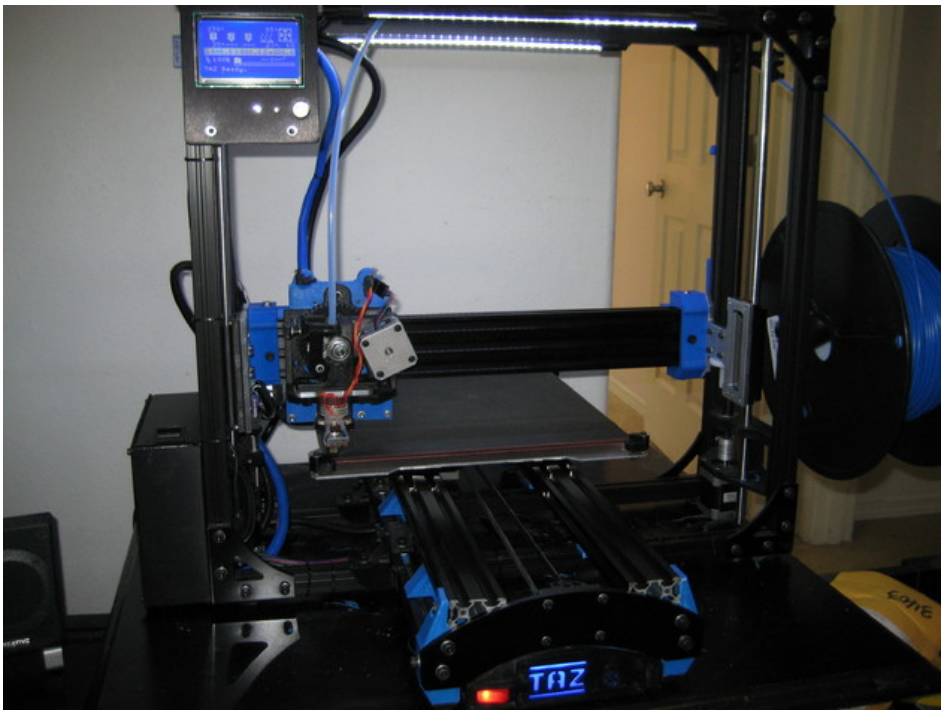
Openbuilds v-slot Y axis retrofit

for Lulzbot TAZ 4 or 5 printers



Assembly Instructions and Reference Guide

Revision 1.0

Prepared 7/10/2016

By **Tim Pierce – aka Piercet**

Acknowledgement

Portions of hardware used in this instruction manual were donated or funded by the Openbuilds Fairshare give back program (http://openbuildspartstore.com/fairshare-program/) and IT Works (https://itworks3d.com). I would like to thank both organizations for contributing to this projects and their commitment to the open source community. I would also like to thank Lulzbot for making such a well put together and flexible 3d printer platform.

http://www.openbuilds.com/

https://itworks3d.com

Introduction

The Openbuilds v-slot Y axis for Lulzbot TAZ 3, 4, 5 or 6 printers is designed work with the X axis modification or as a standalone upgrade and is intended to reduce bed sway and bed sag. When properly installed and aligned, most users experience more even print layers and a stiffer travel path. This has the effect of eliminating approximately half of the apparent “hump” in the middle of the build plate caused by such droop. When combined with the Openbuilds X axis retrofit, the two modifications are able to almost entirely eliminate that effect.

This instruction manual is intended to show a step by step, comprehensive assembly process, including what tools and hardware will be required. It assumes that you are proficient in installing heat set inserts (more information: https://www.matterhackers.com/articles/fasteners-for-3d-printing) , using a drill press, and operation of basic hand tools. Basic modification alignment tips and tricks are included, however you should not attempt this modification unless you are confident in your ability to modify your printer.

Note: Please be aware that any major printer modification may void your factory warranty. I recommend attempting this modification only after your factory warranty has already expired.

Reference:

The Openbuilds Y axis retrofit is an open source project under the Creative Commons : Attribution license. The latest project files are currently maintained here: http://www.thingiverse.com/thing:949082 . The Build thread is available here: https://forum.lulzbot.com/viewtopic.php?f=16&t=2426 Please feel free to ask any questions about this mod, the installation process, etc. there or via the Lulzbot Forum PM system if you like. Technical support is provided on a voluntary basis.

Tools Required:

- Needle nose pliers
- Vernier Calipers
- A marker
- M2 hex driver
- M3 hex driver
- M4 hex driver (for the low profile M5 bolts)
- M5 Hex driver
- Philips head screwdriver (for M6 bolt)
- A drill press (a small harbor freight unit will work fine)
- 7.2mm, 4.9mm and drill bit that comes with m3 tap bits
- M3 and m5 taps and Tap handle
- Scissors for cutting zip ties and belts
- Blue Loctite (optional)

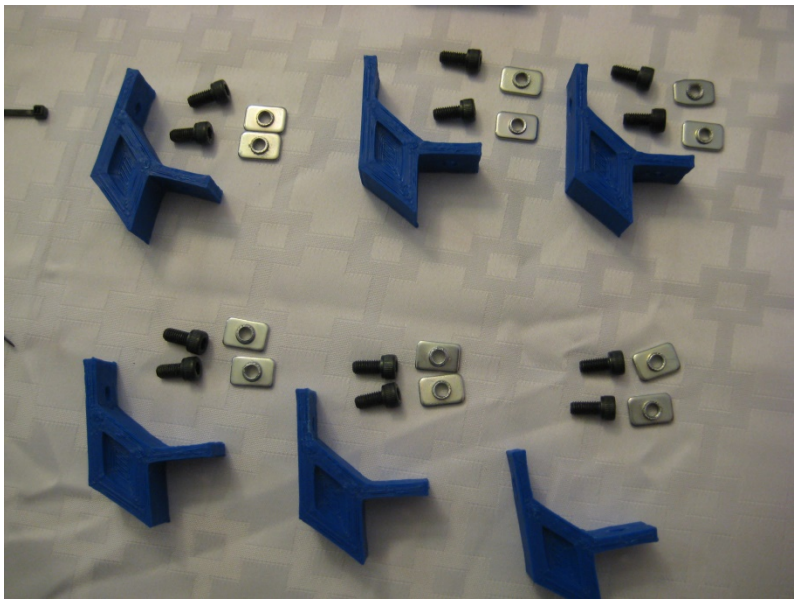
Disassembly:

Remove the stock Y axes as an assembly, and remove everything except for the Y axis to main chassis frame mounts from your stock Taz. You will reuse much of the mounting hardware and components.

Required hardware Bill of Materials:

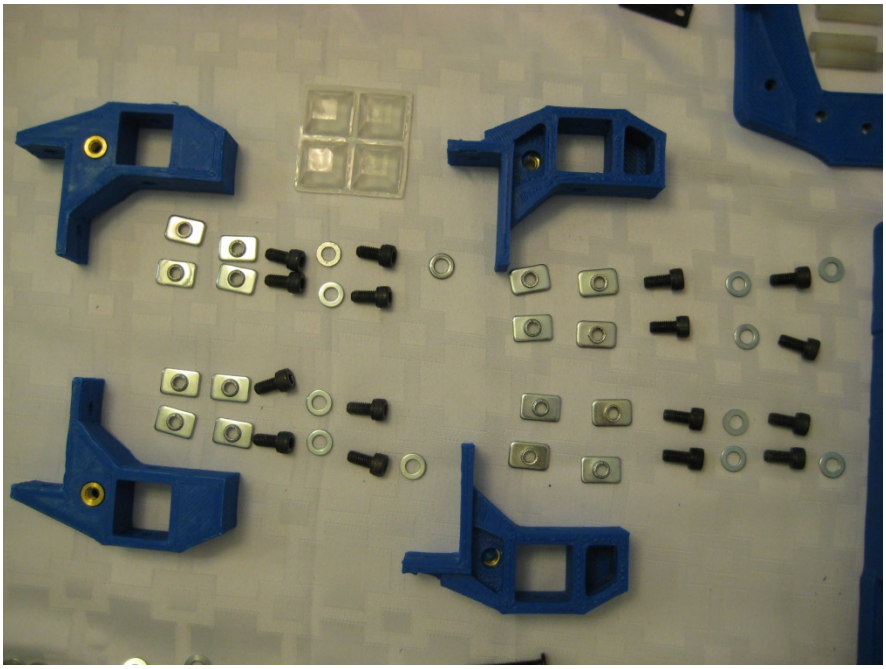
Y Rail supports

- 12x 10mm M5 bolts
- 12x M5 Tslot nuts

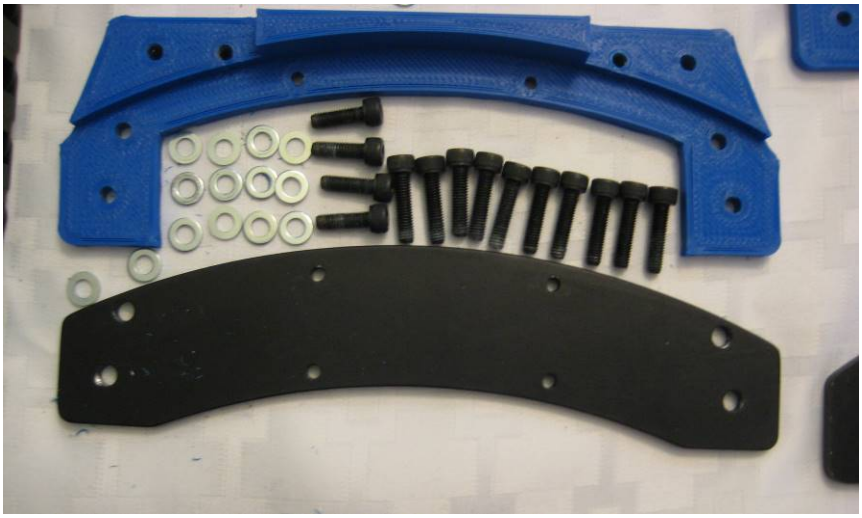


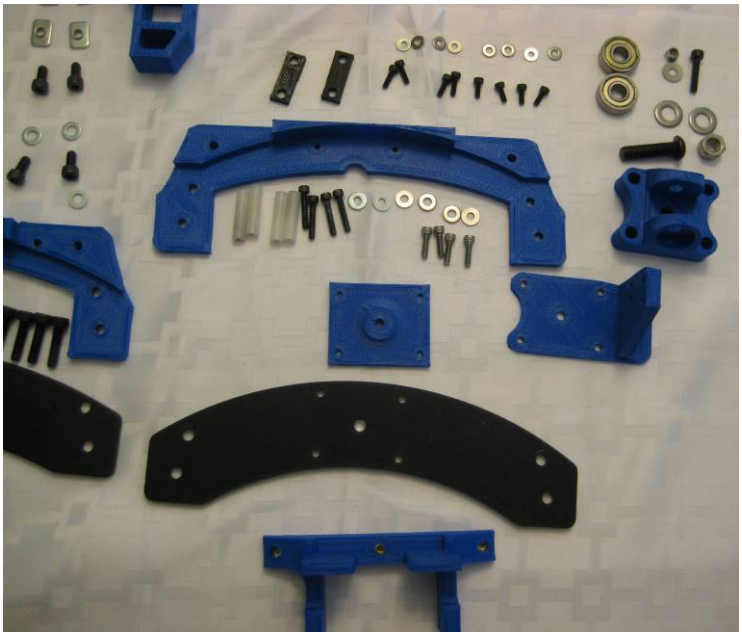
Y corner pieces

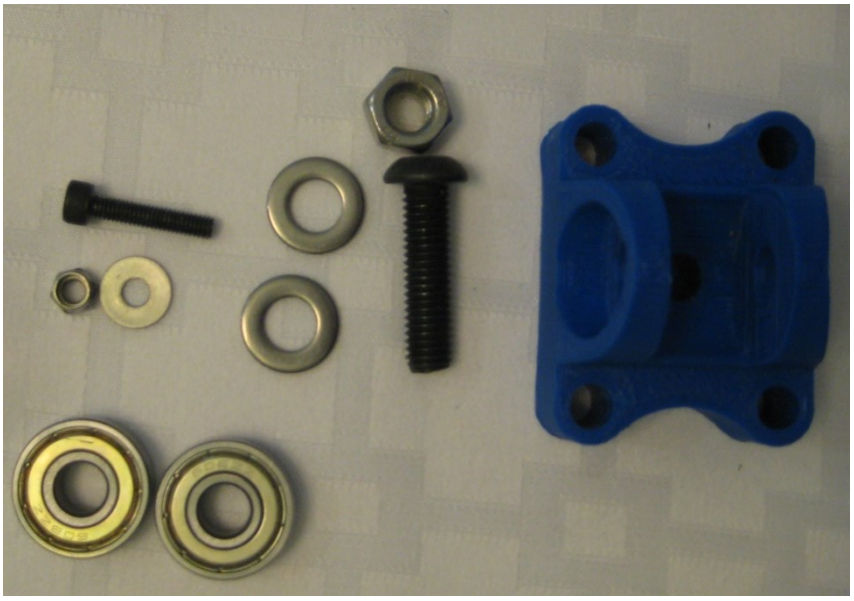
- 16x 10mm M5 bolts
- 16x M5 Tslot nuts
- 12x M5 washers
- 4x 6.75mm long M5 Heat set inserts (http://www.mcmaster.com/#94180a361/=12wc6v8)
- (Taz 3-5) 4x Adhesive furniture feet
- (OPTIONAL) Taz 6 Style feet – 4x 10mm M3 bolts and stock Flexy feet and 4x M3 heat set inserts (http://www.mcmaster.com/#94180a331/=138pg0w)



End plates







Idler side plate end:

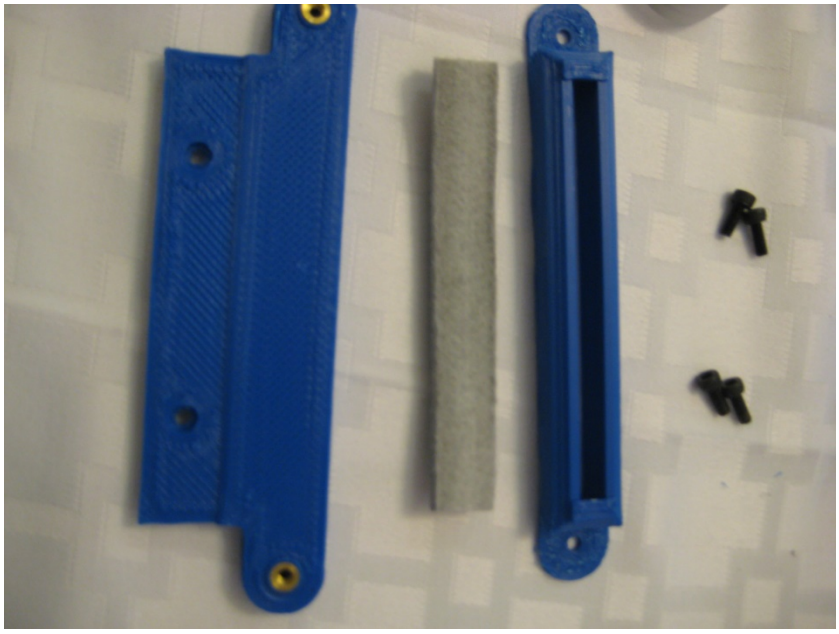
- 4x 20mm M5 bolt
- 2x 16mm M5 bolt
- 6x M5 washers
- 2x 8mm M2 bolt (low profile head preferably)
- 2x M2 heat set inserts (http://www.mcmaster.com/#94180a307/=12wc74i)
- stock X Minimum endstop (not pictured)
- One zip tie
- 4x 18mm 6-32 Cap head bolts
- 4x 10mm long 6-32 Cap head bolts
- 6x 6-32 Washers
- 4x ¼" 6-32 threaded ½" long nylon spacers
- 4x 6-32 nuts to temporarily hold the drill guide in place
- 1x M4 cap head bolt
- 1x M4 washer
- 1x M4 lock nut
- Stock Lulzbot idler hardware (M8 bolt, M8 nut, 2x M8 washers, 2x 608zz bearings)
- One additional X maximum endstop assembly (not pictured https://ultimachine.com/collections/electronics/products/microswitch-ss-3gl13pt)

Motor side plate end:

- 6x 20mm M5 bolt
- 2x 16mm M5 bolt
- 8x M5 washers

- The stock Taz 5 Motor mount and 4x M4 nuts
- 2x 10mm M3 Cap head bolts
- 2x 16mm M3 Cap head bolts
- 2x M3 washers
- Stock Lulzbot Y minimum endstop and M2 bolts
- (Optional) Y motor vibration dampner (Not pictured)
- Motor mounting hardware (stock lulzbot hardware, or for dampner 2x 8mm M3 and 2x 10mm M3 and 2x M3 washers)

OPTIONAL (Nozzle Cleaner adapter)



- Stock Lulzbot nozzle wiper and housing
- 4x 8mm M3 Cap head Bolts
- 2x M3 heat set inserts (http://www.mcmaster.com/#94180a331/=138pg0w)

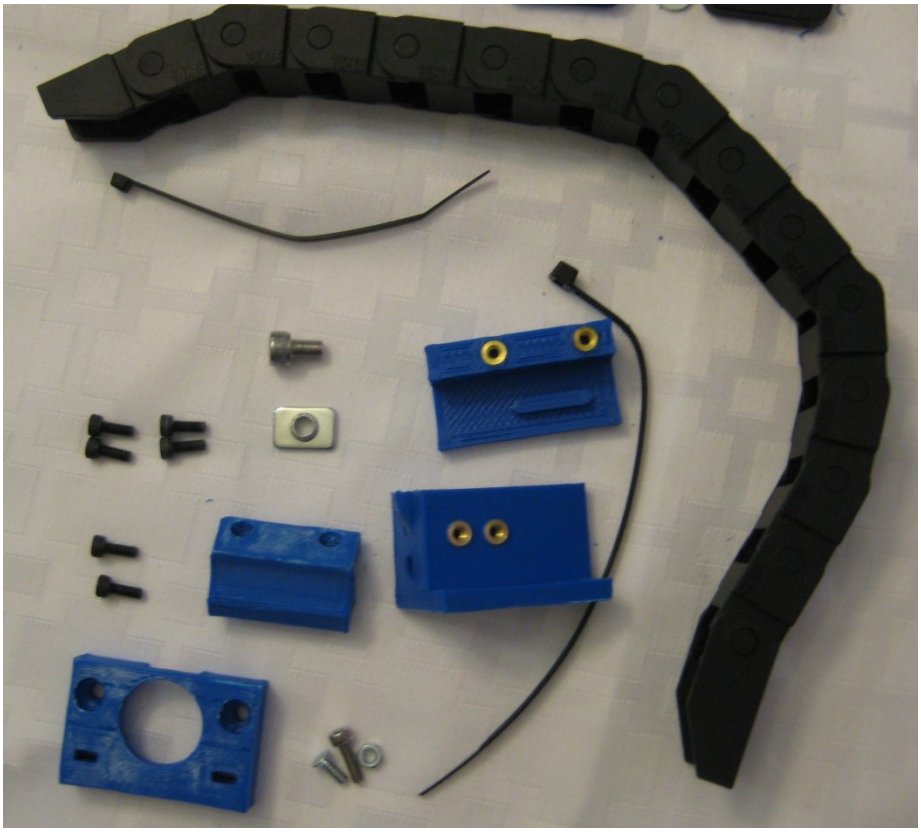
Main rail

- 2x 40mm x 20mm Openbuilds linear extrusion 500mm long extrusion (http://openbuildspartstore.com/v-slot-linear-rail/)

Y Bed plate and Wheels

- 4x bearing wheel sets
- (http://openbuildspartstore.com/xtreme-solid-v-wheel-kit/)
- 2x spacers (6mm) (http://openbuildspartstore.com/aluminum-spacers/)
- 2x eccentric spacers (6mm) (http://openbuildspartstore.com/eccentric-spacer/)
- 4x 30mm M5 Bolts (Low profile head required http://openbuildspartstore.com/low-profile-screws-m5/).
- A stock Taz 1-5 or Taz 6 bed plate
- 16x temporary 12mm M3 bolts and nuts to hold the drill guide plates down. Nuts are not used if adapting a Taz 6 plate
- If installing the idler tensioner and using the Y maximum endstop, you will need 4 M3 heat set inserts (http://www.mcmaster.com/#94180a331/=138pg0w) in addition to the stock M3 bolt and washer mounting hardware for the belt mount
- Stock taz belt and bed fittings for whichever Taz bed variant you are using

OPTIONAL (Cable Chain Mount)



- 1x 10mm M5 Cap head Bolt
- 1x M5 T-nut
- 6x 8mm M3 Cap head Bolt (4x for Taz 6 variant)
- TAZ 6 (stock Mounting hardware for the button thing)
- 1 Zip Tie

Preparation for Installation:

Unless you received this modification in kit form, you will need to print and prepare the following parts:

Main assembly:

- 4x **Openrail_corner_2_0_a.stl**

  OR
- 4x **Openrail_corner_2_0_a_Taz6_foot.stl**
- 6x **Openrail_y_support_2_0_a.stl**
- **(Taz 1-5)** 2x **Combined_Drill_Guide_Plate_2_0_a.stl**

  OR
- 1x **Taz_Openbuild_Y_super_mega_combo_drillplate.stl**

  OR
- (Taz 5) 2x **Combined_Drill_Guide_Plate_TAZ_6_ONLY_Variant.stl**

Now things get a bit complicated. The Taz 3 had a different bolt profile than the Taz 4 and 5, and the Taz 6 uses one of the Taz 4/5 style endplates in place of the Taz 3-5 Idler style endplate. At this point I believe the Taz 6 endplates are both identical to the Taz 4/5 Motor endplate, but I'm not 100% sure. You want one Idler and One motor endplate reinforcement, but which one you need will depend on what the base machine you are starting out from is. A Taz 5 is going to need the 2.0c idler plate and the Taz v4 or v5 motor plate for example.

