3 Slot 6 roll-in nuts for proper alignment. Loosely secure the Print Z-Axis Bracket Font to the 373mm 2040 extrusion with four M3x14 SHCS.



Repeat this process for the rear end of the assembled Bed Frame with the Print Z-Axis Bracket Rear, and four additional M3x14 SHCS.



## Step 6 – Mount Bed Frame

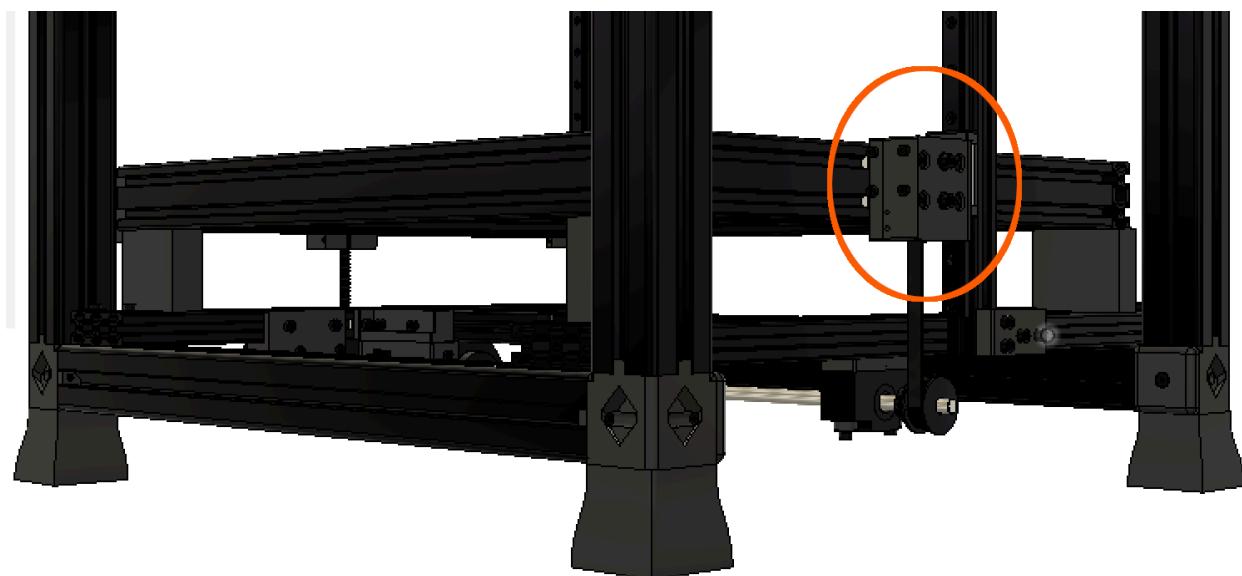
Set the assembled Bed Frame aside and place four printed Bed Frame Alignment Blocks onto the 2060 extrusions as shown below.



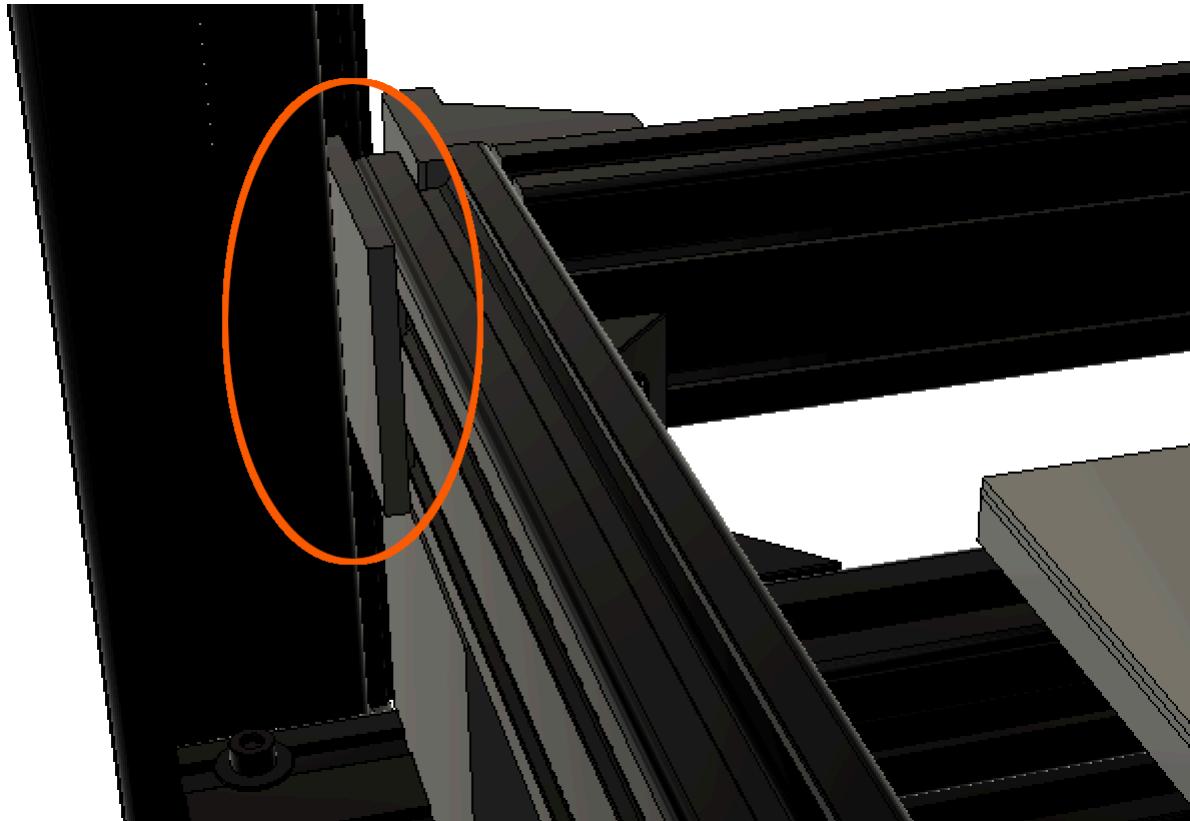
Place the assembled bed frame on top of the printed Bed Frame Alignment Blocks. The bed frame should be stable and flush to the printed alignment blocks at each corner. If your bed frame is skewed so that one corner has some space between the alignment block and associated extrusion, then loosen the SHCS in the a outer 20240 corner brackets and press the bed frame extrusions firmly toward the alignment blocks until they are flush at each corner and re-tighten all SHCS.



