

Draft of Operation Manual and Assembly Manual
3D Printer Recycler
(Filament Recycler)

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ME476C-001

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Introduction:

Many of the big companies start to depend heavily on 3D printers to make their products. Our project is about making our planet cleaner by recycling the plastic waste and turn it into a 3D printer filament. The recycling process consists of two main steps, plastic shredding, and plastic extrusion. This operation manual will guide you through the steps of using the plastic shredding and extrusion devices that are used in the project.

Assembly with Drawing Manual of the plastic:

Polylactic plastic is one of the important elements of the 3D printer recycler. In this project, the dimensions of the polylactic plastic should be suitable to fit into our shredder. The length of the plastic has no effect on the shredder, but the width should not exceed 6" which is the width of the shredder. A sample of a plastic piece that has been used in our project can be shown in figure 1.

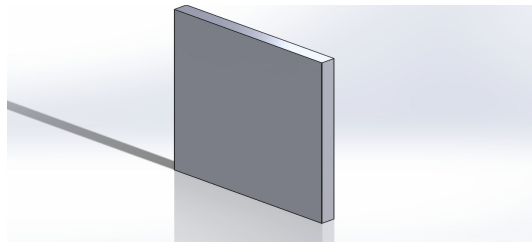


Figure 1: Polylactic Plastic in Solidwork

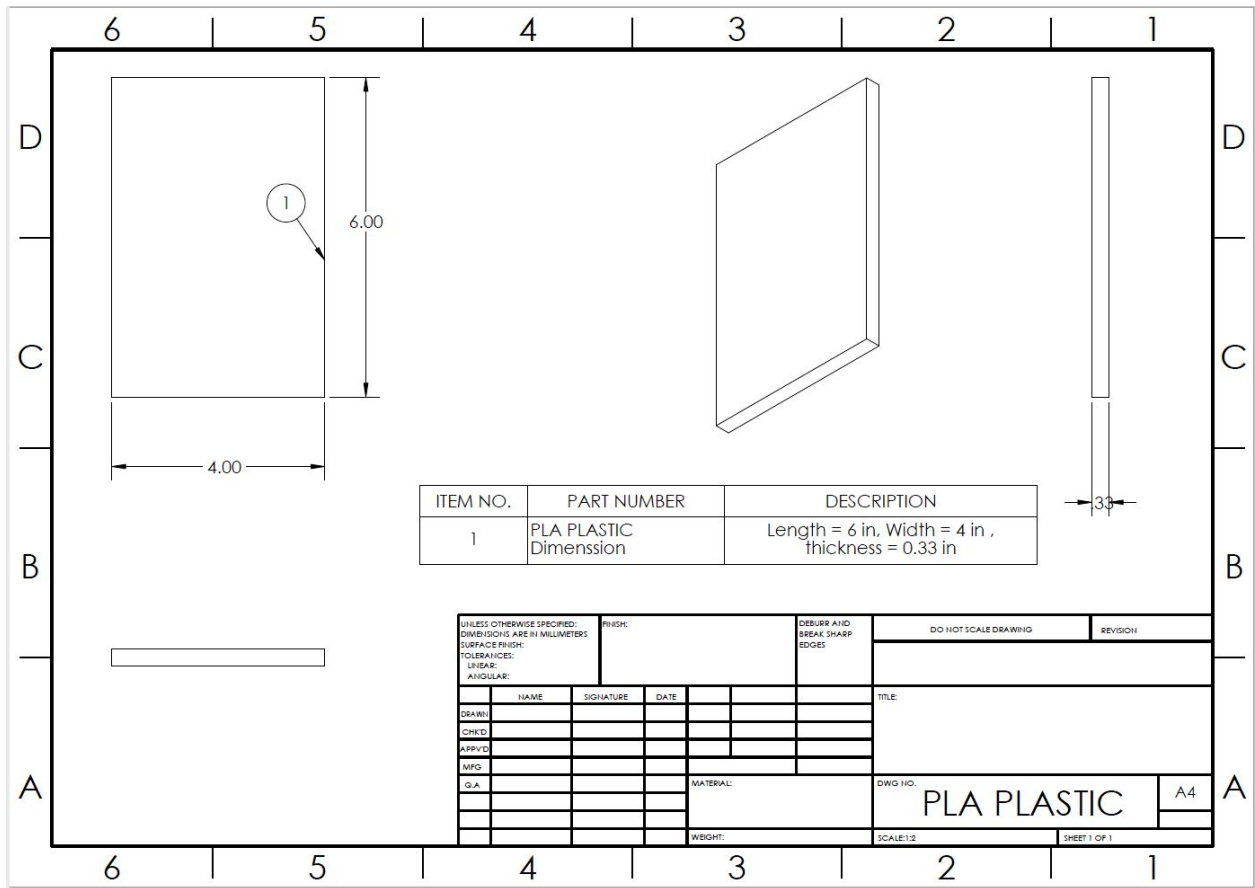


Figure 2: Appendix of polylactic plastic drawing

Figure 2 shows the shape of the polylactic plastic. Also, there is a table inside the drawing that illustrates dimensions of the Polylactic plastic in inches.

Assembly of the extruder components:

The extruder components are the ones responsible for heating the plastic pipe and push it through a nozzle hole with the required diameter. All of the components are off the shelf and none of them needed to be custom made.

The components consist of:

- 1.5 hp single phase Ac motor. (Number 1 in figure 5).
- Auger bit with diameter of $\frac{3}{4}$ ". (number 4 in figure 5).
- PID controller. (number 3 in figure 5).
- Thermocouple.
- One band heater.
- One solid-state relay.
- A Variable Frequency Drive. (number 2 in figure 5).

Assembly of the Variable Frequency drive:

The Variable frequency drive is connected between the power supply and the AC motor. The Variable frequency drive's input from the power supply is 120V at 60 Hz and outputs to the motor 220V at 1-400 Hz. The Variable frequency drive is connected to the High Voltage connection on the AC induction motor. The Variable frequency drive must be connected first to the power supply and checked that it is not running before hitting the run button. After checking that the wires are connected properly, the user may hit the run button on the Variable frequency drive and start increasing the frequency gradually. By increasing the frequency, the speed at which the motor runs must increase as well. Figure 8 illustrates in detail the pin-in and pin-out connections to the Variable Frequency Drive between the power supply and the AC Induction motor.

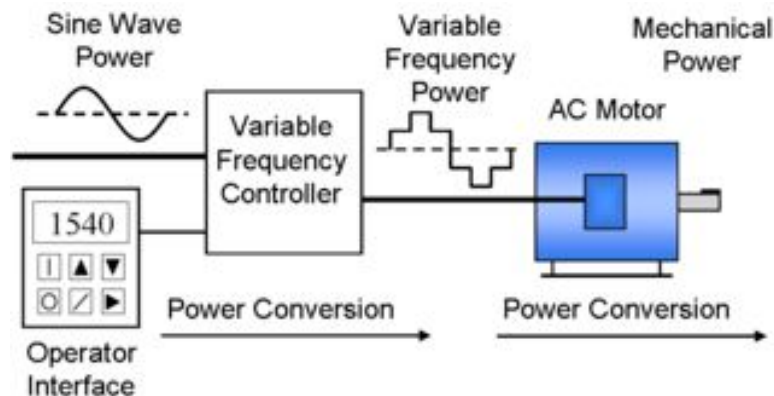


Figure 3. Connections between the power supply and AC Induction motor

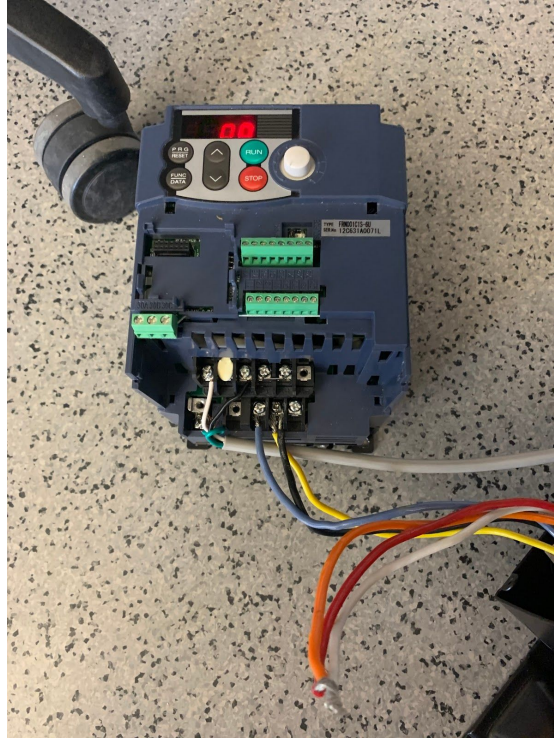


Figure 4. The wire connections to and from the Variable Frequency Drive

Operation instruction of the extrusion device:

These parts are used in the extrusion process to turn the shaft housing into a furnace where the plastic gets melted. Each one of those parts is essential in the heating process. We will need two 120V power sockets to plug in both the PID controller and the Variable Frequency Drive. The PID controller supplies the heat to the band heater and enables us to control the temperature of the band heating. The Solid-State Relay is going to be the switch that supplies the power and cuts it depending on the temperature set on the PID Controller. The Variable Frequency Drive will enable us to lower the speed at which the motor of the extruder operates at. The parts are connected as shown in figure 5 below. Switch the PID controller on and use the upper and lower arrow buttons to adjust the green reading of the temperature on the PID display screen then press set. Wait until the big red reading on the PID display screen reaches your desired temperature. Switch the VFD on and start increase the frequency until the extruder shaft

start rotating. Pour plastic into the pipe hole until it starts to come out of the nozzle hole.

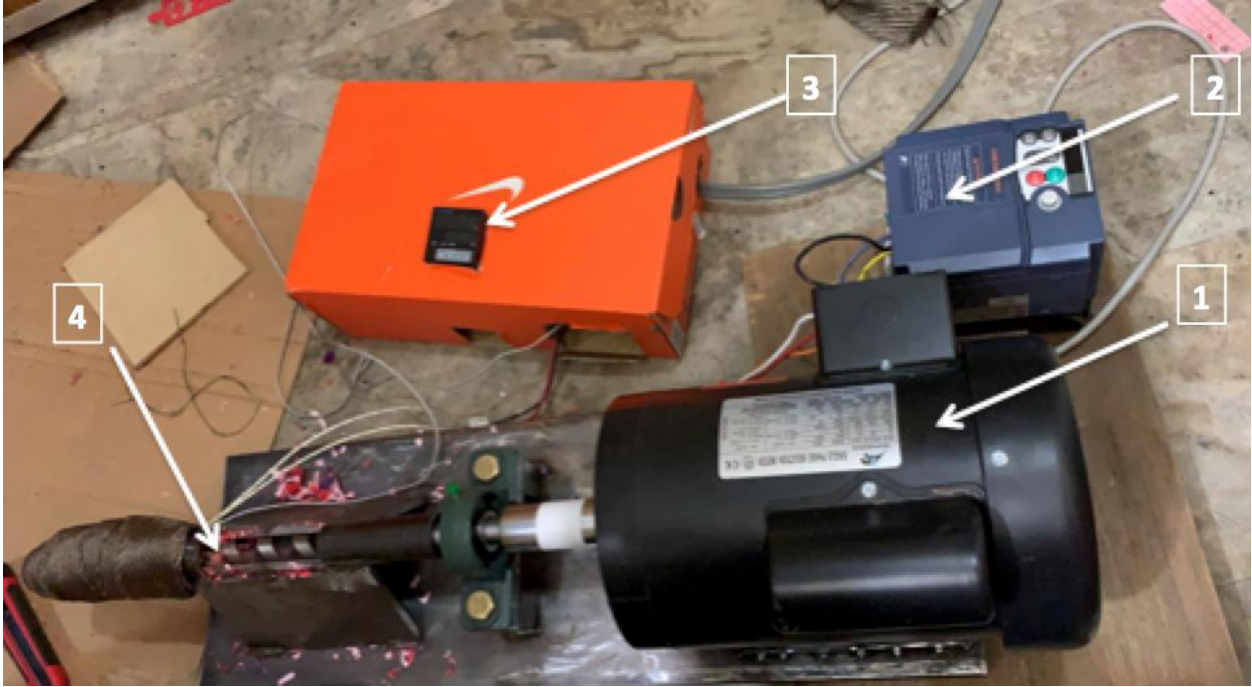


Figure 5. Extrusion components

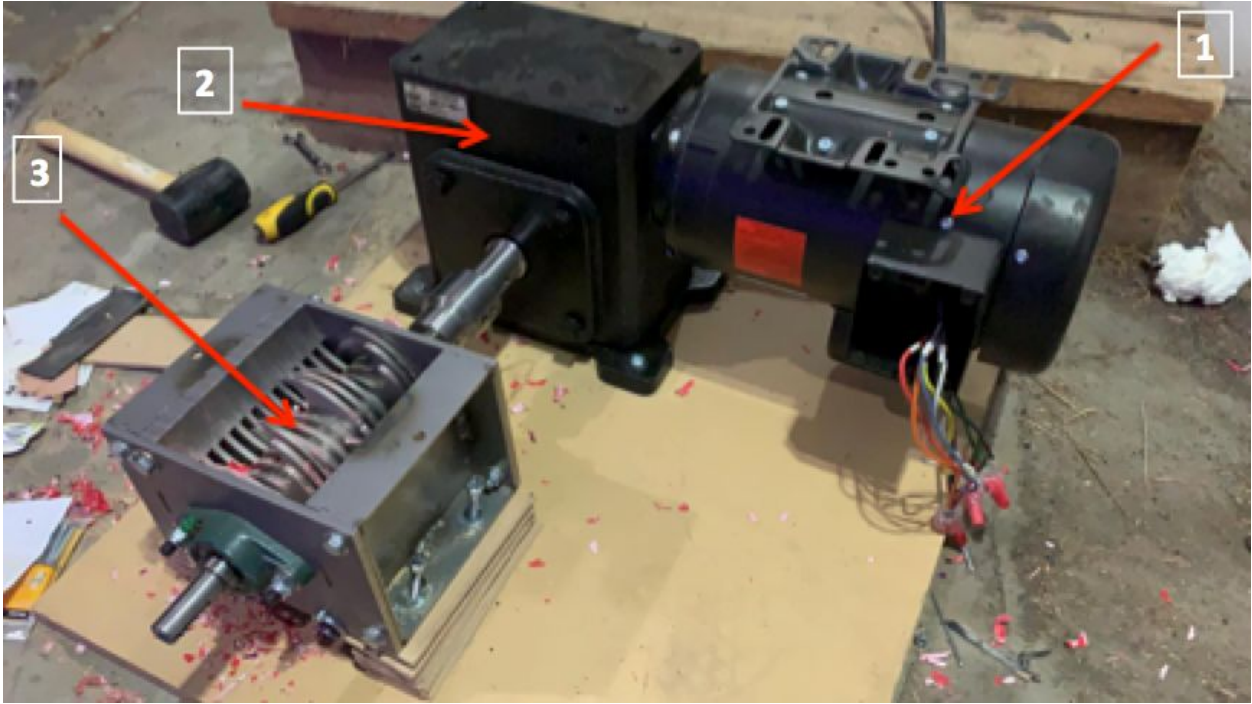


Figure 6. Shredding components

Assembly of shredding device:

The shredding device consists of three main components:

1. Motor:

A 2 hp single phase AC Motor. It has a $\frac{5}{8}$ " output shaft and a 56c face with 4 bolts holes. The motor can be connected to either a high voltage of 115~230 volts which gives a speed of 1725 rpm, or a low voltage of 110~220 volts which gives a speed of 1425 rpm. In our device, the motor is connected to a low voltage.