- 1x **Taz_Openbuild_Y_Endplate_Reinforcement_Idler_2_0_c.stl**
- 1x **Taz_V3_ONLY_Openbuild_Y_Endplate_Reinforcement_Motor_3_0_c.stl**
- 1x (or 2x for Taz 6)
  Taz_V4_or_5_ONLY_Openbuild_Y_Endplate_Reinforcement_Motor_3_0_E.stl

Optional Idler tensioner assembly:

- **Belt_Tensioner_Drill_Guide_1_0_a.stl**
- **Taz_Belt_Tensioner_Idler_Body_1_0_a.stl**
- **Taz_Belt_Tensioner_Z_Max_Belt_Mount_1_0_a.stl**
- **Taz_Belt_Tensioner_Z_max_Endstop_1_0_a.stl**

Optional nozzle cleaner assembly:

- **retrofit_nozzle_wiper2.stl**

Optional Cable chain assembly:

- **Y_bed_chain_anchor_Frame_1_0_a.stl**

Taz 1-5

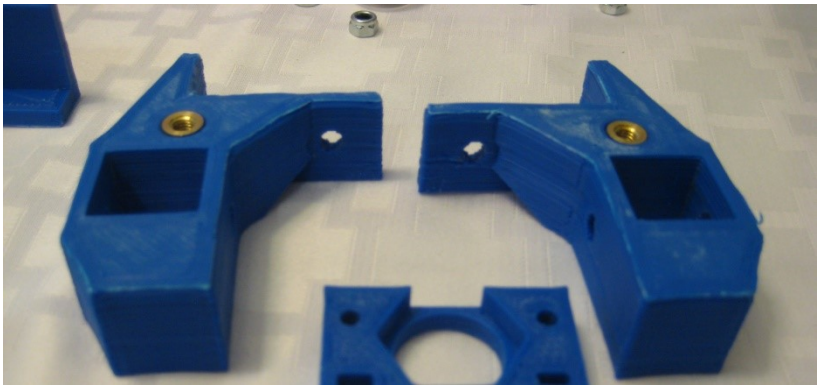
- **Y_bed_chain_anchor_bed_base_2_0_a.stl**
- **Y_bed_chain_anchor_Bed_Latch_2_0_a.stl**

Taz 6

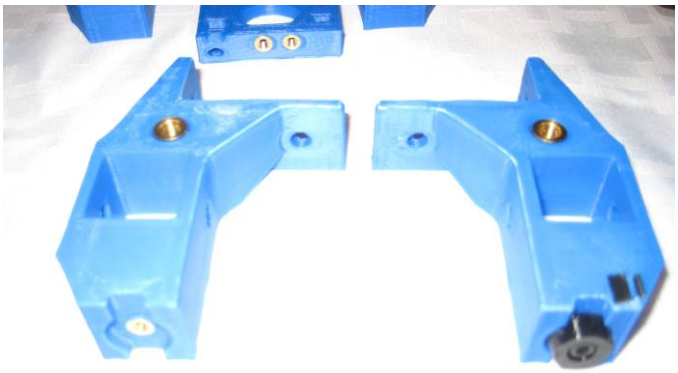
- **Taz_6_button_bed_chain_anchor_A.stl**

Heat set inserts:

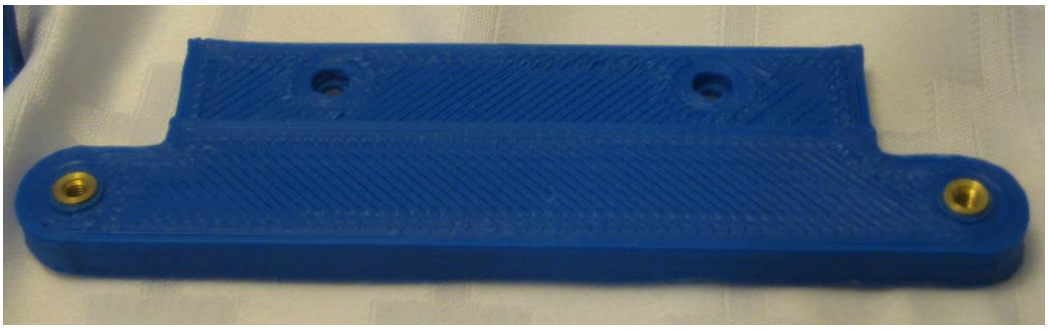
Openrail_corner_2_0_a.stl requires insertion of 1 M5 heat set insert per piece



OR Openrail_corner_2_0_a_Taz6_foot.stl requires insertion of 1 M5 and 1 M3 heat set insert per piece

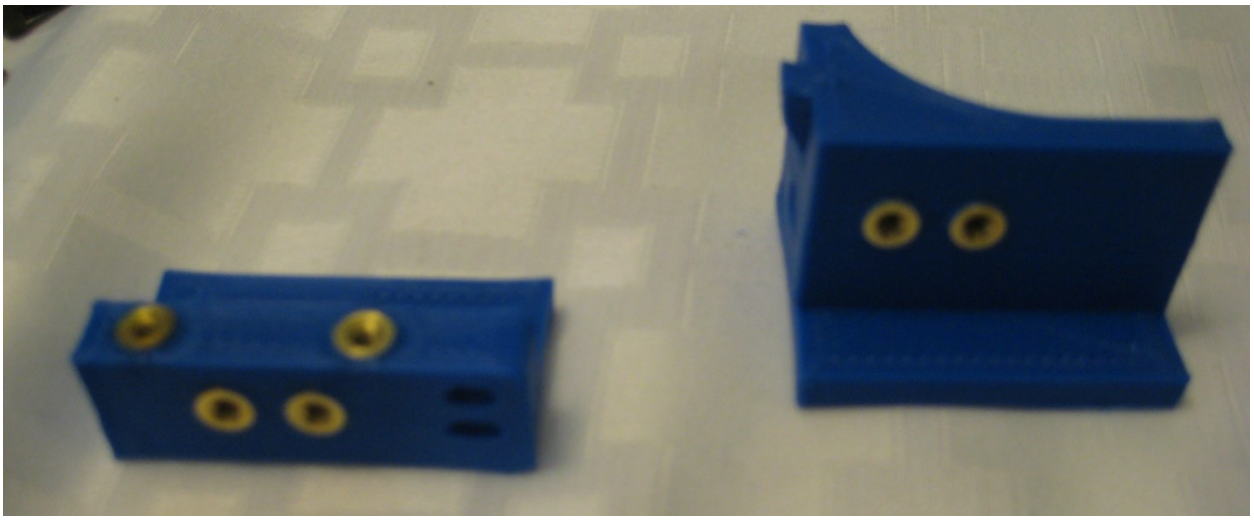


retrofit_nozzle_wiper2.stl requires 2 M3 heat set inserts

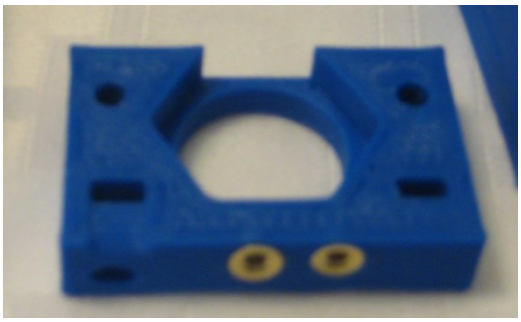


Y_bed_chain_anchor_bed_base_2_0_a requires 4 M3 heat set inserts

Y_bed_chain_anchor_Frame_1_0_a.stl requires 2 M3 heat set inserts

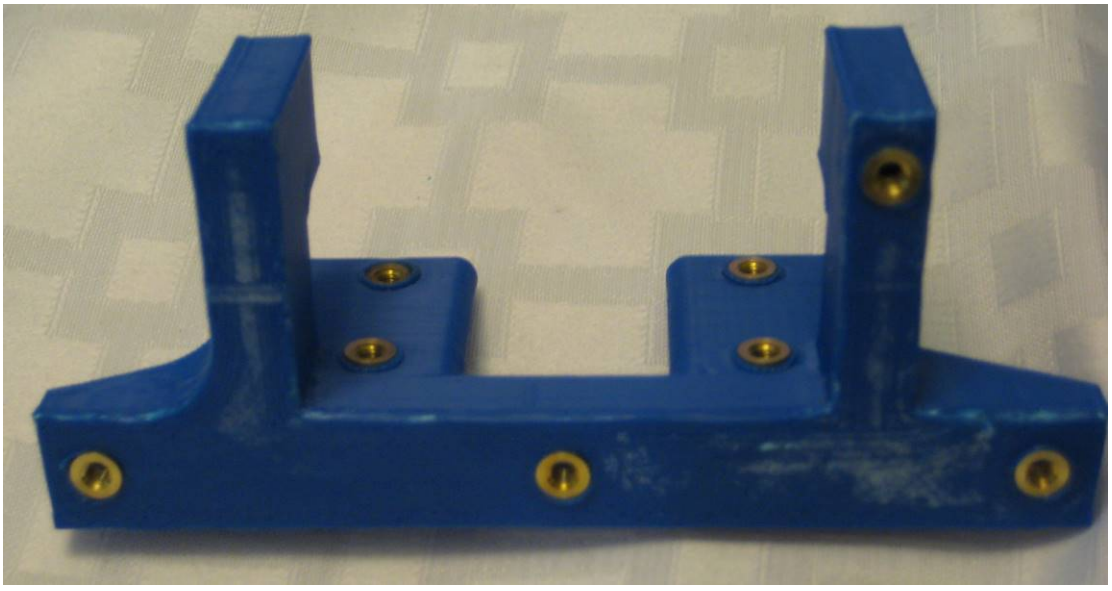


TAZ 6 Only: Taz_6_button_bed_chain_anchor_A requires 2 M3 heat set inserts

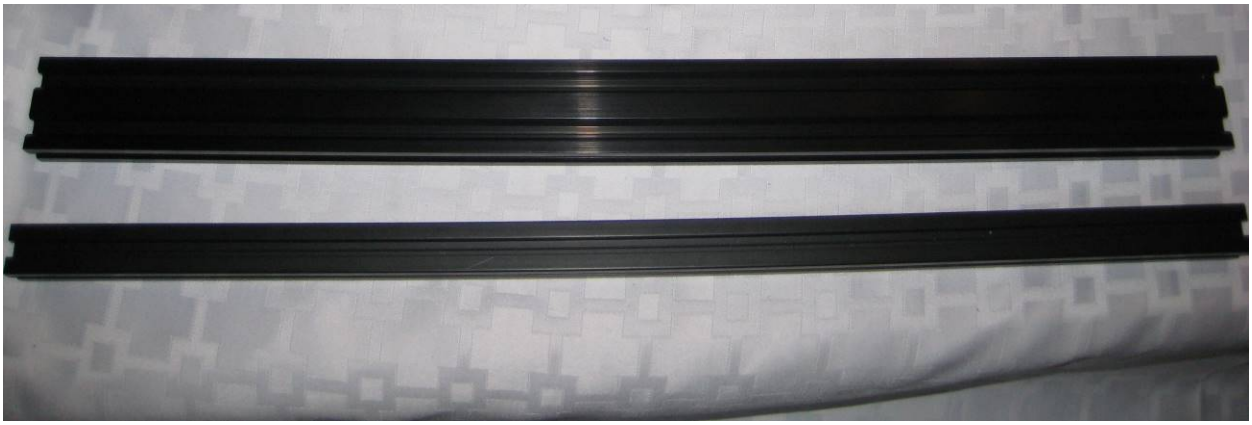


Taz_OpenRail_Idler_Endcap_2_0_b.stl requires (optional) 2 M2 inserts

Taz_Belt_Tensioner_Z_Max_Belt_Mount_1_0_a .stl requires 8 M3 heat set inserts



Rail Preparation:

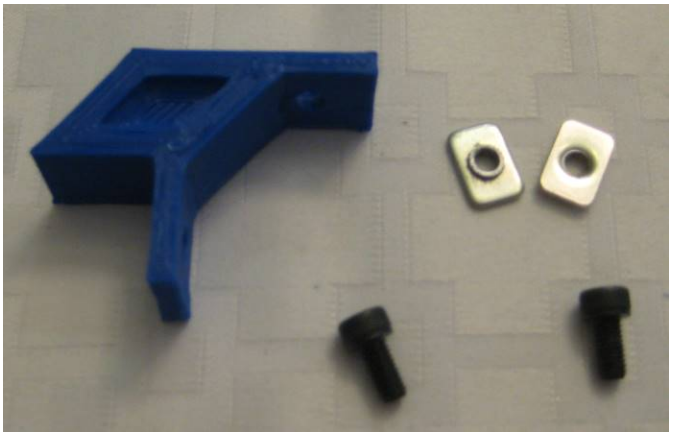


Measure your 500mm x 40mm x 20mm Openbuilds rail to ensure it is in fact actually 500mm long. You can check it next to your stock Taz extrusions if you like. There have been reports of rails showing up at 510mm long rather than 500mm, though this seems to have been resolved recently. If it needs to be shortened, please cut it with a precision instrument.

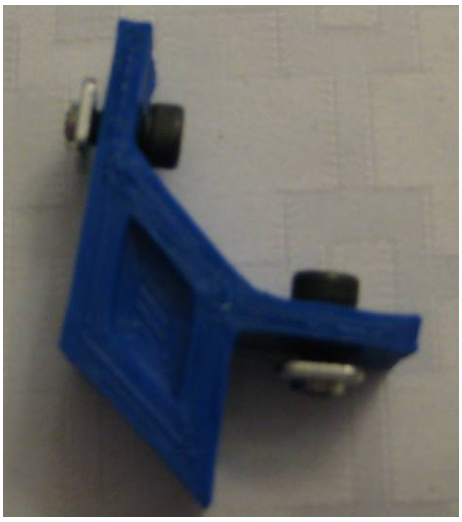
Assembly Instructions:

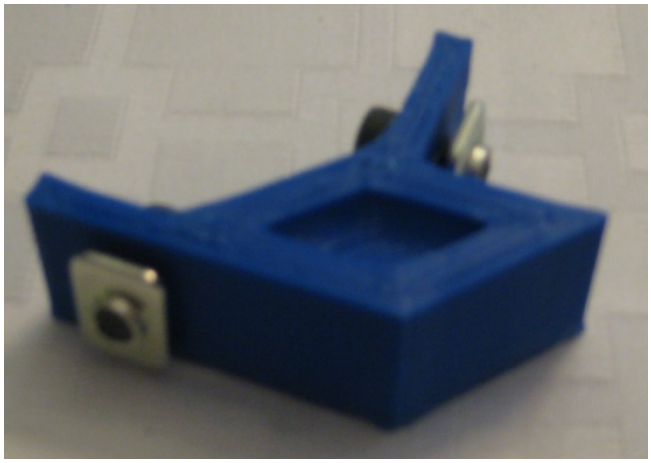
Rail Spacers

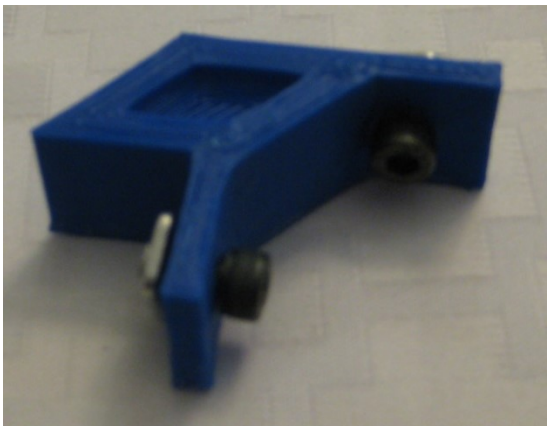
Step 1: 2x M5 10mm bolts and 2x M5 Tnuts, and **Openrail_y_support_2_0_a.stl**



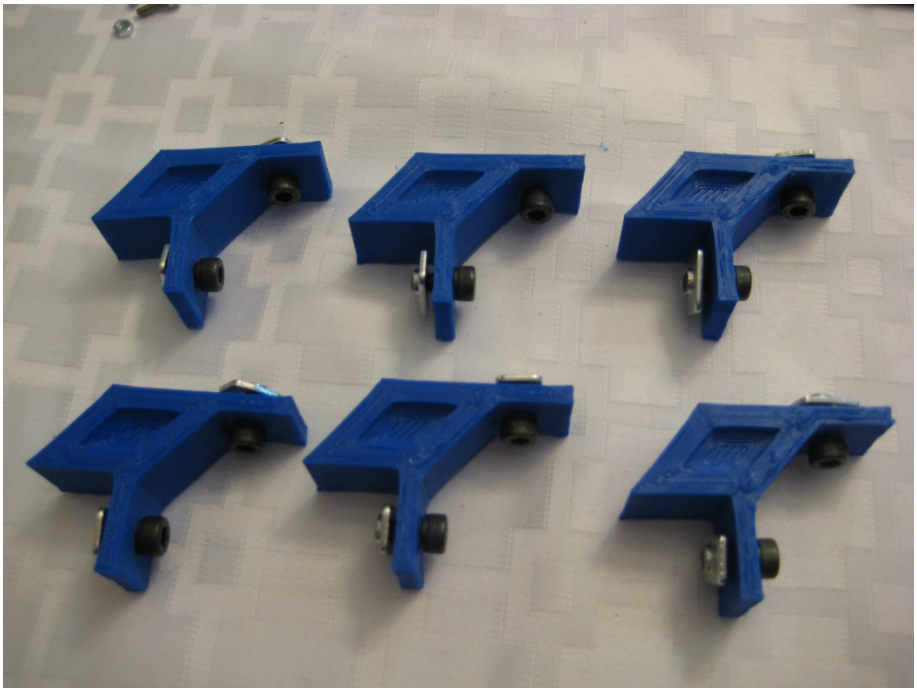
Step 2: Insert the bolts and Tnuts as shown in the pictures below.