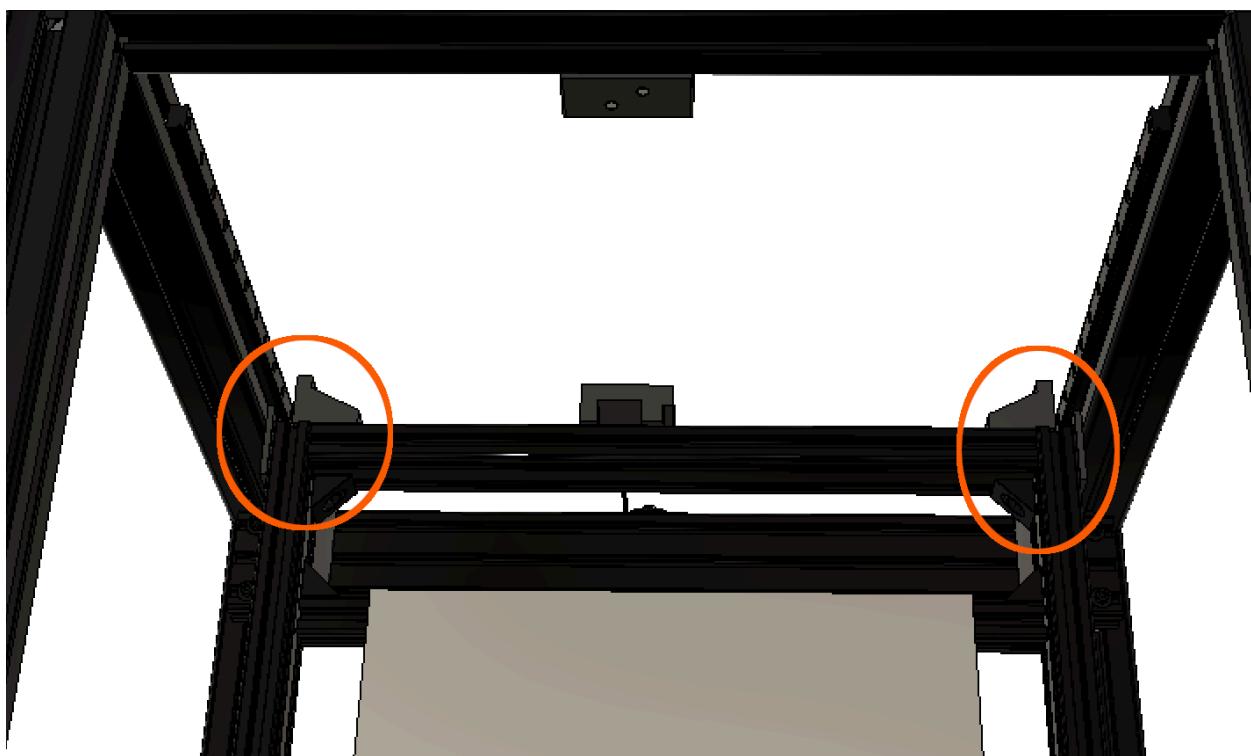
The assembled Bed Frame will now be attached to the machine. When moving the Linear Rail cartridges, be certain to not let them slide down too far to avoid damage. It is best to keep them secured with blue painters tape until fully secured. Start with the Z-Axis linear rail secured to the 373mm 2020 extrusion. Remove the blue painters tape from the MGN12 cartridge and slide it down until it is aligned with the right assembled Z-Axis Belt Tensioner. Loosely secure the MGN12 cartridge to the Belt Tensioner with four M3x50mm SCHS.



