

# ElectroSpinner Assembly Manual

## Whirl-A-Rama

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**Note:**

This machine can be operated with a variety of HV power supplies and syringes. Therefore the construction manuals are divided up into individual components. The suggested building order is cabinet (this manual), syringe, HV power supply and finally the electronics.

All of the files for this project are available at the projects github page at <https://github.com/dougmsbbs/ElectroSpinner>.

## Parts List

### 3D Printed Parts:

Amount	Item
8	Plate Levelers
4	OutSideGuides
8	LevelingCollarB
4	SwingHinge
1	DoubleShaftCollar
2	LevelingCollar
3	TopFittingMountHolder
1	TopFittingMount
2	BeltClamps
1	CenterHub
3	LevelingBracket
1	TopIdlerBracket
1	IdlerWheelB * See note 1 below.
6	DoorTrack
1	DoorLatchBase
1	DoorLatch handle

## **Laser Cut Parts (from Melamine panel):**

Amount	Part
1	B1DuelPost
1	B1Left
1	B1Right
1	B2DuelPost
1	B2Left
1	B2Right
4	CenterRing
6	DeckSpacers
1	T1DuelPost
1	T2Duelpost
1	T1Right
1	T1Left
1	T2Left
1	T2Right
2	SyringeSwivelArms
2	DoorFrame
3	PlateSupports
1	MetalBedPattern * See note 2 below
1	BedPattern
1	BedPatternWNotch
2	BedLevelers
2	DoorFrame
2	SyringeSwivelArm
8	SideCoverBracket

## **Laser Cut Parts (From Acrylic):**

2	LargeSideCovers
4	SmallSideCovers

## **Purchased Items:**

Note: Only items used in the manual are listed. Additional items needed to complete the project will be listed in those manuals (i.e. Electrical manual, Syringe manual.)

Amount	Part	Cost
1	Arduino Uno - or compatible	\$20.00
2	NEMA 17 Stepper Motor	\$20.00
1	GT2 2mm Pitch Timing Belt Pully (5mm Bore - 20Tooth)	\$3.50
1	Ball Bearing GT2 Idler Pully (3mm Bore, 20 tooth)	\$7.00 * See note 1 below
1	GT2 Timing Belt 2mm Pitch 1164mm (1164mm x 6mm)	\$10.00
2	3/4"x5' PVC Pipe-schedule 40	\$3.20
8	3/4" PVC Cap	\$2.88
1	1/4" x 49" x 97" Melamine Panel	\$22.24
6	M3x16mm Bolts	\$1.00
4	3mm Washers	\$1.00
28	3mm Nuts – pack of 100	\$2.06
1	M3x32mm Bolt	\$1.00
76	M4x16mm Bolts – pack of 100	\$4.32
87	4mm Nuts – pack of 100	\$6.84
10	M3x10mm Bolts – pack of 100	\$3.50

24	M3.9x13mm Sheet Metal Screws	\$11.97
(pack of 50)		
7	M4x25mm Bolts – pack of 100	\$5.12
1	120" (3048mm) 18AWG wire(25')	\$6.40
1	80" (2032mm) 28AWG wire(100'spool)	\$6.00
1	Micro Switch	\$2.00
2	M2x16mm Bolts - pack of 100	\$4.13
2	M2 Nuts – pack of 100	\$1.39
1	12"x12"x.015" Sheet Metal	\$15.00
(Stainless steel is best, aluminum or zinc plated will work)		
1	14.5" x 11.5" x .080" Clear Acrylic.	\$10.00
(368.3mm x 292.1mm x 2.032mm)		
12	M3x12mm Bolts – pack of 100	\$2.64
1	M3x25mm Bolt - pack of 100	\$3.25
1	Acrylic Sheet– White 24"x24"x.125"	\$15.00
(609mm x 609mm x 3.175mm)		
1	Poster Paper-White 22" x 28"	\$1.50
(55.8cm x 71.1cm)		

NOTE 1:

You have two options for the belt idler wheel. You can go with the 3D printed one, or the store bought one with bearings. Obviously the one with bearings is better and will last longer. But the choice is up to you.

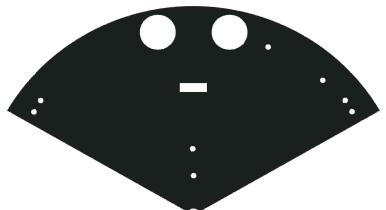
Note 2:

The metal bed pattern is cut out from paper. Do not laser cut this in wood!

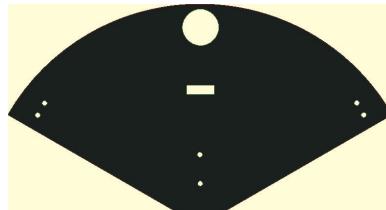
You can either print it out and scissor cut it, or laser cut it.

## Part Identification

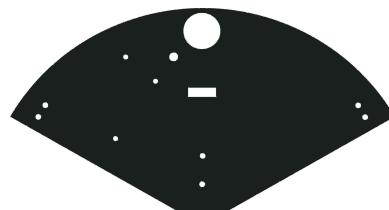
Laser Cut Parts:



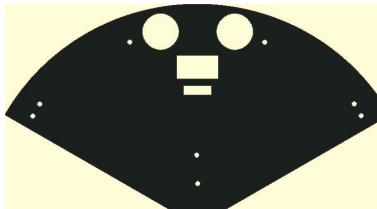
B1DuelPost



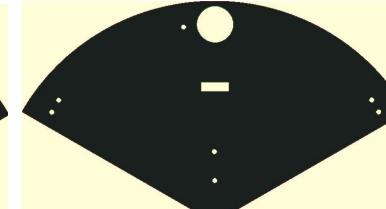
B1Left



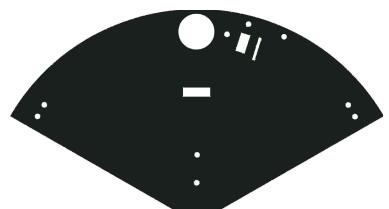
B1Right



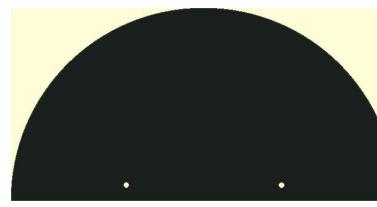
B2DuelPost



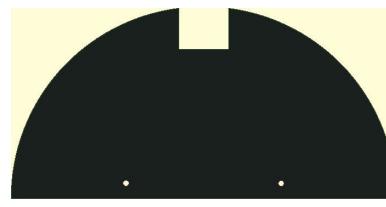
B2Left



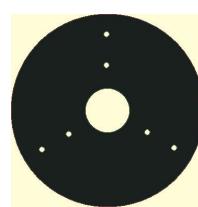
B2Right



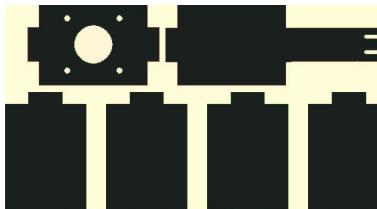
BedPattern



BedPatternWNotch



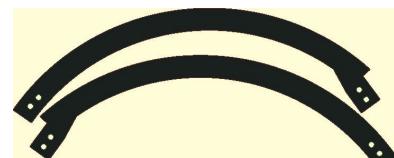
CenterRing



DeckSpacers



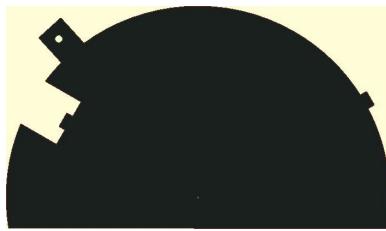
DoorEdges



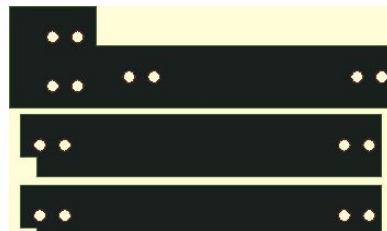
DoorFrame



LargeSideCovers



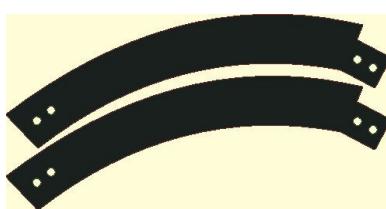
MetalBedPattern



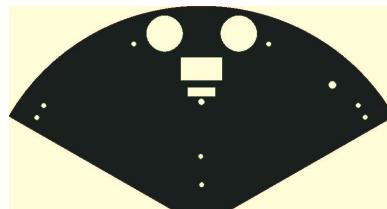
PlateSupports



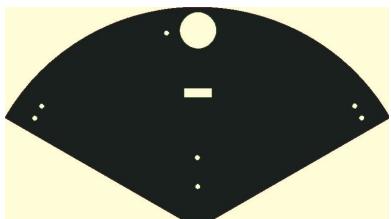
SmallSideCovers



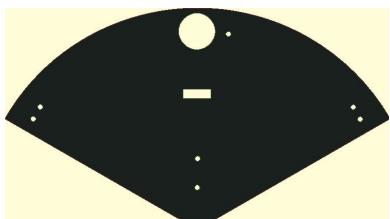
SyringeSwivelArm



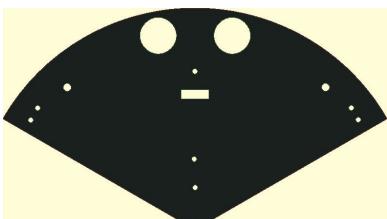
T1DuelPost



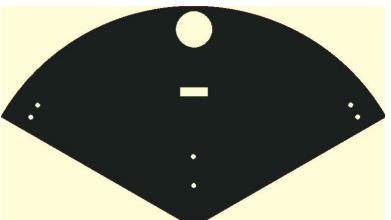
T1Left



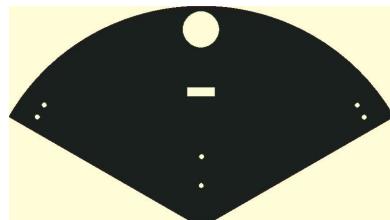
T1Right



T2DuelPost

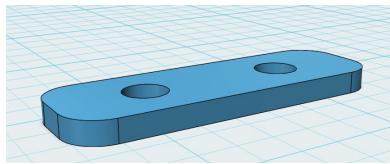


T2Left

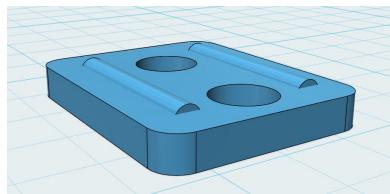


T2Right

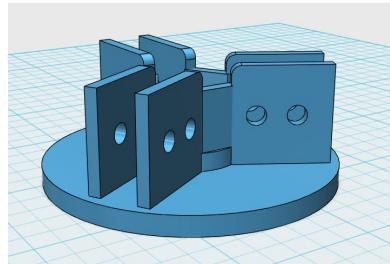
## 3D Printed Parts:



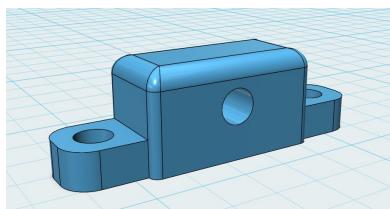
BedLevelers



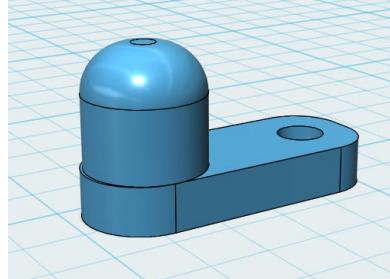
BeltClamps



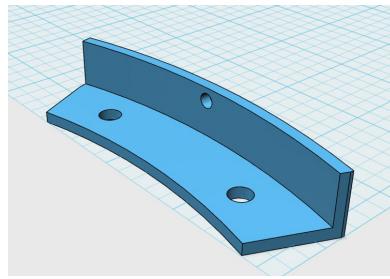
CenterHub



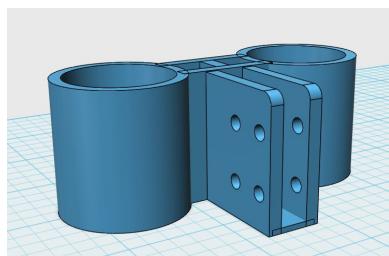
DoorLatchBase



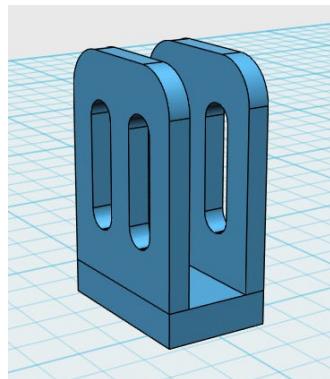
DoorLatchHandle



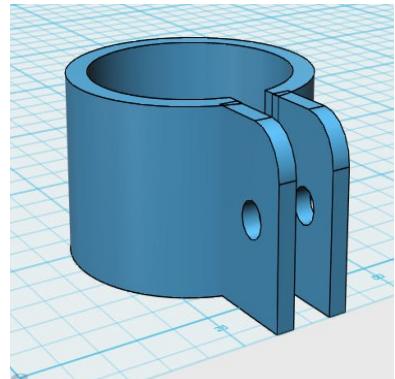
DoorTrack



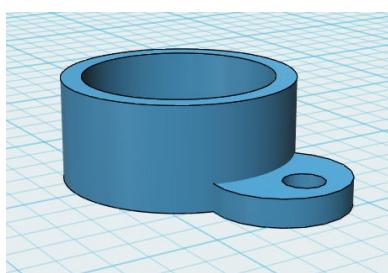
DoubleShaftCollar



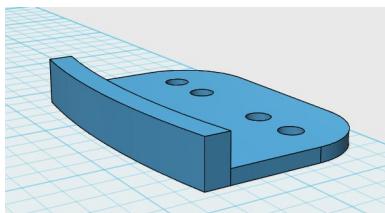
LevelingBracket



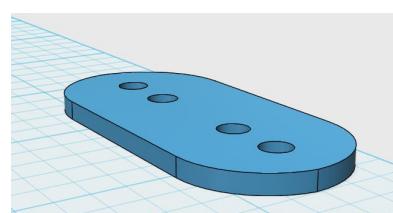
LevelingCollar



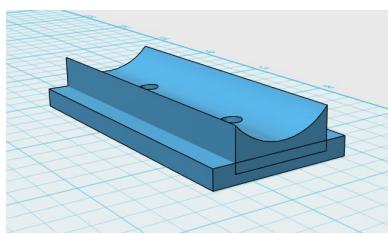
LevelingCollarB



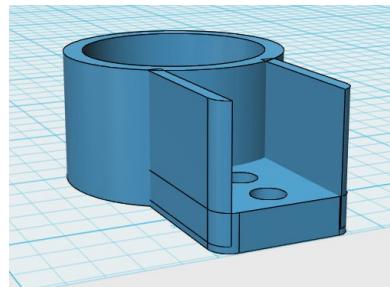
OutSideGuides



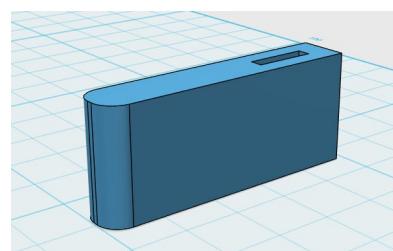
PlateLevelers



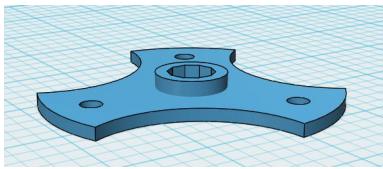
SideCoverBracket



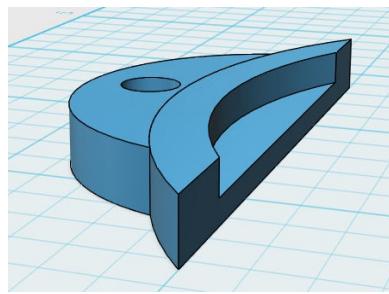
SwingHinge



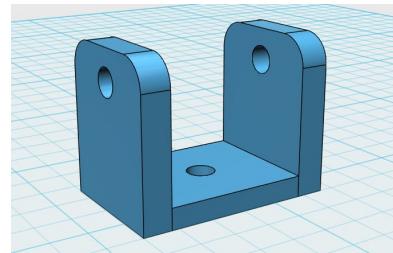
SwitchFlag



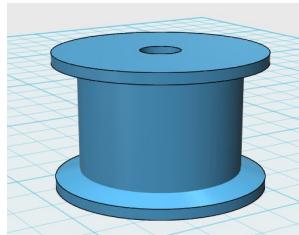
TopFittingMount



TopFittingMountHolder



TopIdlerBracket



IdlerWheelB

## Prepare The Posts.

The first thing we need to do is get our posts cut to size.

I find it best to tape all of the posts together and then cut them all at once, and then you're assured they will all be the same length.

Once you have them taped together cut one end off close to the end. Then measure down 24 inches (610mm) and cut them again. The exact measurement is not critical, in the ball park will do just fine. Getting them all the same length is more important than the actual overall length.



Once cut take the tape off and clean them up. Make sure the ends do not have any burrs on them. Then tap one End Cap onto each post. We only need a cap on one end of each post at this point. Make sure the caps are seated all the way down on each post, and the overall length of each one is the same.

Removing the lettering on the posts is optional. I just turn the post so the lettering is pointing to the back when I'm assembling the machine and it's hard to spot, but it's up to you. You can do a web search to find the best way to take the lettering off, but if you do make sure you don't scratch up the posts, we need it smooth to allow the carriage to run up and down without binding.