2. Worm gearbox:

A left-hand output shaft Worm gearbox. It has a speed reduction ratio of 30:1. It has an input shaft of $\frac{5}{8}$ " diameter and an output shaft of 1.375" diameter. The gearbox has a 56c face with four bolts holes.

3. Shredder:

A single shaft shredder with 13 rotational blades and 13 stationary blades. It has a mesh with a circular hole of 0.25" diameter fixed underneath the blades. The shaft diameter is $\frac{3}{4}$ " and a pillow bearing of the same bore diameter is attached to the shaft from both sides which makes it possible to mount the shredder to a motor from any side of the shaft.

Operation instruction of the shredding device:

The operation of the shredding device is quite simple. To mount the gearbox to the motor all you need is four $\frac{3}{8}$ " Hex screws. Make sure the motor shaft key fit smoothly inside the gearbox keyway. The out shaft of the gearbox is connected to the shredder shaft using a coupler. Make sure to cover the shredder device with a hopper to protect yourself from the plastic debris. Plug in the motor to 110 volts socket and make sure that the shredder blades are rotating smoothly. Place a bucket or a small box underneath the shredder in order to collect the shredded plastic. Carefully, put place in the shredder and wait until it gets shredded properly. Make sure to turn the motor off before you pull the shredder plastic box out.