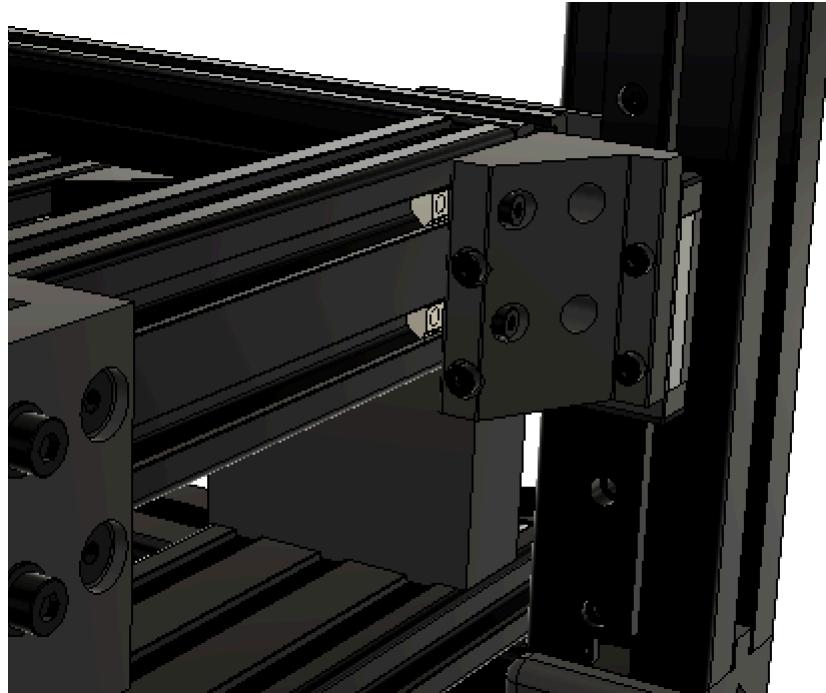
This connection is aligned to provide optimal torque on the Bed Frame while moving along the Z-Axis without causing the bed to tilt or skew during use. Keep the assembled Bed Frame flush to the printed Alignment Blocks at all four corners while you fully tighten the four SHCS. Be careful to not over-tighten screws going into the MGN12 cartridge. Over-tightening can cause deformation of the bearing races inside of the MGN12 cartridge and cause unnecessary drag during use. Install a printed Left Z-Axis Bed Frame Installation Tool on the front 2040 extrusion of the assembled Bed Frame as shown below.



Repeat this for the other printed Left Z-Axis Bed Frame Installation Tool on the rear of the Bed Frame.



Remove the blue painters tape of the front left MGN12 cartridge on the Z-Axis. Slide the MGN12 cartridge until it lines up with the assembled Z-Axis Bracket Front. You may need to slide the Z-Axis Bracket Front forward and backward (left and right in aspect to picture) until it is flush to the MGN12 cartridge. Secure the Z-Axis Bracket Front to the MGN12 cartridge with two M3x10mm SHCS and two M3x35 SHCS. Fully tighten all four SHCS going into the MGN12 cartridge and then fully tighten the four SHCS securing the Z-Axis Bracket Front to the 2040 extrusion on the left of the Bed Frame. Remember to keep the bed frame flush to the printed alignment blocks at all four corners.



Repeat this process to secure the Z-Axis Bracket Rear to the left rear MGN12 cartridge using two additional M3x10 SHCS and two M3x35 SHCS.



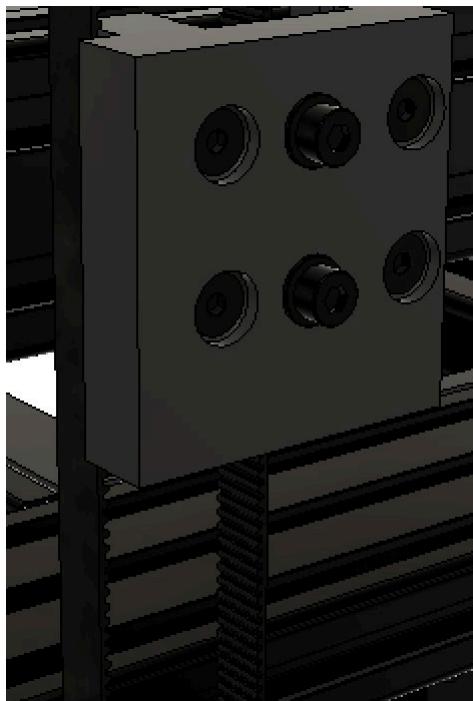
Remove the two printed Bed Frame Alignment Tools.

## Step 7 – Z-Axis Belts and Tensioning

Continue on the left side of the machine. During the process of installing and tensioning the Z-Axis belts, the goal is to keep the Bed Frame flush to the printed Bed Leveling Alignment Blocks at each corner. Start by wrapping the left Z-Axis belt around the left GT2 40t pulley of the Z-Axis Drive Shaft. You may need to turn the Drive Shaft a bit until the teeth of the GT2 40t pulley are properly meshed with the teeth of the belt.