## **Assembling The Bottom Level.**

Find the parts CenterRing, B1DuelPost, B1Left and B1Right and lay them out in position on the table.

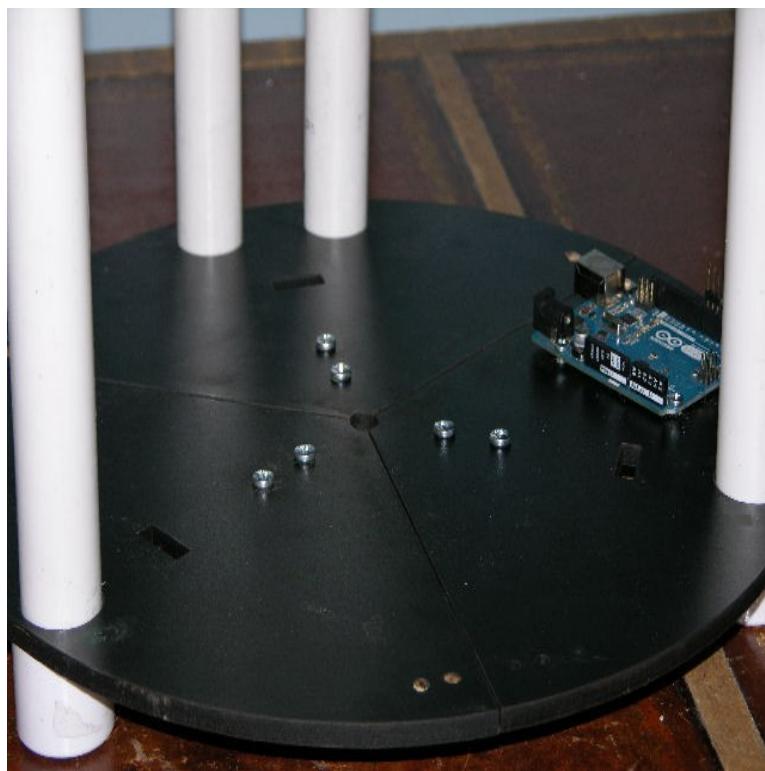
The duel post will always be at the back. The right piece has three extra holes where the Arduino gets mounted, so note the Arduino position in the photo below.

When you are sure they are as shown below, mount the Arduino using three M3x16mm bolts and nuts. The bolts should go in from the top, with the nuts on the bottom.

Mount the CenterRing to the three pieces using six M4x16mm bolts and nuts. Nuts go on the bottom.

Taking care to not force anything, insert a post in each post hole. We want them snug, but if you find you have to force them so hard you're afraid something might break, stop and give each hole a little sanding.

When all three posts are pushed all the way to the cap, it should look like the photo below.



Mount three plate levelers on the outside edges in the holes provided using six M4x16mm bolts and nuts. Only the two holes farthest apart need to be used. Put the bolts in from the bottom.

Place two plain deck spacers in the slots by the two single posts.

The deck spacer with the large hole goes in the slot at the back, as shown below.



Mount the stepper motor to the deck spacer with the large hole. Mount the belt pulley to the stepper motor, then place the assembly back into position in the slot in front of the duel post holes. The stepper should be on the side to the center, with the pulley pointing towards the duel posts.

If everything looks lined up okay, tighten all the bolts down now.

If things are a bit out of whack, twist the plate on the posts until it all looks good, then tighten them all down.

We'll do that for the other plates as we get to them, so I won't mention it again.

The first deck level is now done.

## **Assembling The Second Level.**

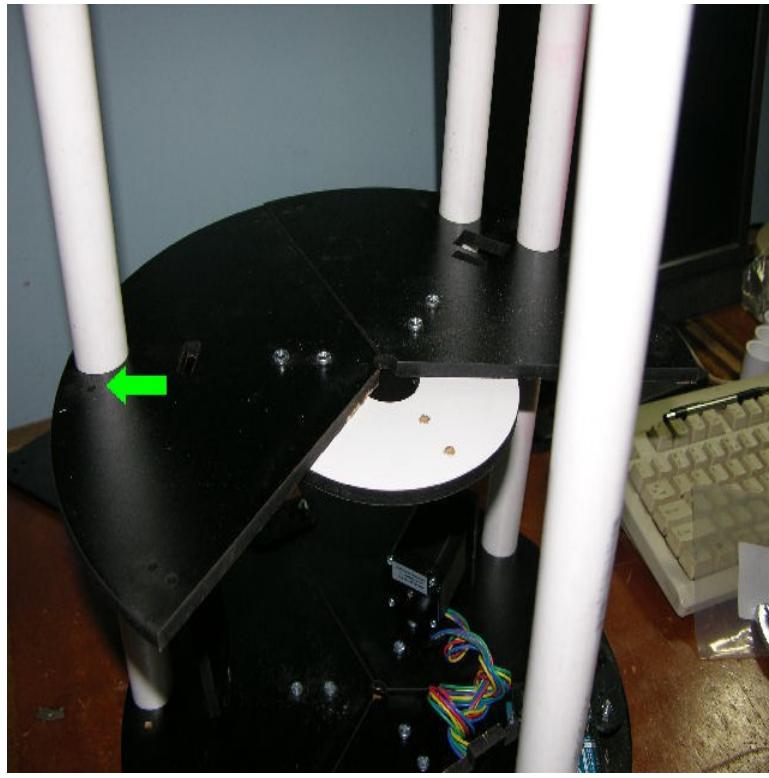
Locate the pieces B2DuelPost, B2Right and B2Left.

Slide the duel post one down the rear posts, stopping before you run out of room to get your hand underneath.

Fasten an Center Ring to the plate, using two M4x16mm bolts. Leave them a little loose to allow adjusting the plates position when they are all mounted. We'll tighten them up at the end.



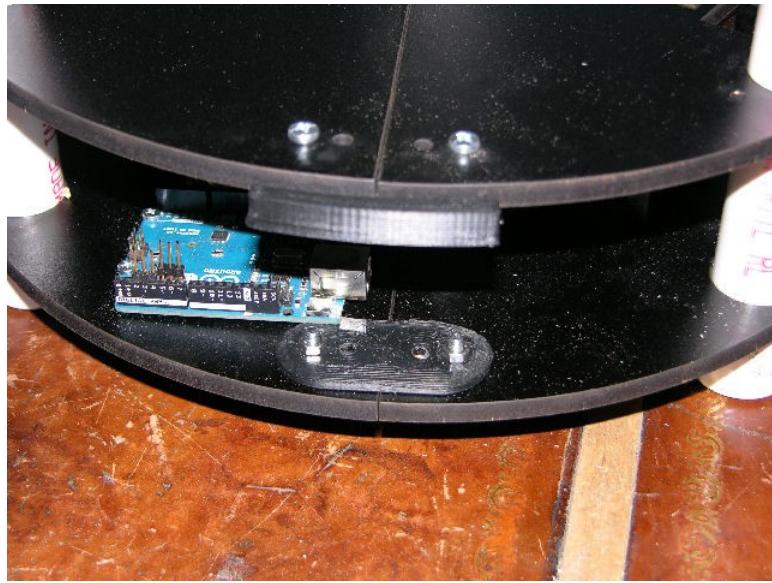
Continue by adding the left plate. Slide it down the post until it's even with the other plate. Note that the plate has a small hole beside the large post hole. That hole should be on the right side of the post, as shown with the arrow in this photo:



Add the right side plate, checking that the small hole beside the plate is on the *left* side of the post this time. Fasten it in place, leaving the bolts just a little loose like before.

Mount a plate leveler to the front of the machine only, placing it under the deck. Fasten in place with two more M4x16mm bolts and nuts.

Mount two outside guides, one on each side, where the plates meet. They should go under the plates and point up. We'll use these to keep our side cover in place later.

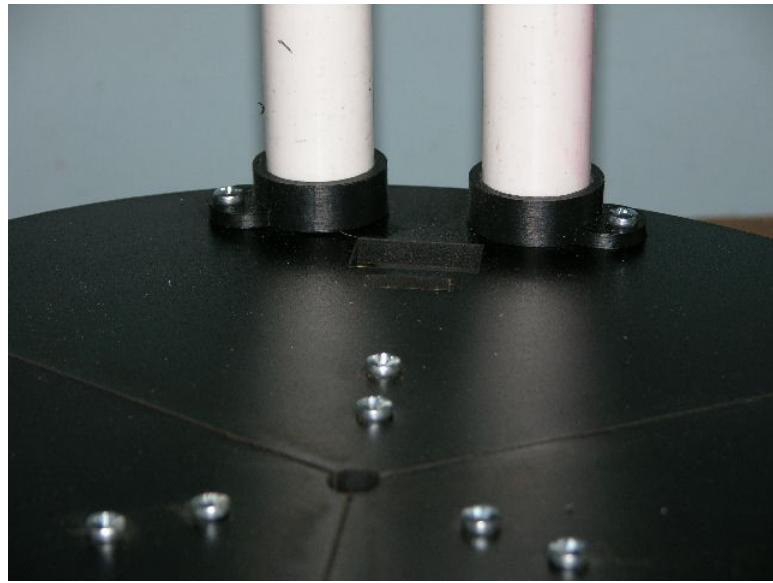


When all of the pieces are in place tap the plates down into position on top of the deck spacers. Work around them from one to the next, not letting any one plate get too far ahead of the others. Make sure they all sit with the deck spacers coming up into the slots on the plates. The plates should fit down snug onto the spacers with the top of the spacer fitting flush with the top of the plate.



