

LYMAN FILAMENT EXTRUDER V6

Construction and Operating Manual



**HUGH LYMAN
INVENTOR**



Wall or shelf mount with variable motor speed control



Wall or shelf mount with fan switch



Desktop or bench mount

The **LYMAN FILAMENT EXTRUDER V6** is a filament extruder that is designed to either be used on a desktop or mounted vertical on a wall or shelves. It also can be mounted vertically on a desktop with a separate stand. It produces filament for use in 3D printers. It extrudes 3mm ABS filament at about 25 inches per minute with a diameter tolerance of +/- 0.06mm. Other plastics can be extruded, however have not been tested. This version V6 is patterned after the LYMAN FILAMENT EXTRUDER II, configured different but with similar electronics. This extruder is simple and easy to build. Add a spool wind up system and you will have a complete system.

Watch the video on YouTube for the setup procedure:

<https://youtu.be/GHHyPwk5r84>

The following pages illustrates how I built the extruder.

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To begin with print the 3D printed parts from the STL files which are furnished separately.

I have designed these parts so that they may be printed on a 3D printer with a maximum 9x7 inch bed.

There are two hopper feed attachments, one for horizontal use and one for vertical mounting.

This photo shows three of the electronic case sides printing. There are 4 of these sides and the 4th one has two extra hole in it for attaching the fan bracket.

This photo shows the motor half of the extruder base. My printers can print the whole extruder base, but I have better warp control printing it in two pieces. Even so, there is some warping that has to be dealt with.

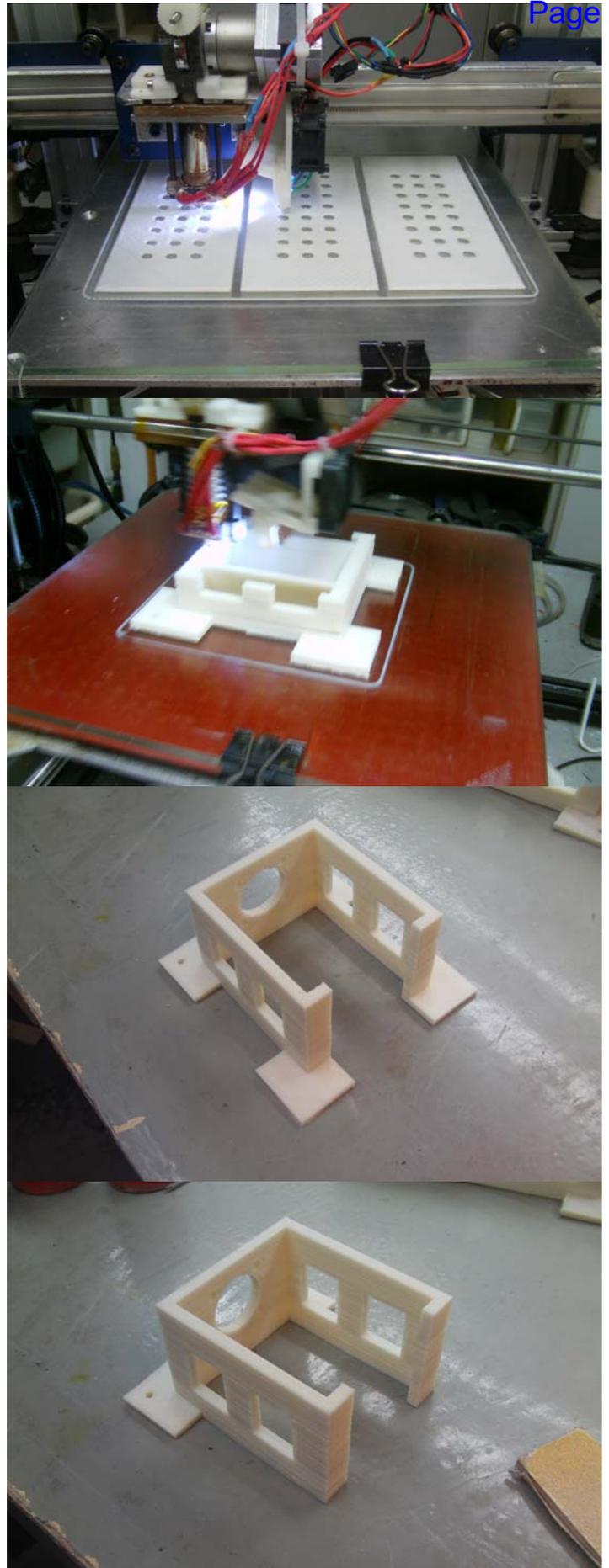
I printed the extruder base with 3 perimeters and 60% infill. All other parts were printed with 2 perimeters and 30% infill.

This is the only part that should be printed with ABS filament for better heat control and the rest of the parts PLA should be sufficient. All my parts were printed with ABS from filament extruded on my V5 extruder.

Illustrated in this photo is the motor base half. There are four outriggers at the corners, two for mounting the base to the electronic case and two only for use in clamping the part to the printer bed. I use two steel bars across the outriggers clamped to the bed with clamps. The print is paused and I attach the bars when the outriggers are fully printed. As the print continues there is a layer separation as the part tries to warp. If you look close above photo you can detect the line at about 10mm high.

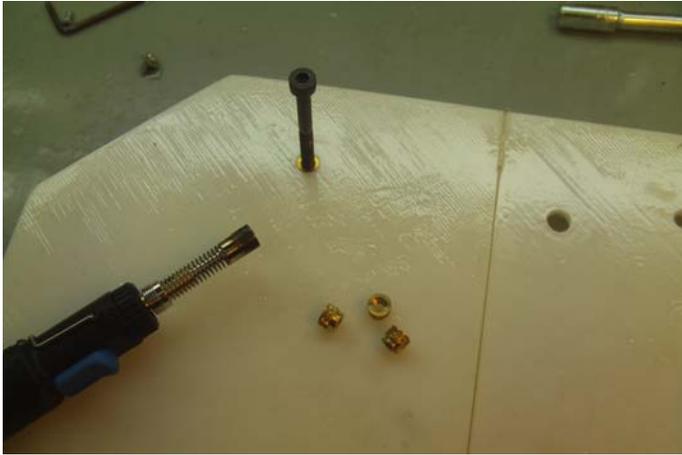
As I got a one small crack in the layer it had to be treated with solvent cement and clamped tight.

The Auger mount half of the base is even worse. Repairing it required the use of #4707 heavy bodied solvent cement.

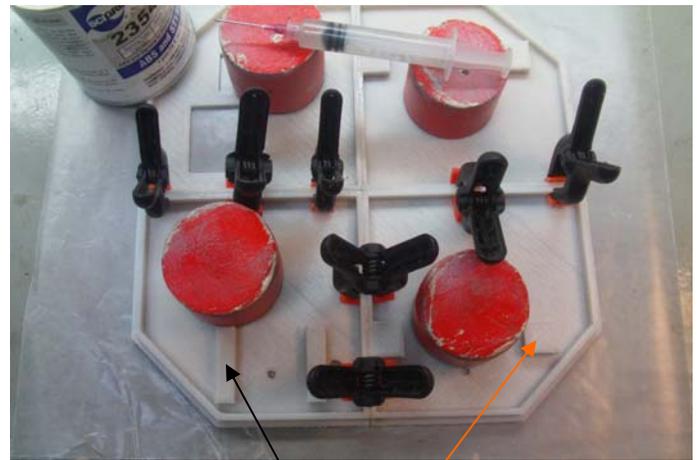


The Case Top parts here shown are cemented together using SCIGRIP #2354 ABS Solvent Cement. The fixture time is 5 minutes.

The Standoffs are for mounting the Power Supply and the SSR. Using the parts as template, mark and drill holes for the #4 screws



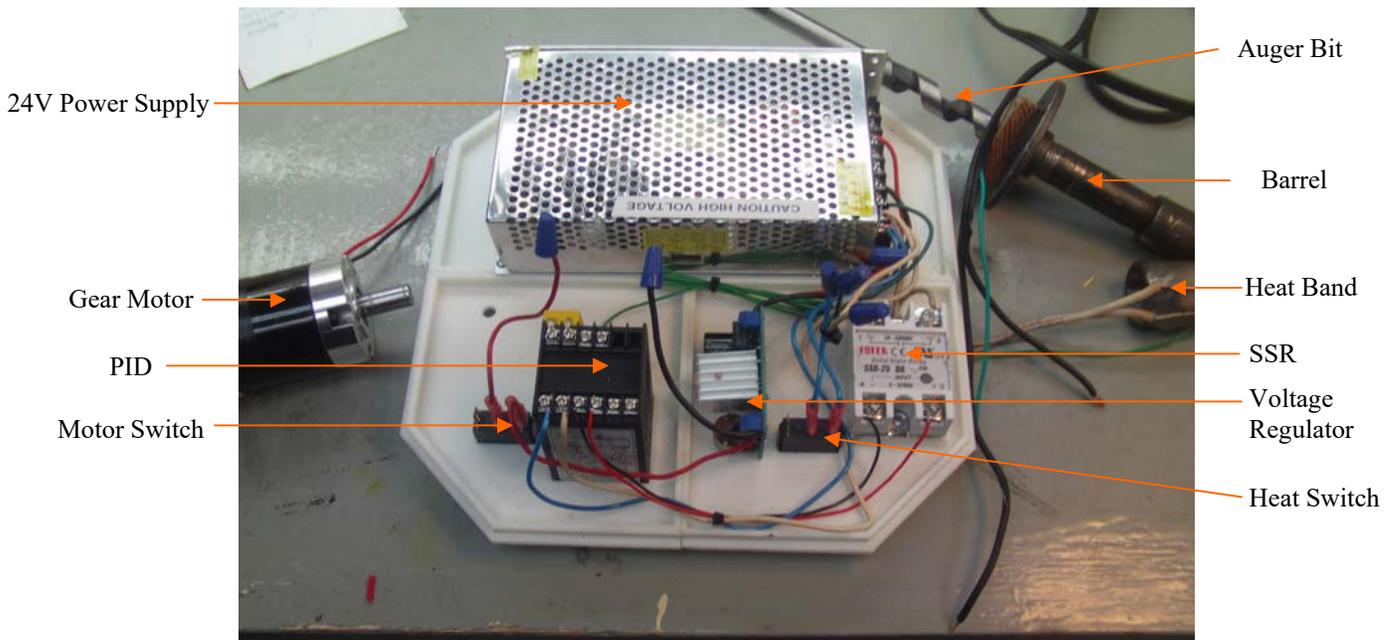
Once the top is assembled the Brass Heat Inserts are attached for mounting the Extruder Assembly. The four holes are resized with a 5mm drill bit. They can be inserted with a soldering iron or as I do, attaching them to a long 4mm bolt and heating the insert with a mini torch for 8 seconds. This way I can get them in straight and plumb.