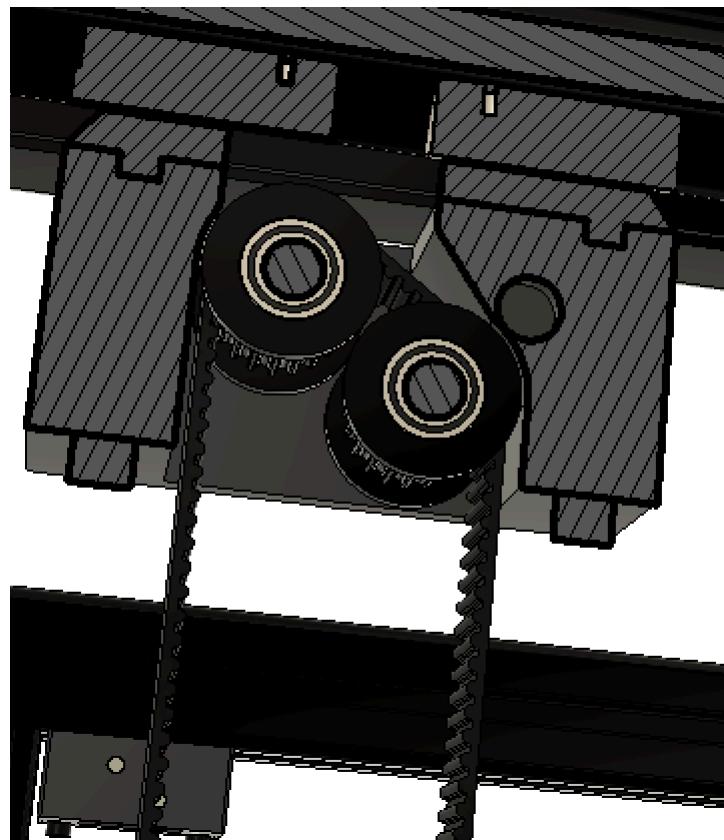
The belt routes by this guide on the rear side of the Belt Tensioner.



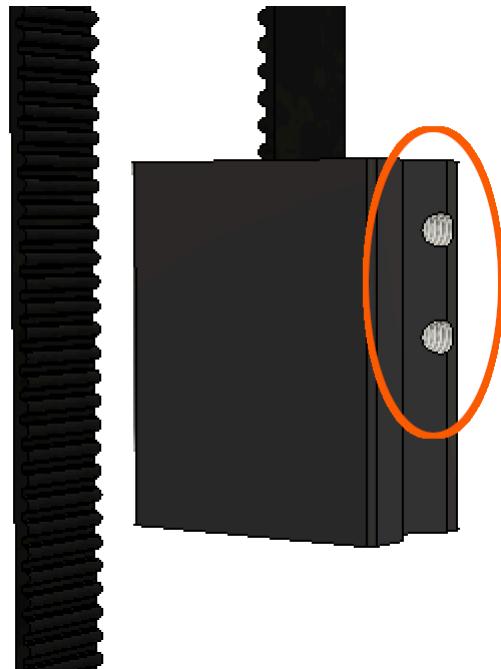
At the top of the machine, the belt feeds through one side of the Z-Axis Belt Idler assembly curves up and then around the idler pulleys then back down through the other side. It may help to bend or preform the end of the Z-Axis belt to help facilitate this routing process.



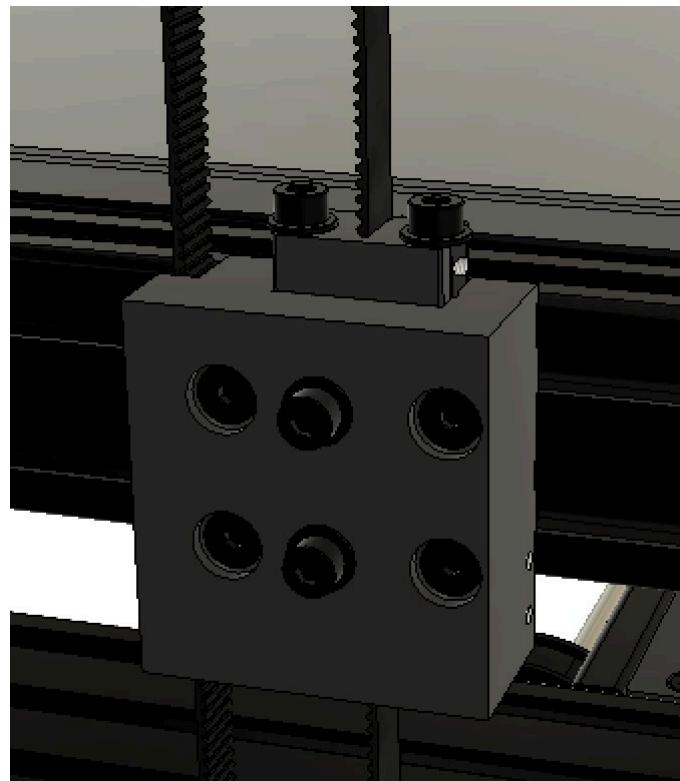
If you are having difficulty feeding the belt through the Belt Idler assembly, here is a view of the belt path if you were able to look inside of the part.