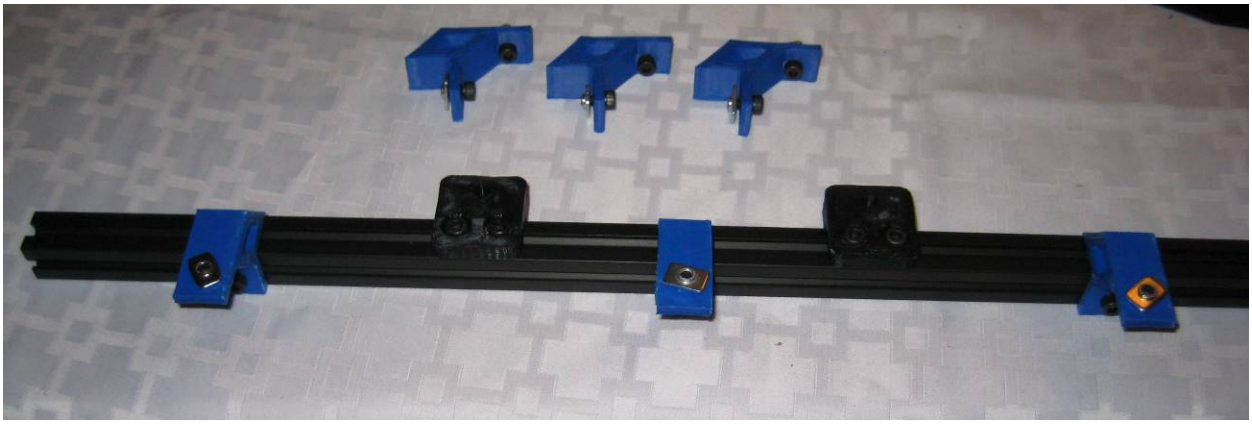




Step 3: Repeat until you have a total of 6 identical assemblies

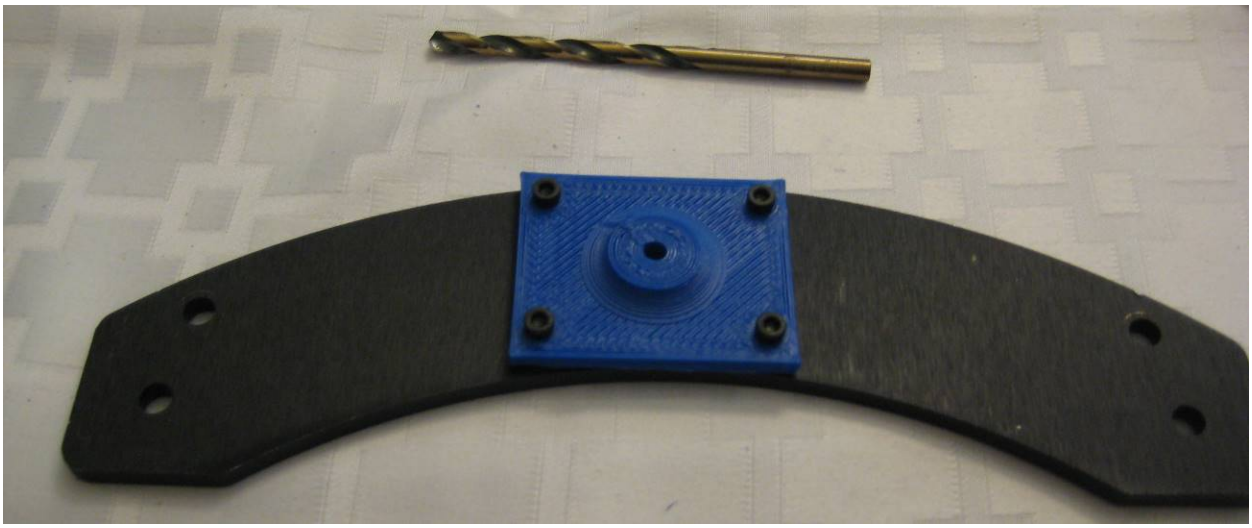


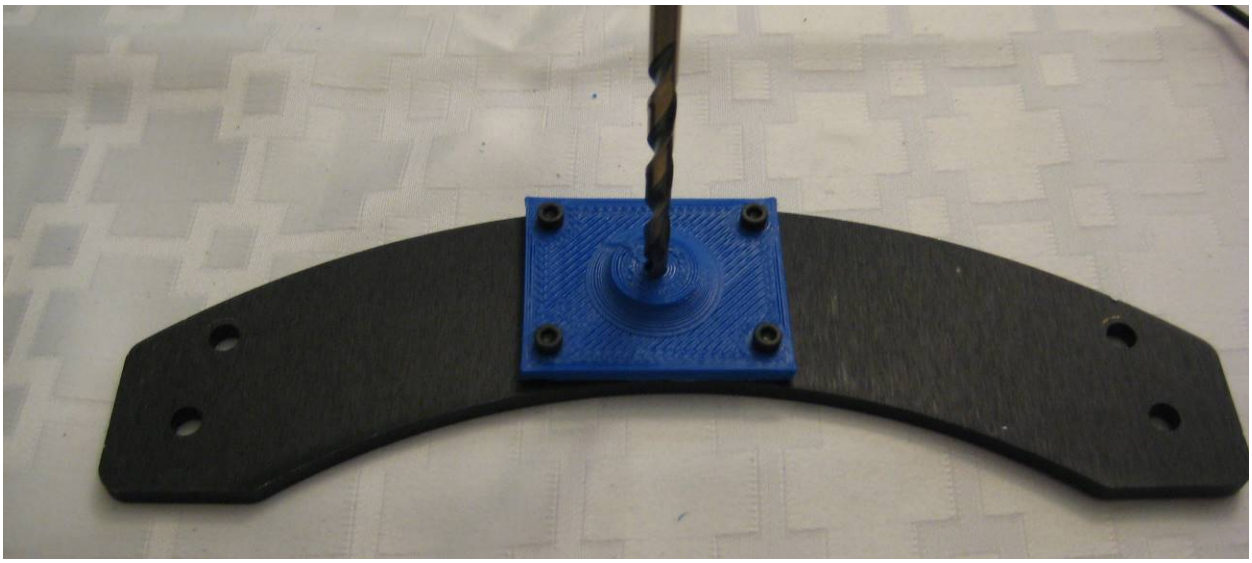
Step 4: Install 3 of the support assemblies onto each rail, spaced evenly as shown. Use your Vernier Calipers to ensure a good spacing. Note that the stock Y bed mount tabs face outward when constructing this step.



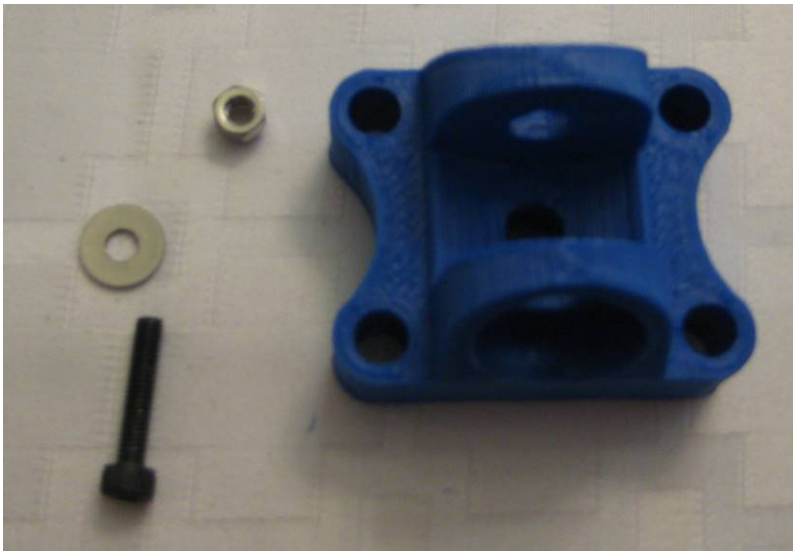
OPTIONAL (Idler Tensioner)

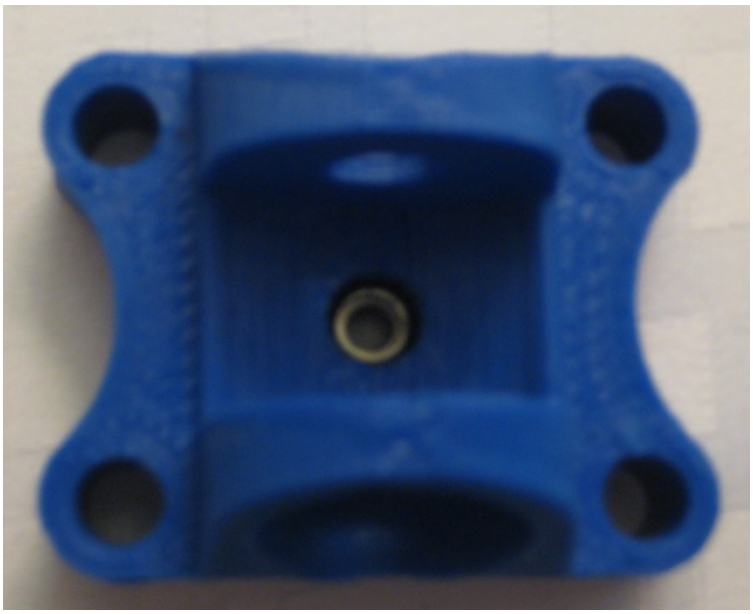
Step 6: (Optional) Locate the Y Idler endplate and the **Belt_Tensioner_Drill_Guide_1_0_a.stl**. Using 4 temporary M3 bolts and nuts (10mm should work) center the drill guide on the plate and drill a hole using the 4.9mm Drill bit.





Step 7: Locate the Taz_Belt_Tensioner_Idler_Body_1_0_a.stl, the M4 nut, the 12mm M4 bolt and the M4 washer. Use the bolt and washer to pull the nut into the inner socket, being careful not to strip the socket. If it feels like it is going to strip, lubricate the bolt or get one that isn't quite as stiff in the nut. Remove the bolt and washer and set aside for later.

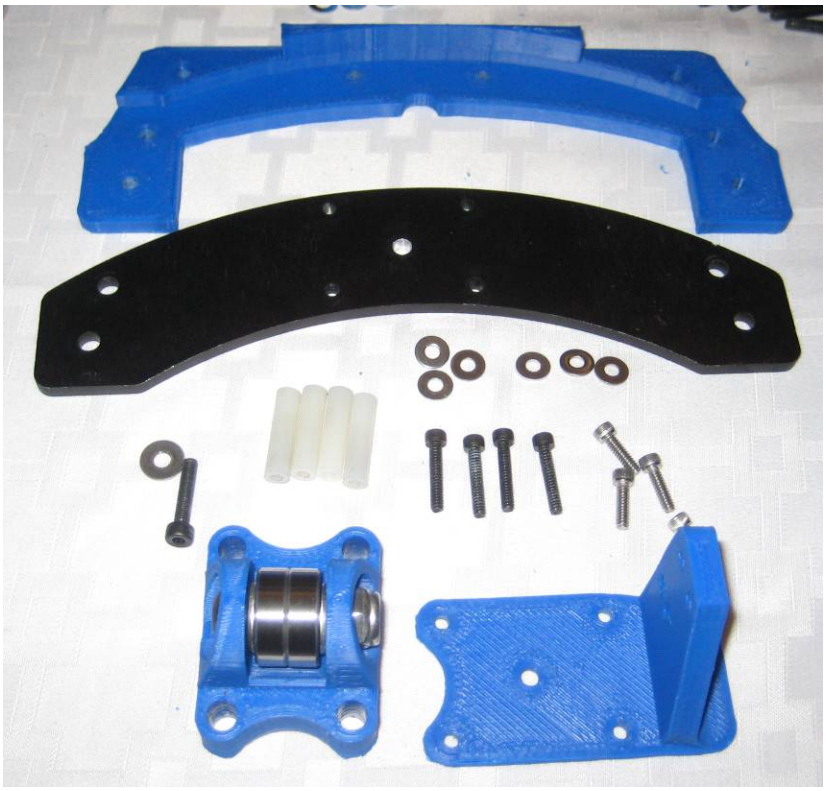




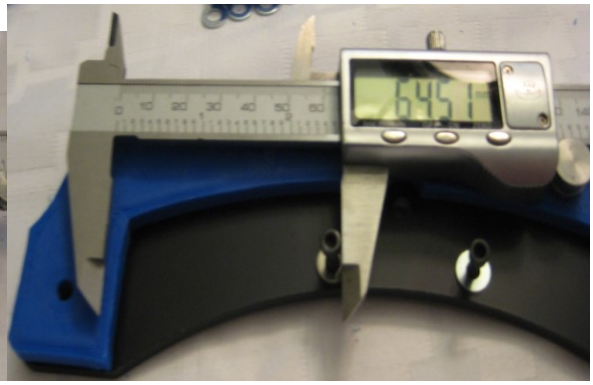
Step 8: Install the stock Taz Idler hardware (M8 bolt, M8 nut, 2x M8 washer, 2x 608zz bearings) into the Idler housing.

Idler Endplate

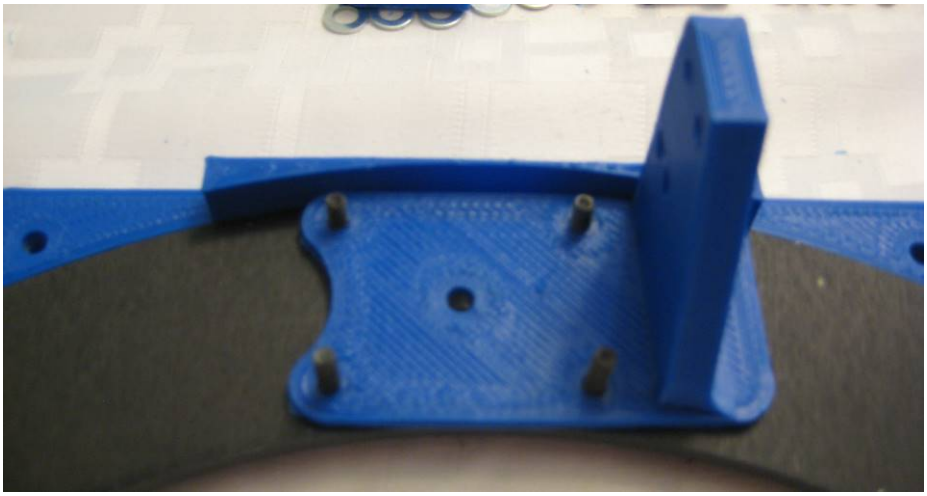
Step 9: Gather the rest of the idler endplate parts. If you are using the stock idler here, you will use the stock mounting hardware and 2 longer12mm M3 bolts in place of the tensioner assembly.



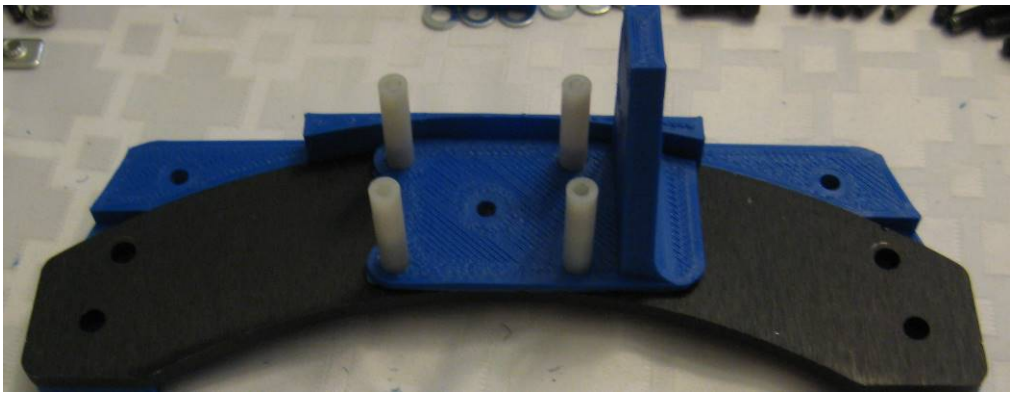
Step 10: Using your Vernier calipers, ensure that the idler endplate is aligned offset to the right, then install 2 18mm long 6-32 bolts through the **Taz_Openbuild_Y_Endplate_Reinforcement_Idler_2_0_c.stl** and the Idler endplate. Install two other 18mm 5-32 bolts through washers into just the endplate in the lower holes as shown.



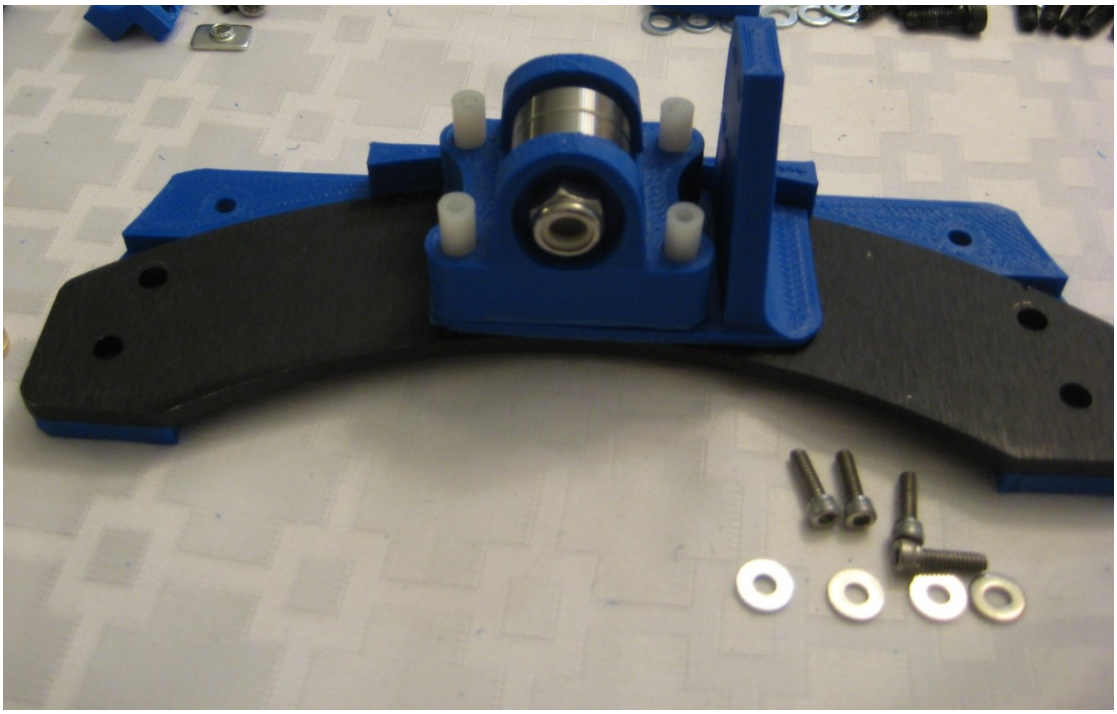
Step 11: Being careful not to lose your bolts, flip the entire assembly over and insert Taz_Belt_Tensioner_Z_max_Endstop_1_0_a.stl over the 4 bolts



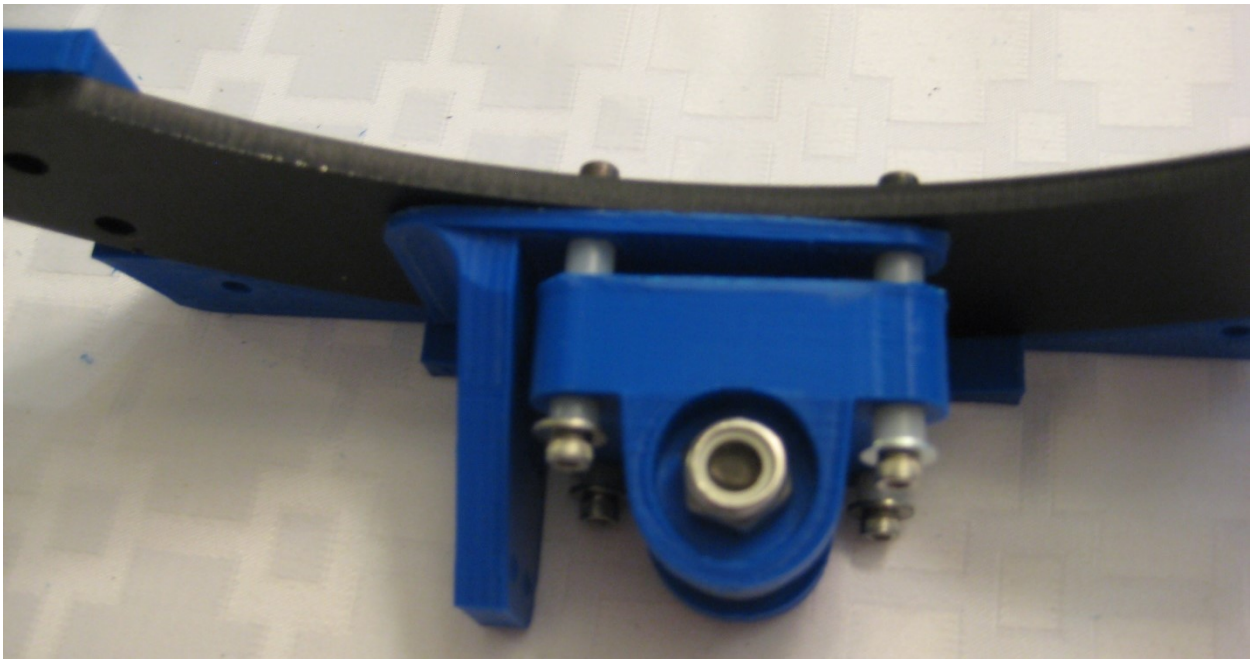
Step 12: Thread the 4 ¼" nylon spacers onto the bolts, using them to hold the Z max endstop mount in place



Step 13: Fit the Idler assembly over the 4 nylon spacer posts. The idler assembly should move up and down easily without too much force. If it is too stiff, use a ¼" drill bit to clearance the holes until a smooth fit is achieved.