Slide four leveling collar B's into place, one on each post.

Align the holes in each collar with the holes beside each post, and fasten them in place with a M4x16mm bolt and nut. Make sure as you do so that each plate is pushed all the way down on the posts, and the bottom plate is sitting on top of the post cap.



The second level is now done.

## **Preparing For The Third Stage.**

Slide a swing hinge down onto each of the front two posts, open end facing up.

Slide the double shaft collar (carriage) down onto the duel posts. Note that this should fit snugly but still move pretty freely. If it's too tight lightly sand the inside until it does fit okay. Too loose is bad and will lead to inaccurate movement. Too tight and it will stress the motor and might bind up. Take your time and try to get it in that sweet spot.

NOTE: I know from personal experience that the pipe you get might vary between manufacturers. The two main sources where I live are different in the outside diameter. If you get a carriage that is too loose you may have to modify the pattern and print another one with smaller holes. Also, the end caps should be gotten from the same place you get the pipe to make sure they fit correctly.

Now slide one Leveling Collar onto each of the front two posts, with the rounded corner facing down.

Next, place another Swing Hinge onto each of the front two posts, open end facing down.

Place a leveling collar B on each of the four posts, with the flange pointing up.

Push all of the above at least five inches down the posts.



## Time To Get The Third Stage On.

Locate the T1DuelPost, T1Left and T1Right parts.

Start by placing the T1DuelPost on the two rear posts. Note that it has one small hole on the right side of it. We'll be passing the HV wire through this hole before we're done. Just make sure that hole is on the right side, and that there is no matching hole on the left side.

Now place the other two parts on the front posts. They go just like the T2 parts did, with the small holes by the post holes toward the center of the machine.

See this photo for how it should go together:



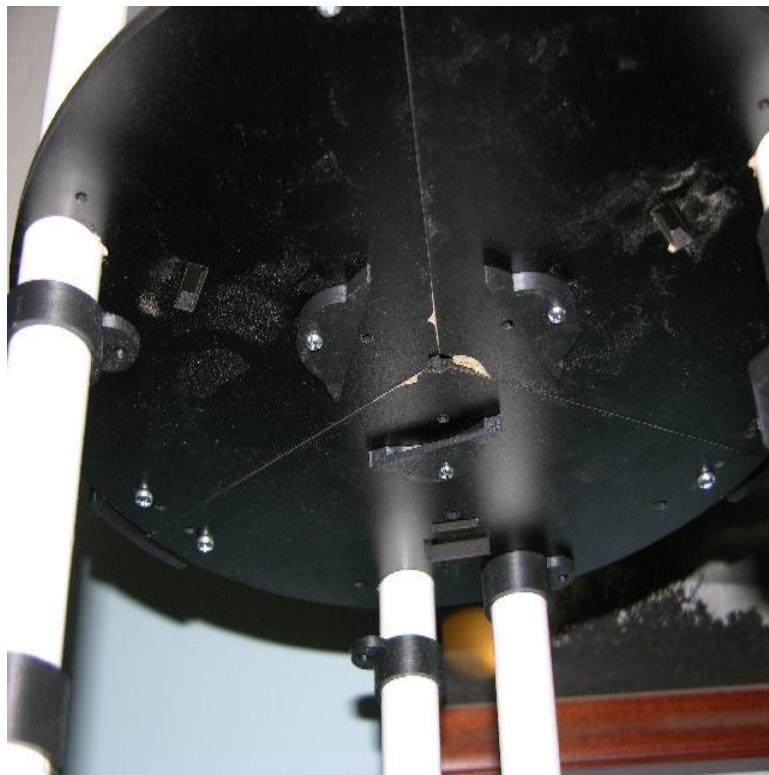
The center ring is a bit different than it was on the bottom plates. Here, we are only going to use the outer three holes, leaving the center ones empty.

Start by taking three of the M4x25mm bolts and one at a time push the bolt up

through a top fitting mount holder, then up through one of the outer holes in the center of the plate, then up through the center ring. The notch in the top fitting mount holder points up.

Put a nut on the bolt, and repeat for the other two, as seen above.

Here's a look underneath.

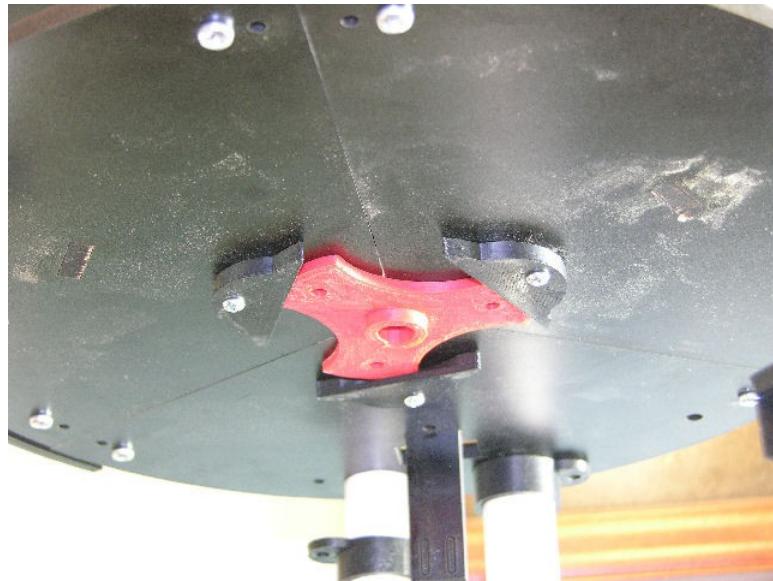


Notice how the mount holders are positioned, with the flat side aimed at the center.

Install a plate leveler in the holes at the front of the machine. Basically the rest of this level is just an upside down version of the second level, with outside guides (this time on the top of the plate pointing down) and a plate leveler at the front. The last several photos show how it should all look when you're done.

To make sure you have the mount holders pointing right put the Top Fitting Mount in place by holding it with the flat side up in the center of the mount holders and twisting it sideways until it is under the top fitting mount.

Like this:



As you can see, mine needed a little adjustment. Just move the mount holders around until the fitting mount sits in there all nice and pretty, then tighten the bolts down.

Place the deck spacers into the slots by each post for them, and we're ready for the top level. The plate leveler with the long extension goes into the slot by the duel posts, with the long tail pointing down.



## The Top And Final Layer.

Stick a M3x16mm or longer bolt up through the center hole in the top idler bracket. Then fasten the IdlerWheelB to the TopIdlerBracket using an M3x32mm bolt and nut. If you are going with the Idler pulley with the bearings, use that instead.

Then stick the bolt in the center of the idler bracket up through the hole in the T2DualPost plate. It's the hole almost between the duel posts. Put a 3mm washer on the bolt, and a 3mm nut. Just start the nut onto the bolt. We'll be tightening it up when we get to the part where we tension the belt.



Slide the T2DuelPost onto the duel posts, just like we did with the others. Notice that this time there are two small holes, one to each side of the T2DuelPost. The green arrows point to those holes in the photo below.

Attach a CenterRing to the underside of the T2DuelPost, using both holes this time. Insert the bolts from the top.

Slide the T2Left and T2Right pieces onto the posts fastening them to the center ring as you go.

Attach three plate levelers to the outside edges of the plates, putting the levelers under the plate and the bolts through from the top.

When you have that done, it should look like this photo:



Next, carefully work the top plates down the posts until you have room to install the end caps fully seated on the posts. Then go ahead and put the end caps on, making sure they are fully seated. I use a small tap hammer to insure they really are seated well. If you have caps that give you problems getting into place because they are air tight and tend to work back up due to compression when you put them on, drill a small hole in the top of the cap. It just needs to be big enough to let the air out.

If your end caps are loose on the posts (they shouldn't be, but just to be safe check) then you can drill a small hole in the back side of caps and install a sheet metal screw to hold them in place.

DO NOT glue them in place. You might want to take it apart someday. Don't burn that bridge now!