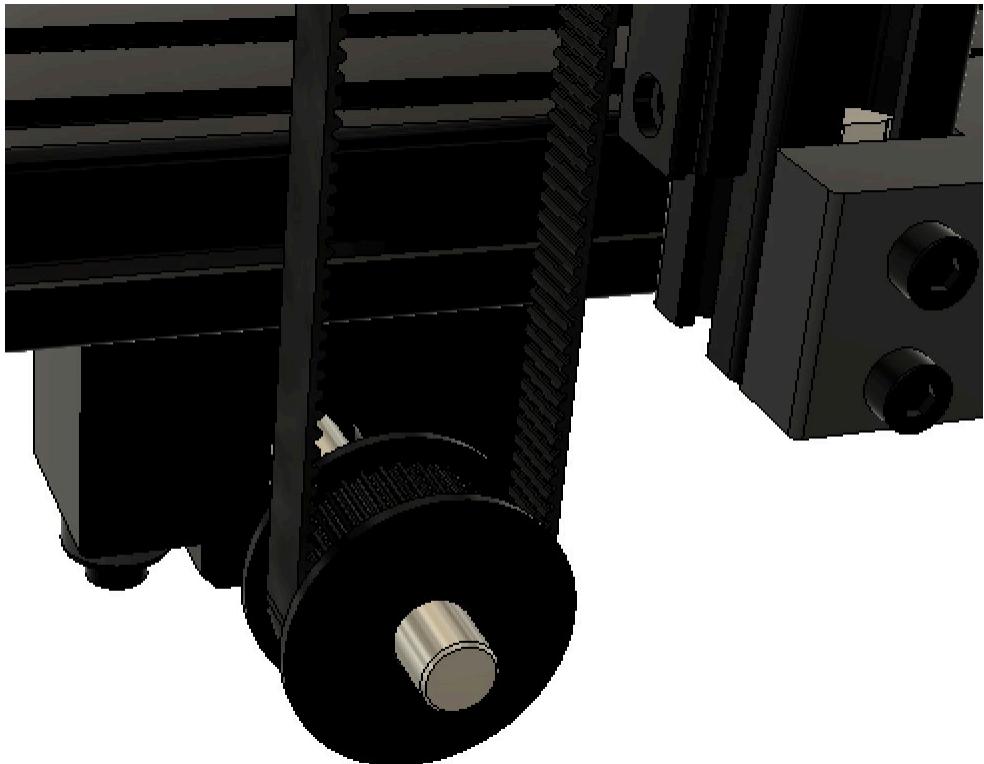
After the belt is properly through the Belt Idler assembly, install the belt end into Print Z-Axis Belt Tensioner Left Part 02. If the material you chose to print the tensioner blocks in can withstand medium strength thread locker without compromising strength, then coat two M3x6mm Set Screws with medium strength thread locker. Install the two M3x6mm Set Screws into the holes you threaded earlier in Printed Z-Axis Belt Tensioner Left Part 02 and tighten until each Set Screw is snug against the installed GT2 Belt.



Slide Print Z-Axis Belt Tensioner Left Part 02 into Print Z-Axis Belt Tensioner Left Part 01 and loosely secure with two M4x40 SHCS each going through an M4 washer as shown below. Equally turn each M4x40 SHCS to remove slack in the belt but not enough to cause the bed to start lifting off of the printed Bed Frame Alignment Blocks. We are not tensioning the belt at this point.



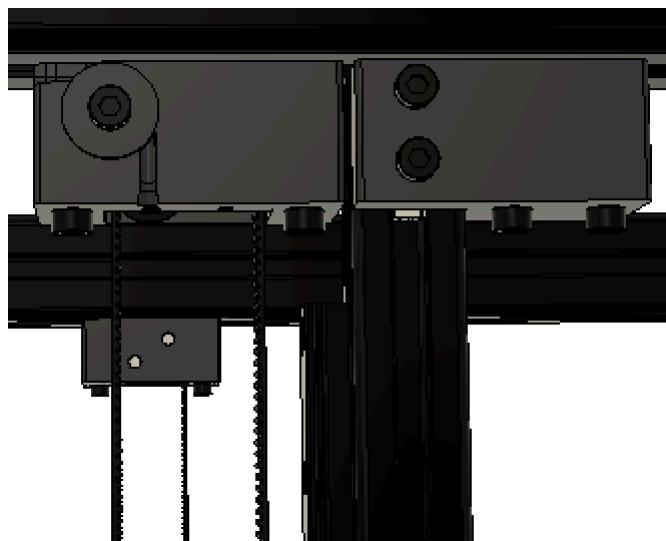
Orient your machine with the right side facing you. Wrap the right Z-Axis belt around the right GT2 40t pulley of the Z-Axis Drive Shaft. If the teeth of the GT2 40t pulley do not mesh with the teeth of the Z-Axis belt, we cannot simply turn the drive shaft as we did previously. We will instead need to loosen the two set screws in the 40t pulley and let the pulley turn on the stationary shaft until the GT2 profiles line up. If it is necessary to loosen the set screws, you will want to use the Print Z-Axis 40t Pulley Installation Tool to keep the 40t pulley aligned in the Z-Axis belt path while you resecure the set screws.