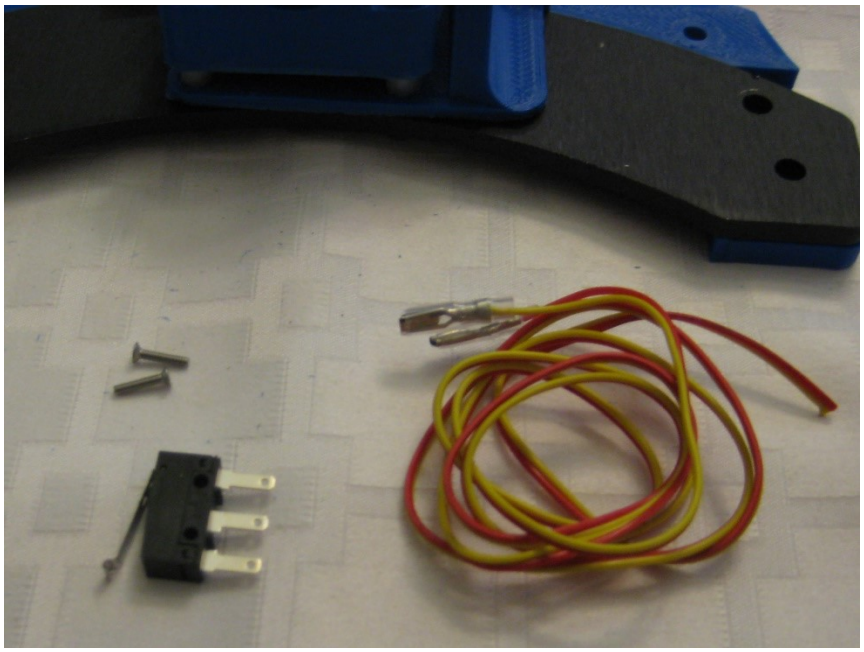


Step 14: Install the 4 washers and 4 10mm 6-32 bolts into the ends of the nylon spacers. This will prevent a belt incident if the m4 belt ever fails.

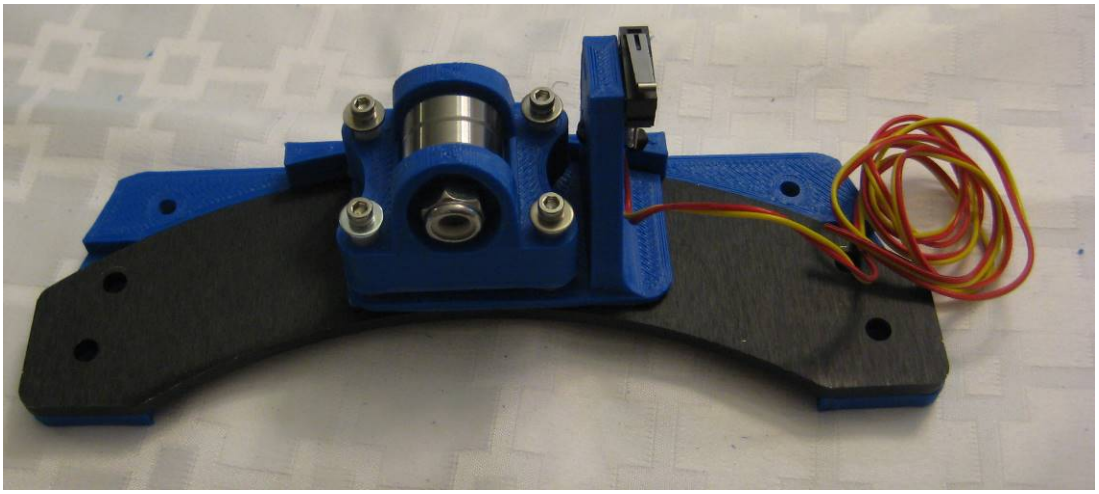


Step 15: install the M4 bolt and washer into the front of the idler plate. Start with about 3-4mm worth of spacer between the Y max mount plate and the idler body.

Step 16: (OPTIONAL) Locate the Y max endstop and M2 bolts



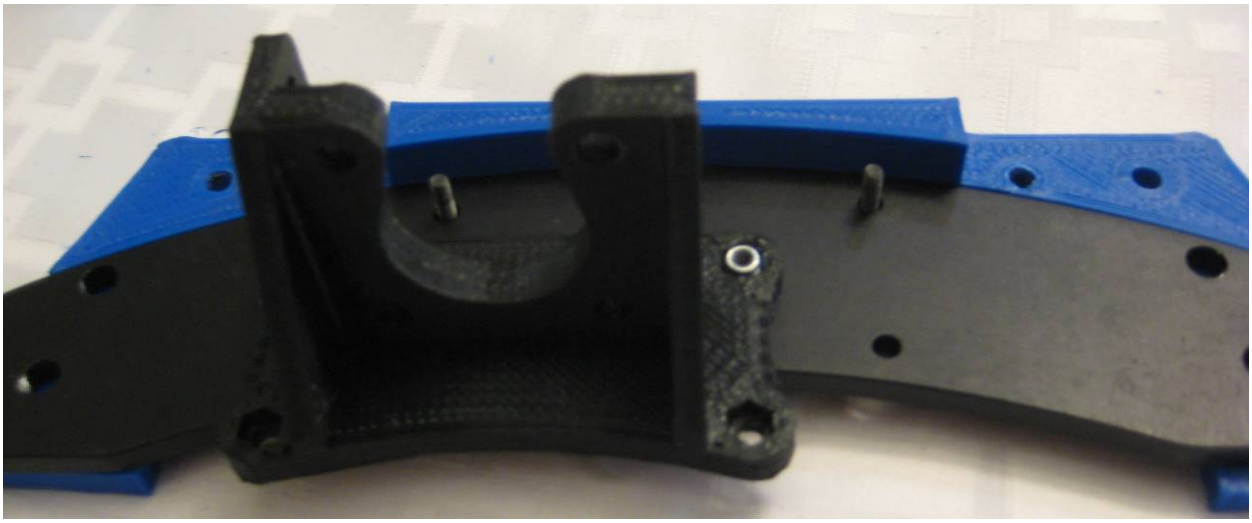
Step 17: install the Y max endstop as shown in the picture and set the assembly aside for now



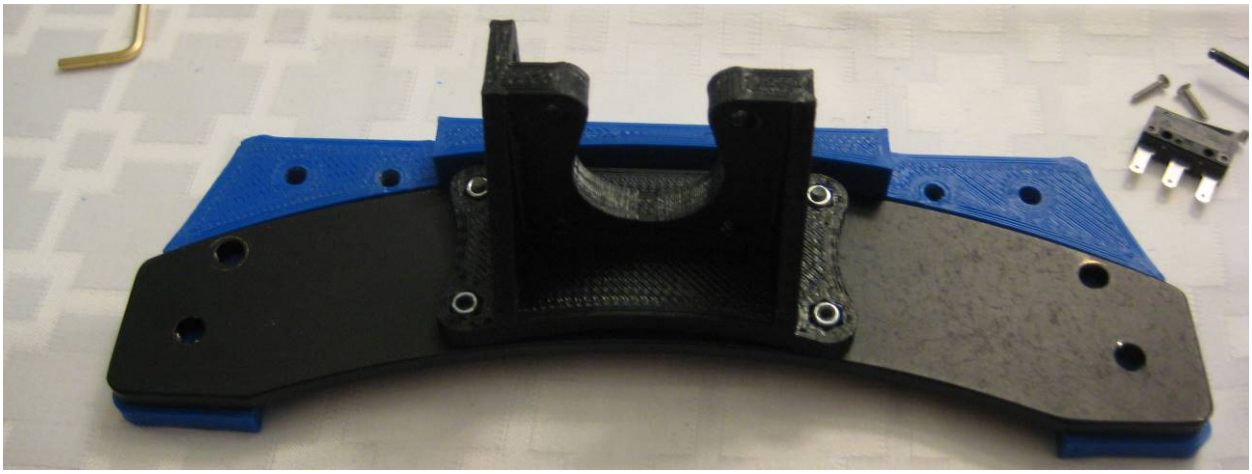
Motor Endplate

Step 18: Locate whichever version of the motor endplate spacer and endplate you will be using (Shown is a Taz 3 style plate and **Taz_V3_ONLY_Openbuild_Y_Endplate_Reinforcement_Motor_3_0_c.stl** however the assembly sequence is identical for all of the plate types. You would also reference this for a stock Taz 6 idler and motor side. Insert 2 16mm M3 bolts through the plate and the guide.

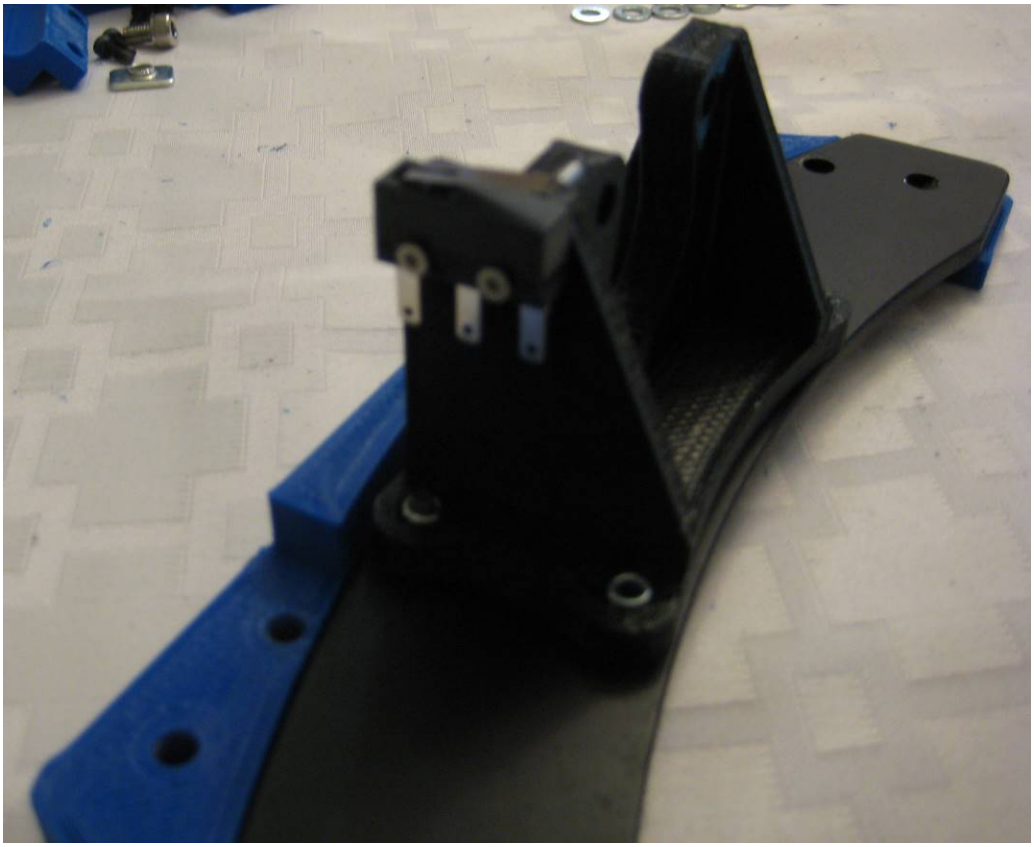
Step 19: Insert the M3 nuts into the stock lulzbot Y motor mount.



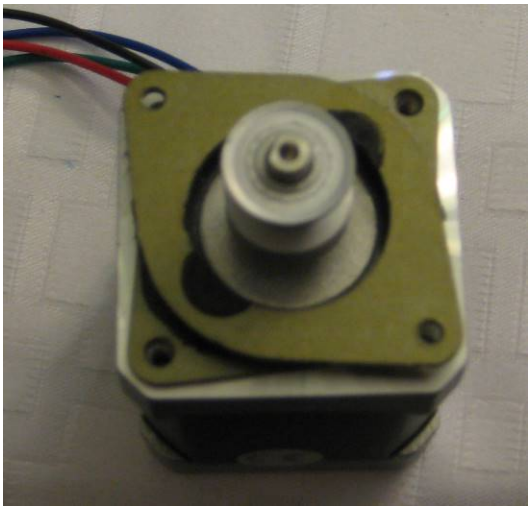
Step 20: using the 16mm M3 bolts and 2 additional 10mm m3 bolts and 2 M3 washers, mount the motor mount to the plate.



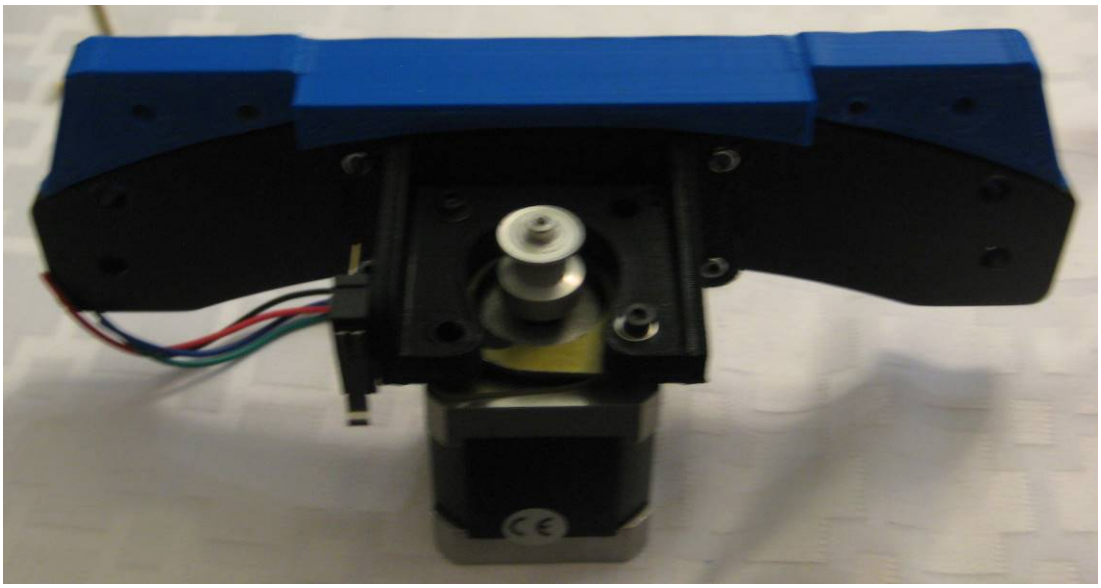
Step 21: Ensure the stock Y minimum endstop is installed. If it isn't install it with the stock M2 bolts.



Step 22: (OPTIONAL) Locate the stock Y axis motor and a Vibration Damper. Install the vibration damper in 2 of the motor mount holes using some 8mm M3 bolts. This will appreciably help minimize bed noise without affecting print quality.



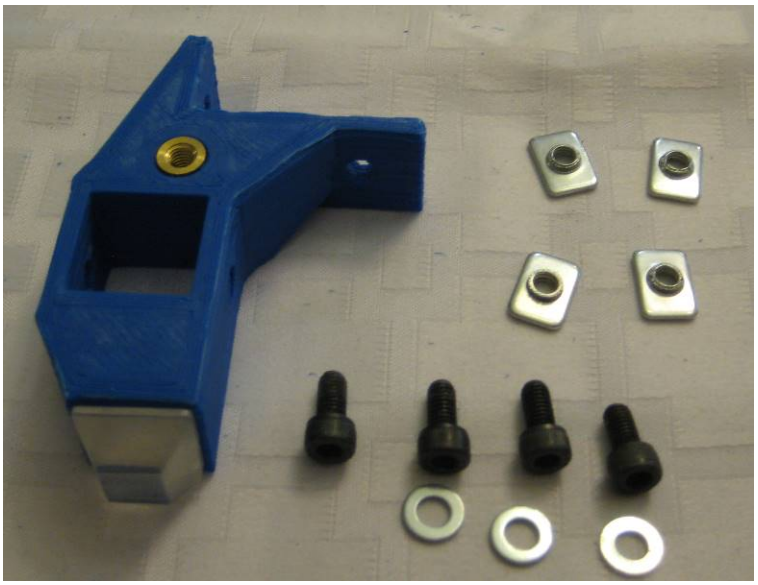
Step 23: Using 2 10mm m3 bolts and 2 washers, reinstall the stock Motor. Set the assembly aside for now.



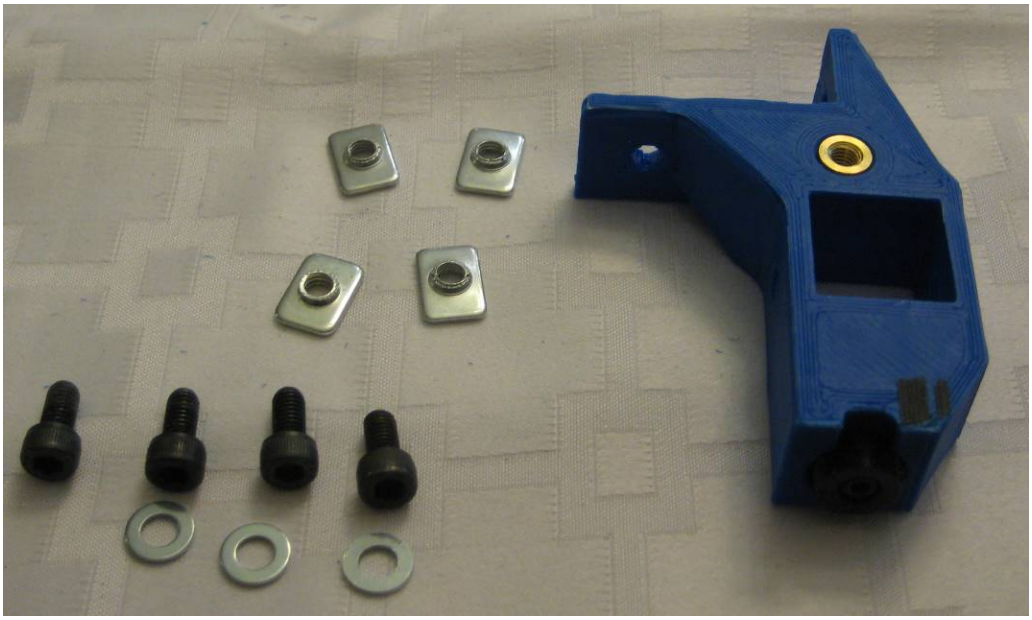
Corner Assembly

Step 24: Locate either **Openrail_corner_2_0_a.stl** or **Openrail_corner_2_0_a_Taz6_foot.stl** depending on which version you wish to use. They may be used interchangeably and the 6 variant foot will fit the earlier Taz frames without issue. Also locate 4 10mm M5 bolts, 3 m5 washers and 4 M5 Tnuts.