Standoffs

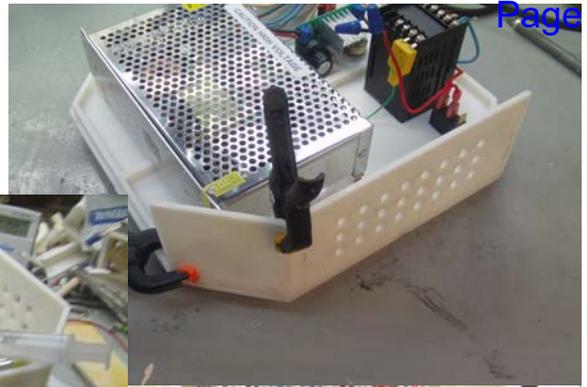
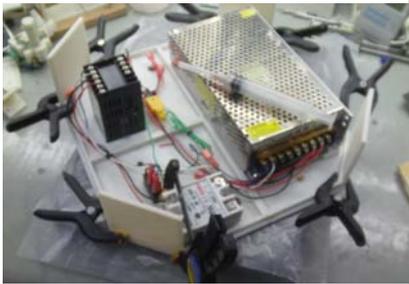
I mount all the electronics before the sides and bottom case parts are attached. The Case Top is sitting on 1/2" board keeping the Switches, PID and Voltage Regulator Knob from getting damaged.

Note: There is no soldering required with these components.



Now the rest of the Case side parts are attached, again using Solvent Cement.

There are some differences in these picture as they are taken on two different units as I built.



Final Case assembly is cementing the bottom parts to the Case Sides.

Note I am using a foam pad under the Case to protect the electronic parts.

Also I have printed the case in one piece.

Align the Motor Case and the Auger Case and cement them together. Alignment is critical so take extra care.



There are two hole drilling template stl file included. Print these and use to mark for the holes. Left is the MDF block template and right is the flange template. The MDF block template can also mark the cut size of the block.



The 1/2" MDF block is an insulator between the black iron flange and the Auger Hopper Case part. The auger hole is drilled with a 3/4" bit and the bolt holes are 1/4". Pressed tight in the auger



The 4" black iron nipple used for the barrel is fabricated with a 1/16" hole that is drilled through so there are two hole about 1" from the flange end. The inside of the barrel will need burr dressing.

The black iron nipple used for the barrel has a weld ridge on the inside. Here I drill it out as much as possible with a 5/8" drill bit and then continue to dressing the inside of the barrel with a dremel to remove any burrs and the weld ridge.

Note the 1/2" black iron coupler attached to the nozzle end. This is attached as strong as I can make it, as you don't want it to turn when changing the nozzle.

The brass bushing in the MDF block can be pressed in with a press or a wood mallet. Make sure not to damage it. It should fit tight so not to turn with the auger turning. It may also need dressing.

The flange shown here has not been drilled.

The flange here is attached to the nipple. Again, here the nipple is tightened till the end of the nipple is flush with the face of the flange. You will need a big pipe wrench for this.

Note the holes have been drilled to match the MDF block holes.

With the Barrel finished I clean it out with a shop towel and solvent, otherwise the first extrusions white in color will be gray.

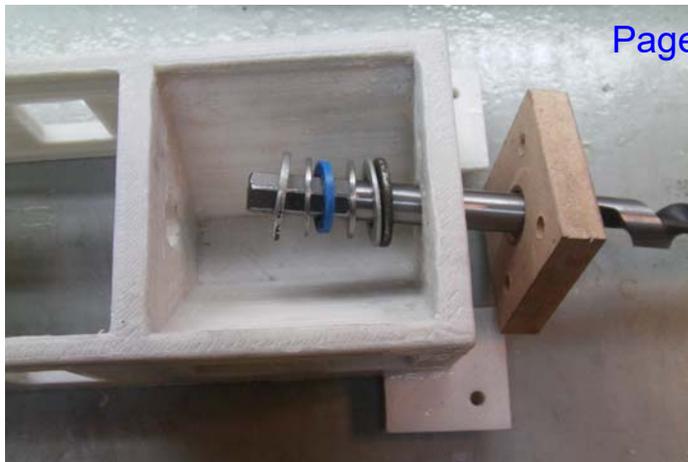
The Auger Bit is one that I got from Filabot. I don't know the brand but it is one that has a 0.60 diameter. The Auger Case is designed to accommodate this bit, wherein only one end needs to be cut off.

I cut it at 11-3/8" long and then grind the end with a taper.



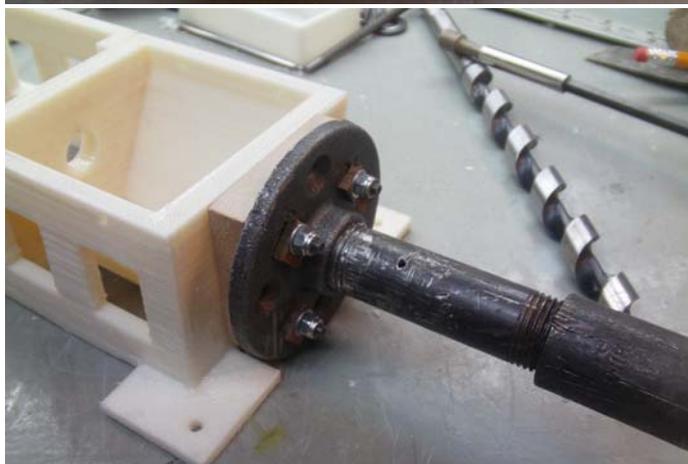
Assemble the Auger Bit through the MDF Block, Auger Case and slip on the 1/2" washers and Thrust Bearing.

First put on two 1/2" washers, then the Thrust Bearing consisting of (2) 1/2" stainless steel washers with the plastic ball bearing between and then another 1/2" washer. You do not want the auger to touch the motor shaft.

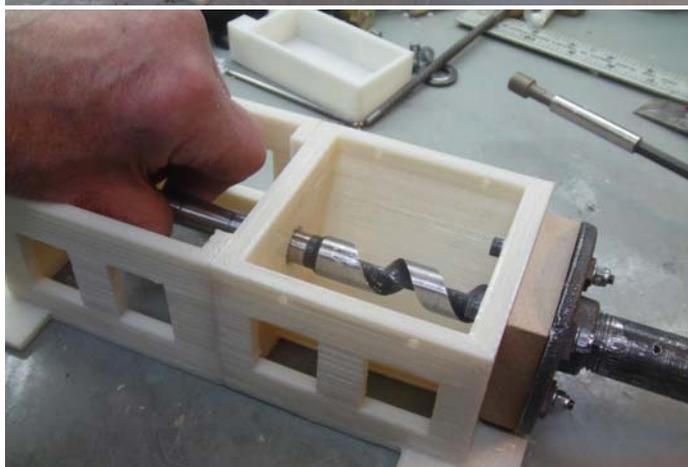


Assemble the Auger Motor Case with the MDF block and the Barrel assembly using 4 M4 x 40mm socket head cap screws, 8 M4 washers, 4 phenolic washers.

The bolts are not tight but just loose enough for the barrel to rotate with the oversize holes in the flange and the block. This lets the auger bit center itself in the barrel.



Insert the Auger Bit. The Auger Bit should rotate freely using your fingers to turn it.



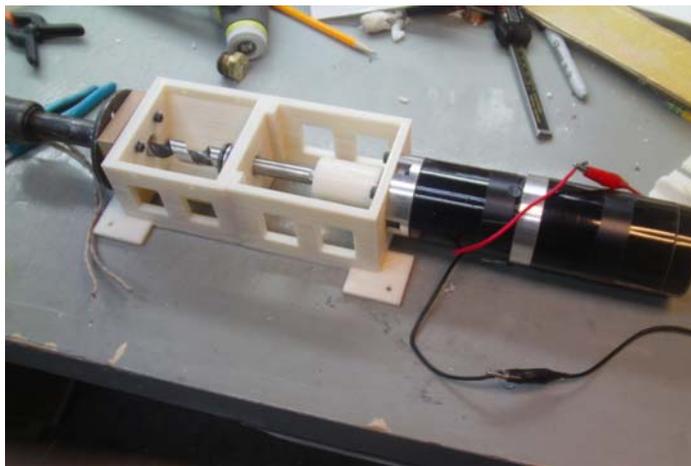
The motor is attached first to the Motor Case with (4) M5 x 16mm socket head cap screws using M5 washers.

The printed coupler is then attached to the motor shaft. This coupler may be snug and require some dressing.

The Auger Bit hex end is pushed into the coupler hex end. Again this may require some dressing.