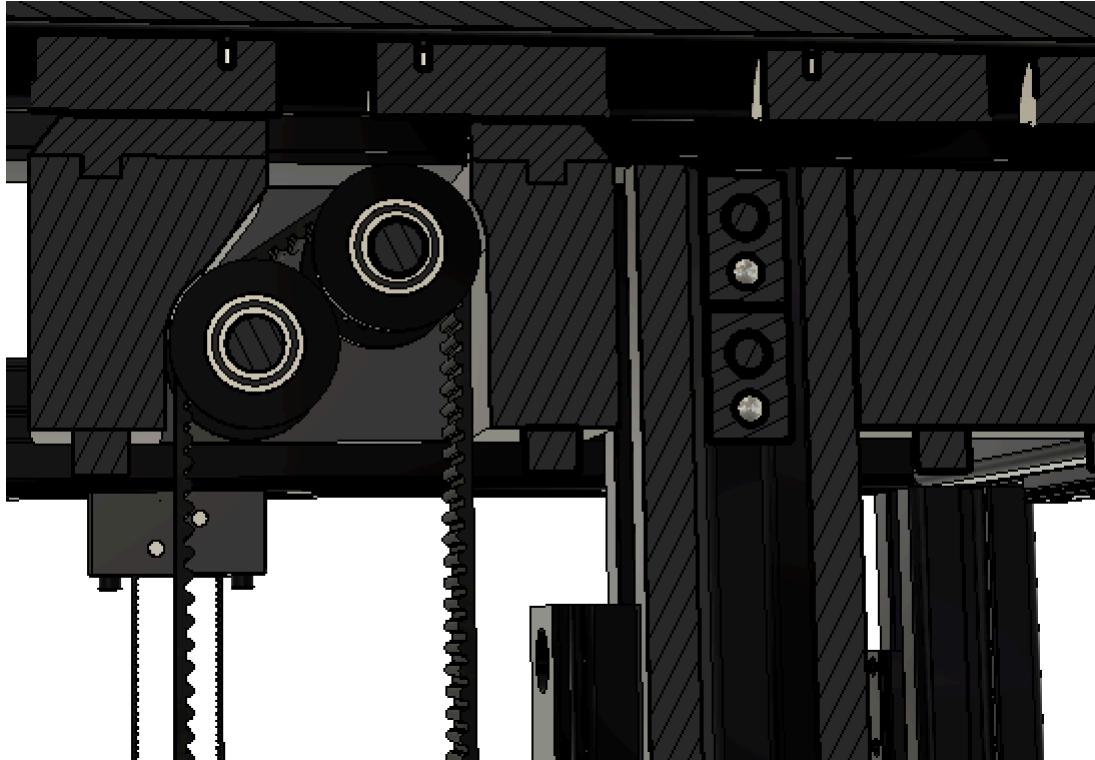
Feed the right Z-Axis Belt through the belt guide slot of the right Z-Axis Belt Tensioner Block as shown.



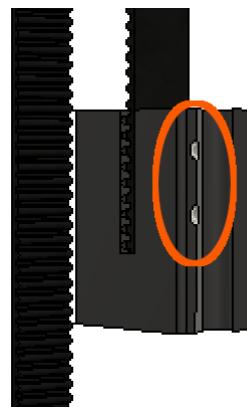
Similar to the left side of the machine, the belt feeds through one side of the Z-Axis Belt Idler assembly curves up and then around the idler pulleys then back down through the other side. It may help to bend or preform the end of the Z-Axis belt to help facilitate this routing process.



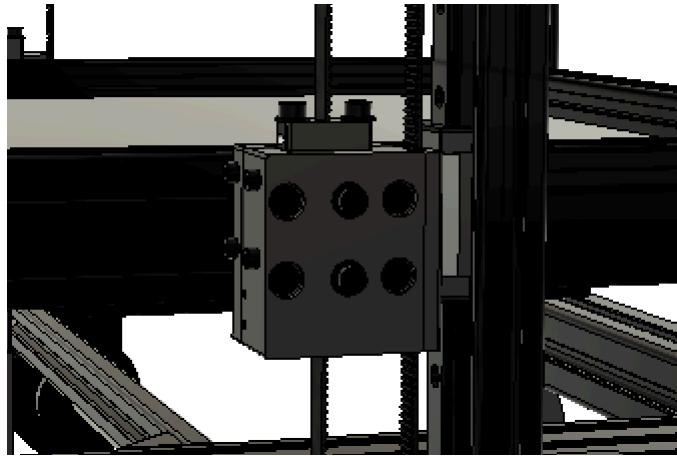
If you are having difficulty feeding the belt through the Belt Idler assembly, here is a view of the belt path if you were able to look inside of the part.



