

# Syringe Assembly Manual

## Whirl-A-Rama

Copyright 2016 by Douglas Miller

Licensed as Creative Commons Attribution-ShareAlike 3.0

Questions or corrections should be emailed to [dougmsbbs@hotmail.com](mailto:dougmsbbs@hotmail.com)



# Table of Contents

Read This Before Beginning.....	3
Note 1:.....	3
Note 2:.....	3
5/16" Screw: .....	3
1/4" Screw:.....	3
Other Screws:.....	3
Parts List.....	4
3D Printed Parts:.....	4
Purchased Items: .....	4
Part Identification.....	6
Getting the Parts Ready.....	7
Add the Cap to the Syringe Mount.....	7
Carriage Slide.....	8
Mount the Nut for the Threaded Rod.....	9
Mount the Stepper Motor.....	9
Assembling on the Rail .....	10
Adding the Limit Switch.....	11
Attaching the Pump to the Cabinet.....	11
Soldering the Limit Switch Wiring.....	12

## **Read This Before Beginning**

### **Note 1:**

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, syringe, HV power supply and finally the electronics.

### **Note 2:**

There are several options when building the syringe for different screws. You **do not need all off the parts listed. Pick only the ones below for the screw you intend to use!**

The plunger mount is designed to take several different sizes of screws. A separate block is used as an insert to the plunger mount. Therefore: print the plunger mount, and just one of the blocks, whichever one fits the rod you intend to use.

#### **5/16" Screw:**

CarriageScrewHolder5-16

#### **1/4" Screw:**

CarriageScrewHolder1-4

#### **Other Screws:**

To use any other screw, modify the part CarriageScrewHolder1-4 to accommodate the nut for the screw you are going to use.

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
1	CarriageScrewHolder5-16
1	PlungerCarriageSlide
1	CarriageScrewHolder1-4
1	PlungerMountCap
1	PlungerMountThreadedRod
1	SyringeTipMount
1	SwitchMount
1	SyringeBodyMount
1	SyringeMotorMount
2	TSlotArmConnector

## **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, Cabinet manual.)

Amount	Part	Cost
1	Shaft Coupler – Rigid.	\$4.99
	To fit Stepper and Drive Screw	
1	Nema17 Stepper Motor	\$20.00
7	T-slot Nut 1/4-20	\$2.94

7	1/4-20 Button Head Cap Screw	\$1.61
1	18" (457mm) 1010 Series T-Slot Rail	\$4.14
1	MicroSwitch	\$2.00
2	25" (635mm) Small Signal Wire	\$1.00*
1	M3x20mm Bolt	\$.10*
5	M3 Nut	\$.10*
5	M3 Lock Washer	\$.05*
1	18" (457mm) Threaded Rod	\$3.00

Your choice of thread. Comes with

nut holders for 1/4" and 5/16"

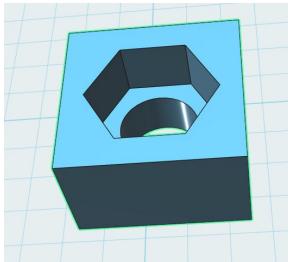
File can be edited for others.

1	M3x12 Bolt	\$1.00*
2	M3x24mm Bolt	\$1.00*
4	M3x8mm Bolt	\$1.00*
2	M2x16mm Bolt	\$1.00*
2	M2 Nuts	\$1.00*
4	M4x16mm Bolt	\$1.00*
4	M4 Nut	\$1.00*

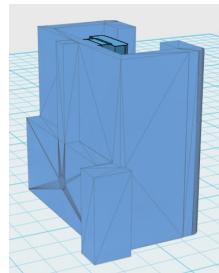
\* Cost for these items are token values. It really depends on how many you buy and where you buy them. Many of these are less than 5 cents each, if you can buy them that way. Also, like the small signal wire, you most likely have some around which will work fine. No sense buying a spool full if you only need a foot or two.

# Part Identification

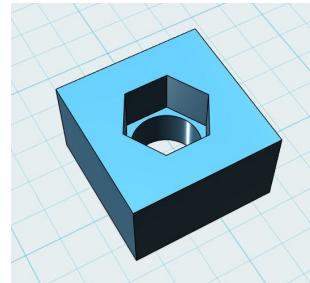
3D Printed Parts:



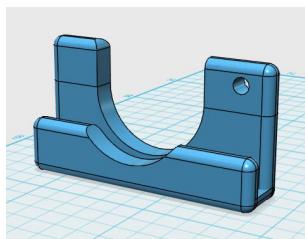
CarriageScrewHolder5-16



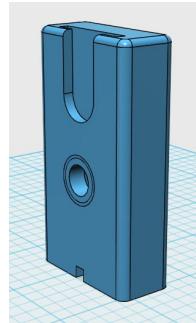
PlungerCarriageSlide



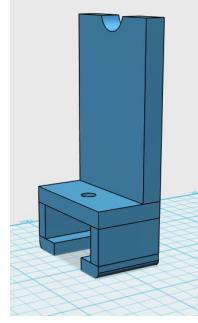
CarraigeScrewHolder1-4



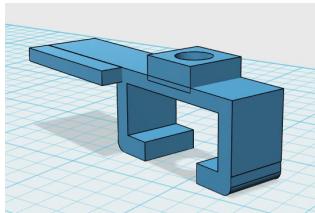
PlungerMountCap



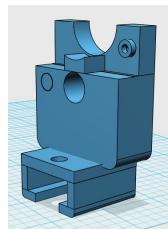
PlungerMountThreadedRod



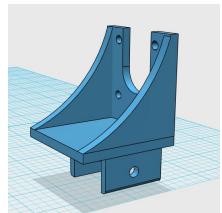
SyringeTipMount



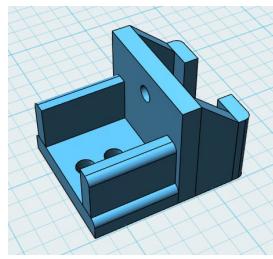
SwitchMount



SyringeBodyMount



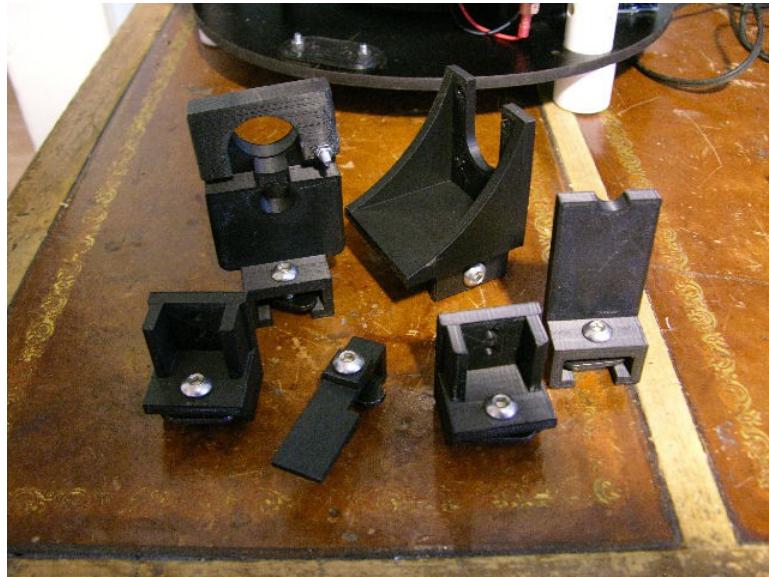
SyringeMotorMount



TSlotArmConnector

## Getting the Parts Ready

Insert a 14-20 button head cap screw into the holes in the six parts shown below, and start the t-nut on all of them. Just get them started, we only need to catch a thread or two at this point. Set them aside until they are needed.



## Add the Cap to the Syringe Mount

Insert a M3x20mm bolt through the recessed hole in the SyringeBodyMount. Slide on the PlungerMountCap as shown below.

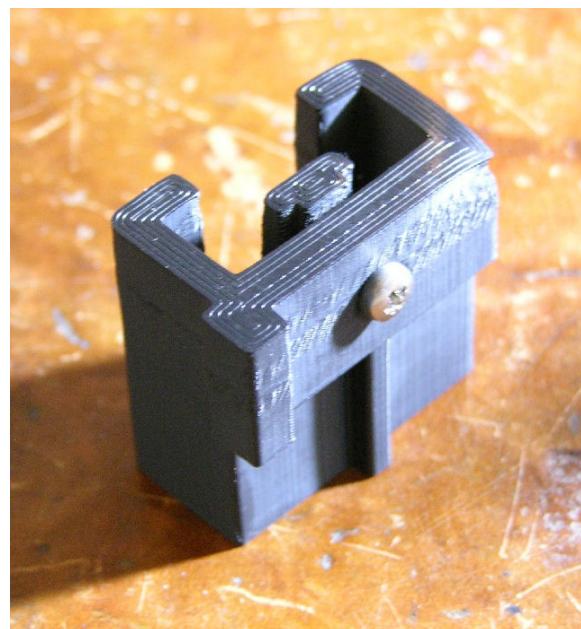
Then put a 3mm nut, a 3mm lock washer, and another 3mm nut on the bolt.

Tighten down the first nut until there is some resistance when moving the cap, but not too much. We want it to move, just not have a lot of play in it. Hold that nut while tightening the other nut, with the lock washer between them.



## Carriage Slide

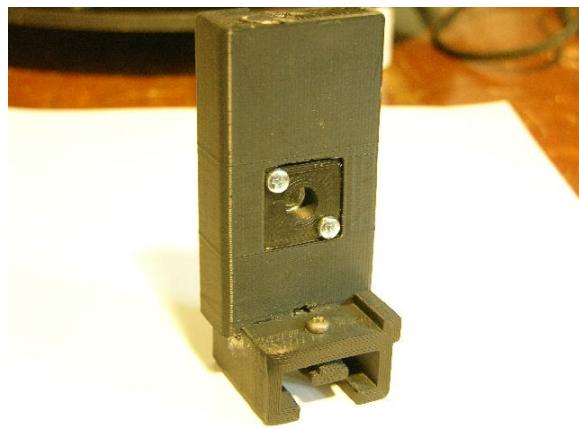
Insert a M3x12mm bolt down through the hole in the top of the PlungerCarriageSlide, and down through the hole of the tab below. Press a M3 nut in the recess provided in the tab below, and start the bolt through the nut. Do not tighten down all the way. We'll use this later to adjust the slide once it's installed.



## **Mount the Nut for the Threaded Rod**

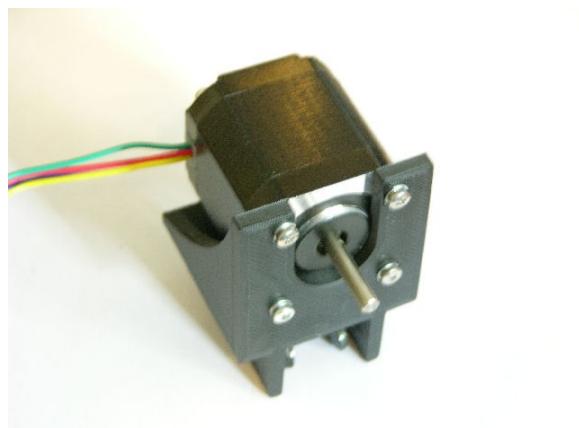
Now use some super glue to glue the PlungerMountThreadedRod onto the top of the PlungerCarriageSlide. Make sure it's in the orientation as in the photo below.

Insert the nut for the screw you have chosen into the carriage screw holder, and then press that into the plunger mount, with the nut trapped between the two. You can either glue it in place with super glue or, as I have done here, drill two holes in opposite corners and hold it in place with two M3x24mm bolts and nuts.



## **Mount the Stepper Motor**

Using four M3x8mm bolts and four 3mm lock washers attach the stepper motor to the SyringeMotorMount.



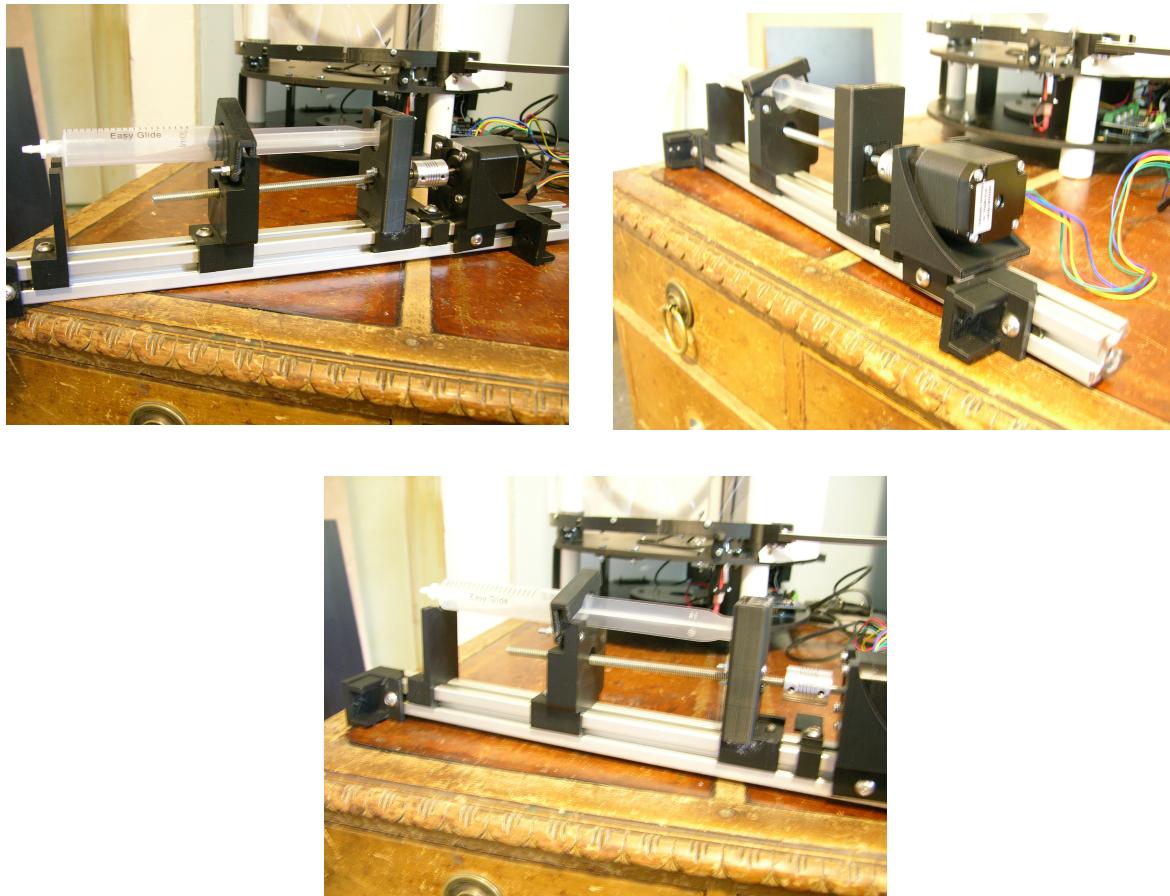
That was simple enough, right?

## Assembling on the Rail

Take a look at the photos below, and starting from the end the motor is on, slide all the pieces in place on the T-slot rail. Notice the orientation of each piece carefully. When you get the motor mount in place, add the shaft coupler to it. Turn the threaded rod into the nut on the plunger mount, and tighten that down into the shaft coupler.

At this point the exact distances are not all that important. You'll have a chance to tweak it all later. If you already have one of the syringes you are going to use, put that in place as you go along and use that to set the distances.

Again, you can do any final adjustments later. If you later use different sizes of syringes, you will be adjusting it then anyway.

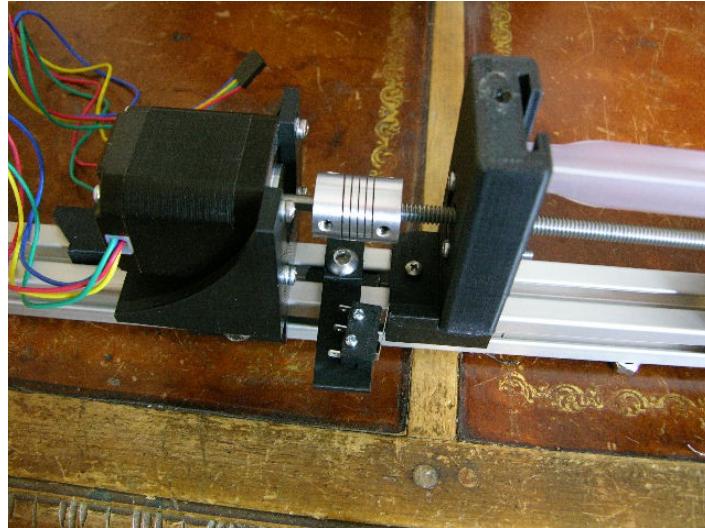


When it all looks like that, we have one more little chore to do before we mount it on the cabinet. We need to mount the limit switch.

## **Adding the Limit Switch**

The holes for the limit switch were left off on purpose. It lets you position it as you wish for the best fit for your syringe. Turn the shaft until you get it where you would like the home position to be, then hold the switch in place and drill the holes.

Fasten the switch in place with two M2x16mm bolts and nuts.



That's the end of that. Now lets get that bad boy onto the cabinet!

## **Attaching the Pump to the Cabinet**

Get the M4x16mm bolts handy, then hold the syringe assembly into place on the cabinets swing arms. You may have to adjust the positions of the TslotArmConnectors to get them lined up.

Slip a bolt through one of the holes in the top arm connector. Then add on to the bottom one.

You'll have to be a bit careful while you do all this, making sure not to let the weight of the entire arm rest on just one of the swing arms. They will hold all that weight, but it's a bit much for just one of them.

Add the other screws top and bottom, and fasten them down, starting with the two

bolts on top. It will pull the weight up off the bottom one somewhat.



## Soldiering the Limit Switch Wiring

Take the two small signal wires and solder them on the limit switch.

We need them on the normally open terminals.

That's it. You are done here.

You will wire up the other end of the switch and the stepper motor in the Electronics assembly manual.