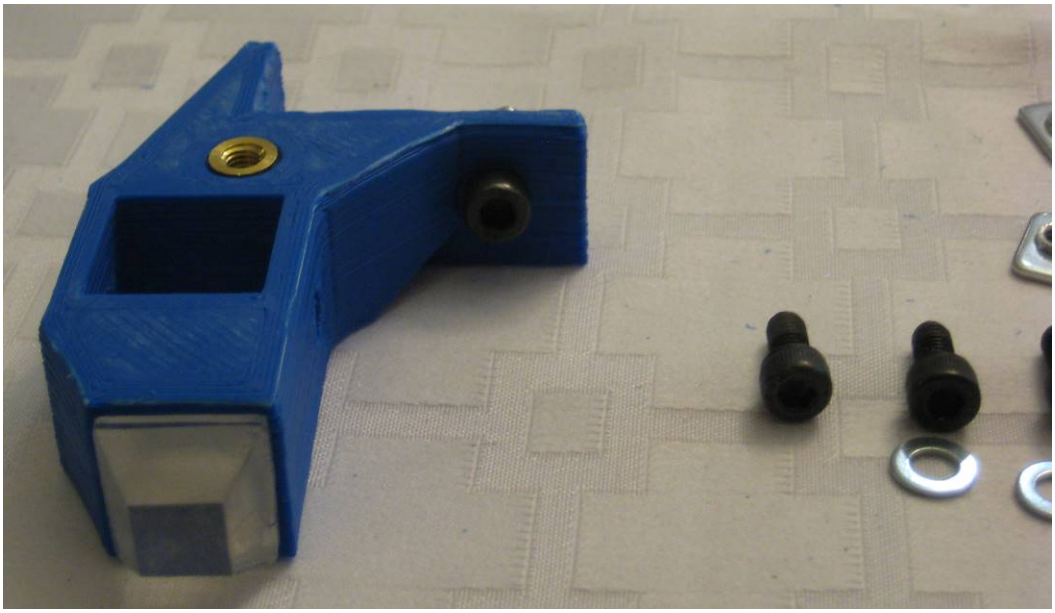
Note: I installed the adhesive feet at this point, but they kept coming off during subsequent steps so you may want to install them at the very end.



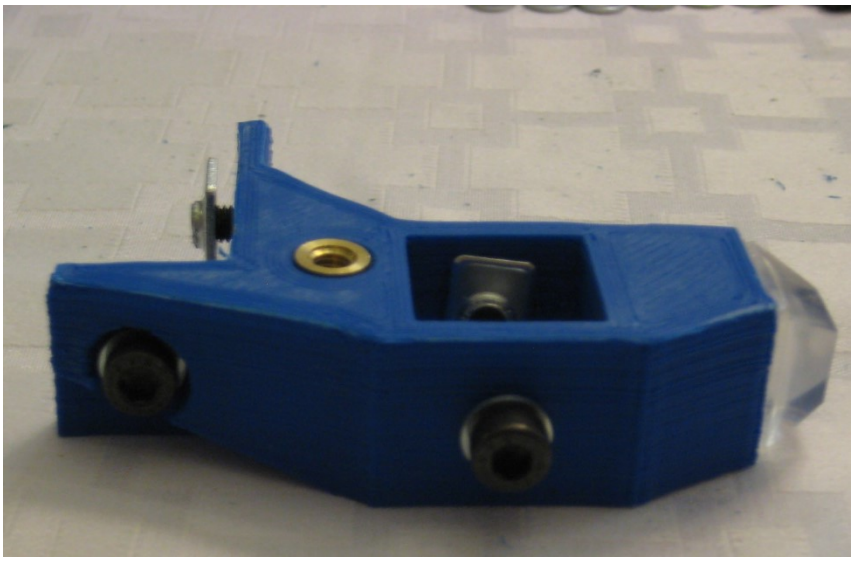
The Taz 6 variant also requires the stock Taz 6 flexy foot and M3 Cap head bolt. The Flexy feet may be printed or can be sourced from I-T-W.com

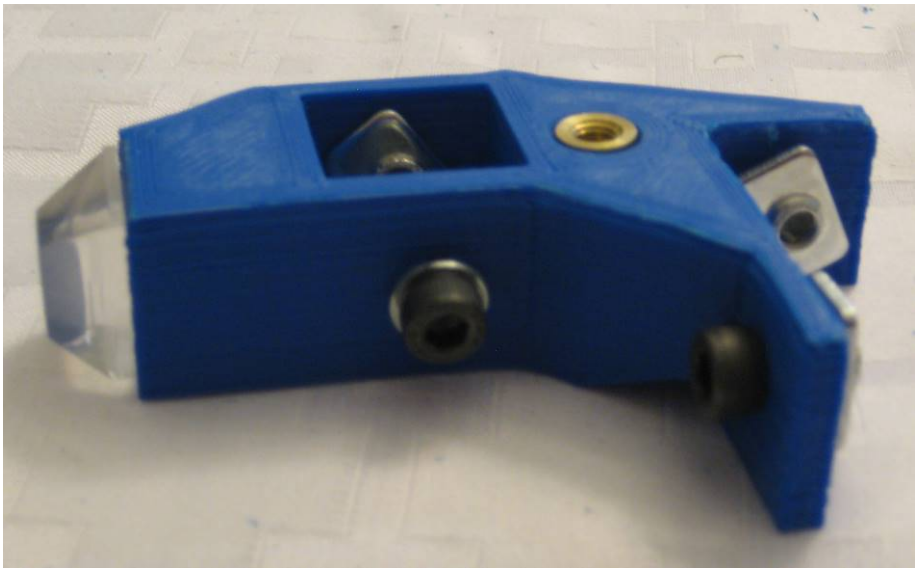


Step 25: Install 1 of the M5 bolts without a washer through the lower Rail mount holeand into 1 Tnut. There is no good explanation for why this one doesn't get a washer, I just felt like leaving that one off since it will be under the frame.

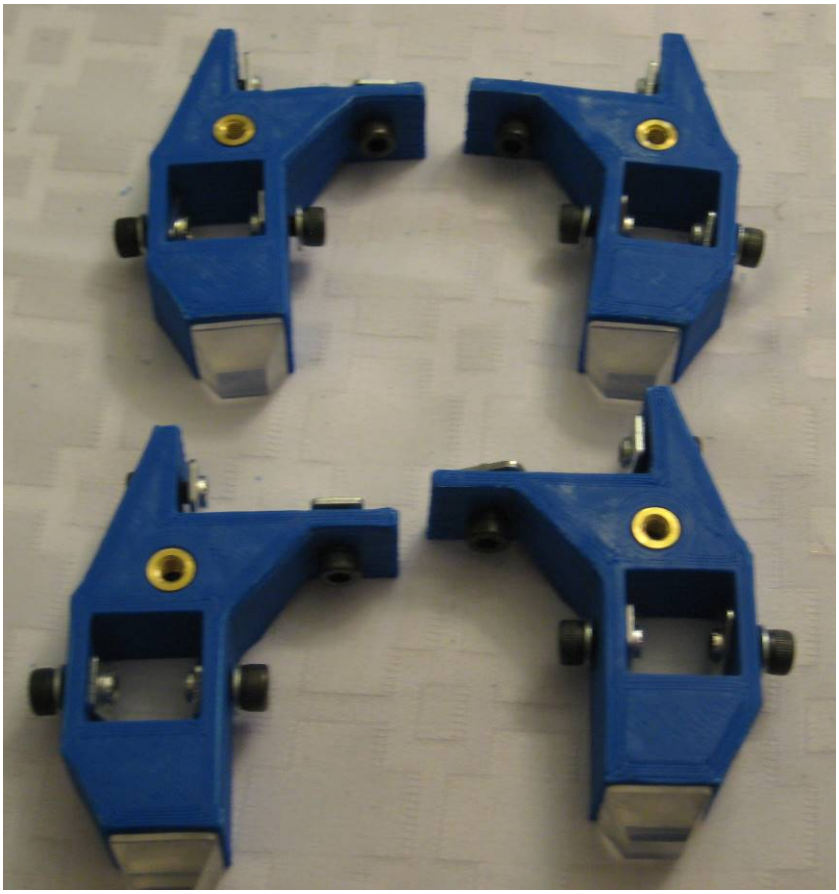


Step 26: Install the remaining M5 bolts, washers and Tnuts as shown.

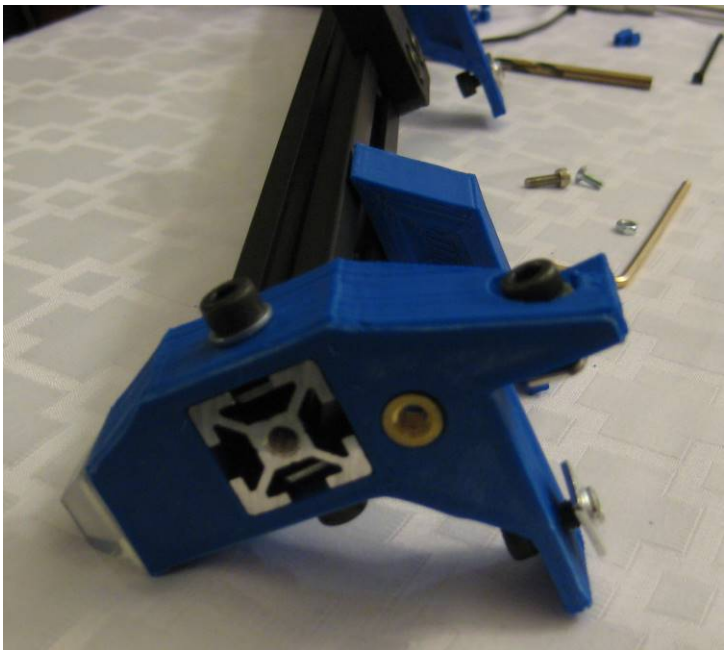




Step 27: Repeat until you have a total of 4 corner assemblies as shown.



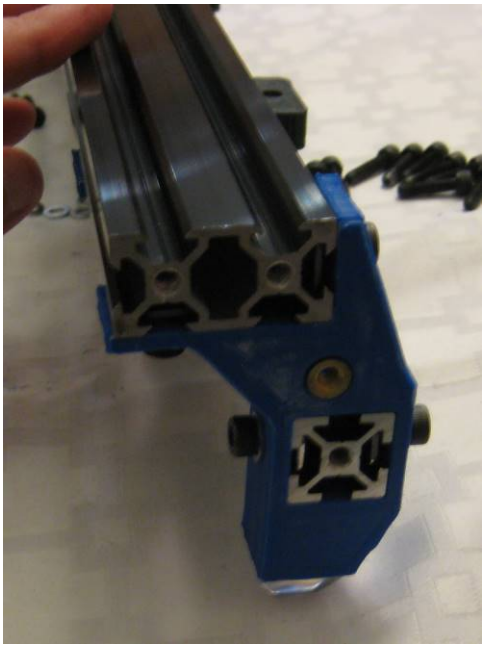
Step 28: Slide the completed corner assemblies onto the stock Taz lower rails until they are flush with the ends, and then tighten the lower M5 bolts and T-nuts. Do this for all 4 corner assemblies.



Bearing Rail Assembly

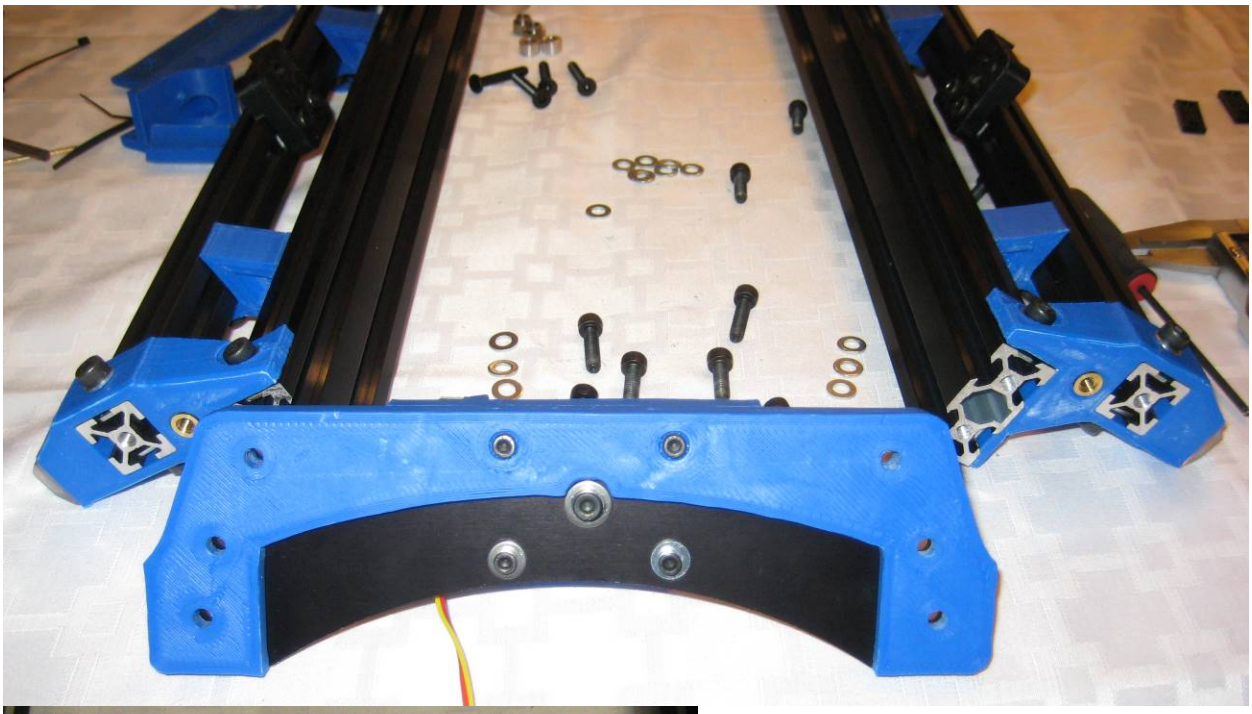
Step 29a: (Not pictured) Use your M5 Tap to thread all the holes in the end of the openbuilds V slot rails. You will only use 6 of the 8 possible holes, but by tapping all of them you eliminate the “oops, I reinstalled the rail and now the tapped hole is in the other spot and inaccessible” issue.

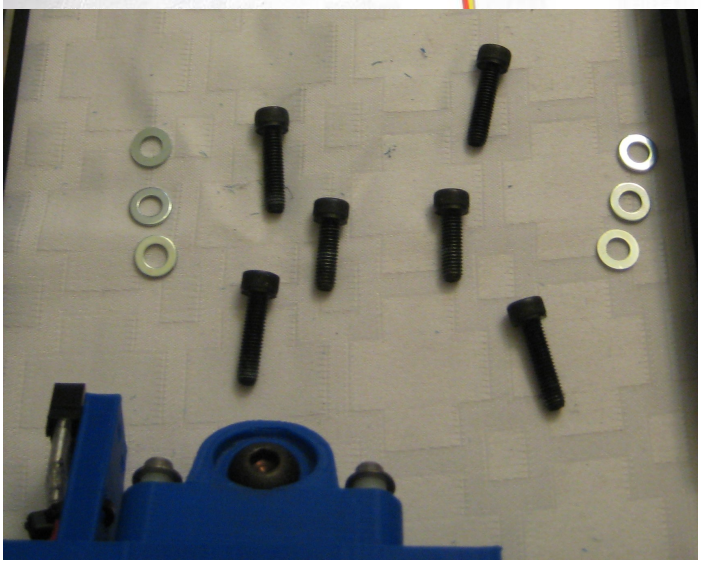
Step 29b: Slide the Openbuilds Rail onto the front corner, down the three supports and then over the back corner. It should be flush with both ends. Loosely tighten the M5 bolts at this time. We may need to adjust later. Repeat for the other rail.



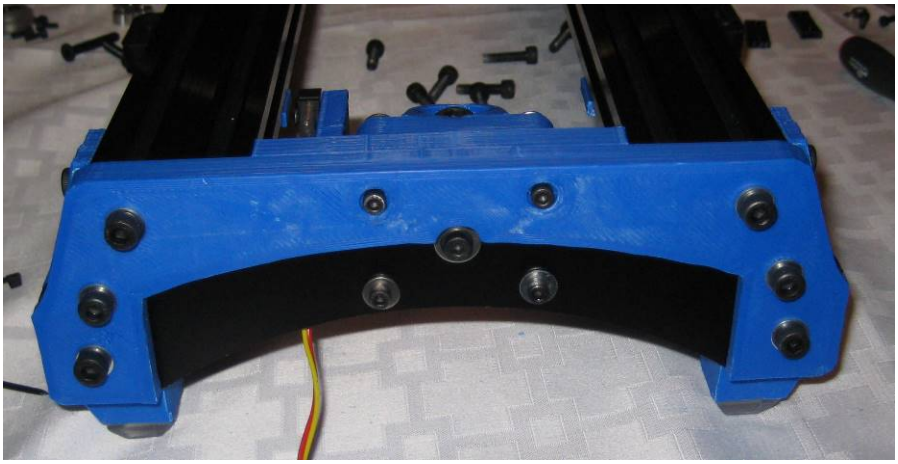
Final Frame Assembly

Step 29: Locate the two Rail assemblies, and the Idler plate assembly. Also locate 4 20mm M5 bolts 2 16mm M5 bolts and 6 m5 washers