After the belt is properly through the Belt Idler assembly, install the belt end into Print Z-Axis Belt Tensioner Right Part 02. If the material you chose to print the tensioner blocks in can withstand medium strength thread locker without compromising strength, then coat two M3x6mm Set Screws with medium strength thread locker. Install the two M3x6mm Set Screws into the holes you threaded earlier in Printed Z-Axis Belt Tensioner Right Part 02 and tighten until each Set Screw is snug against the installed GT2 Belt.



Slide Print Z-Axis Belt Tensioner Right Part 02 into Print Z-Axis Belt Tensioner Right Part 01 and loosely secure with two M4x40 SHCS each going through an M4 washer as shown below. Equally turn each M4x40 SHCS to remove slack in the belt but not enough to cause the bed to start lifting off of the printed Bed Frame Alignment Blocks.



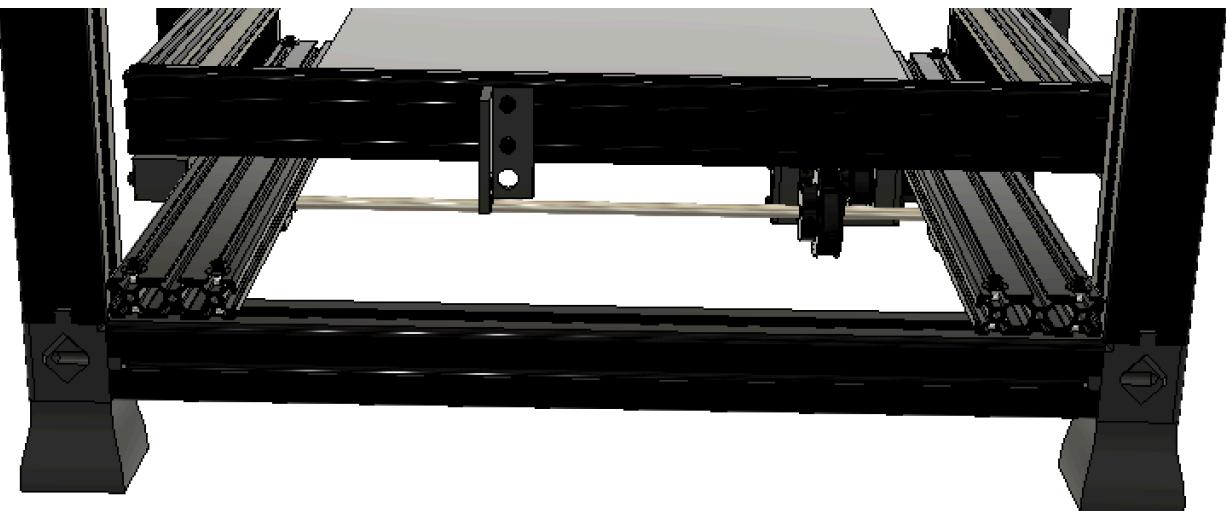
Proceed to tension both of the Z-Axis belts using the following method. Begin with equally tightening the M4x40 SHCS going through the printed Z-Axis Belt Tensioner Part 02 of one side until you reach the desired tension of the Z-Axis belt. The Bed Frame will have lifted up on the side where the belt is tensioned. Proceed to equally tighten both M4x40 SHCS going through the printed Z-Axis Belt Tensioner Part 02 of the opposing side. As the Bed Frame of the opposing side begins to lift off of the printed Bed Frame Alignment Blocks, turn the Z-Axis Drive Shaft by hand to lower the Bed Frame back down onto the Alignment Blocks. Continue these steps of equally turning the tensioning screws and turning the drive shaft until both ends of the Bed Frame are flush with the printed alignment blocks. Check that both Z-Axis belts have the desired tension in them. If one belt still seems too loose, then equally tighten those screws until the desired tension is achieved and begin to further tighten the opposing side until the Bed Frame is once again flush. If you find that you have fully tightened the SHCS in the tensioning block and the belt is still too loose, then you will need to remove both of the M3x40 SHCS, remove the printed tensioner Part 02, remove the belt from the printed tensioner Part 02 by loosening the M3x6 set screws, then trimming one or more teeth from the end of the belt before reassembling and continuing to tension. When the Z-Axis tension is achieved, turn the drive shaft to raise the Bed Frame and remove all four of the printed Bed Frame Levelling Blocks.