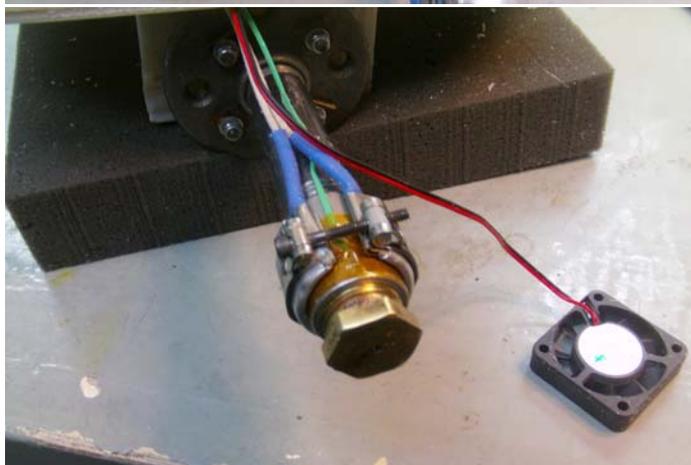
Here is the Extruder Assembly fully assembled. It is hooked up to a 24V power supply and brake in running dry.



This is attaching the K type Thermocoupler with Kapton 1/2" tape.

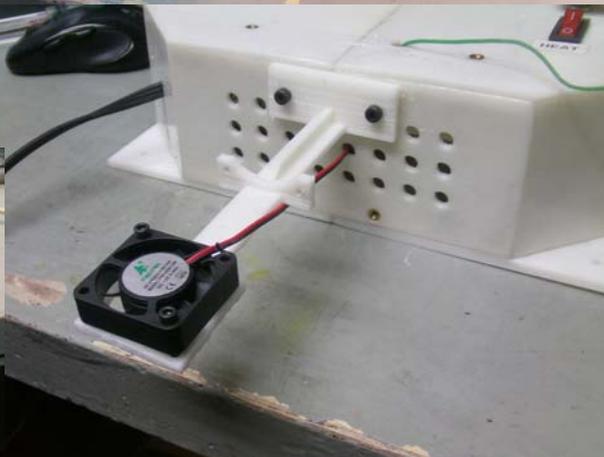


The Heat Band is next slipped over the 1/2" black iron coupler and tighten.



The Fan mounting bracket is designed for either horizontal or vertical mounting of the Extruder. In the Desktop horizontal position the filament feeds through the bracket end. However I do not use the fan or the variable speed control.

The Fan Bracket is mounted to the Case with (2) M4x12mm SHCS. The mounting holes are 3.5mm for the screws to thread into the plastic case side.



This is the Extruder fully assembled and extruding filament in the horizontal desktop configuration.

In this configuration the Extruder has a hopper transition (red) to fit a 3" cardboard shipping tube over.



Here is the filament cooling up on the floor as it is extruded. It is extruding between 20 to 25 inches per minute at a tolerance of +/- 0.06mm.

My filament Spool Winder is a good addition to handle the filament for 3D printing as seen in the video.



The vertical configuration shown here shows a different hopper transition for the 3" tube. Also the fan is mounted for the vertical mounting.

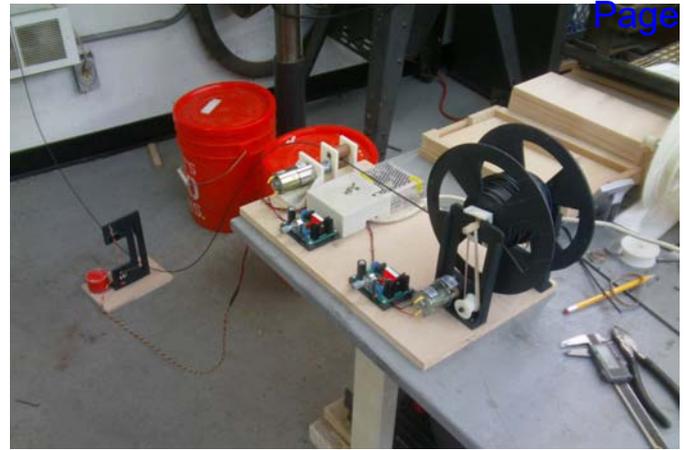
I made two models, one with a variable voltage regulator to control the motor speed and the other with the variable voltage regulator omitted and a fan switch in its place.

If you are extruding 1.75mm filament you may need to slow the motor down. As I extrude 2.60mm filament I use the fan switch in lieu of the speed control.

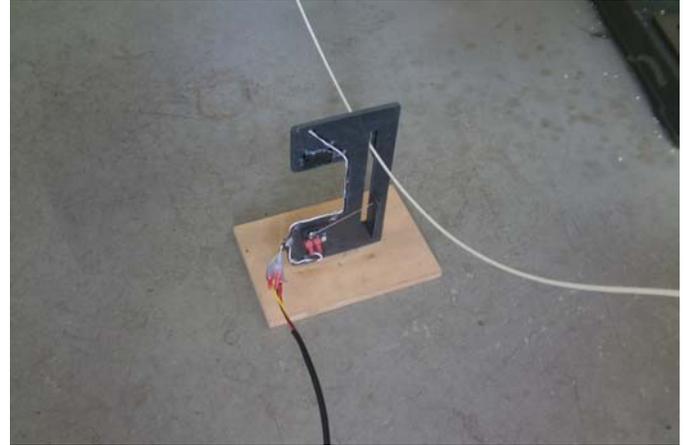


The spool winder is new and will be published separately on Thingiverse. A level wind is optional. The gear motors used here are some random ones I had on hand. Shown are two 12V digital speed controllers.

This is without the level wind mechanism as it does well without.

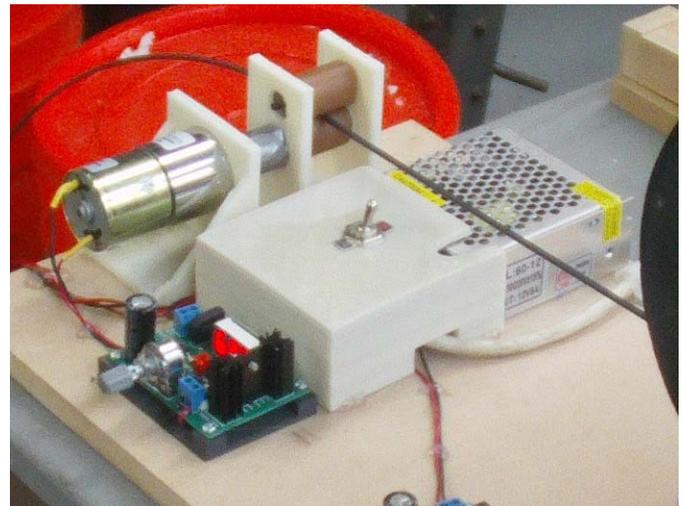


This is the filament sensor to control the spool winder to compensate for the filament transition from Extruder to Spool. If the loop goes up the sensor will turn off the winder motor. If the loop goes down it will start the spool motor.



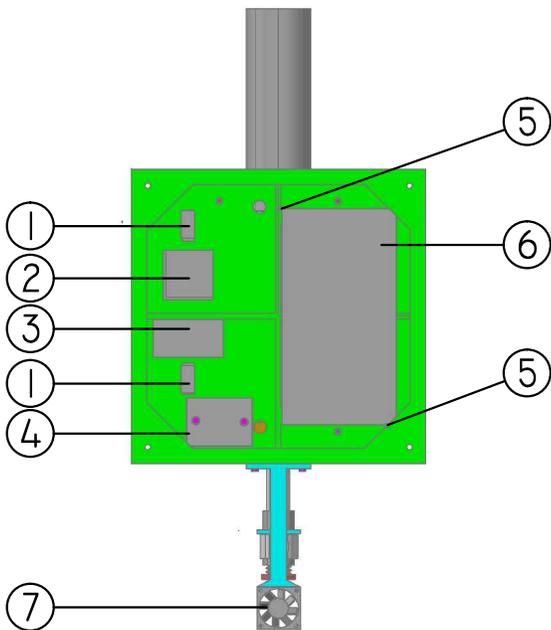
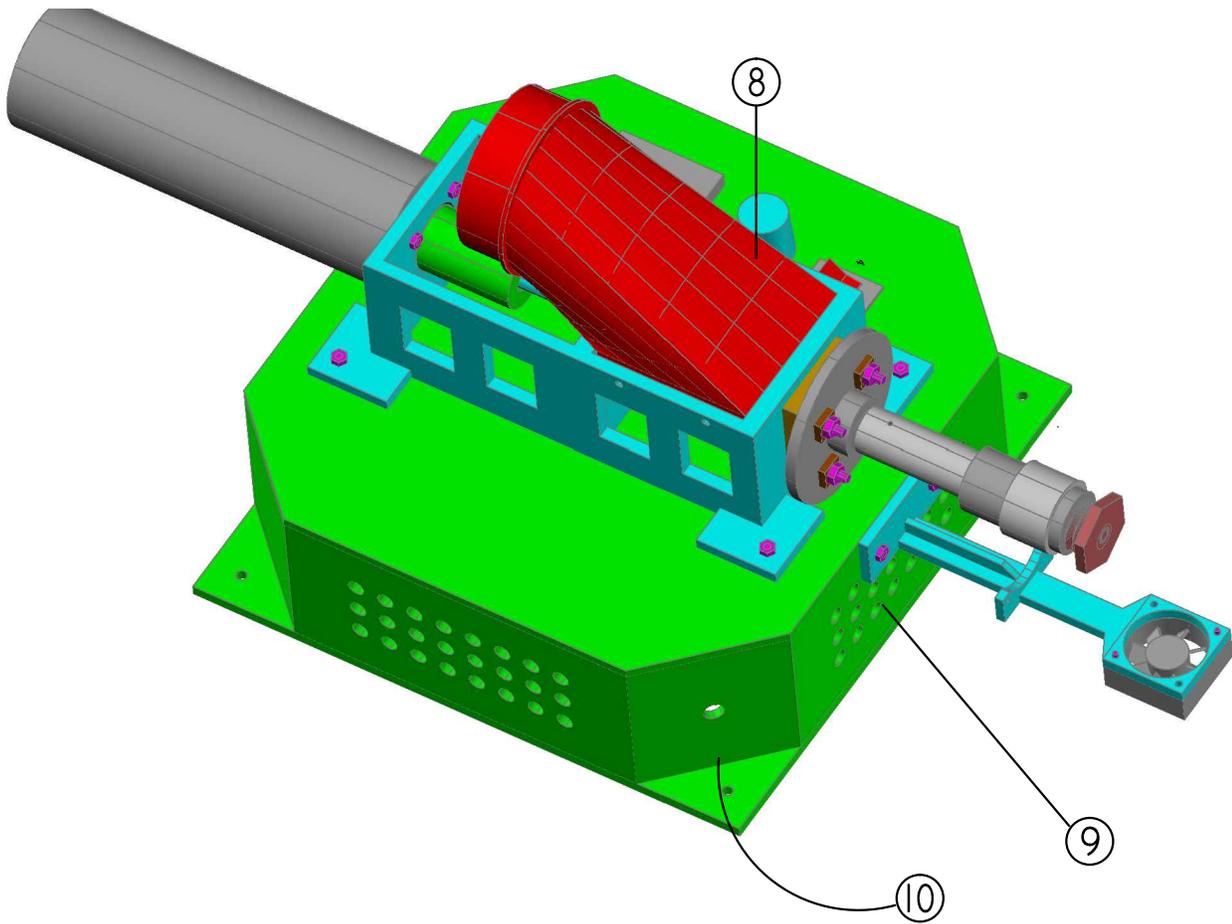
This Spool Winder has two variable voltage controllers one managing the feed drums and one managing the spool speed.