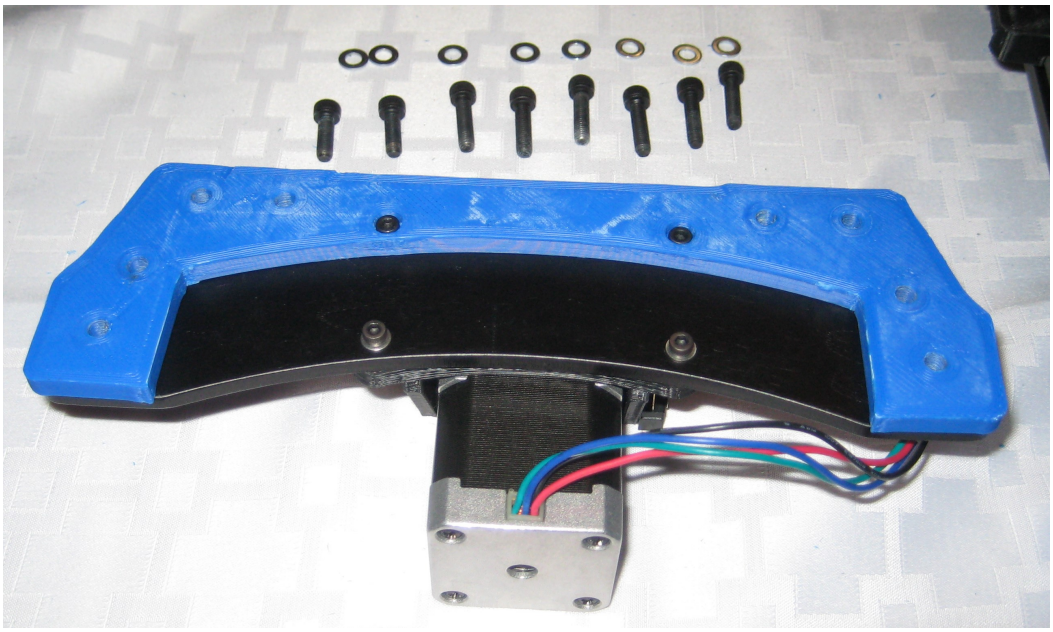




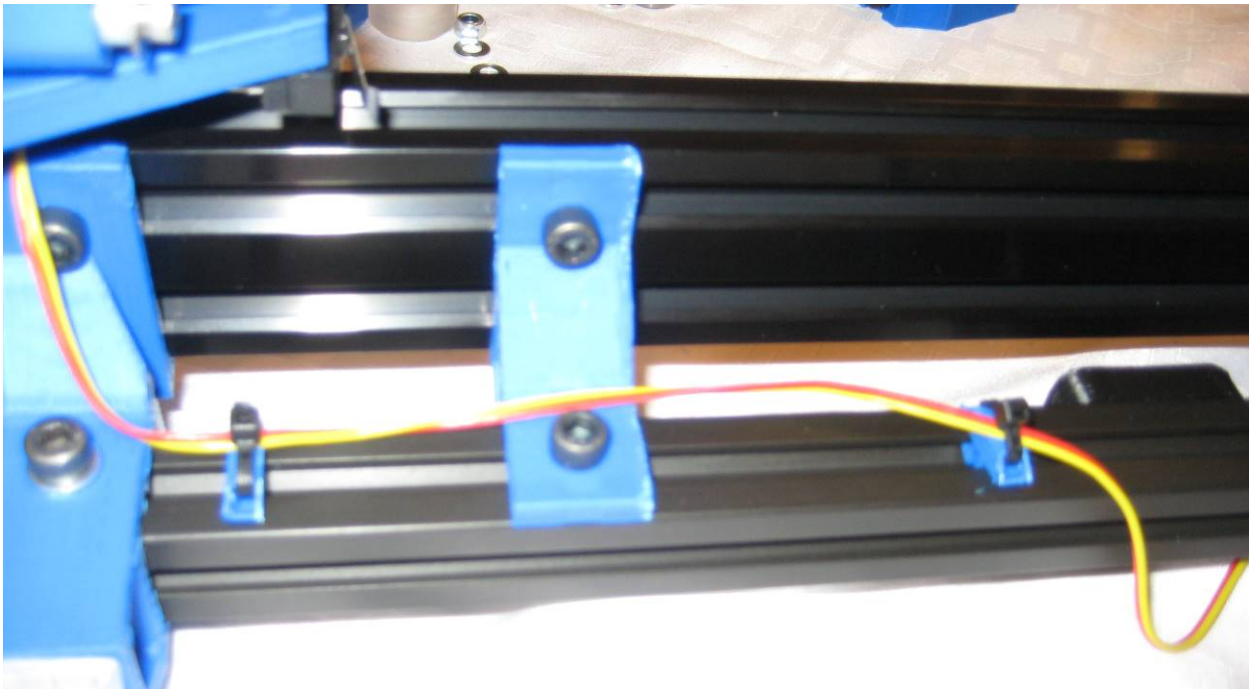
Step 30: Use the 4 20mm long M5 bolts and washers through the Idler plate assembly and into the upper and lower rails, and use the 16mm long M5 bolts and washers in the middle holes into the Heat set inserts in the corner pieces .



Step 31: Locate the Motor endplate and 6 20mm M5 bolts, 2 16mm M5 bolts, and 8 M5 washers. Install the plate on the other side of the main frame assembly opposite the Idler plate. The 16mm screws again go through the plate and into the heat set insert in the corner pieces. (Not pictured. I think the camera guy was sleepy at that point)

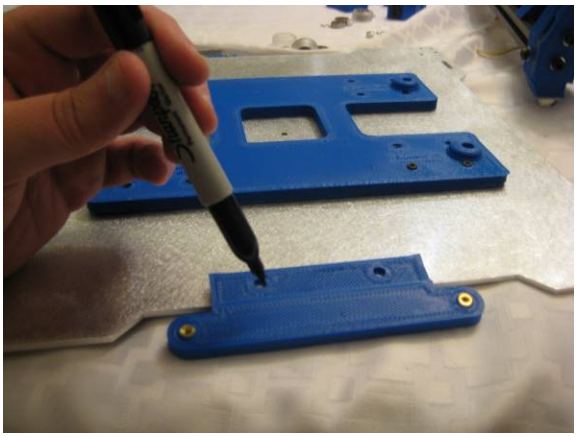


Step 32: Using your favorite cable retention clip make 3 cable retainers and run the Y maximum endstop cable towards the middle of the frame. You will eventually run that all the way into the control box.

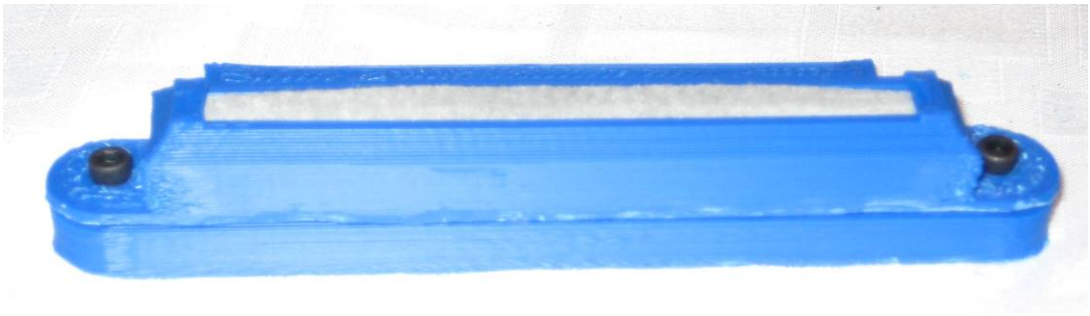


Bed Assembly

Step 33: (OPTIONAL) If you will be installing the Nozzle wiper, use the nozzle wiper adapte**r** **retrofit_nozzle_wiper2.**stl and a marker to locate two holes on the stock Taz 5 bed. You can either choose a side location similar to the stock taz 6 (which will require moving the bed over) or the back location as shown here)

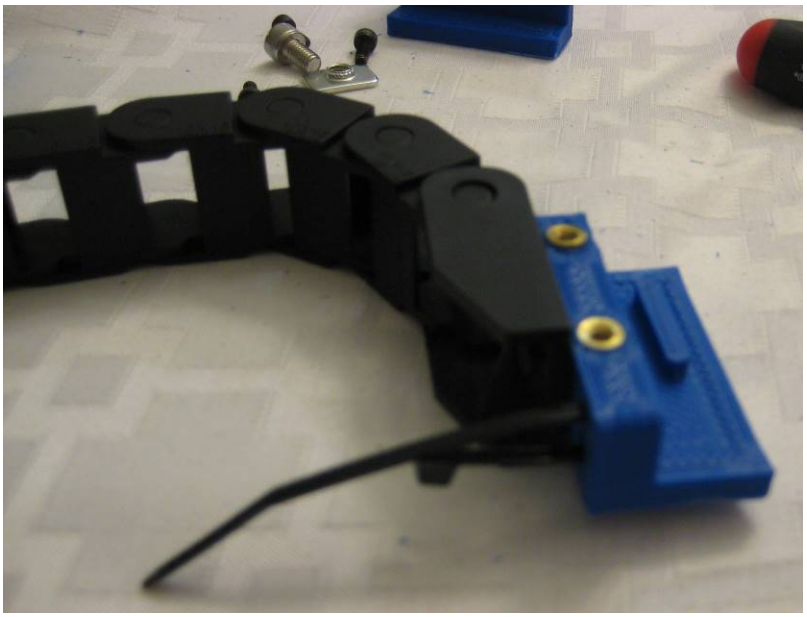


Step 34: Assemble the Nozzle cleaner using 2 8mm m3 bolts

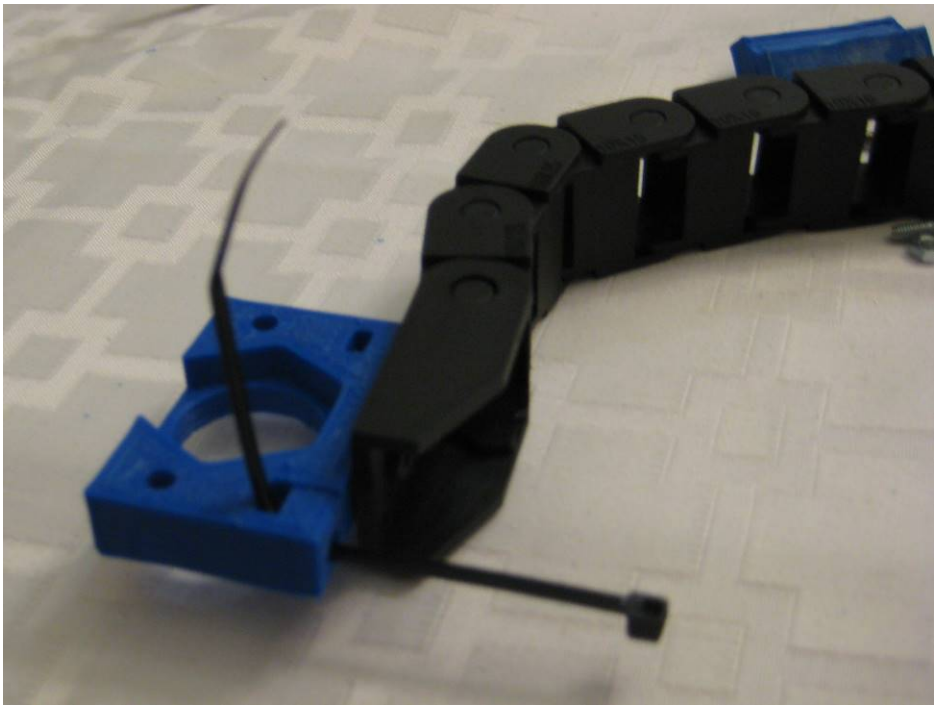


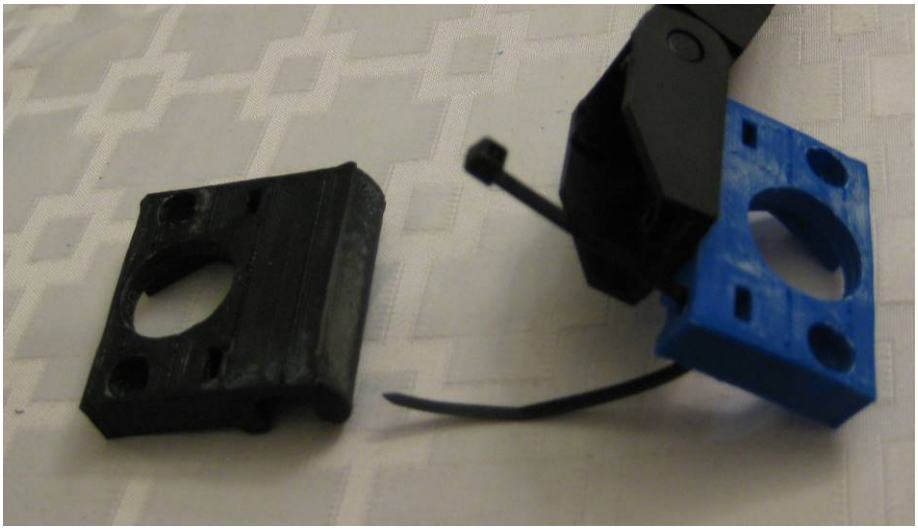
Step 35: (OPTIONAL) Using 4 8mm M3 bolts, bolt the Igus 10 x 15mm cable chain into the cable chain ends. For a Taz 6 use the button housing specific end. You will also want to insert a Zip tie for securing the cable later in either style end.

Taz 1-5 style



Taz 6 Style



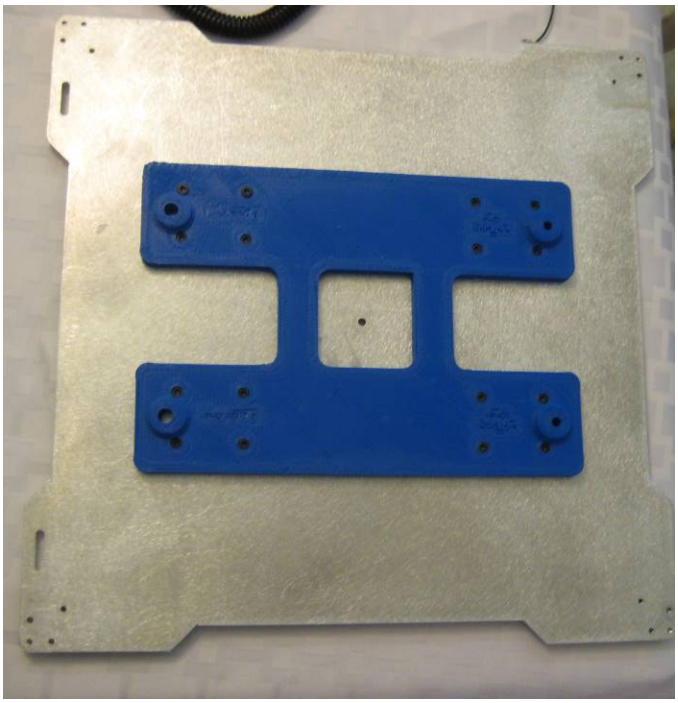


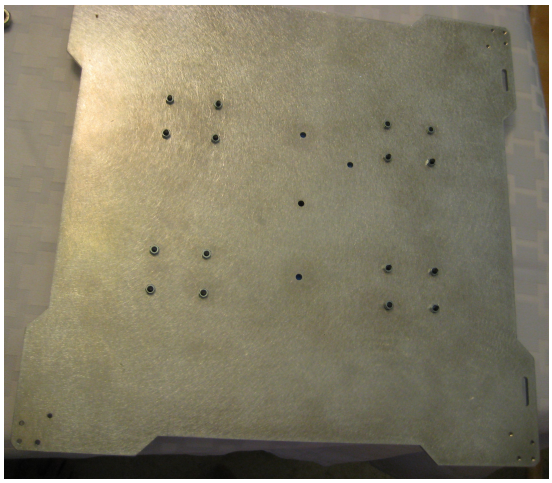
Step 36: Ok, now it's time for the scary bit. You are going to drill large holes in your perfectly good Taz bed. Please make sure that you remove all the hardware that is in the way (including especially the glass bed) and then mount the drill guides to the plate using M3 bolts and nuts. You will want to decide which side of the Taz you want to have the Openbuilds eccentric wheel on for adjustments. For my Taz, I chose to have them on the left side of the machine. Insert all the bolts, line everything up using a tsquare, and then use a drill press to drill 2 7.2mm holes and 2 4.9mm holes. The 7.2mm hole in particular is critical, you cannot use a "close enough" drill bit here, you will ruin your plate.

Step 36a: Also drill the holes for the optional nozzle cleaner at this time

Please note: a hand drill is **NOT** adequate here. You need some form of drill press. If you are off even 1 degree, your bed wheels will not engage properly.

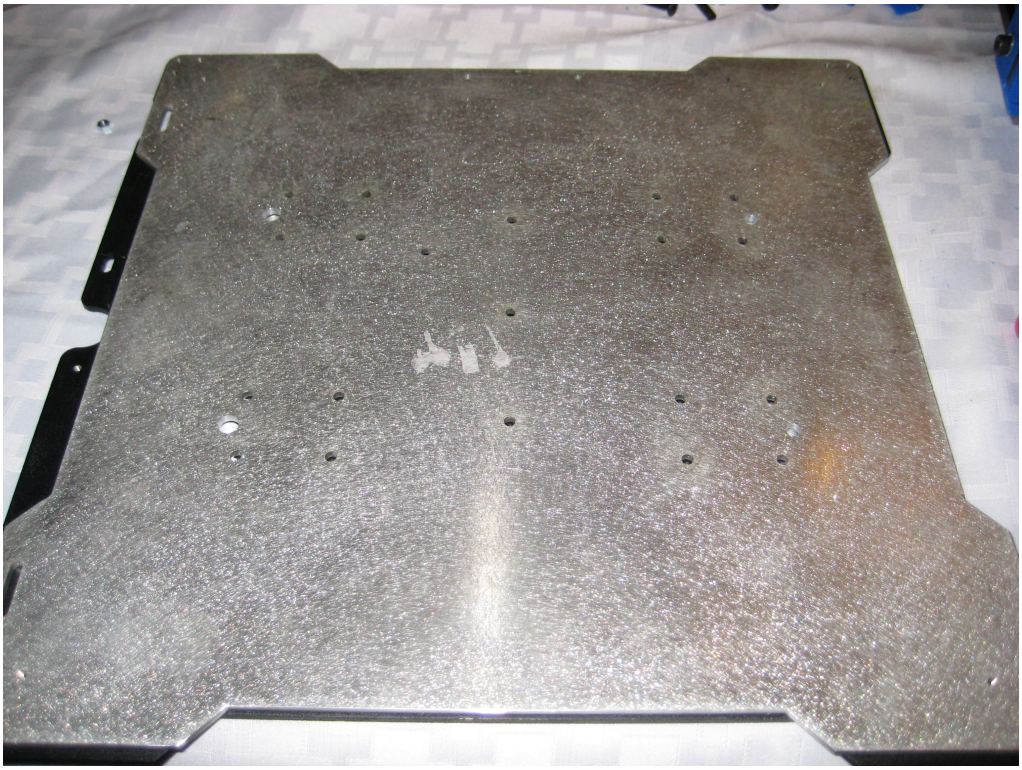
In the event you have a critical hole drilling failure for whatever reason, it is possible to shift the drill guide up towards the edge and make another hole.



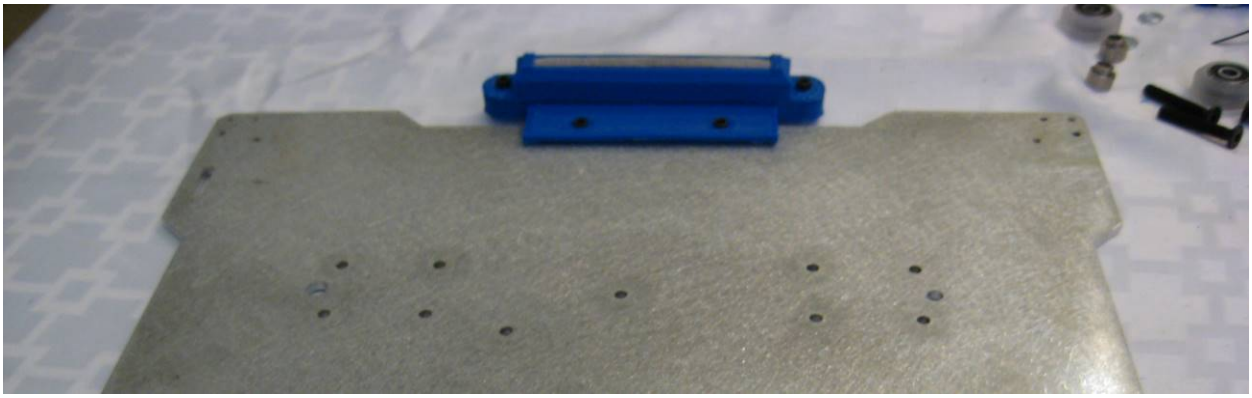


The Taz 6 plate is somewhat different. Since the holes are in a slightly different spot, and threaded for M3 bolts, you can forgo using the nuts to hold it in place and just use bolts.

Step 37: Inspect your new holes and ensure they look like the pictures. Clean up any rough metal or burrs with a deburring tool a file or similar.