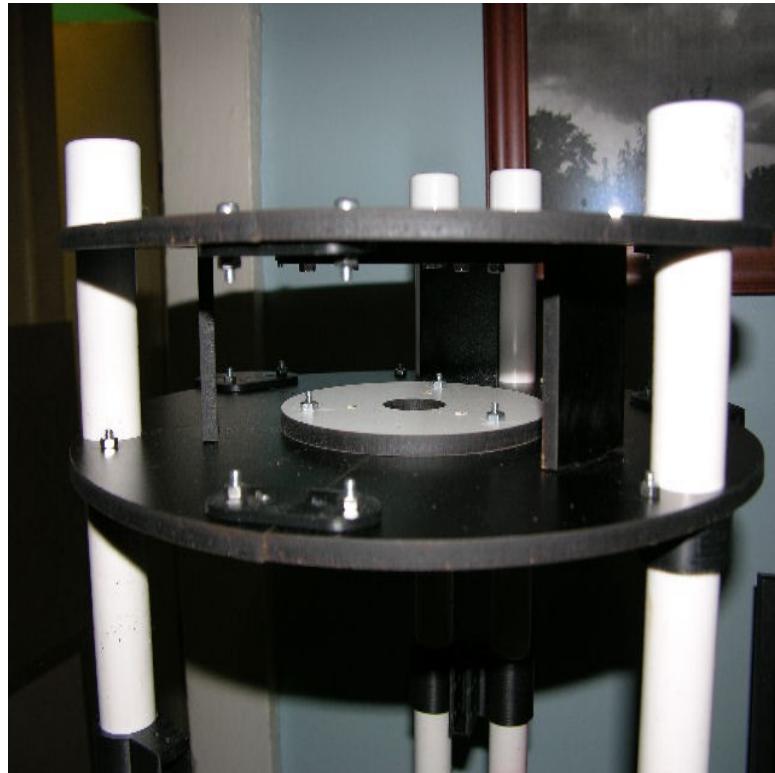
When all the end caps are fully seated bring the top plates up until they are firmly against the end caps.

Then bring the T1 plates up into place, making sure to get the plate spacers into the slots on the top plates. Bring everything up even and snug together.

Next, slide the LevelingCollarB's up, line up the holes, and bolt them into place

using four M4x16mm bolts and nuts.

It should now look like this:



Slide the two SwingHinge's on the front two posts up as far as they will go, and hold them in place with the two leveling collars that are just underneath them, using two more M4x16mm bolts and nuts. You don't need these up hard against the hinges, we still want the hinges to swivel.

The top level is now complete.

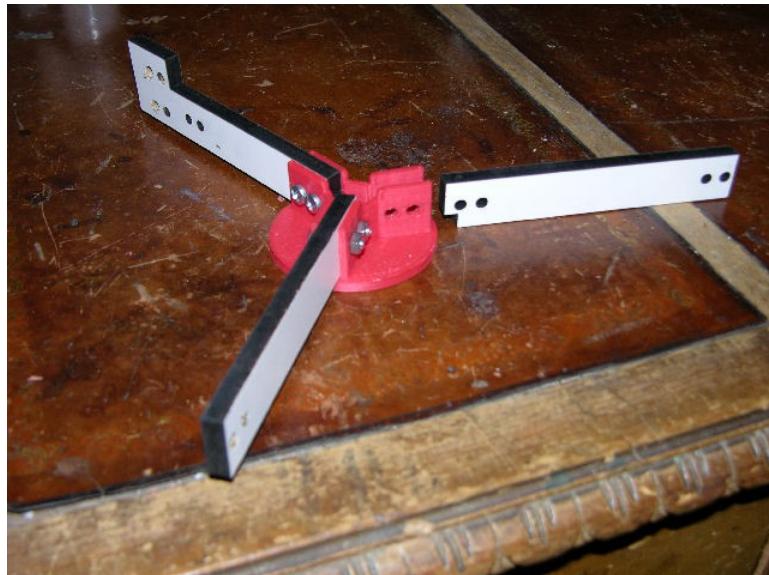
## **Putting The Center Plate Assembly Together.**

Find the three leveling brackets, and the center hub, all 3D printed. You will also need the the laser cut plate supports.

Start by attaching the two straight plate supports to the center hub. The small notch going down, as seen below.

For all of this stage use M4x16mm bolts and nuts.

Attach the other plate support to the center hub with the raised portion pointing up, again, this photo shows that.



Now attach the three leveling brackets to the ends of the plate supports. See the photo below.

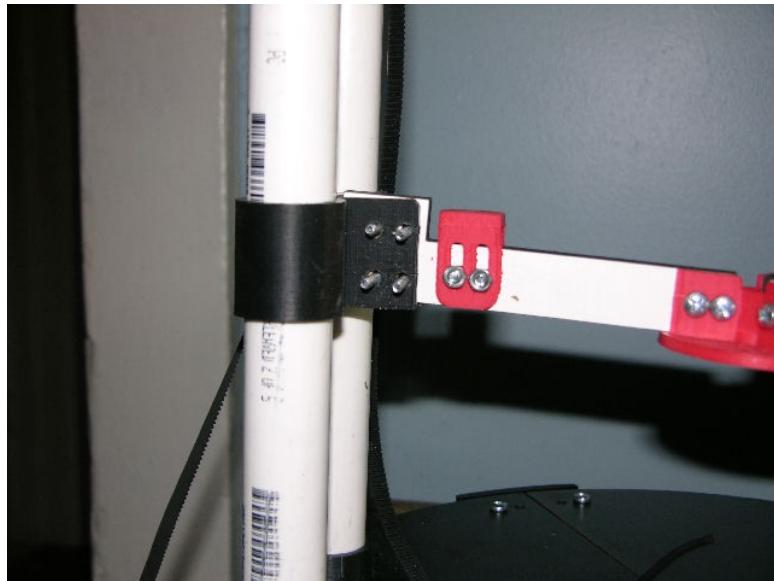
Don't worry to much about their exact positioning. I just try to line up the bottoms of the leveling brackets with the bottom of the plate support and let it go for now. We'll have a chance to adjust them later.



For the next step you will need four M4x25mm bolts and nuts. You will also need the two belt clamps and the belt itself.

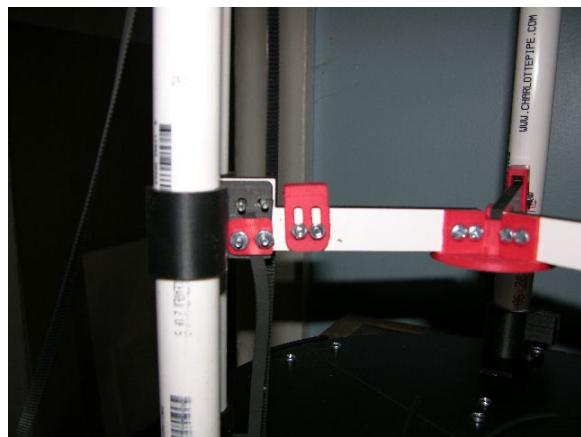
Start by running the belt down through the slot in plate B2DuelPost, around the pulley on the stepper motor, then back up through the slot and to the slot in the T1 plate at the top. Put it over the idler pulley and back down to the carriage.

Put all four of the bolts through back side of the DuelPostCollar, through the plate support, and out the other side.

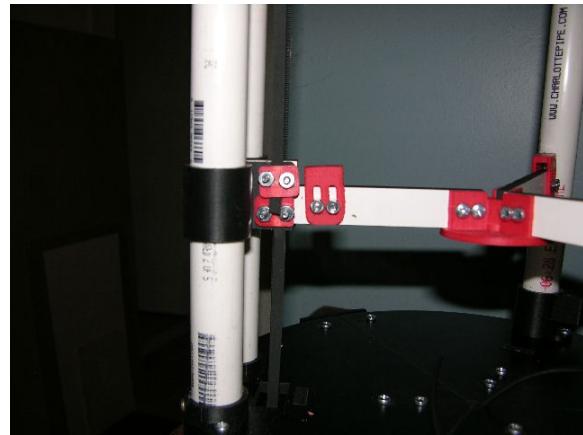


Hold the bottom end of the belt in place between the bottom two bolts and slide a belt clamp horizontally over the bottom two bolts. Make sure the teeth on the belt are to the inside.

Put two 4mm nuts on those bolts and tighten them down.



Make sure the belt is running correctly over the stepper pulley and the idler pulley on top, and that the belt is not twisted. Then hold the end of the belt coming down from the top between the top two bolts. Slip the other belt clamp over the bolts and the belt, add two nuts, and while tugging on the belt to take out any slack, tighten the bolts down.



Trim the belt ends, leaving yourself a bit of extra to grab onto if you ever need to re-tension the belt.

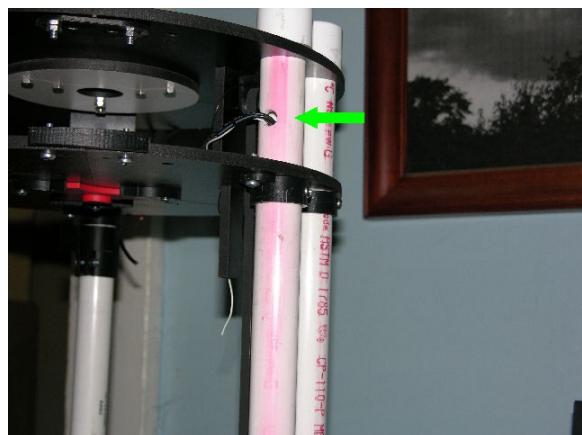
The plate support is now ready, and the belt is in place.

We're really starting to get there now!

## Time For Some Wiring

Drill two 3/8<sup>th</sup> inch (9.525mm) holes in the rear duel posts, at the top between the top two decks. The exact size you drill them really doesn't matter. As long as you can pull wire through them, they're good.

Drill two matching holes between the bottom two decks. See photo below for the holes positioning. The other two holes are in the same basic position on the other rear post. Keep all four holes positioned so they won't show when we wrap the outside of the machine later.



Sorry about the wires already having been pulled in those photos. I got a little carried away before I grabbed the camera, and didn't have the heart to pull them back out again.

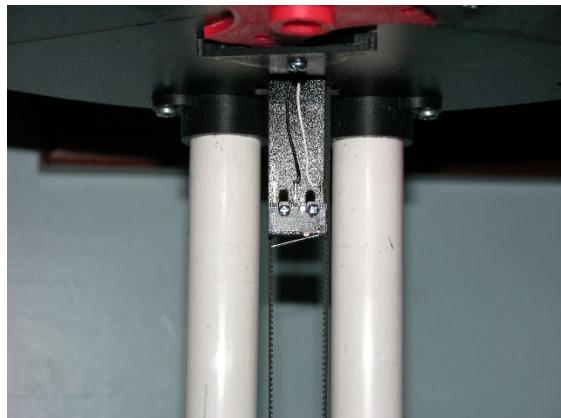
In the holes on the right side of the machine pull two 18 gauge wires at least 40 inches (1016mm) long to power the HV power supply, and two small signal wires. The signal wires should also be about 40" long.

Through the holes in the posts on the left side of the machine, pull one 60" (1524mm) 18 gauge wire for the ground wire. This will go all the way from the HV supply to the grounding plate by the time we're done.

Feed the two signal wires that are between the upper decks down through the hole

by the rear deck spacer. It's the small hole towards the center of the machine.

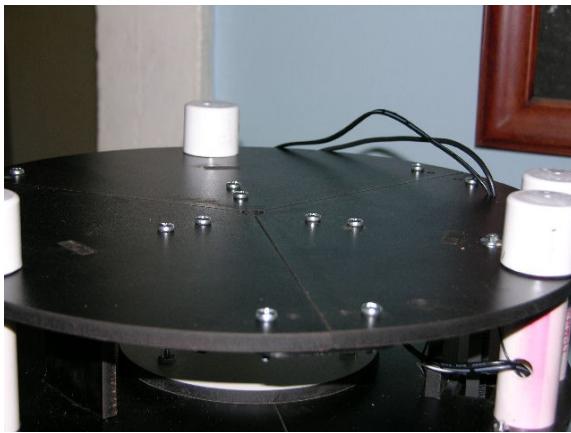
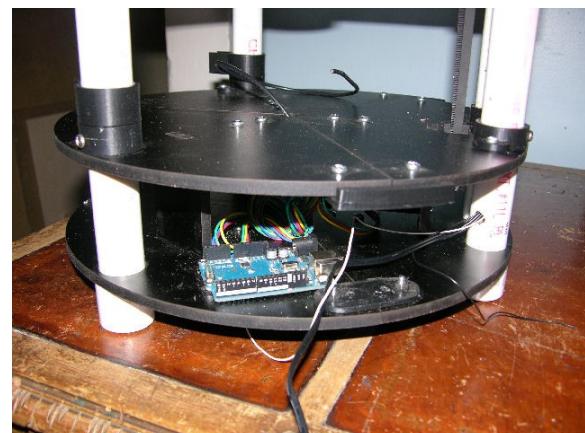
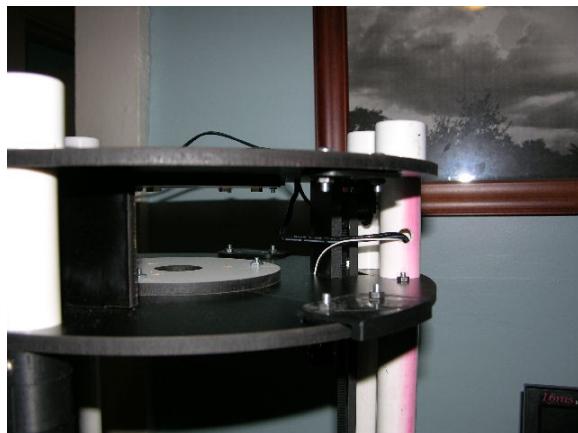
Solder the wires to a micro switch in the normally open position, then mount the switch to the tail of the deck spacer with M2x16mm bolts, using the two slots for the bolts.



Route the two 18 gauge wires that are coming up the right post around the deck spacer and up through the small hole on the left side of posts. See photo below.

Route the single 18 gauge wire running up the left side post up through the hole on the left top plate, right along with the power supply wires.

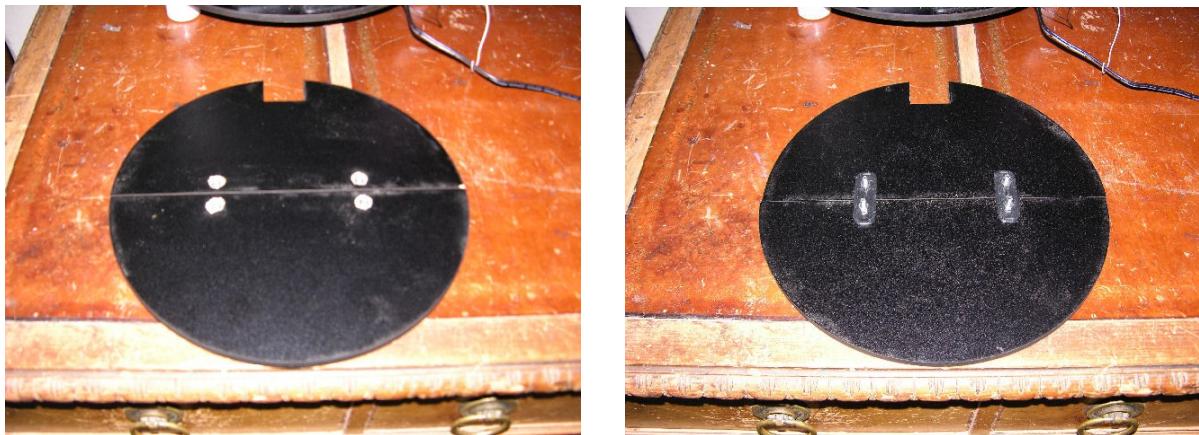
Run the bottom end of the single 18 gauge ground wire over to and up through the hole in the center of plate B2, which puts it up into the work chamber.



## Assembling The Bed Plate

Locate the laser cut parts BedPattern and BedPatternWNotch, and the 3D printed parts BedLevelers. You will also need the MetalBedPattern cut out of paper.

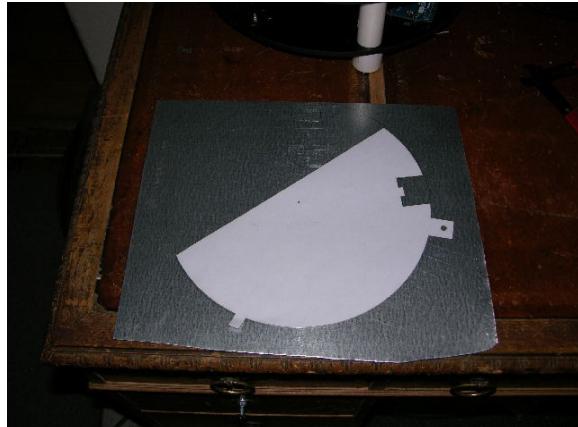
Carefully bevel the holes in one side of each plate to recess the heads of the M4x16mm bolts. Through those holes insert four of the bolts, and on the other side of the plate slip on the BedLevelers. Add nuts and tighten down.



Lay the sheet metal plate on the table, and put the bed plate you just assembled upside down on top of it. Mark the metal plate all the way around it.

Cut the MetalBedPattern out of paper. Either print it out and cut with scissors or laser cut it.

Now take the MetalBedPattern you cut out of paper and lay it down within the scored bed pattern on the metal sheet and score around all the tabs. Flip the paper over once to get the second tab position.



You only need one of the large tabs. That's where you will attach the ground wire with an alligator clip.

Cut the pattern out of the metal using tin snips. Try not to dent the metal inside of the lines. I prefer to stay a tiny bit outside of the lines and then grind it back to finish it.

Drill a 3/8<sup>th</sup> inch (9.525mm) hole in the large tab. Exact size is not important. This is where you'll attach the alligator clip on the ground wire, when we get that far.

When that's done bend the tabs down.

Time to glue the metal to the plate. I use Loctite Spray Adhesive Heavy Weight 300.



Follow the directions on the can. If you left the edges of the metal outside the lines it should be no problem to get it lined up. Let it set up a bit to make sure it's well and truly stuck on there, then Dremel the edges, or do like I do and take it to the belt sander.



The plate is now ready. Go ahead and set it in position in the machine.



That concludes the plate assembly.

## Time To Get Things Swinging

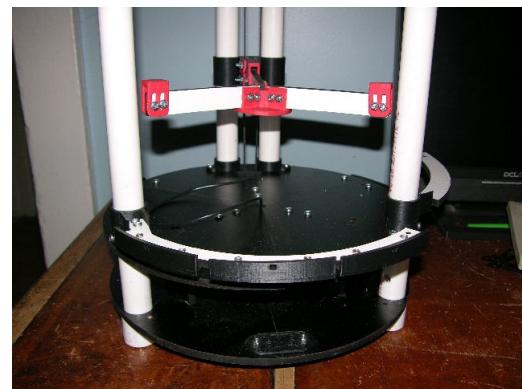
You will need the parts DoorFrame and SyringeSwivelArm, two of each.

You will also need the six DoorTrack 3D printed pieces.

Start by laying the DoorFrame pieces out on the table. For the top track the DoorTrack's will face down. On the bottom piece they will point up.

Now lay the DoorTrack Pieces on top and align the two on the ends so they are even with the ends of the DoorFrame. The middle one you'll just place in the middle of those two pieces. Drill a hole through the DoorFrame to match each hole in the DoorFrames. It's easier to see it in this picture below than describe it.

What you want to wind up with is the one that will go on top of the machine has the DoorTrack's on top of the wooden DoorFrame and pointing down. The one going on the bottom of the machine will have the DoorTracks's on the bottom of the DoorFrame and pointing up. There should be a groove created between the two for the door itself to rest in.



Fasten all of these in place with M3x12mm bolts and nuts.

Now you're ready to attach the door assembly's to the cabinet.

You will be using the M4x16mm bolts and nuts for this.

On the top two SwingHinge's put one bolt in each hole from the top. Then hold a

DoorFrame in the swing hinge pocket, push the bolts down through them, and attach with 4mm nuts.

For the bottom two the bolts go first through the DoorFrame and SyringeSwivelArm's first, then down through the swing hinge. Attach with four more 4mm nuts.

It should look like this:



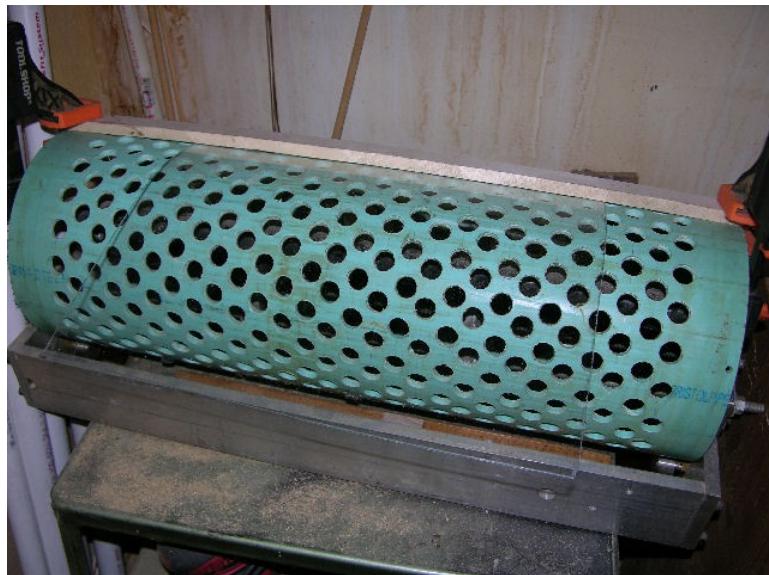
## Acrylic Door Bending

Cut the sheet of clear acrylic down to 14.5" x 11.5".

Now we need to bend it to fit in the door track. There are a lot of ways to do this, and you can search the internet to find what works for you.

Myself, I like to bend it around a form, and it so happens I have a piece of PVC pipe about nine inches in diameter from a former project I was working on. I suggest you find something similar to bend yours around. You do not, of course, have to have all the holes drilled in the pipe like mine has.

Fasten the long side of the acrylic to the pipe like shown here:



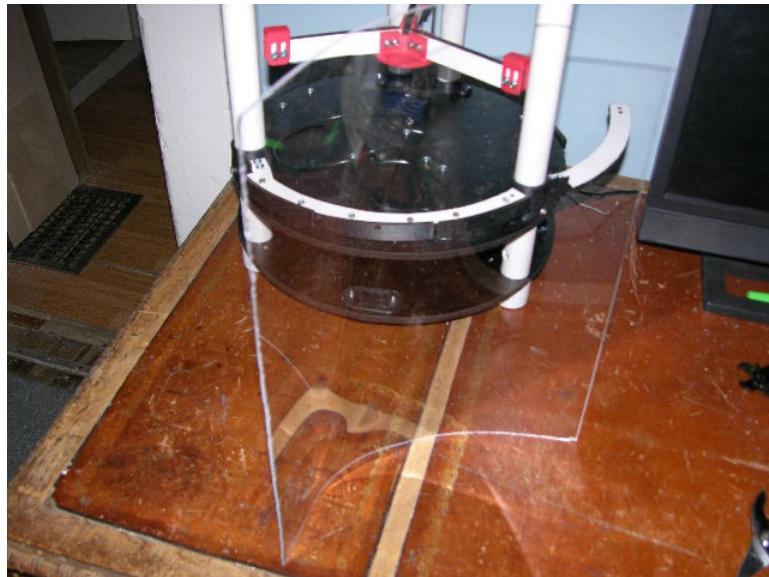
I just use a scrap piece of wood and a couple of clamps to hold it in place.

Then take a heat gun and work it back and forth, starting at the top. Don't concentrate on one area, work the entire strip all the way from one side to the other, heating it evenly. Eventually it will start to sag, and then you can pull it down a bit and work on the next section.

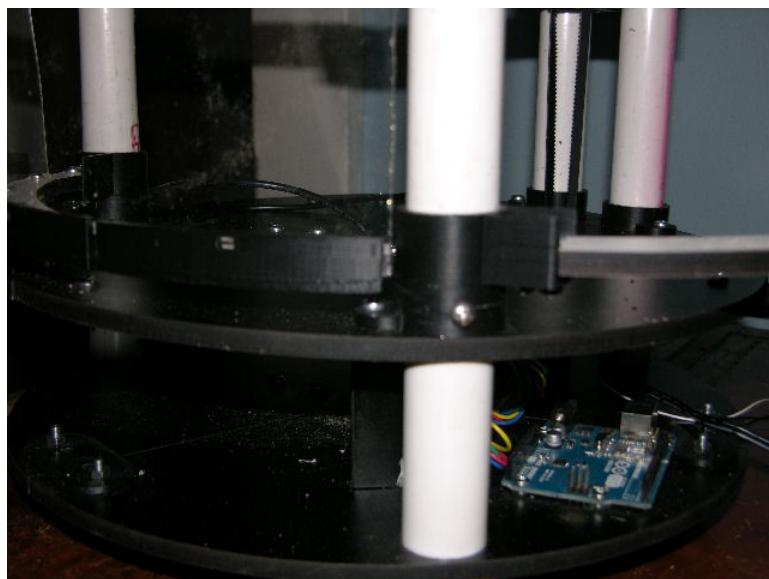
When it's done hold it in position until it cools.

You do NOT need this to be perfect. Mine certainly are not. You just need it close enough to fit into the door track on the machine.

This is what I wound up with this time:



Slip the bent acrylic into the lower track. Line up the right edge so it's even with or sticking out slightly from the door track.



Drill a 3mm or slightly larger hole in the first door track. Use a slow speed and take your time. Do not put much pressure on the acrylic! Let the bit work through it, don't try to force it. Cracking it at this point would NOT be a good thing.

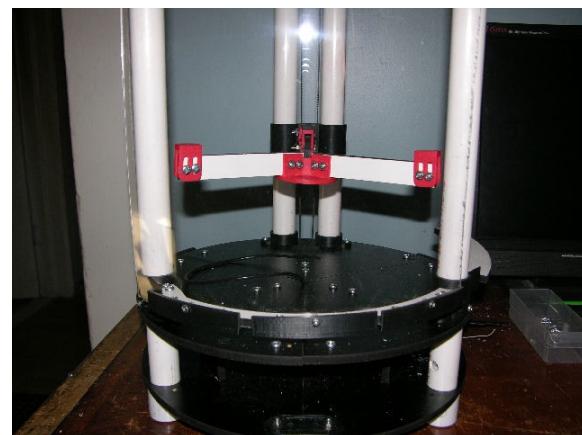
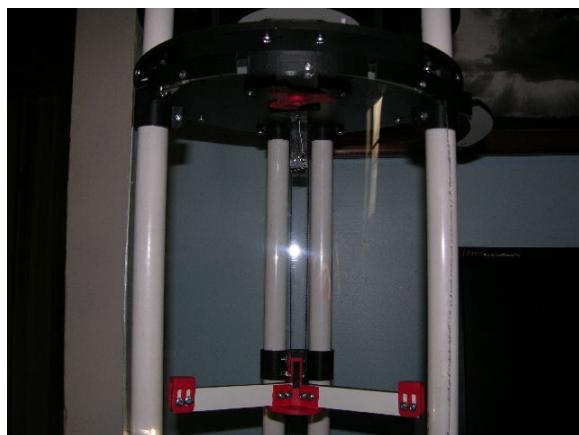
Insert a M3x10mm bolt through the hole, and tighten down with a 3mm nut.

**DO NOT OVER TIGHTEN!** It'll crack on you if you do.

Then work from right to left, drilling the middle hole, adding the bolt, tightening it down, then do the same with the left most one.

At every step on the way, make sure the acrylic is seated down in the slot.

Now do the same thing on the top swing arm. Start from the right and work left, constantly checking to be sure it's seated in the track.



Congratulations! You now have a door on the cabinet.

Optional:

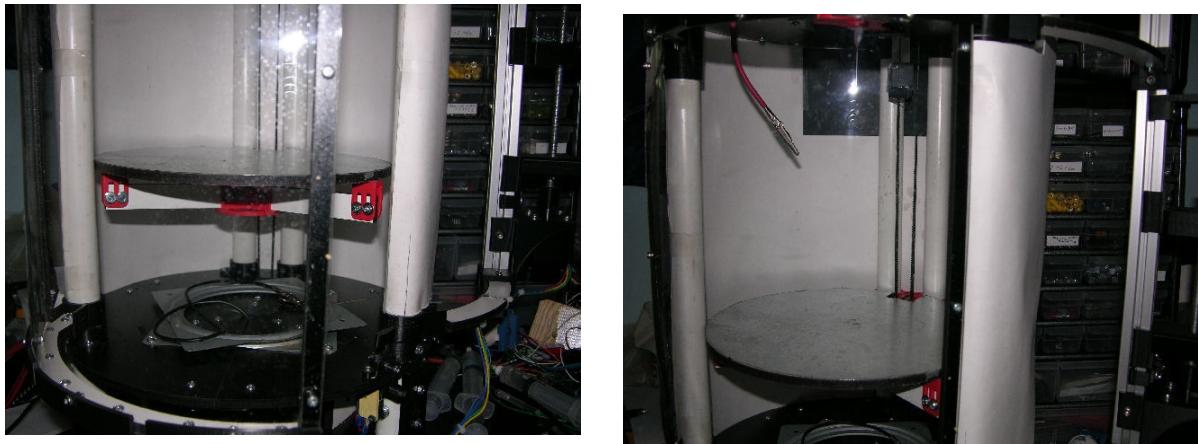
If the vertical sides of your door bow out, you can add some laser cut pieces to bring it into line.

Laser cut the DoorEdges.

Then fasten them vertically on both the left and right side of the door, taking the

same precautions as before when drilling through the acrylic.

The picture below shows my first machine, which needed them.



Get a bolt loosely on the bottom and without tightening it all the way put one in the middle. When that's loosely pulled into place, add the top bolt. Only then tighten all three of them down.

Repeat for the other side of the door.

## Adding The Side Covers

We're going to charge right ahead and add the side covers to the cabinet. We *could* go ahead and do the wiring, but I think that's best left for a manual by itself.

The covers are easy enough to remove and replace, so lets just get them on now.

You will need all eight of the SideCoverBrackets's, and sixteen M3.9x13mm pan head Phillips screws.

Lets start at the top. Align one of the side cover brackets with the post, between the two decks, as shown below. Drill a 2.7mm hole though each of the two holes and into the post. Then hold in place with two of the M3.9x13mm screws.

For the back two posts, don't drill too deep. Remember, you have wires in there!

When aligning the bracket, look at the top of the bracket and the top plate, and just try to center it on the post. You can get a real good idea by judging the amount of overhang it has there.

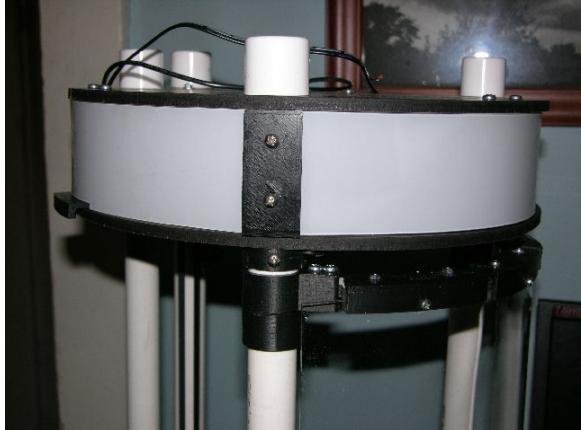
Repeat for all the other posts, top and bottom.

Now install the side covers. The two long ones go in the front of the machine, top and bottom. The four short ones go in the sides.

You can just stick one end into place and bend the pieces until they snap into the other side. If you need to, trim each piece a bit until they fit well. Don't bend them too far or you'll snap them in half!

To later remove these pieces it's best to remove the two screws on one of the SideCoverBrackets that hold it into place. I've snapped a few in half until I learned the hard way to just go ahead and take the two screws out.

Do yours look about like this? Good, you nailed it!



## Wrapping It Up

To finish the project we need to cover those open sides. To do that we'll avoid trying to bend even larger sheets of acrylic and just go with easily and cheaply replaced craft paper.

If you prefer to go with bent acrylic or some other material, go right ahead. It's not critical what the material is, as long as it keeps body parts out of the work chamber.

Start by measuring the space between the bottom of the deck B2 and the top of the deck on tier T1. Measure it in a few spot, maybe right up by the hinges on both sides, and then again at the back by the twin posts.

Cut the paper down along it's longest length. You should wind up with a piece that's 28 inches (71.1cm) by the measurement you just took.

Now take out all the screws you put in the LevelingCollarB's and set them aside. We'll be putting them back in here in a bit.

Starting on the left side of the machine and working your way clockwise around the cabinet, tape the paper into position. Start in the middle of that left post, and make sure the paper is sitting in the outside guides.

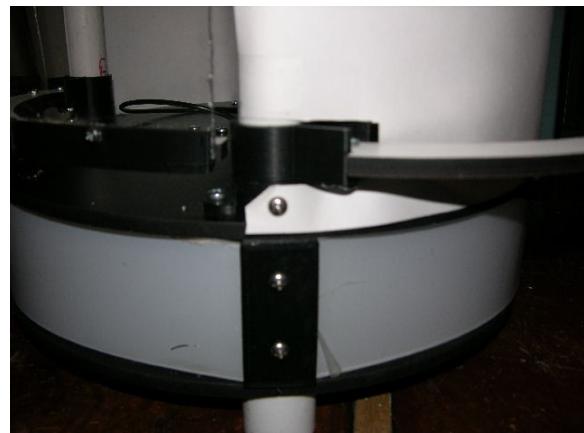
Double check to make sure everything is looking good all the way around, with no big buckles. Add enough tape to make sure everything stays in place.

Then, also starting on the left post, work your way around clockwise again, replacing those screws you took out one at a time. You can find the holes again by scraping your fingernail in the area where you think they should be. When you find one, push the screw through the paper and screw it down.

Noticed we have a little problem around the hinges, did you? Well, we'll take care of that right now.

We need to cut slots out to make room for the hinges. Just take a pair of scissors and carefully cut out a slot for them, about one inch tall and two inches wide. Adjust as needed when you try moving the hinges in and out.

See the pictures below if you're not sure what the heck I'm talking about.



Only one more task, and our cabinet build will be complete.

## Adding The Door Latch

Find the 3D printed parts DoorLatchBase and DoorLatchHandle.

Because they seem to come out a little different every time I haven't nailed down the perfect place to place the holes for these yet. So you'll have to drill them yourself.

**Update:** I took a shot at those holes. If you have the version that are now laser cut, good for you. If not, just go ahead and drill them.

Put the M3x25mm bolt through the latch handle. Add a 3mm nut and run it down tight. This tends to come loose now and again, so I suggest when you have it down tight you put a small drop of gel super glue on the nut and bolt, making sure not to get any on the plastic.

Let the glue set up, then continue.

Close the door, then with the handle pointing up hold the base in under the door. Keep it about an inch from the post. Note where it seems to fit best, where it will hold the door in place, and is not so tight that you have to really push the door in to get the handle to turn.

When you find the sweet spot carefully hold it in position while you open the door.

Drill two 3mm holes down through the door latch base and the T2 plate. Install two M3x16mm bolts and nuts and tighten them down, then check the door for function.

If it needs a bit of adjustment one way or another you can try just enlarging the holes a bit.

Fit well? Cool, your cabinet is done!