## Step 8 – Bed Harness Chain Mount

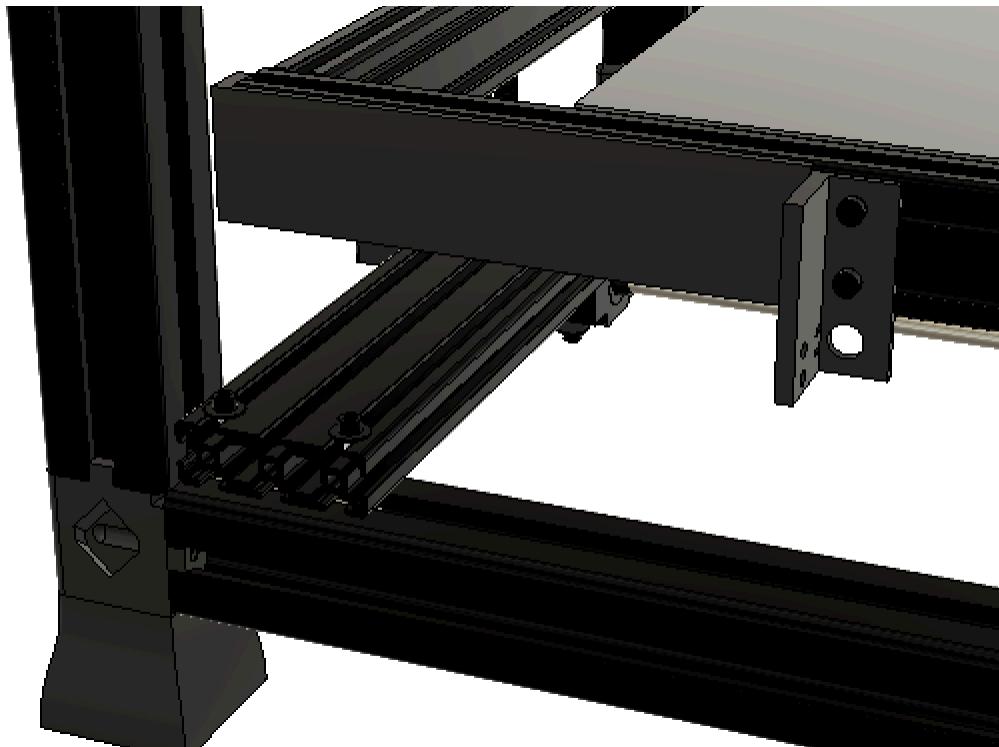
Orient the machine with the rear facing you. Install two M4 Slot 6 roll-in nuts into the rear 2040 extrusion of the Bed Frame as shown.



Place the Print ZChainMount Top over the two M4 roll-in nuts and loosely secure it to the 2040 extrusion with two M4x8mm SHCS.



Place the Print Z Chain Mount Top Installation Tool onto the Bed Frame as shown. Slide the Z Chain Mount Top until it is flush with the printed installation tool. Make certain the printed installation tool is flush with the corner of the frame and then fully tighten the two M4x8 SHCS.



Remove the printed installation tool.

## Step 9 – Safety Precautions

With a near infinite possibility of Heated Bed Combinations, safety precautions must be exercised by the user to prevent injury from electrocution or fire. If your chosen Bed Plate is unfinished, it may be electrically conductive enough to warrant running an electrical ground lead to your bed plate and the bed frame. Some Bed Plates have an integrated heater such as many DC powered options. For the Bed Plates with an attached heater, such as a silicone heater mat, adding a thermal fuse to the bottom of the heater pad is paramount for fire safety. Many silicone heater mats are attached using a thin film of double-sided adhesive. With extended thermal cycling of the build plate, this adhesive can fail causing the heater mat to dislodge from the build plate and fall to the floor of the printer and pose a fire hazard. This is also true in theory of silicone mats that are vulcanized to the build plate. Other heater related failures such as a SSR (Solid State Relay) used with an AC heated solution may fail. Firmware is often designed to account for such a failure; however, the thermal fuse can also act as a backup safety mechanism for this type of failure as well. Below are some photographs showing the installation of a thermal fuse to an AC silicone heating mat. Select a thermal fuse that is not resettable and has a thermal destruct temperature which will function in your machine. The one selected in this example will trigger at 185C degrees. Next, cut one of the power leads going to the heating mat. For AC, it doesn't matter which lead is cut. For DC, it is preferable to cut the positive lead. The thermal fuse often comes with ferrules that are expected to crimp the stripped power lead to the bare lead of the fuse. Do not

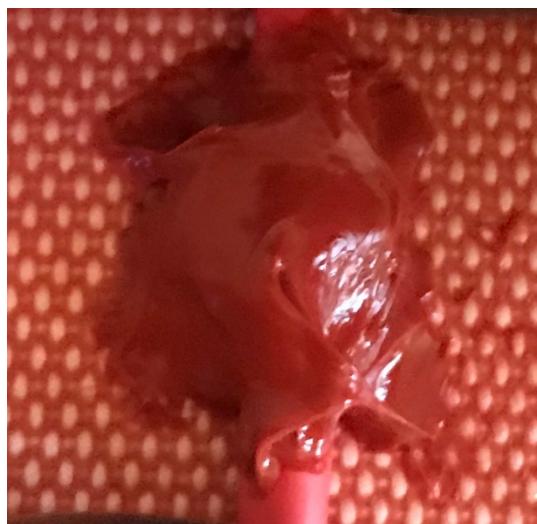
solder a thermal fuse to a power lead. It is also advisable to use a high temperature silicone shrink tube to cover the crimped connections to reduce the chance of electrocution. Here is the prepared thermal fuse crimped and heat shrink tubing applied.



Use some weights to hold your fuse to the heated mat and verify that the fuse is flush to the surface.



Secure your thermal fuse to the heated mat with some high temperature RTV silicone adhesive.



Allow plenty of cure time according to the instructions of your adhesive before removing the weights. Congratulations, you have finished the installation of your Standard Heated Bed!