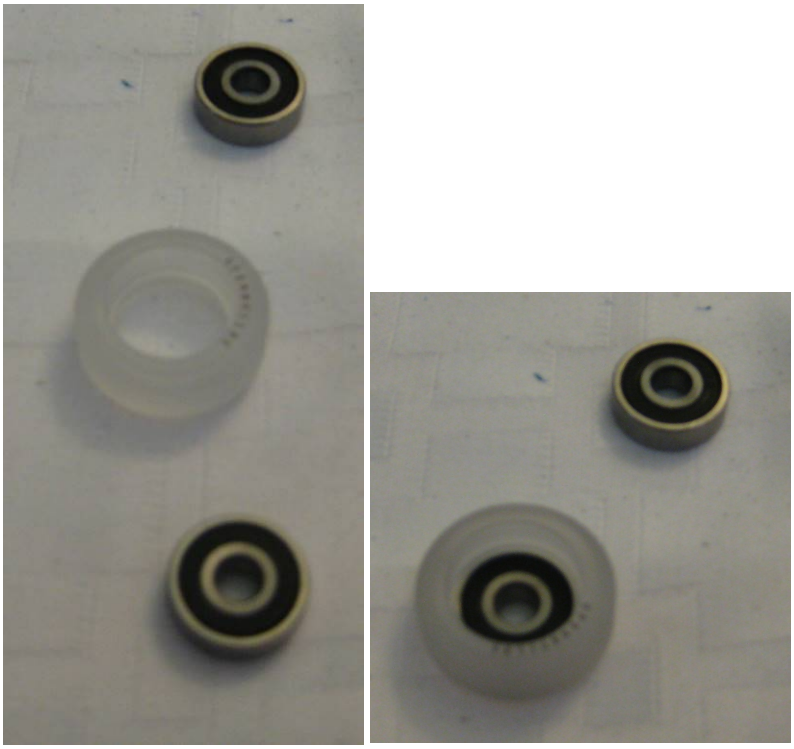


Step 37: (OPTIONAL) Tap the M3 threaded hole for the nozzle cleaner, and install the nozzle cleaner with 2 8mm long M3 bolts

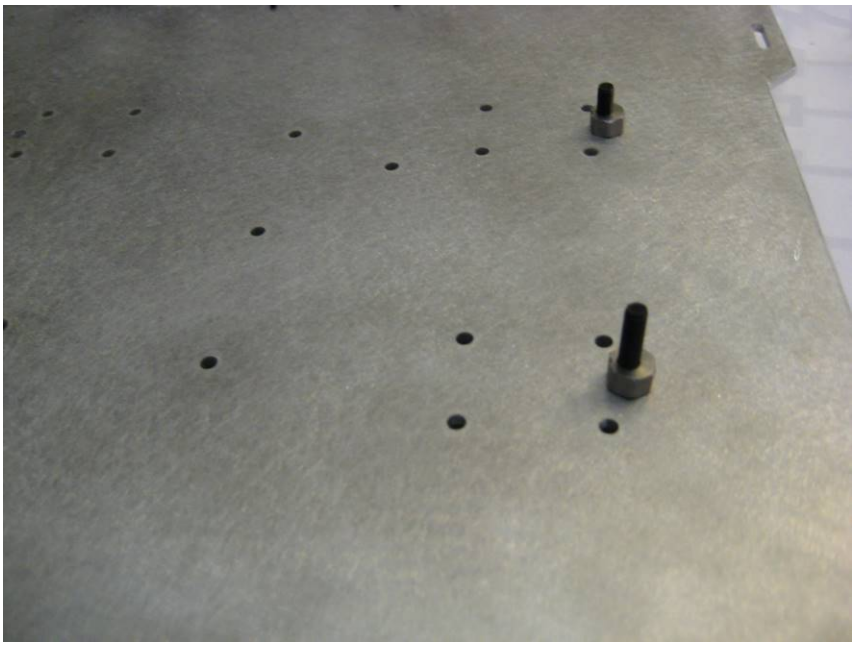


Step 38: Locate your 4 Openbuild wheel kits, 4 30mm flat head M5 bolts, 2 eccentric spacers and 2 6mm non-eccentric spacers.

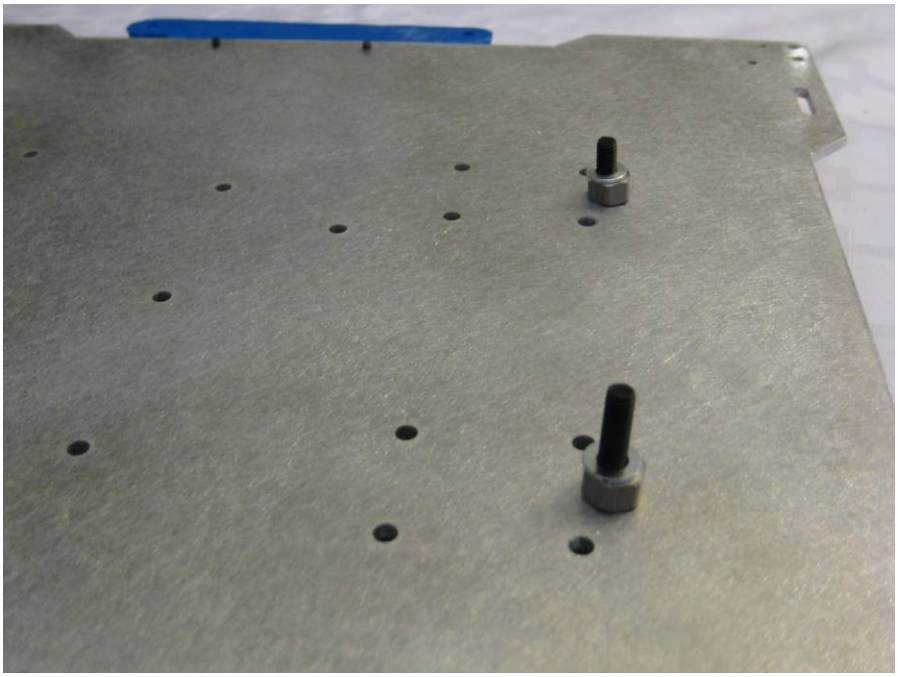
Step 39: Assemble the 4 Openbuilds wheels by inserting the two bearings until you hear a click. The edge of the bearing should be flush with the edge of the wheel.



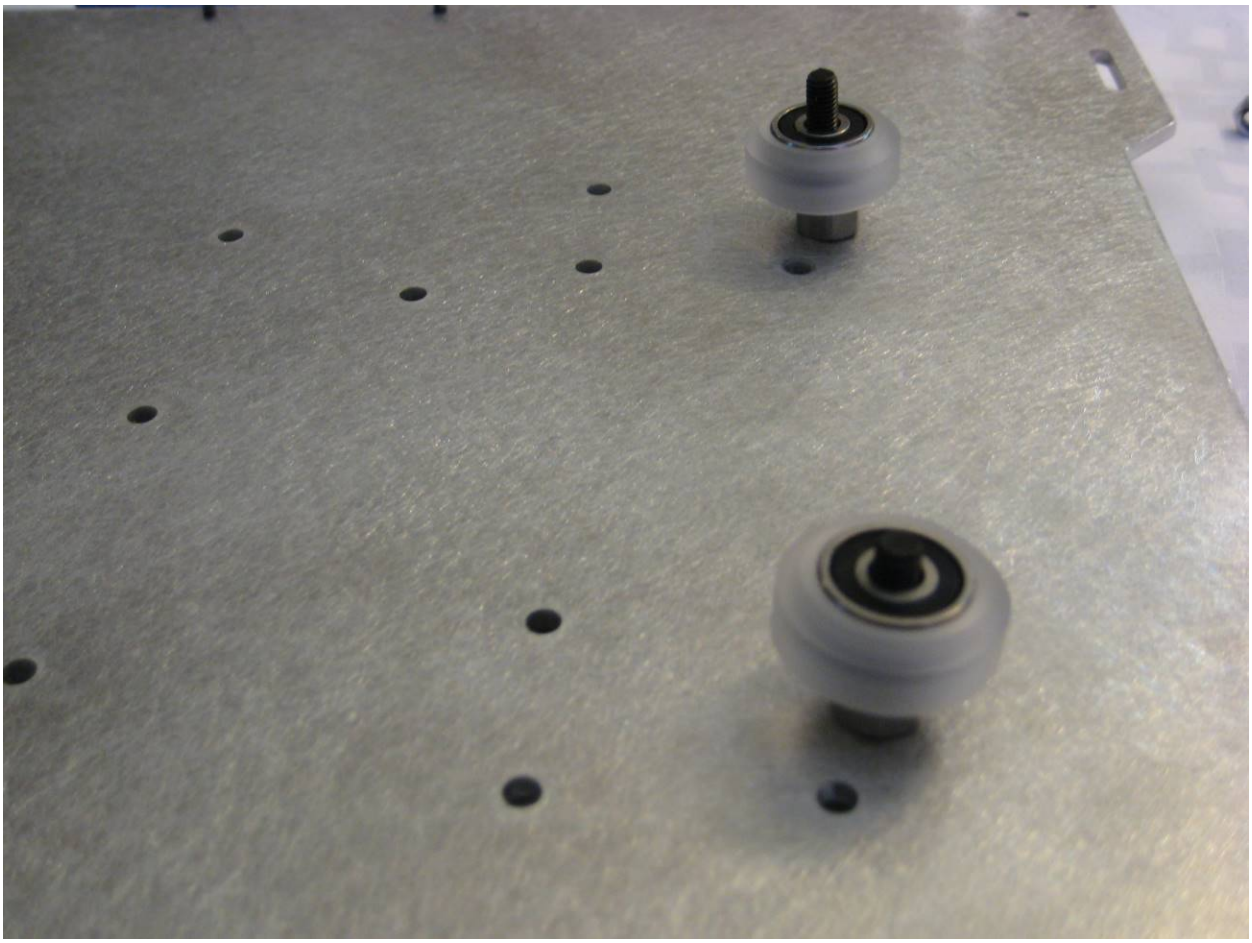
Step 40: Insert 20 30mm M5 flat head bolts through the top side of the bed and install the two eccentric spacers. You will want the eccentric spacers set for maximum width. There will be a small mark or notch on the side of the spacer that indicates maximum width. We will adjust this later.



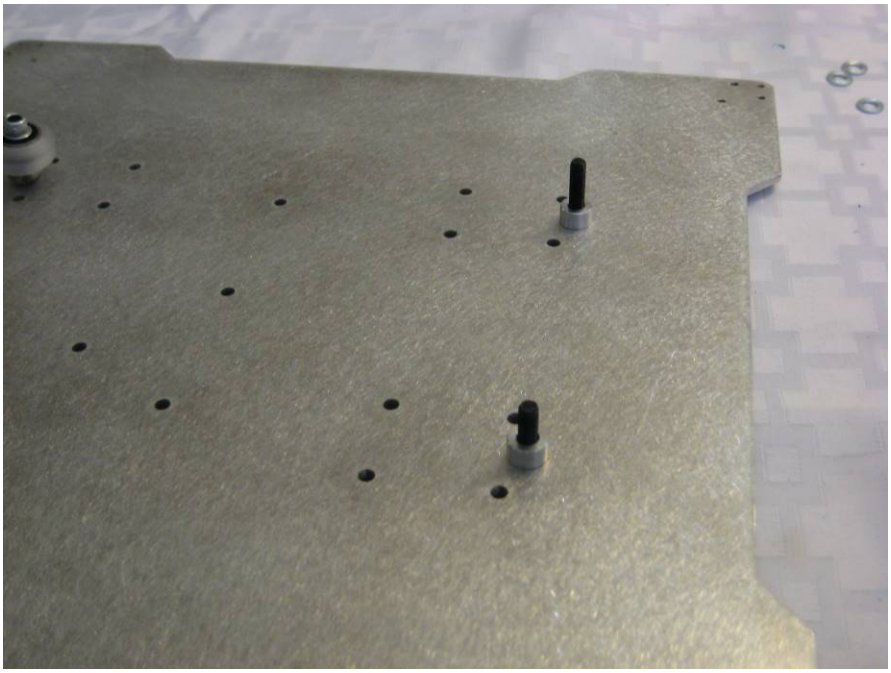
Step 41: Install a washer over the spacer



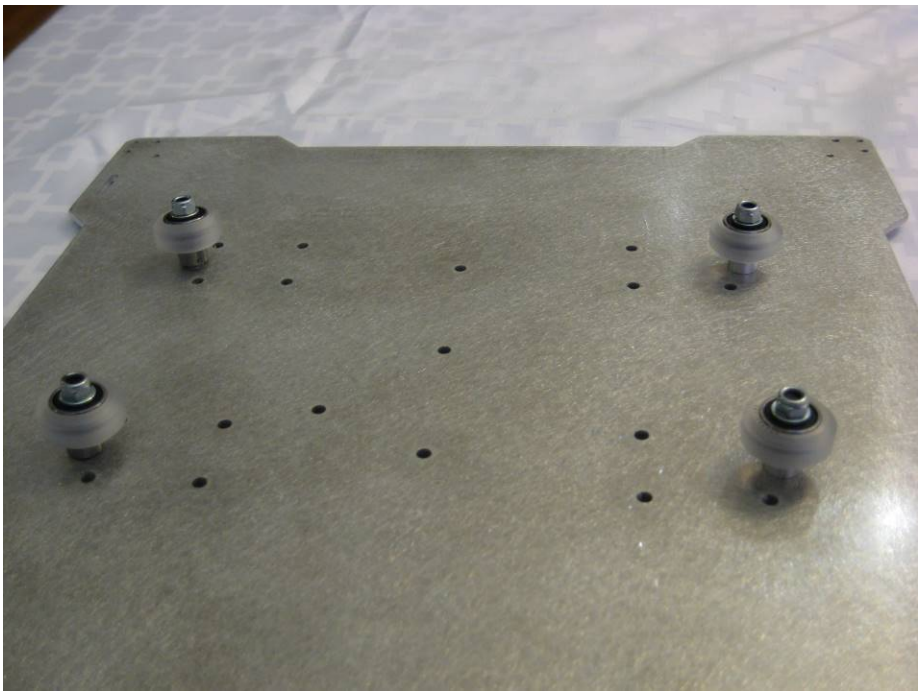
Step 42: install the wheel and another washer, followed by an M5 nut. Loosely tighten this nut at this time, we will fully tighten this later.



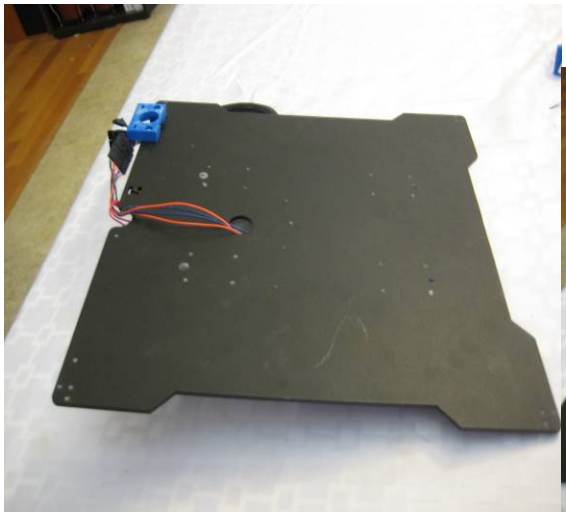
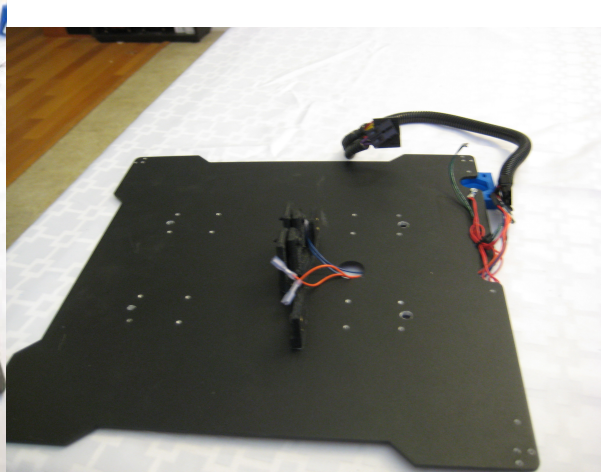
Step 43: Repeat the process with the other set of wheels in the smaller holes, but use the non-eccentric spacers this time



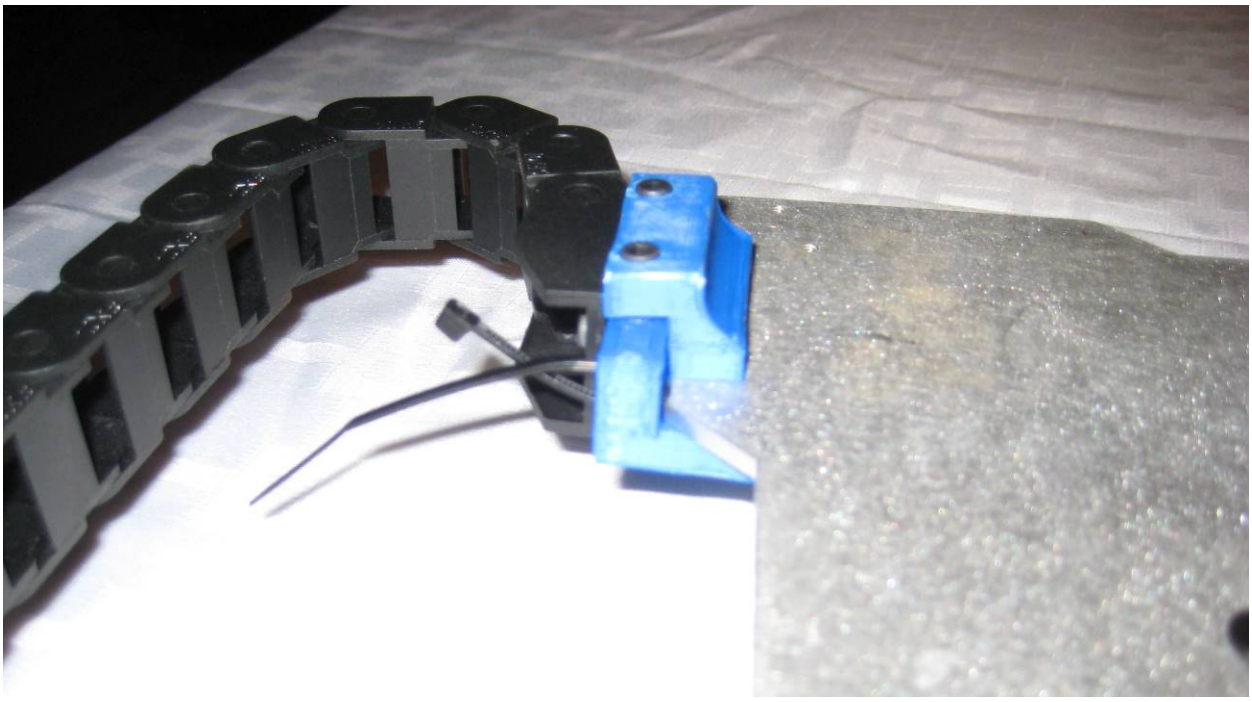
When finished you should have 4 wheels as shown.