It has now wound up dozens of spools of filament.

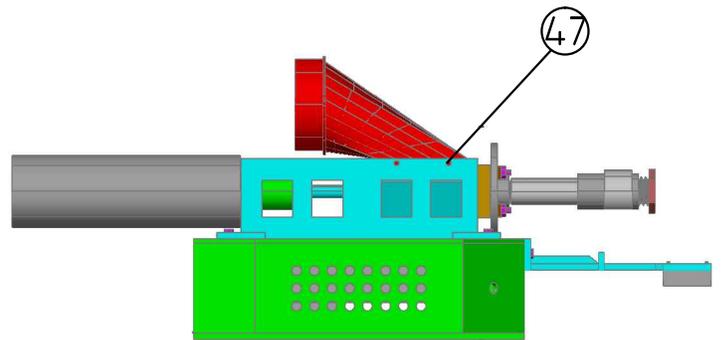


The spool motor is now fixed and the spool shaft has a rubber band belt that hold the spool against the latex cob. This can be done without the voltage regulator if you us a motor with the right rpm.





BOTTOM VIEW



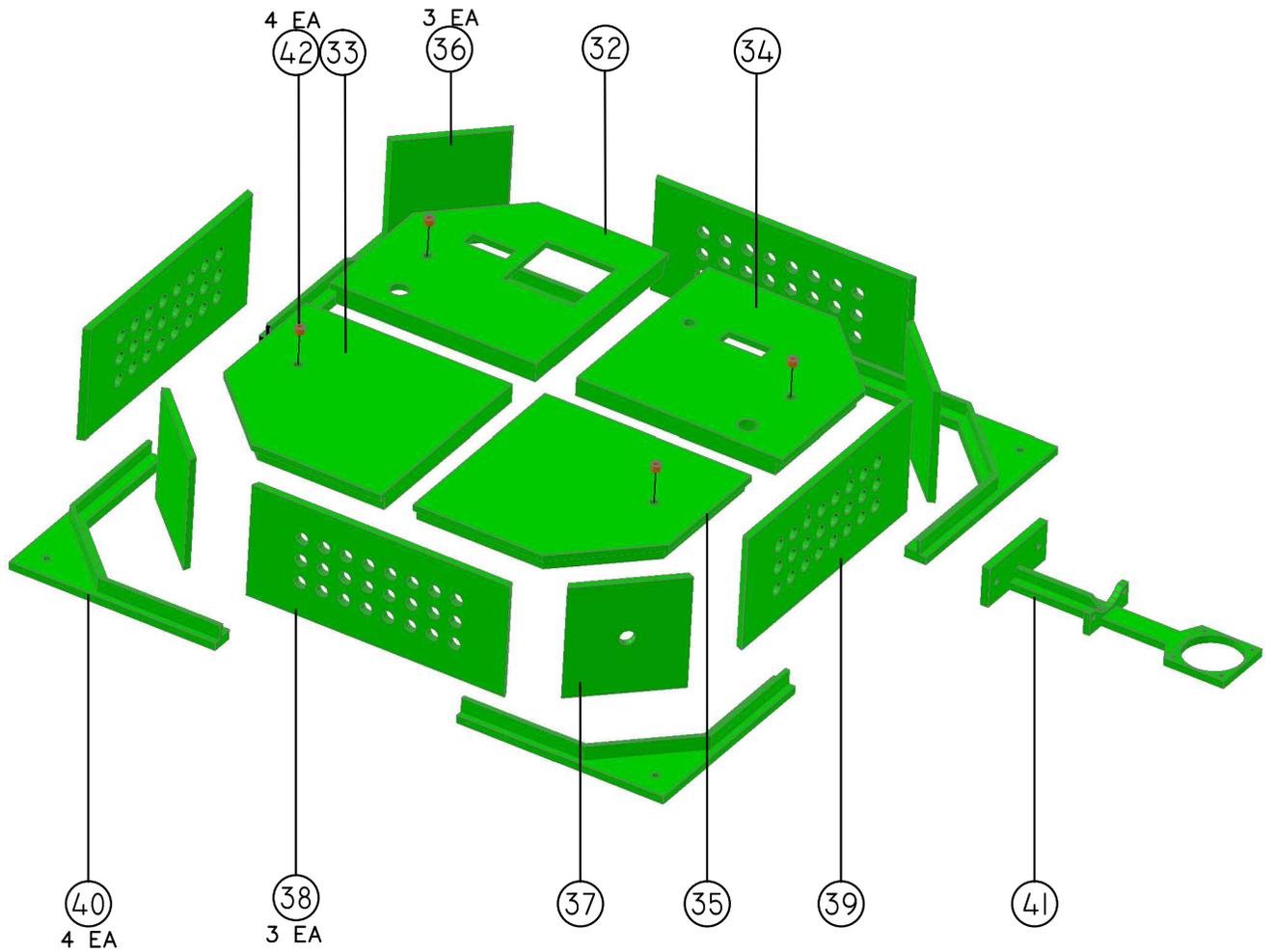
SIDE VIEW

HUGH LYMAN
INVENTOR

EXTRUDER V6 VIEWS
LYMAN FILAMENT EXTRUDER V6

SCALE: NONE
DRW: H.LYMAN
DATE: 4/25/15

A01



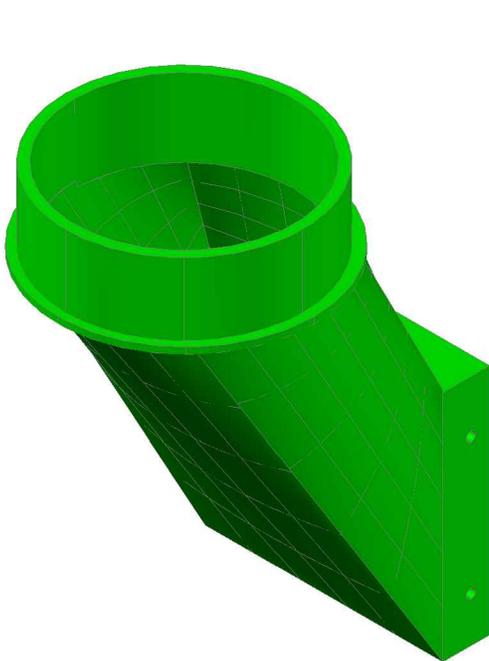
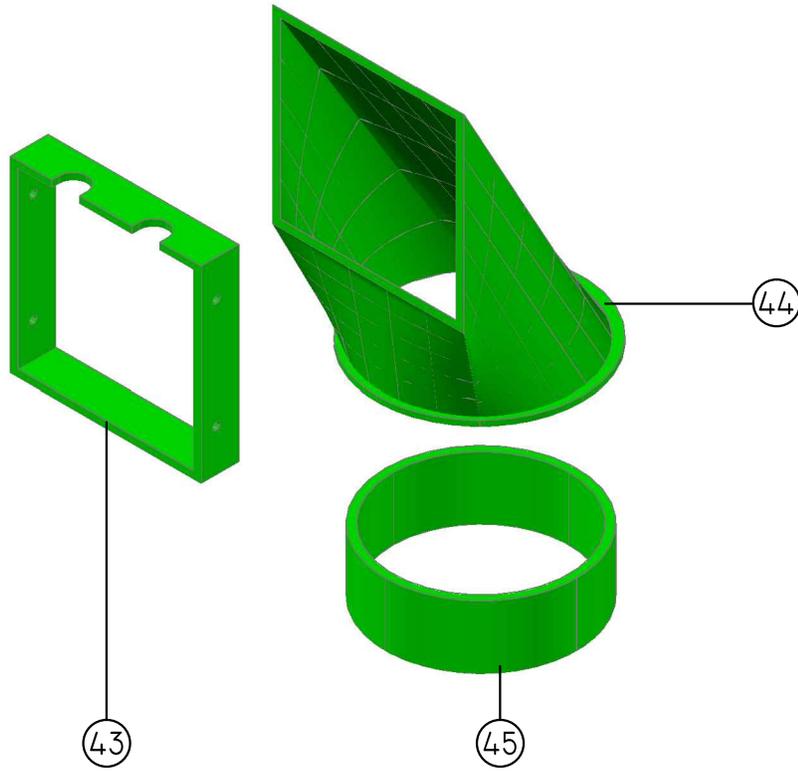
ASSEMBLE USING ABS
SOLVENT CEMENT

HUGH LYMAN
INVENTOR

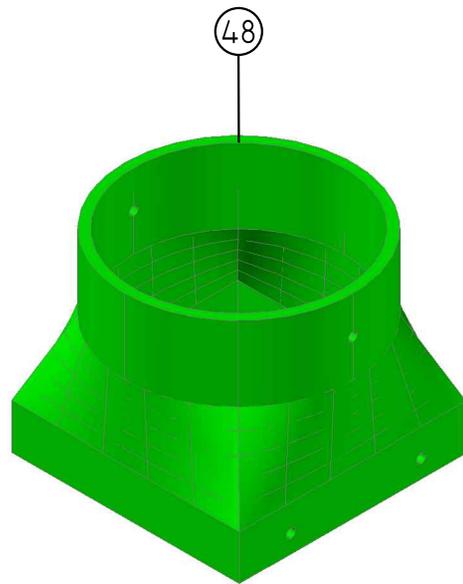
ELECTRONIC CASE ASSEMBLY EXPLODED
LYMAN FILAMENT EXTRUDER V6

SCALE: NONE
DRW: H.LYMAN
DATE: 4/25/15

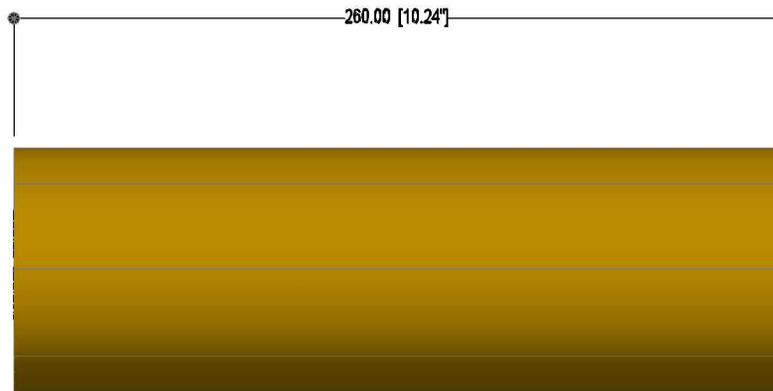
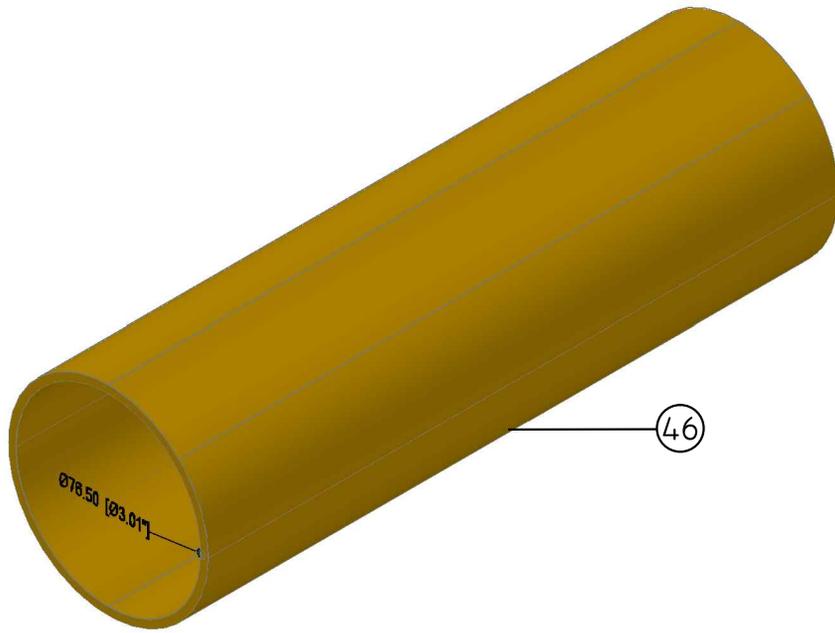
A03



VERTICAL HOPPER
TRANSITION
ASSEMBLE PARTS USING
ABS SOLVENT CEMENT



HOIZONTAL HOPPER
TRANSITION



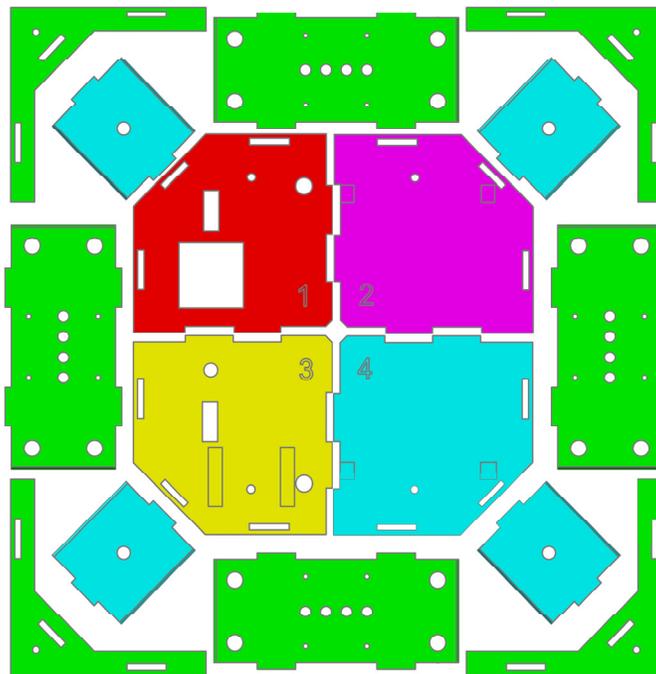
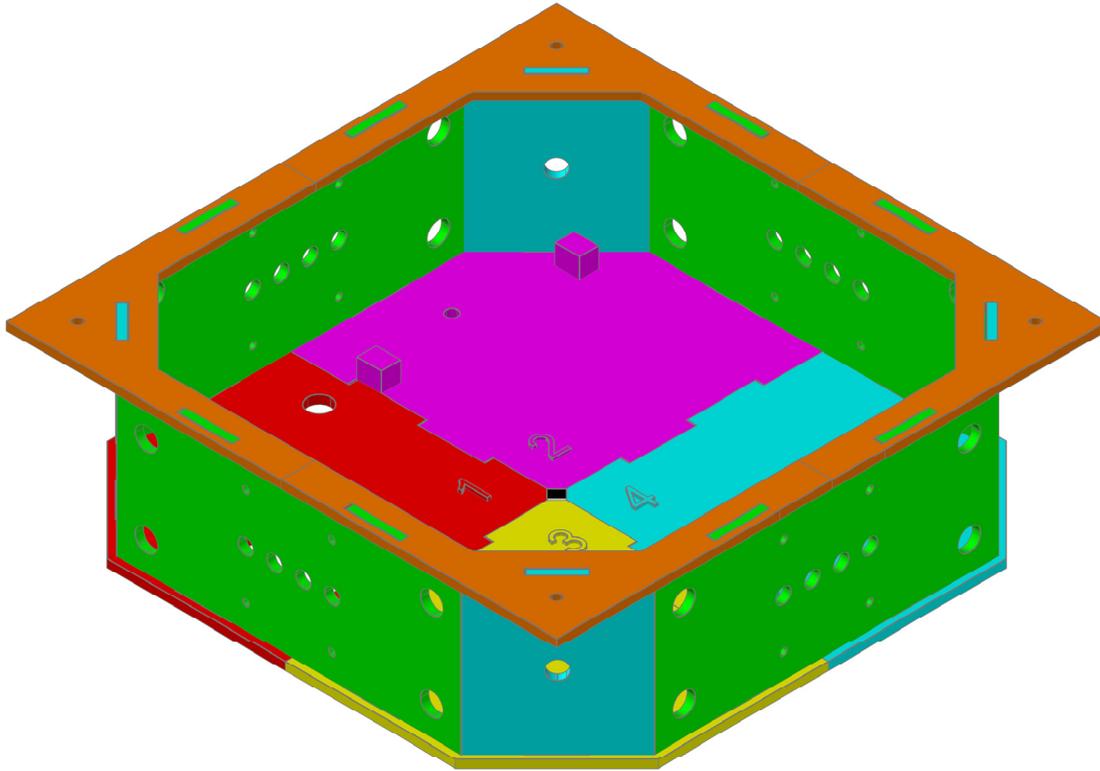
STANDARD 3" ID SHIPPING TUBE 10" LONG

HUGH LYMAN
INVENTOR

HOPPER EXTENSION TUBE
LYMAN FILAMENT EXTRUDER V6

SCALE: NONE
DRW: H.LYMAN
DATE: 4/25/15

A05

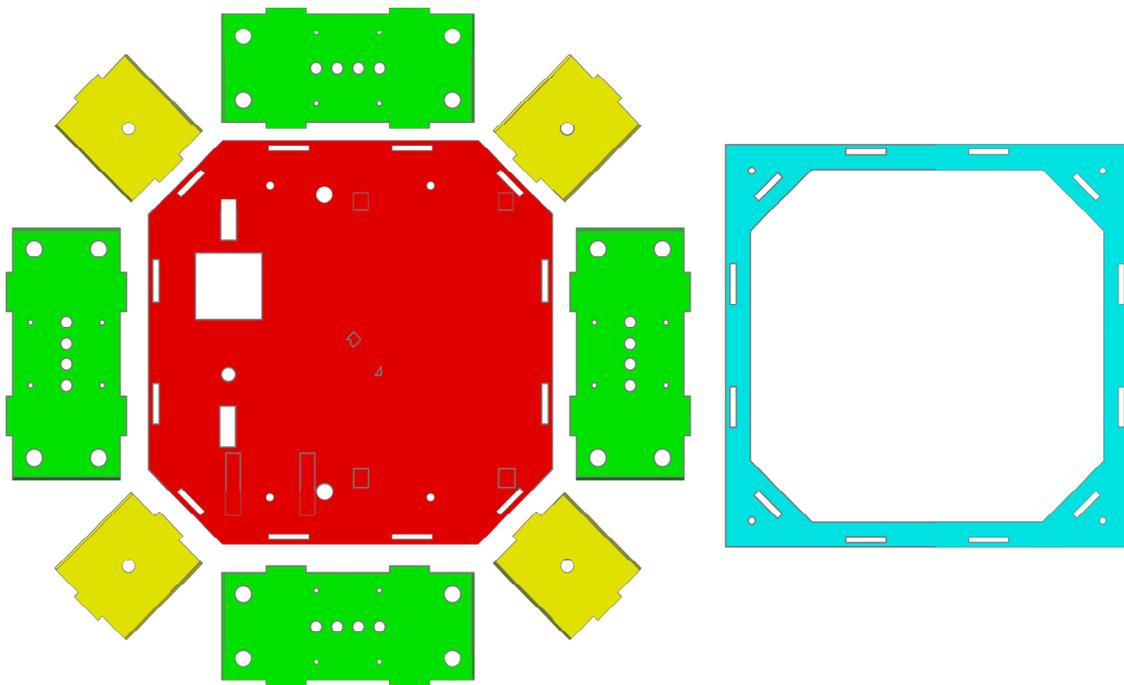
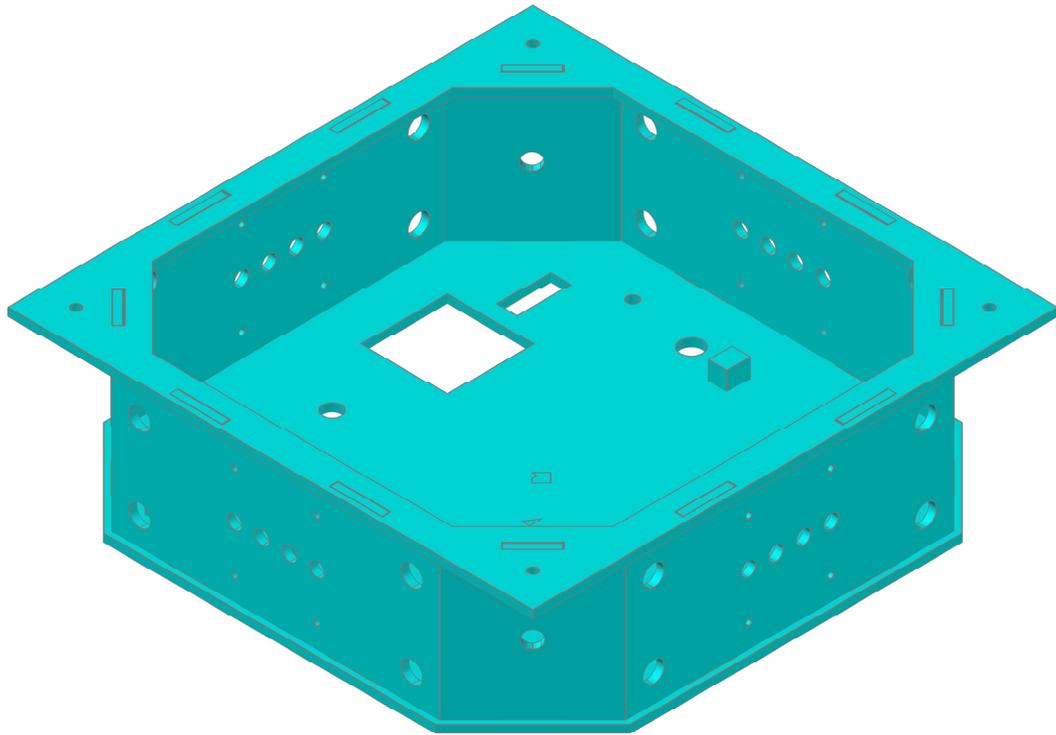


HUGH LYMAN
INVENTOR

EXTRUDER V6 CASE
LYMAN FILAMENT EXTRUDER V6

SCALE: NONE
DRW: H.LYMAN
DATE: 5/15/15

A01

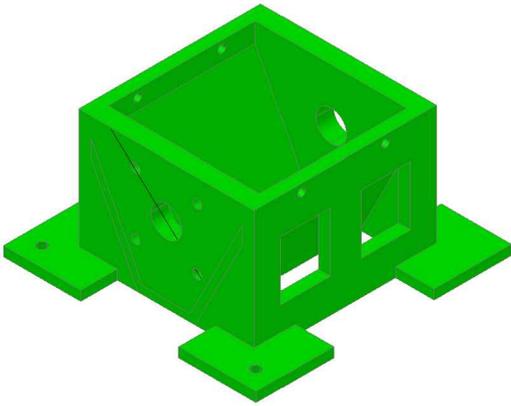


HUGH LYMAN
INVENTOR

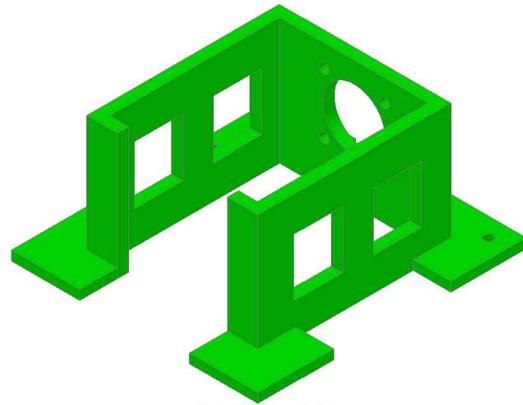
CASE PARTS V6 TOP & BOTTOM EA ONE PART
LYMAN FILAMENT EXTRUDER V6

SCALE: NONE
DRW: H.LYMAN
DATE: 5/15/15

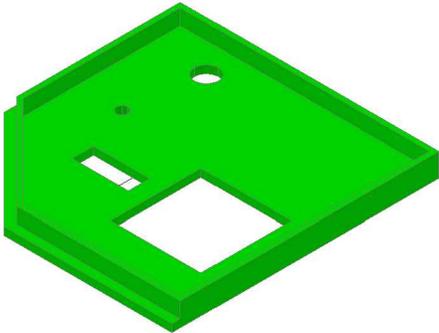
A02



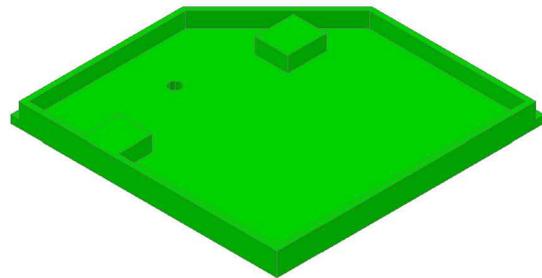
PART # 20a
AUGER BASE
3 PERIMETERS 50% INFILL



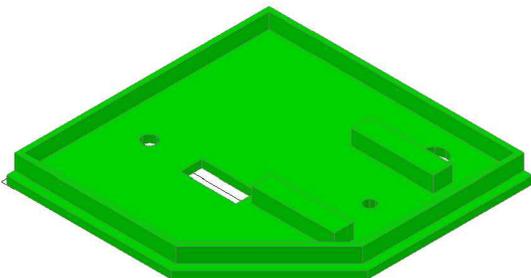
PART # 20b
MOTOR BASE
3 PERIMETERS 50% INFILL



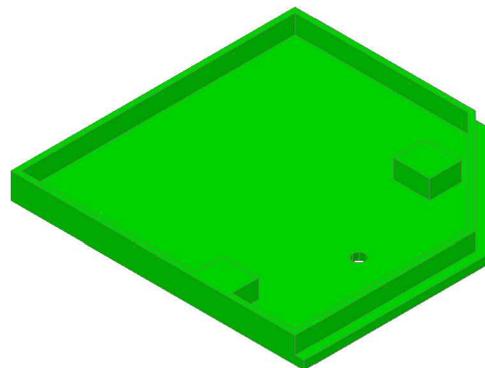
PART # 33
CASE TOP, TOP LEFT



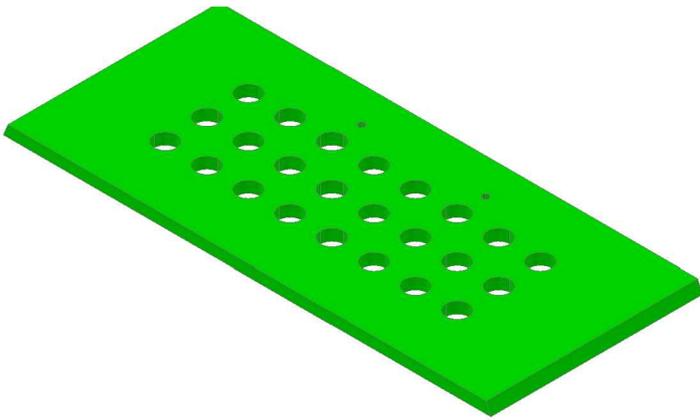
PART # 32
CASE TOP, TOP RIGHT



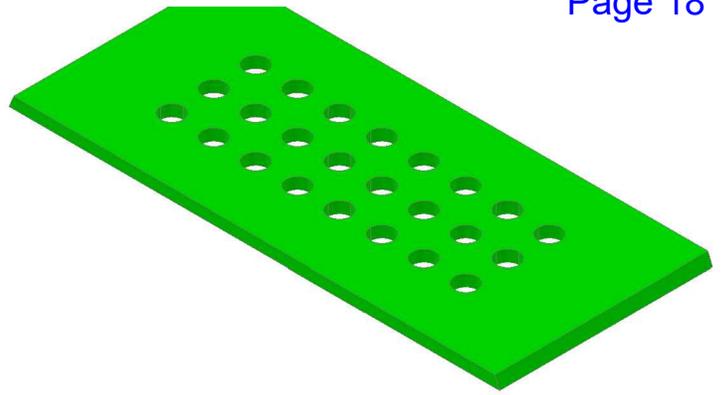
PART # 35
CASE TOP, BOTTOM LEFT



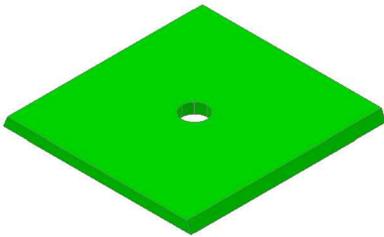
PART # 24
CASE TOP, BOTTOM RIGHT



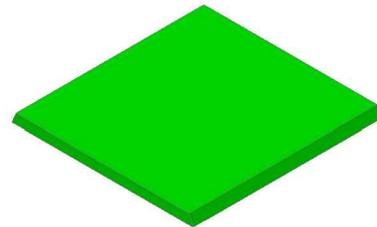
PART # 39
FRONT SIDE PANEL
ELECTRONICS BOX



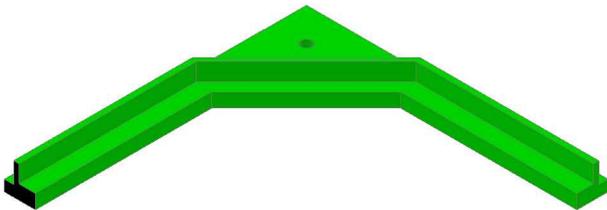
PART # 38
SIDE PANELS
ELECTRONICS BOX
3 REQUIRED



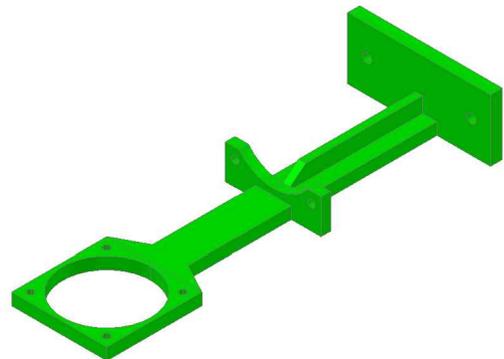
PART # 37
BOTTOM PANEL
ELECTRONICS BOX



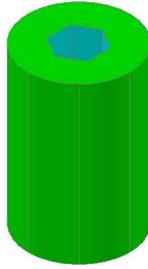
PART # 36
SIDE PANELS
ELECTRONICS BOX
3 REQUIRED



PART # 40
BOTTOM PANELS
ELECTRONICS BOX
4 REQUIRED



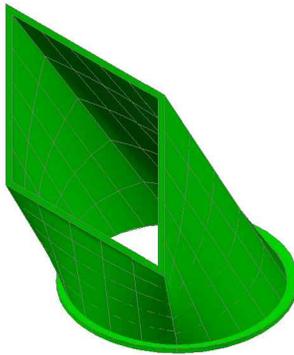
PART # 41
FAN BRACKET



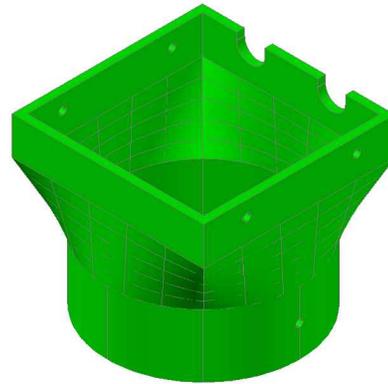
PART # 21
COUPLER
MOTOR TO AUGER



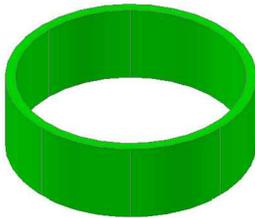
PART # 8
KNOB
VARIABLE VOLT REG



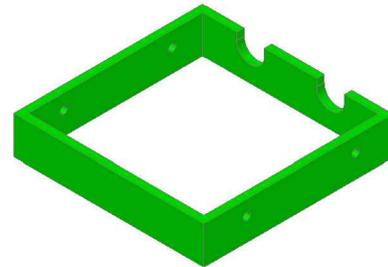
PART # 44
VERTICAL HOPPER
TRANSITION



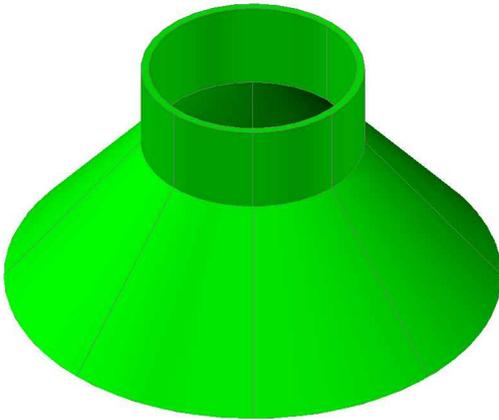
PART # 48
HOIZONTAL HOPPER
TRANSITION



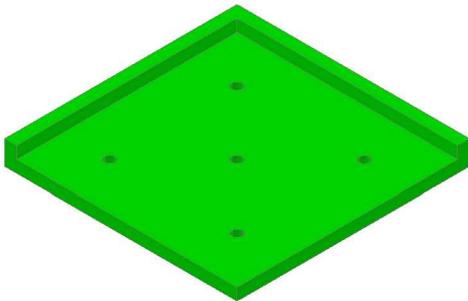
PART # 45
VERITICAL HOPPER
TRANSITION



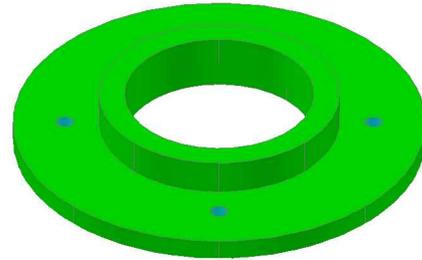
PART # 43
VERTICAL HOPPER
TRANSITION



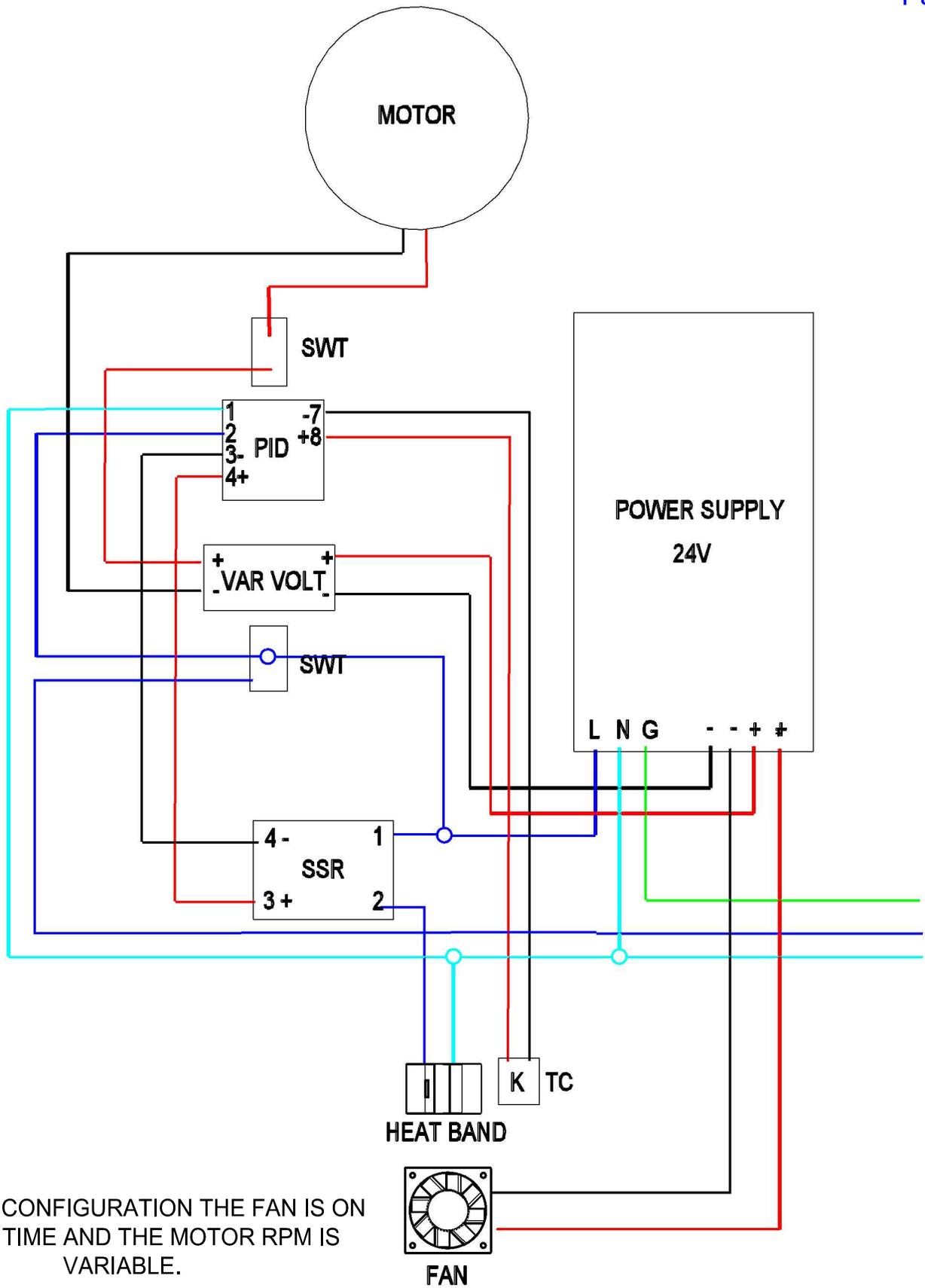
PART # 49
HOOPER FUNNEL



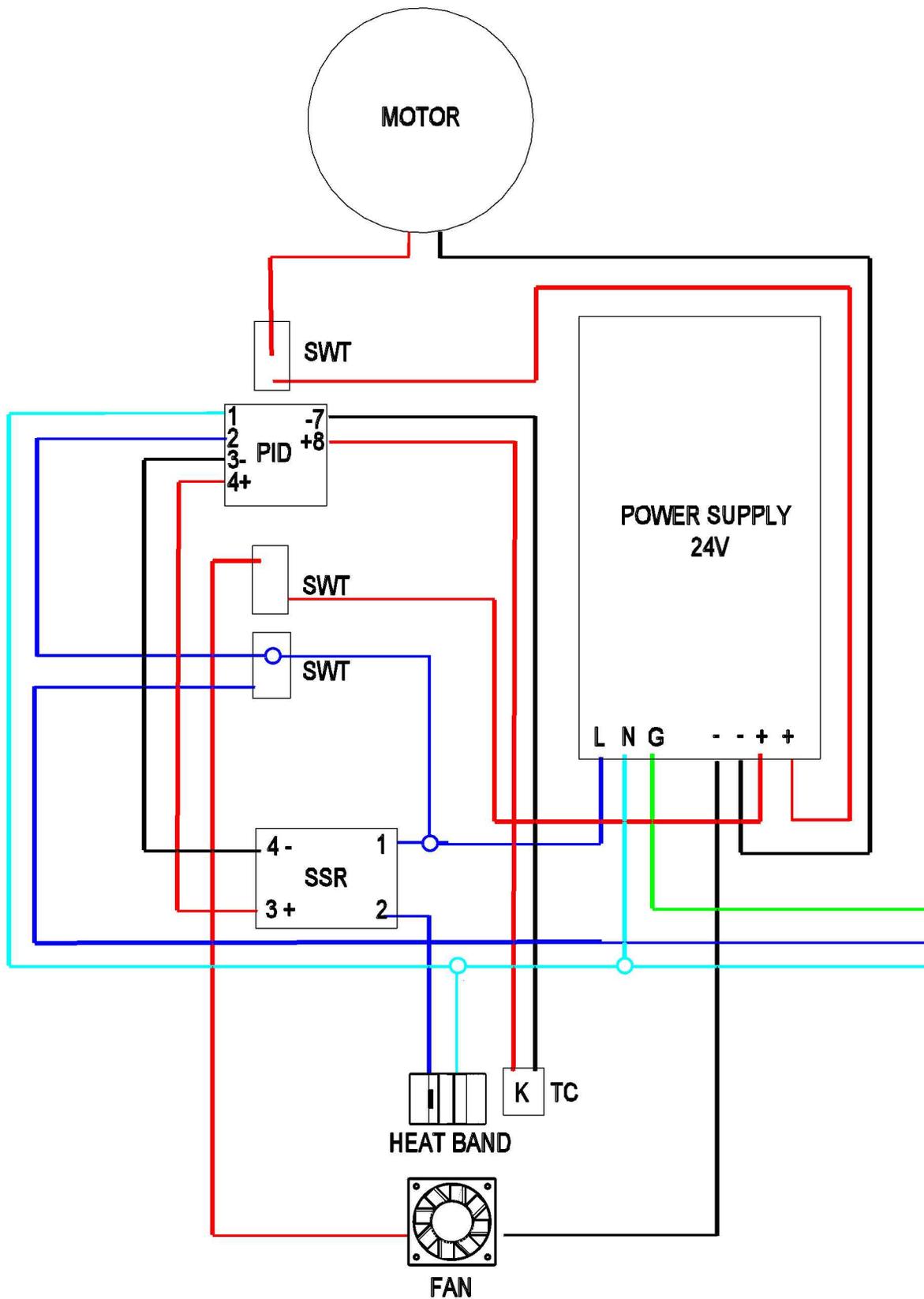
PART # 50
WOOD BLOCK TEMPLATE



PART # 51
FLANGE DRILL TEMPLATE



WITH THIS CONFIGURATION THE FAN IS ON ALL THE TIME AND THE MOTOR RPM IS VARIABLE.



WITH THIS CONFIGURATION THE MOTOR IS AT FULL SPEED OF 15 RPM AND IS NOT VARIABLE AND THE FAN IS ON OR OFF WITH THE SWITCH

BOM - LYMAN FILAMENT EXTRUDER V6									
Part #	DESCRIPTION	SIZE	UNIT	QTY	FOB UNIT PRICE	SUB TOTAL	SUPPLIER	SUPPLIER PART #	NOTES
1	Switches	120V	EA	3	\$0.50	\$1.50	Electric Goldmine	G20531B	These were on sale
2	PID		EA	1	\$25.00	\$25.00	eBay	MYPIA - TA4	
3	Voltage Regulator	24V	EA	1	\$6.95	\$6.95	MPJA		Optional
4	Solid State Relay		EA	1	\$5.00	\$5.00	eBay	FOTEK SSR-25	
5	Screws	#2 x 1/2"	EA	2	\$0.05	\$0.10	Fastenal		
6	Power Supply	24V	EA	1	\$25.00	\$25.00	eBay	LH LIHUA-249W	
7	Fan 12 or 24V	40mm	EA	1	\$1.00	\$1.00	eBay		I used 12V
8	Knob for V.V.		FT	6	0.008	\$0.05	Pellets from Glenn		Self extruded filament
9	M4 Bolts	12mm	EA	6	\$0.28	\$1.68	Fastenal		
10	Computer Power Cord	3 wire	EA	1	\$1.25	\$1.25	eBay		
11	Brass Plug	1/2" NPT	EA	1	\$2.00	\$2.00	Fastenal		hollow core
12	Heat Band	1"	EA	1	\$23.00	\$23.00	Zoro Tools		
13	Coupler black iron	1/2"	EA	1	\$2.62	\$2.62	McMaster Carr		
14	Nipple Black Iron	4 x 1/2"	EA	1	\$1.30	\$1.30	McMaster Carr		
15	M4 Nuts		EA	4	\$0.03	\$0.12	Fastenal		
16	Phenolic Washers M4	1/8" DIY	EA	4	\$0.15	\$0.60	McMaster Carr		
17	Flange black iron	1/2"	EA	1	\$2.09	\$2.09	Zoro Tools		
18	Phenolic Insulator Block	2x2x3/8"	EA	1	\$1.50	\$1.50	McMaster Carr	8710K216	Use template to size
19	Auger Bit	5/8 x 17"	EA	1	\$17.00	\$17.00	Filabot		
20	Extruder Case	filament	FT	105	0.008	\$0.84	Pellets from Glenn		Self extruded filament
21	Coupler motor to auger		FT	16	\$0.01	\$0.13	Pellets from Glenn		Self extruded filament
22	Gear Motor	15 rpm	EA	1	\$76.00	\$76.00	Phidgets	60ZY105-2430/563XJ168G	
23	Gear Motor						DONGZHENG MOTOR CO LTD		
24	M4 Washers		EA	8	\$0.03	\$0.24	Fastenal		
25	M4 Bolts	40mm	EA	4	\$0.28	\$1.12	Fastenal		
26	Washers	1/2"	EA	3	\$0.10	\$0.30	Hardware Store		
27	Thrust Bearing	1/2"	EA	1	\$2.80	\$2.80	McMaster Carr		
28	M5 Bolts	16mm	EA	4	\$0.17	\$0.68	Fastenal		
29	M5 Washers		EA	4	\$0.05	\$0.20	Fastenal		
30	Welding Blanket		EA	1	\$2.25	\$2.25	eBay		Cut from large piece
31	Thermocoupler	Type K	EA	1	\$1.00	\$1.00	eBay		
32	Case top right top		FT	22	0.008	\$0.18	Pellets from Glenn		Self extruded filament
33	Case top left top		FT	22	0.008	\$0.18	Pellets from Glenn		Self extruded filament
34	Case top right bottom		FT	22	0.008	\$0.18	Pellets from Glenn		Self extruded filament
35	Case top left bottom		FT	22	0.008	\$0.18	Pellets from Glenn		Self extruded filament
36	Case side small		FT	24	0.008	\$0.19	Pellets from Glenn		Self extruded filament
37	Case side with hole small		FT	8	0.008	\$0.06	Pellets from Glenn		Self extruded filament
38	Case side large		FT	56	0.008	\$0.45	Pellets from Glenn		Self extruded filament
39	Case side with brkt hole		FT	17	0.008	\$0.14	Pellets from Glenn		Self extruded filament
40	Case bottoms		FT	36	0.008	\$0.29	Pellets from Glenn		Self extruded filament
41	Fan Bracket		FT	10	0.008	\$0.08	Pellets from Glenn		Self extruded filament
42	Brass Plastic Heat Inserts	3mm	EA	4	\$0.13	\$0.52	McMaster Carr		
43	Vertical hopper A		FT	9	0.008	\$0.07	Pellets from Glenn		Self extruded filament
44	Vertical hopper B		FT	31	0.008	\$0.25	Pellets from Glenn		Self extruded filament
45	Vertical hopper C		FT	9	0.008	\$0.07	Pellets from Glenn		Self extruded filament
46	Shipping tube	3" ID x 12"	EA	1	1.120	\$1.12	ULINE		
47	Screws	#2 x 3/4"	EA	8	\$0.05	\$0.40	Fastenal		
48	Horizontal hopper transition		FT	24	0.008	\$0.19	Pellets from Glenn		Self extruded filament
49	Hopper Funnel		FT	32	0.008	\$0.26	Pellets from Glenn		Self extruded filament
50	Template for Wood Block		FT	4	0.008	\$0.03	Pellets from Glenn		Self extruded filament
51	Template for Flange		FT	4	0.008	\$0.03	Pellets from Glenn		Self extruded filament
52	5/8" ID Bronze Bushing		EA	1	0.990	\$0.99	McMaster Carr	2938T18	
	ABS Solvent Cement		OZ	2	\$1.50	\$3.00	eBay	2354	SCIGRIP
	Electrigan Tape		IN	12	\$0.01	\$0.12	Hardware Store		
	Kapton Tape	1/2"	FT	3	\$0.04	\$0.12	eBay		
	TTT (this,that, the other)		LOT	1	\$5.00	\$5.00			
	Wire	22 ga	FT	6	\$0.10	\$0.60	eBay		
	Wire Connectors		EA	10	\$0.10	\$1.00	Hardware Store		
	SUB TOTAL COST					\$219.00			
	ESTIMATED FRT IN		@	10%		\$21.90			Many items on eBay include Free Shipping
	TOTAL COST					\$240.90			