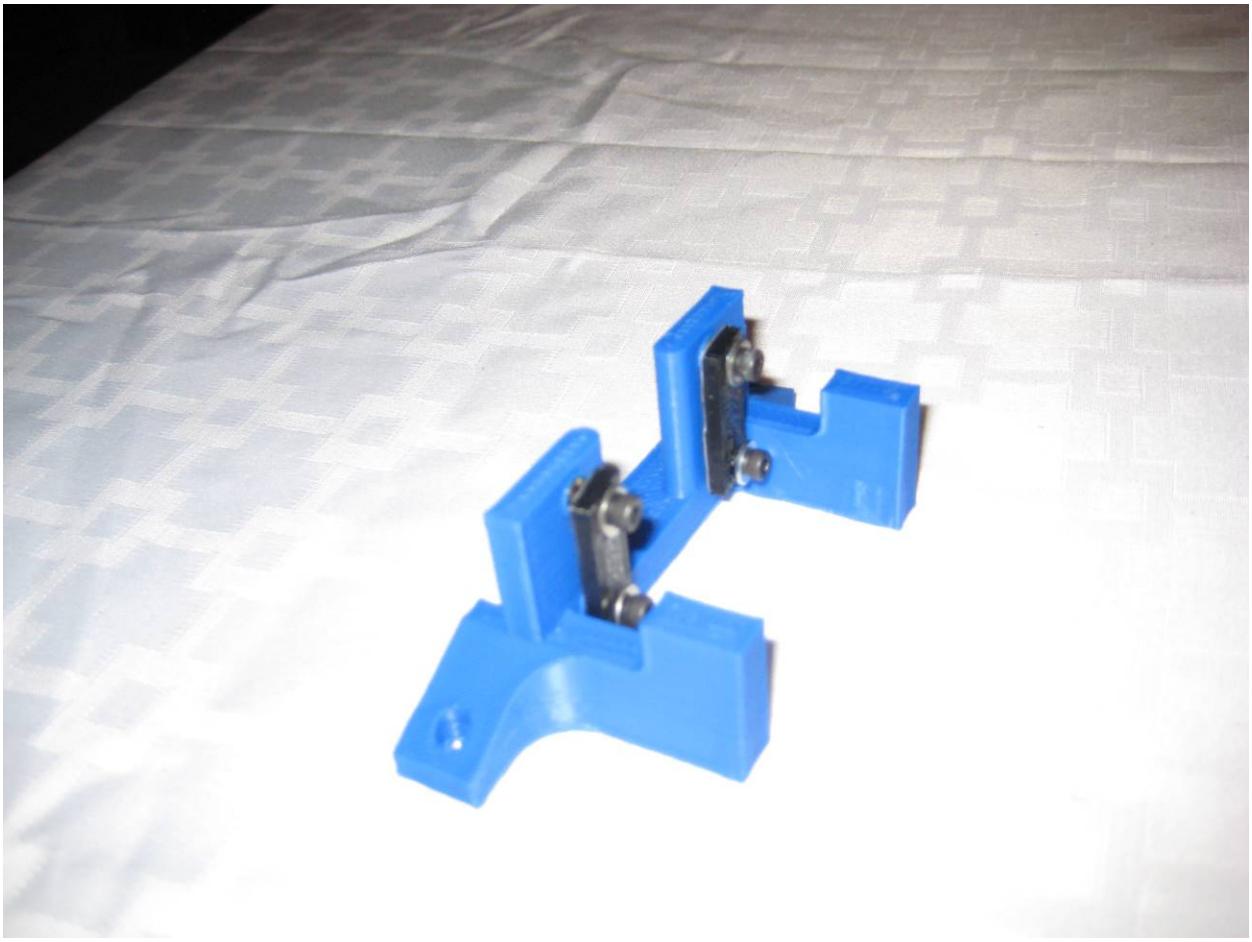
The process is identical for the Taz 6 specific bed.

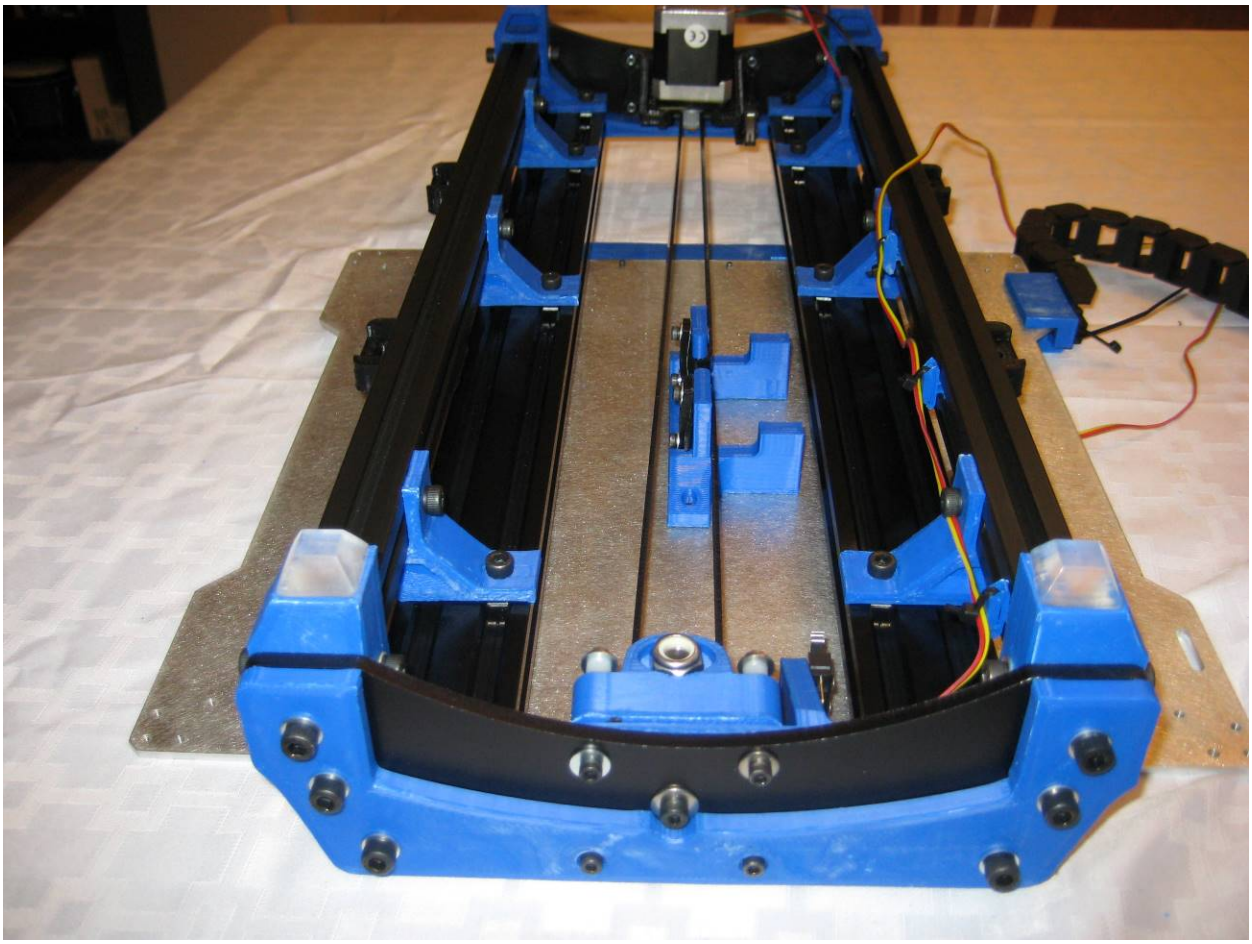
Step 44: (OPTIONAL) Using 2 8mm M3 bolts, attach the cable chain to the bed.



Step 45: Re-assemble the Belt mount, and install it onto the bottom of the bed plate using the stock M3 bolts and washers

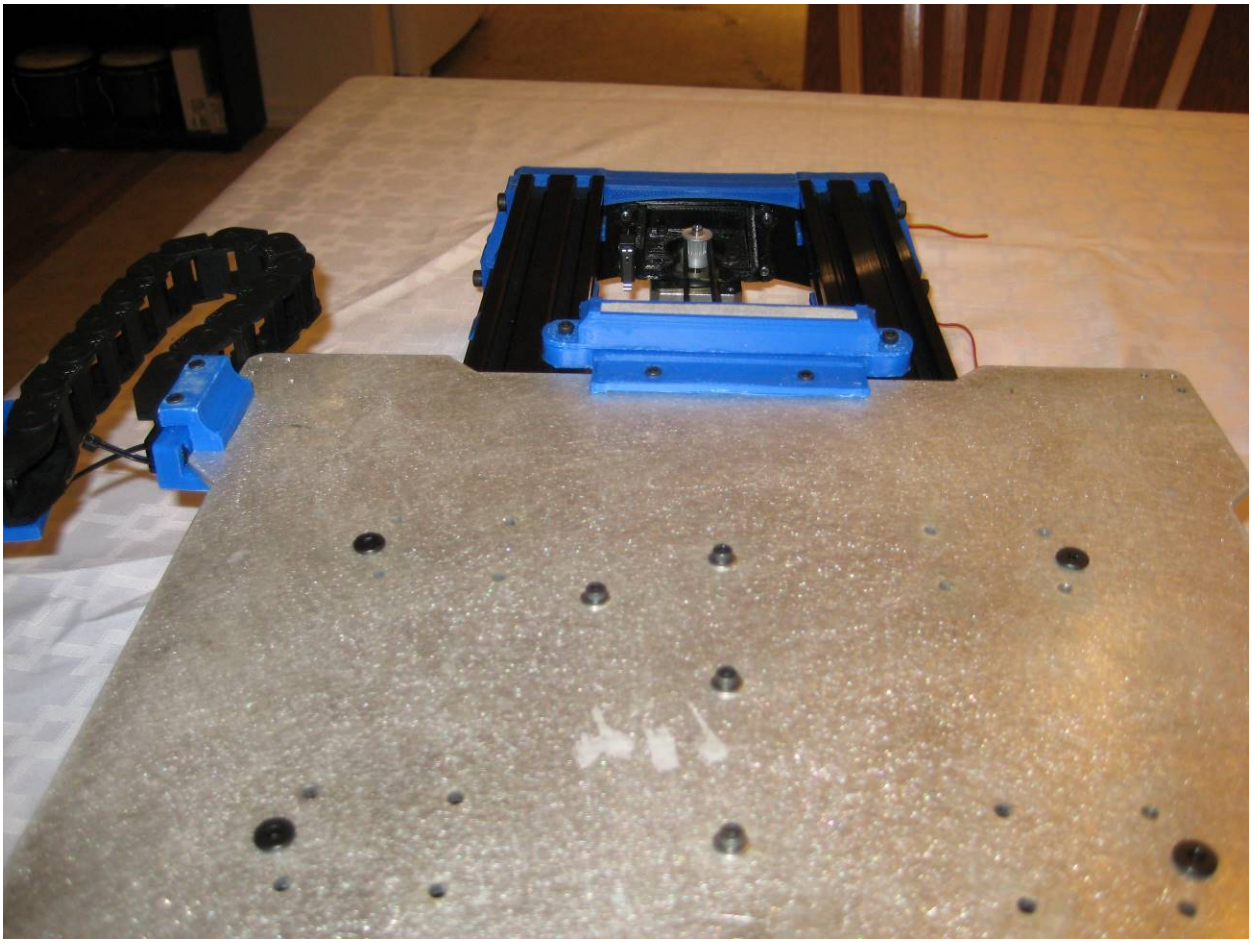


Step 46: Attach the stock belt in the stock belt mount locations.

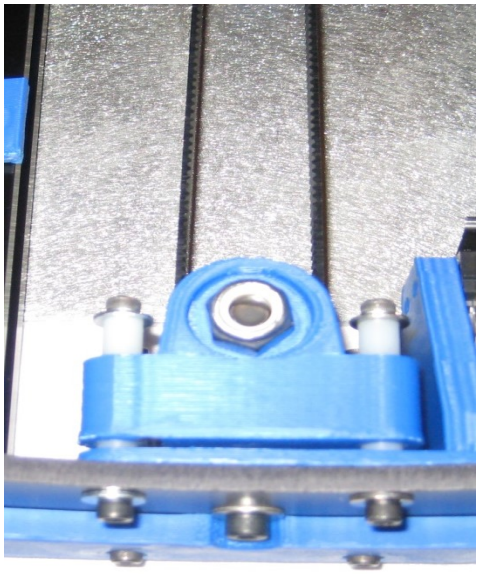


Step 47: Tighten the wheel bolts, ensuring the wheels are sitting in the v notch groove. As you are tightening them, check to make sure the wheels turn smoothly but have no play in them. Once finished, turn the eccentric spacer to tighten the wheels against the rail. There should be no excess movement or

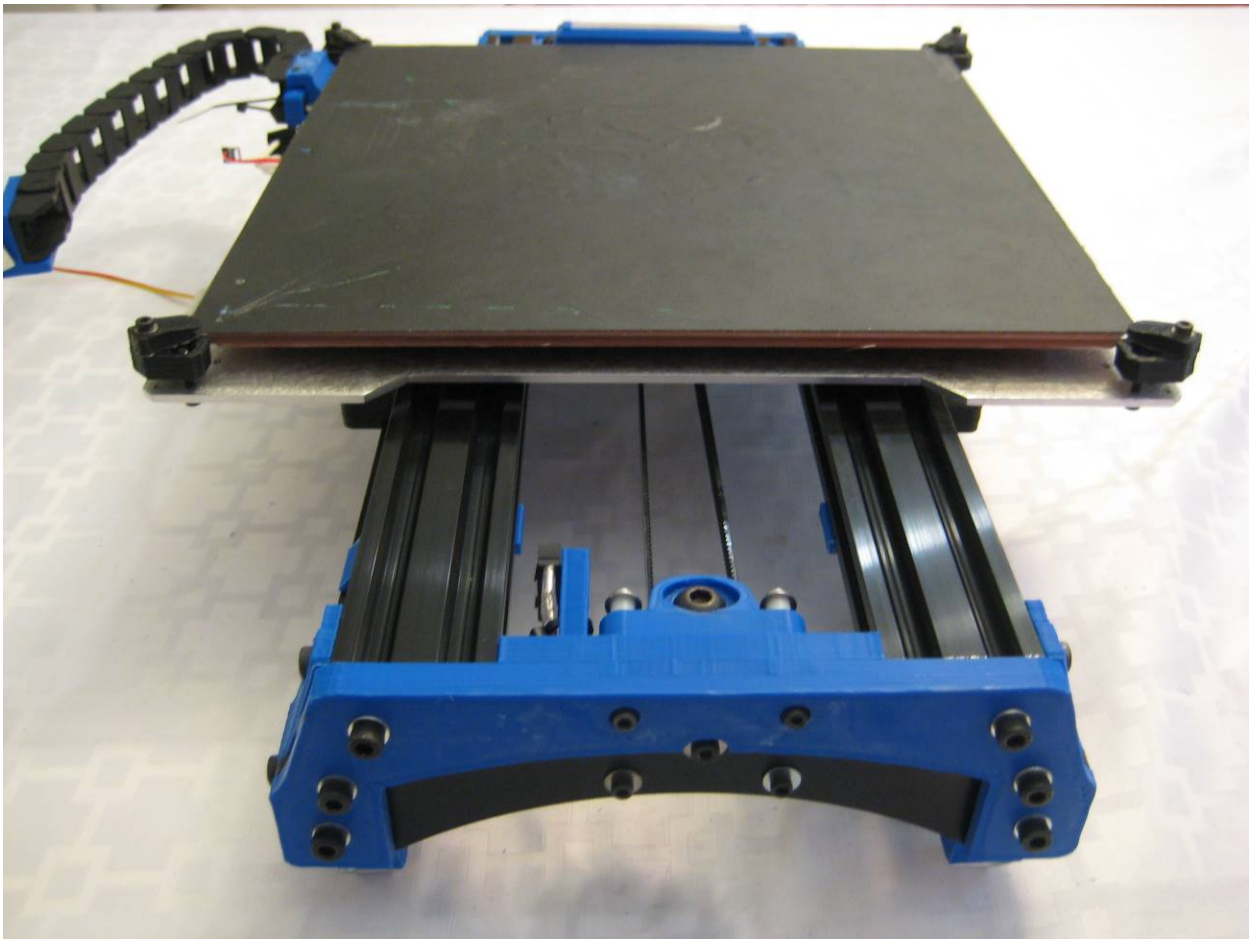
play from side to side or up and down. The bed should only move forward and back.



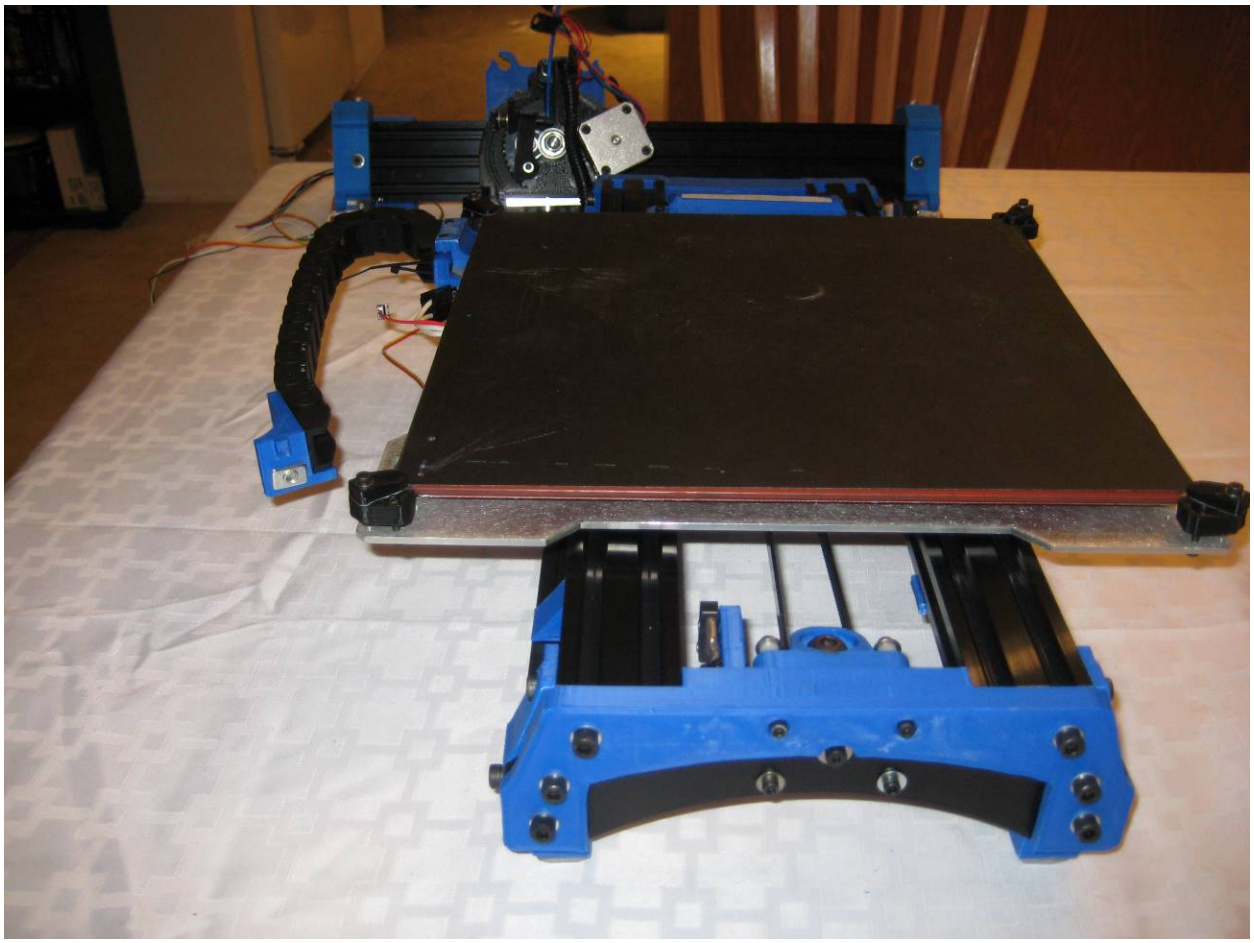
Step 48: Now tighten the new Y idler tension bolt.



Step 49: Reinstall your bed mounting hardware in the same manner it was removed



Step 50: Reinstall the Y axis in your Taz and reattach all leads.



Congratulations! You now have a fully operational Openbuilds V-slot Y axis! Enjoy!

Troubleshooting:

If the Y axis Frame is not level at final assembly:

- Loosen the bolts and adjust the rails until you get a truly flat surface. This may take some trial and error

If the Y axis goes the wrong way or fails to home:

- Make sure the belt is installed correctly

If the bed looks crooked.

- Either the bed frame is bolted on crooked, or you didn't have the bed drill guide square before drilling. Check for square, and if necessary purchase a second $35 bed plate.

If the endstop worked before and now it doesn't

- Ensure the endstop is still attached to the Rambo board in the appropriate socket. Electrical fault issues are outside the scope of this document.

Notes: