

SOUTHERN POLYTECHNIC STATE UNIVERSITY

# 3D Printing Guide: MakerBot Replicator 2X

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Operating and Troubleshooting Guide

Architecture Department

8/13/2014



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**Revision Table**

<b>Version</b>	<b>Dated</b>	<b>Description</b>	<b>By</b>
1.00	06/25/2014	Original DRAFT	Kris Peterson
1.1	08-13-14	Added photos for clarity	Kris Peterson

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FOR OTHER ISSUES GO TO:	
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## Overview

### Process

You must first create your 3D file using your preferred software. The software must be able to export either \*.OBJ, \*.STL, or THING format.

Your object must be in MM (metric) and cannot exceed 24.6cm by 15.2cm by 15.5cm

You will need to download and run the MakerWare software from the MakerBot link below.

<http://www.makerbot.com/makerware>

### Material

Two types of filament: ABS

PLA (tends to warp less)

You will need to provide your own filament. See MakerBot's website for detailed specifications (link below).

<https://store.makerbot.com/filament>

You can use filament from other sources just make sure that the diameter is correct. You may also get different results based on other manufacturer's materials density, melt temperature, quality and other factors.

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## Machine operation

### Preparing your 3D file

#### File Preparation Overview

To start, you should create your object file using your preferred software and then export it as an OBJ, STL, or THING format to an SD card. You will then use MakerWare software to create a file that can be run on the MakerBot printer.

#### Download of MakerWare

You MUST download the latest version of MakerWare from

<http://www.makerbot.com/makerware> (**Note:** MakerWare digitizer software download is not needed, this is scanner software). Follow installation instructions.

MakerWare can open the following file formats:

**.STL, .OBJ, or THING** (model file needs to be defined in **MILLIMETERS!**)

MakerWare can save files in the following formats:

**STL** and **THING** (a **THING** file saves the 3D object and its location on the build plate)

MakerWare can export to formats **X3G, GCODE, S3G** (**X3G** is the most common for MakerBot)

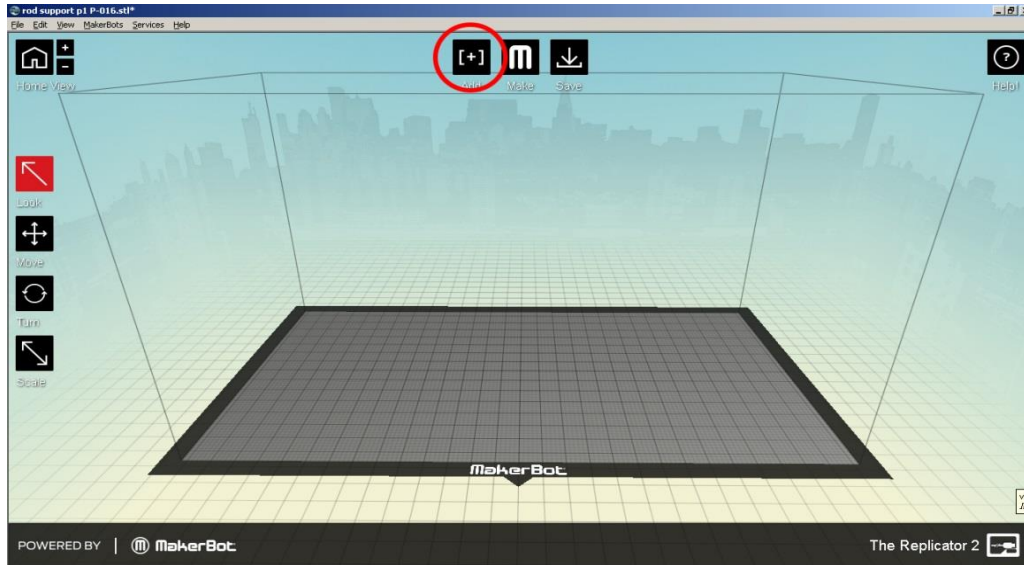
**CRITICAL NOTE:** MakerBot and MakerWare expects data files to be in **mm**, check your files (especially STL) for unit conversion from inches to mm

## File Preparation Steps

Open MakerWare

Click 'ADD' to open your file

**Note:** sometimes a pop-up window will ask you to place the model on the platform; select yes to place on platform.



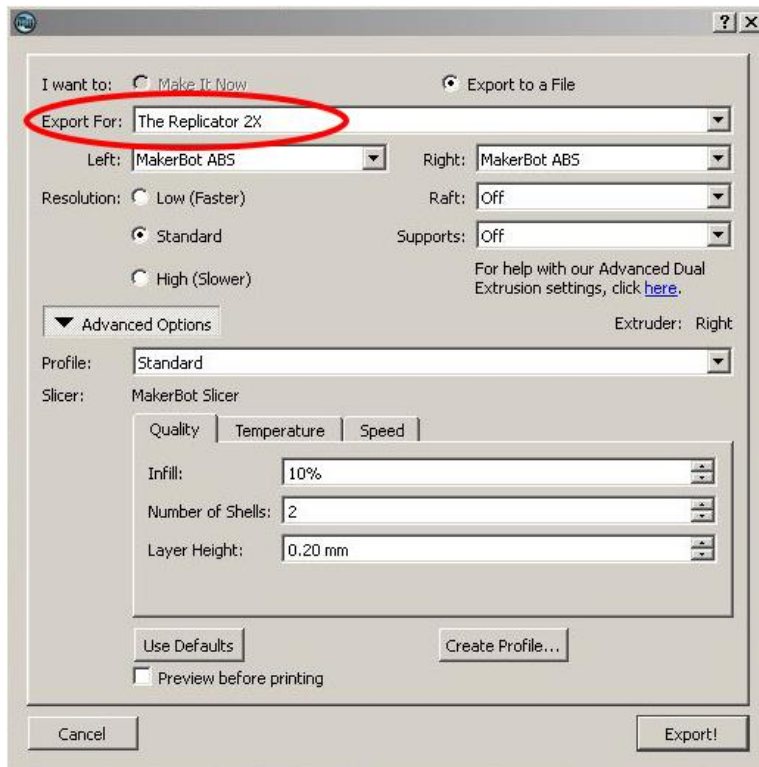
## Creating your Build File

MakerBot requires X3G files to run

To Export to **X3G** file go to 'file' and 'export'

A setting window will pop up to allow changes in **quality, speed, temperature, fill percentage, rafts, etc.** More information on these job attributes is in following sections.

Make sure you are exporting to: **'Replicator 2X'**

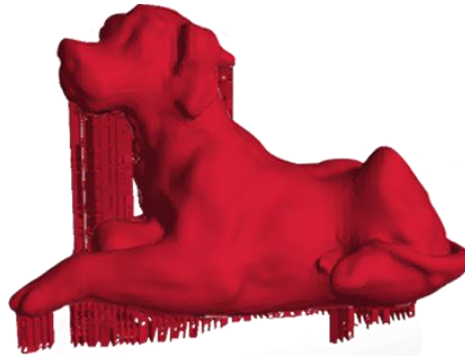




## Rafts and Supports



Raft



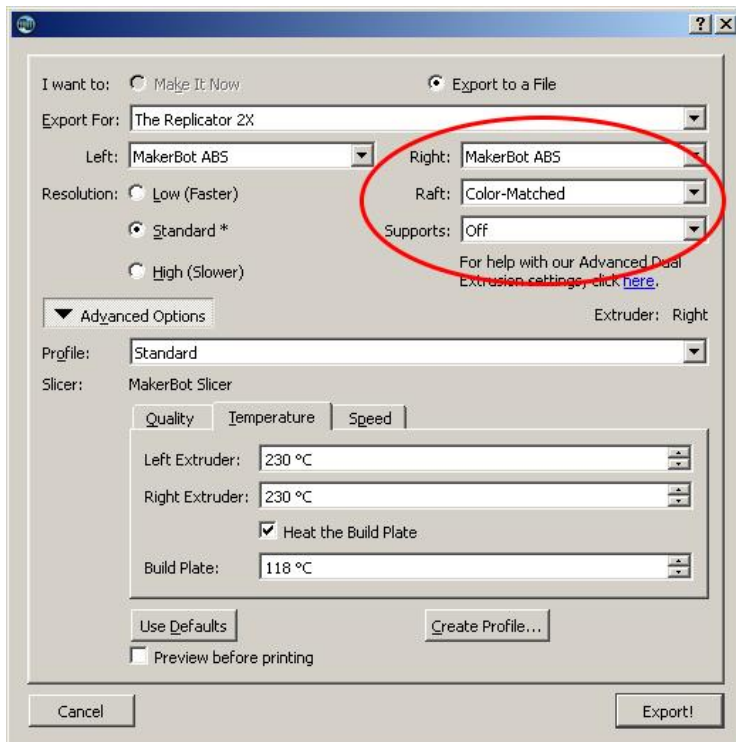
Supports

If there is little surface area between the build plate and model, a raft can be added. A raft is a printed base that can be easily removed from the model.

To add a Raft, select the drop down button and select either “color-matched, left extruder, or right extruder”. If you don’t want the raft to be printed with the same color select right or left extruder depending on how the filament is loaded in the printer.

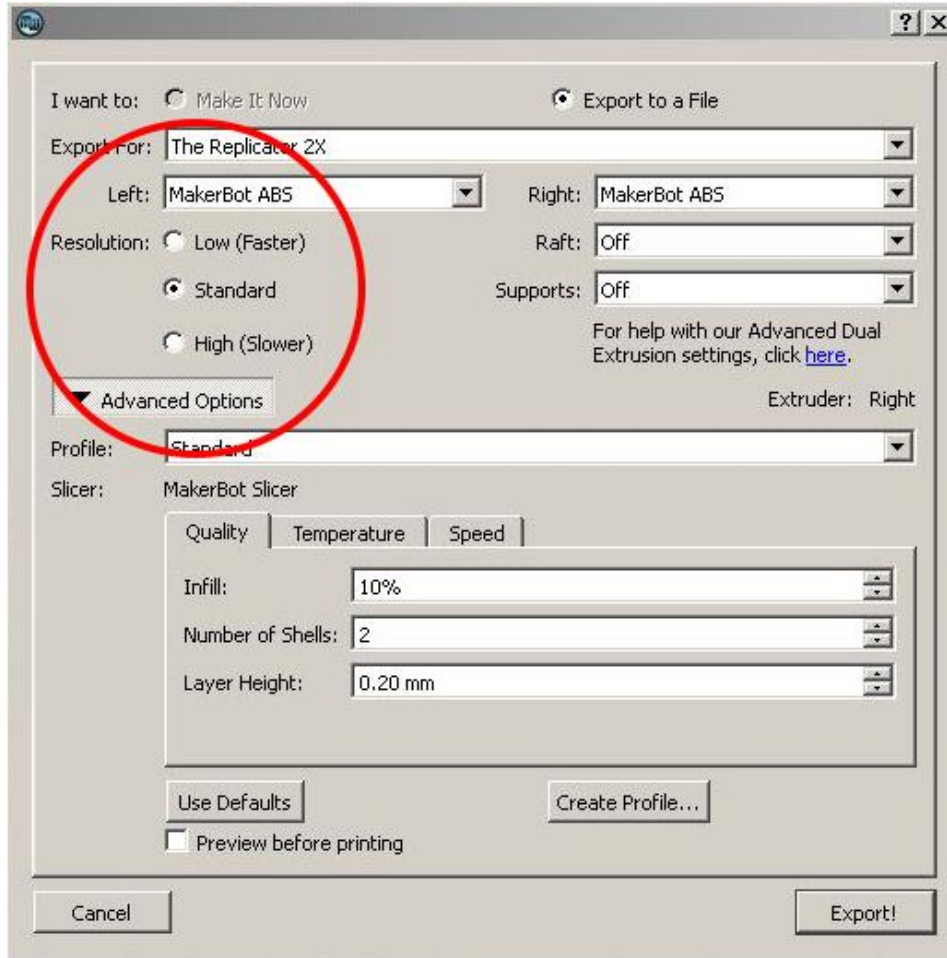
Supports are support material built around (under) areas of the model that cantilevers

To add a support, select the drop down and select “On”

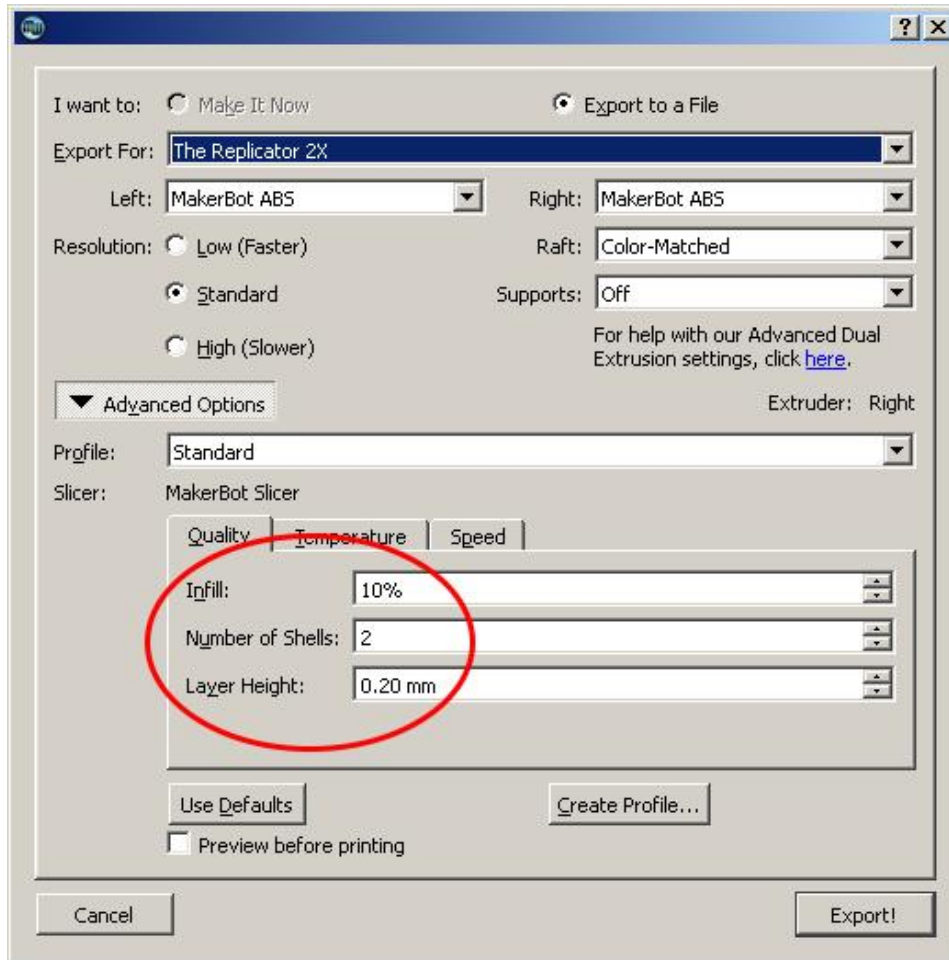


## Resolution

You can change the quality of the finished part by changing the “resolution” setting <low, standard, high>. Note that raising the resolution significantly increases the time required to make your object.



## Advanced options - Quality



\*The infill is how solid the void spaces inside the model get filled [10% is standard for a hexagon pattern]. A higher percentage will result in a more solid object, so 100% infill will make your object completely solid, while 0% infill will give you something completely hollow. You should avoid solid infill as the object will not cool properly and will be subject to distortion.

\*The number of shells is the number of layers the extruder adds plastic to the perimeter of a print. [Two shells are standard. More shells result in a stronger object but may introduce distortion.]

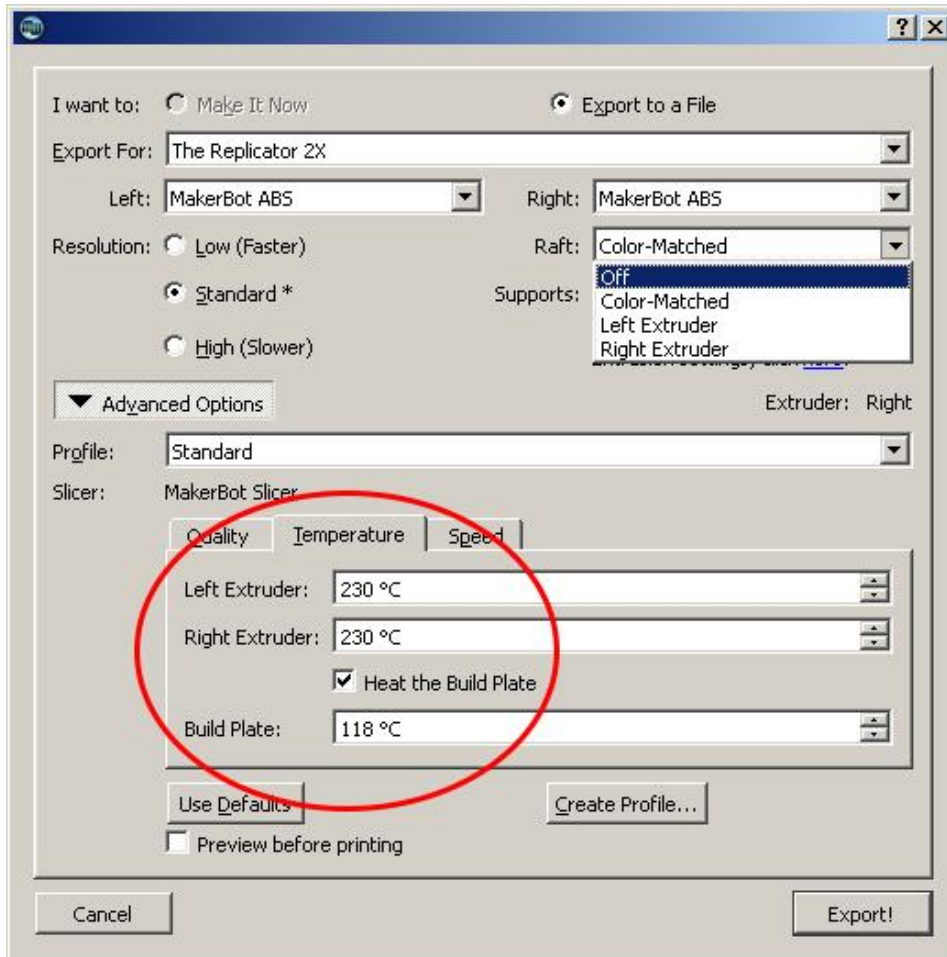
\*Layer height is how thick each layer of filament gets added to the model <0.20 is standard layer height \_ the smaller the layer height the better the quality>

## Advanced options - Temperature Settings

\*THE RECCOMENDED build plate **TEMPERATURE** is **115-120 degrees**

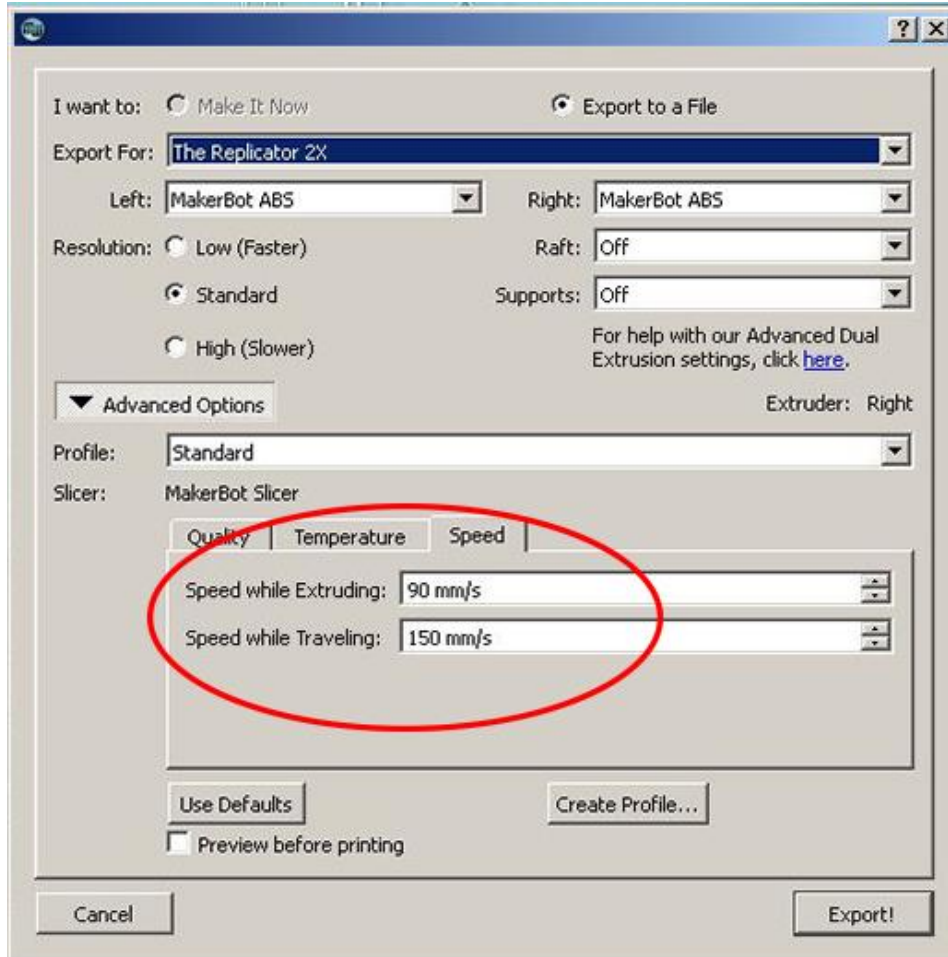
\*Note: You might want to lower the extruder temperature by ten degrees if you're printing very slowly, or raise the heated build plate temperature by five degrees to improve adhesion.

DO NOT INCREASE THE TEMPERATURE OF THE EXTRUDERS



## Advanced options - Speed Settings

The speed tab covers two settings. **Speed while Extruding** is both the speed at which your extruder moves while it's extruding plastic and the speed at which plastic is coming out of the extruder. This speed needs to be slow enough for the layer being extruded to bond with the layer underneath it. The extruder can move faster when it's not extruding plastic, so we have a separate setting for that: **Speed while Traveling**.



## Export

You can save your files to an SD card for directly inserting in the Makerbot or you can save them to your hard drive. Saving to your hard drive will require that you connect your computer directly to the MakerBot using a USB cable. MakerBot do not read USB thumb drives.

When you have completed the settings select **'Export!'**.

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## Power up the MakerBot to print your object

Turn on the Power

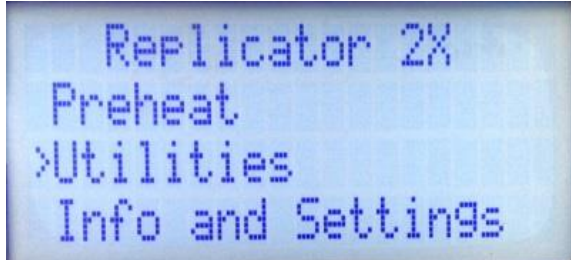


Power button is located on the back side of the machine on the right.

Unless you are continuing a print job, you will need to change the filament.



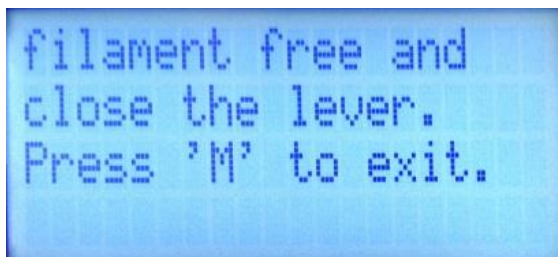
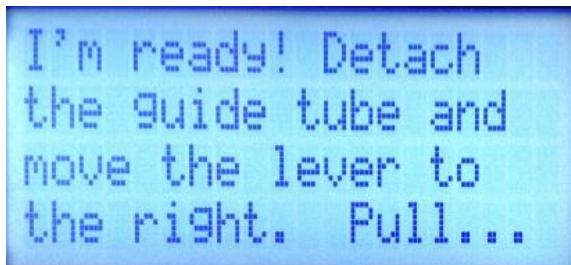
## Changing Filament



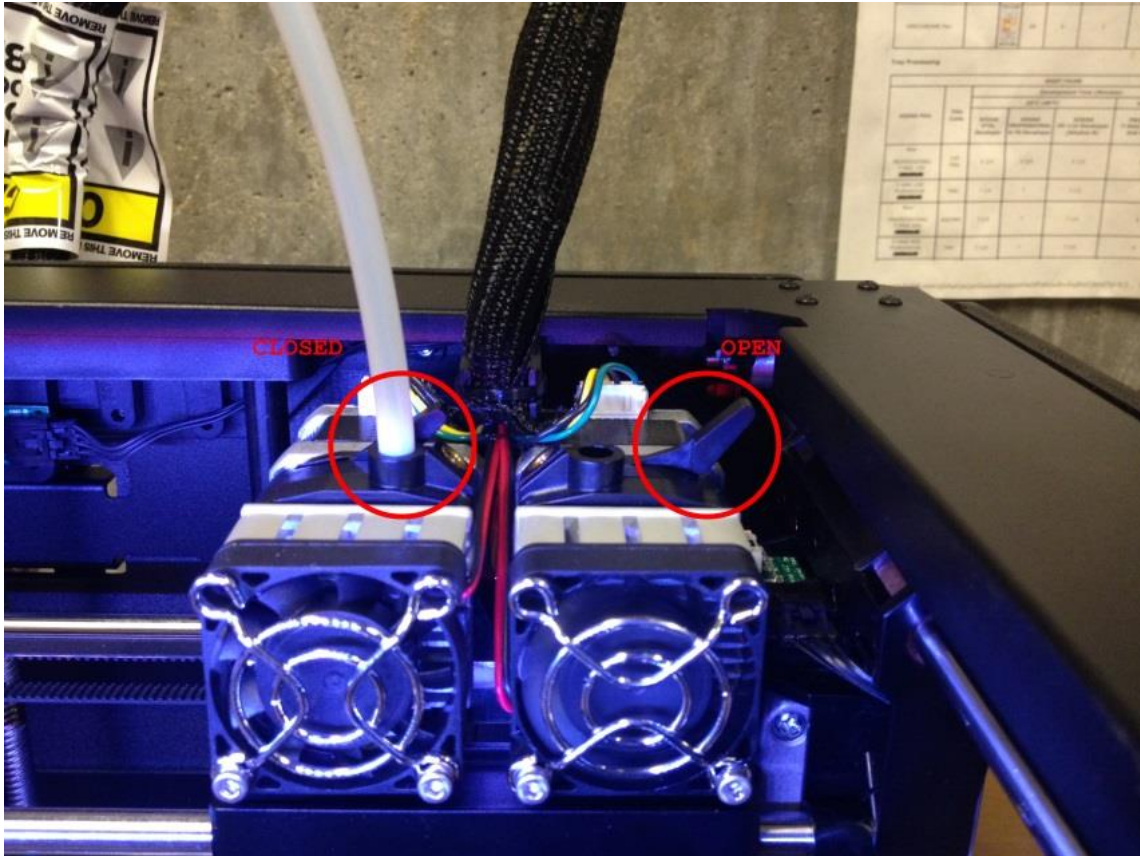
From the home screen, go to “Utilities”.

Select “Change Filament”. Select unload right or left.

The extruder will proceed to heat up and will inform you when it is ready.



Flip the black lever on the top of the extruder to the open position (**Note:** the open position is always switched to the outer edges of the extruder and the closed position is switched to the center of the extruder.)



Remove the guide tube.

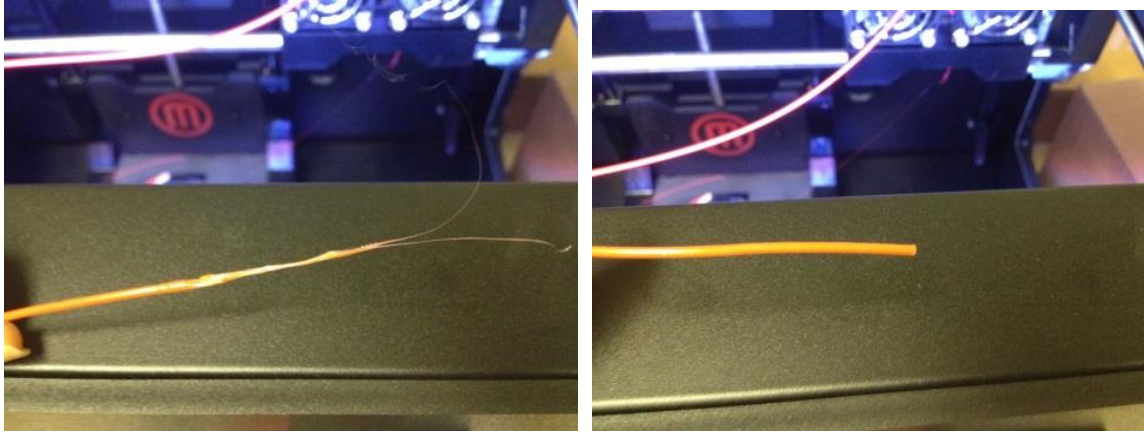
Pull out the filament. Press 'M' to Exit.

Remove spool by squeezing the spool holder.



## Loading the Filament

Neatly trim the end of filament

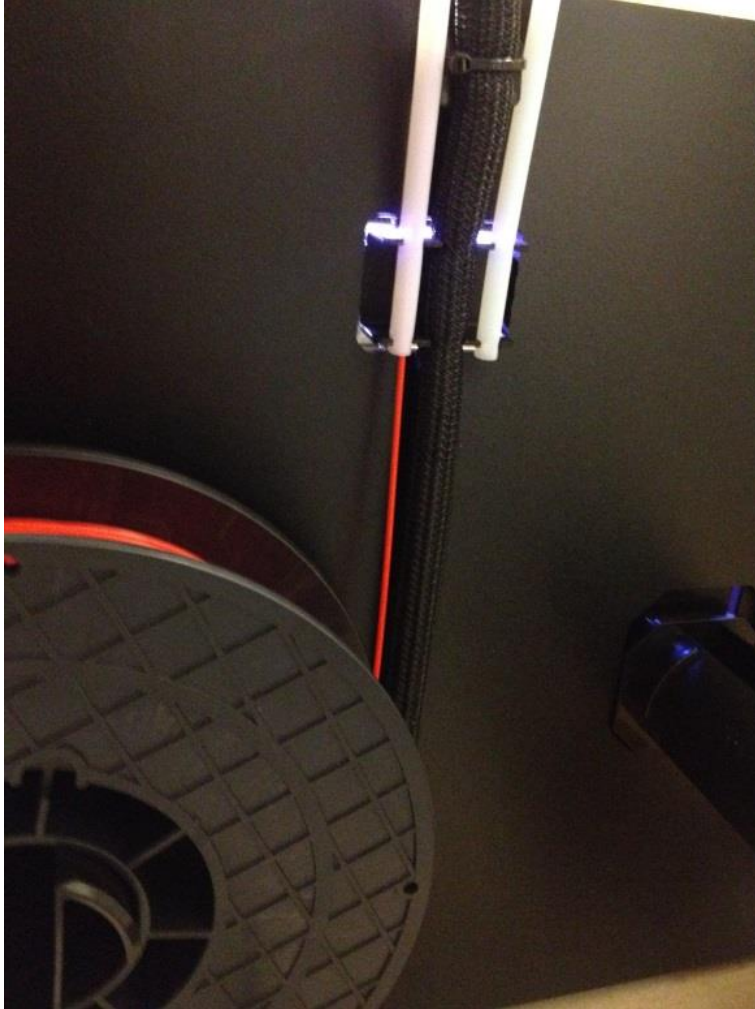


WRONG!

PERFECT!

Place your spool on the spool holder in the back.

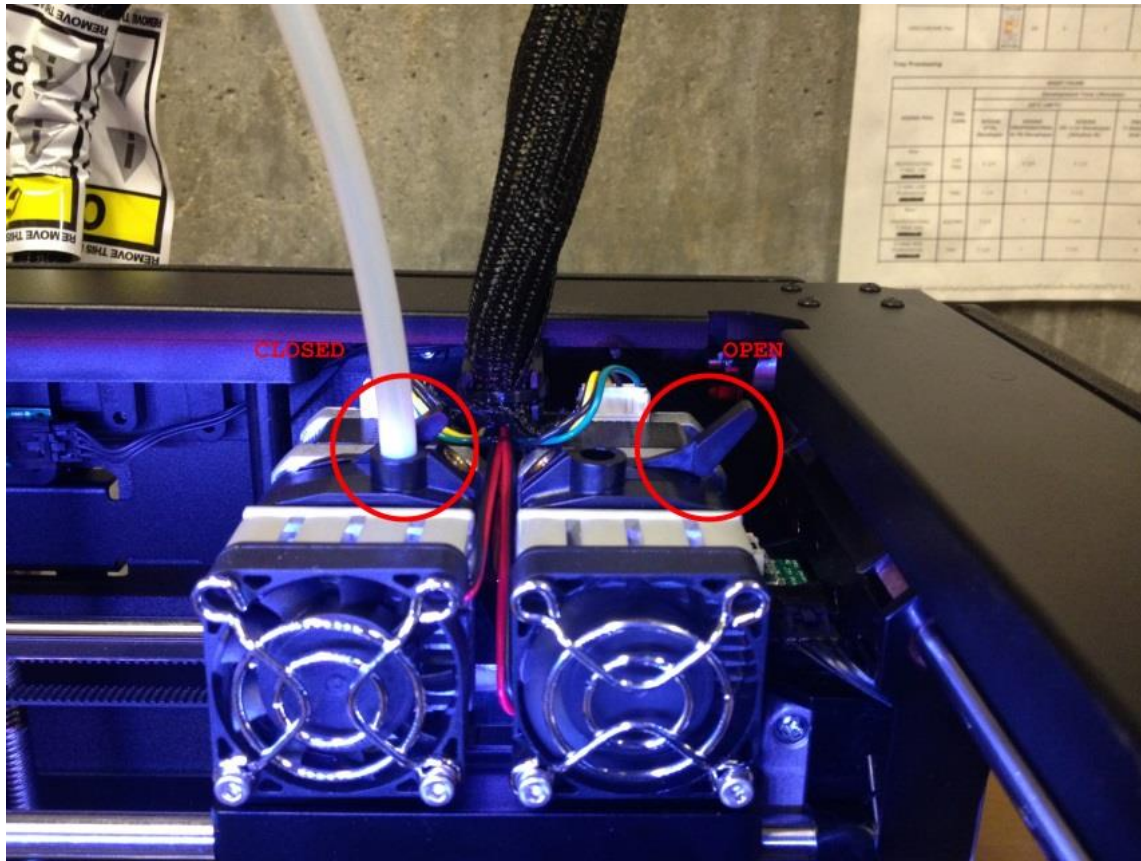
\*\*Make sure the filament is feeding from the bottom of the spool up into the feed tube, so that the right spool is pulled in a counter-clockwise motion and the left spool is pulled in a clockwise motion.



While keeping the filament tight on the spool, push the filament through the guide tube until it comes out on the other end.

Go back to the change filament screen and select 'LOAD' right or left.

Flip the black lever on the extruder to the closed position



Push the filament through the extruder hole, a motor will begin to pull on the filament.

Release and after a few seconds the filament will begin feeding through the extruder.

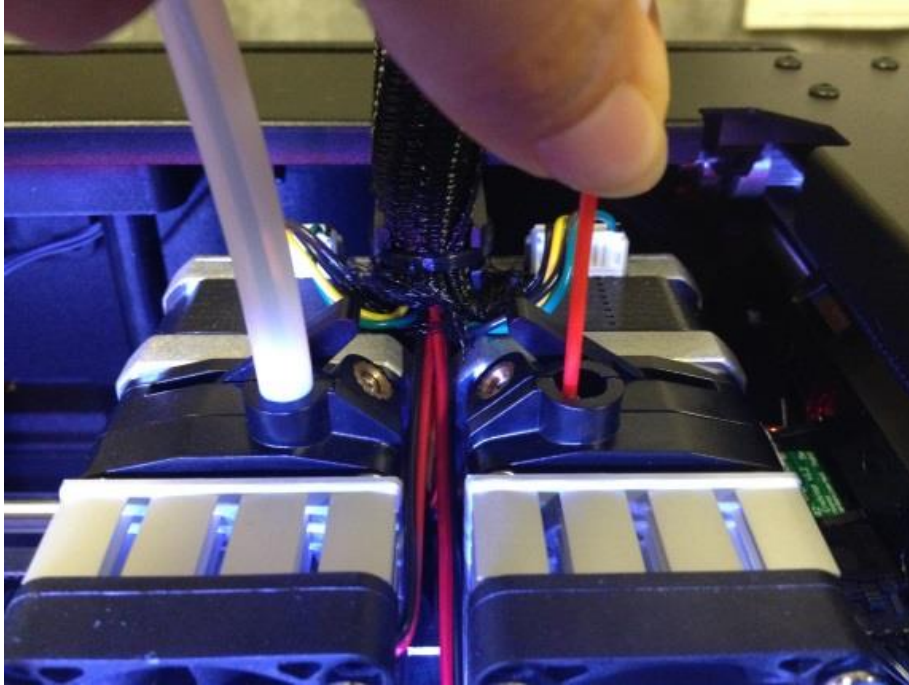
Press 'M' to exit.

I'm ready! Pull the  
guide tube off and  
push the filament  
through...

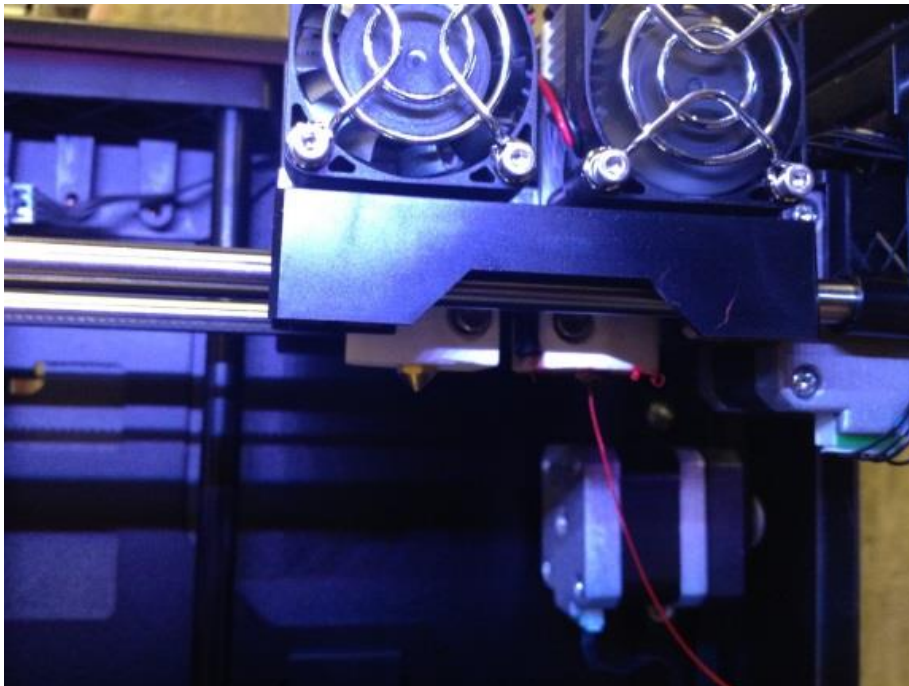
until you feel the  
motor tug it in.  
Push for a few more  
seconds, then wait.

When filament is  
being extruded from  
the nozzle,  
Press 'M' to exit.



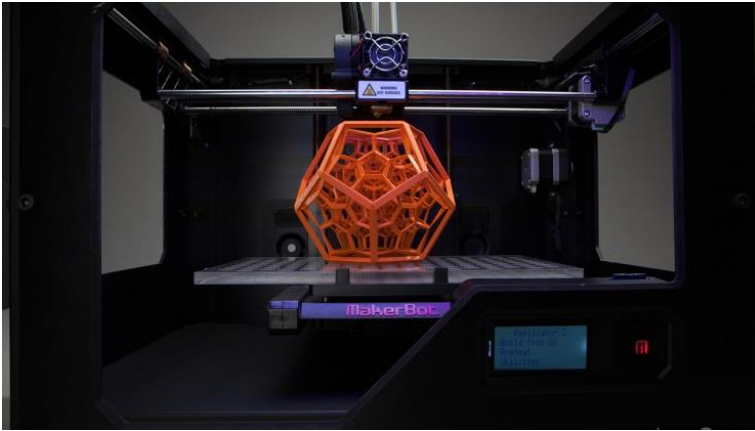


\*Push the filament until the motor pulls the filament into the extruder



\*When you see filament come out of extruder press M

## TIME TO PRINT!

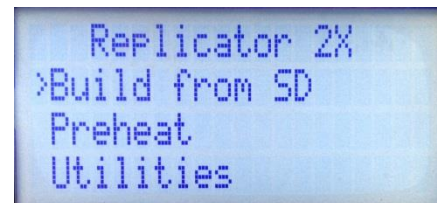


### Printing from an SD card

Put the SD card in the front right slot just behind the door



On the MakerBot, go to main page and select 'Build from SD'



Scroll thru the project list until you find your project. Press 'M' to select and print.

When printing is completed, use the white rubber "scraper" to remove the object from the platform.

## Printing from your computer

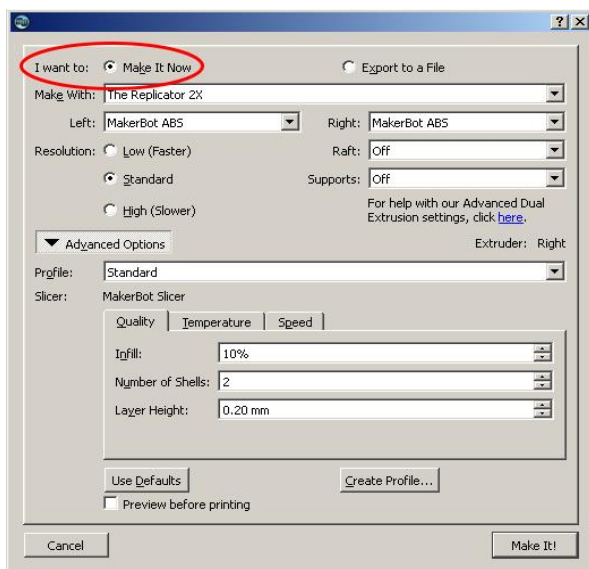
Connect computer to cable to computer USB port and print directly from MakerWare



Once your computer is connected to the MakerBot, in the MakerWare software, go to 'File' and select 'Export' or 'Make Now' (both bring up the same window).

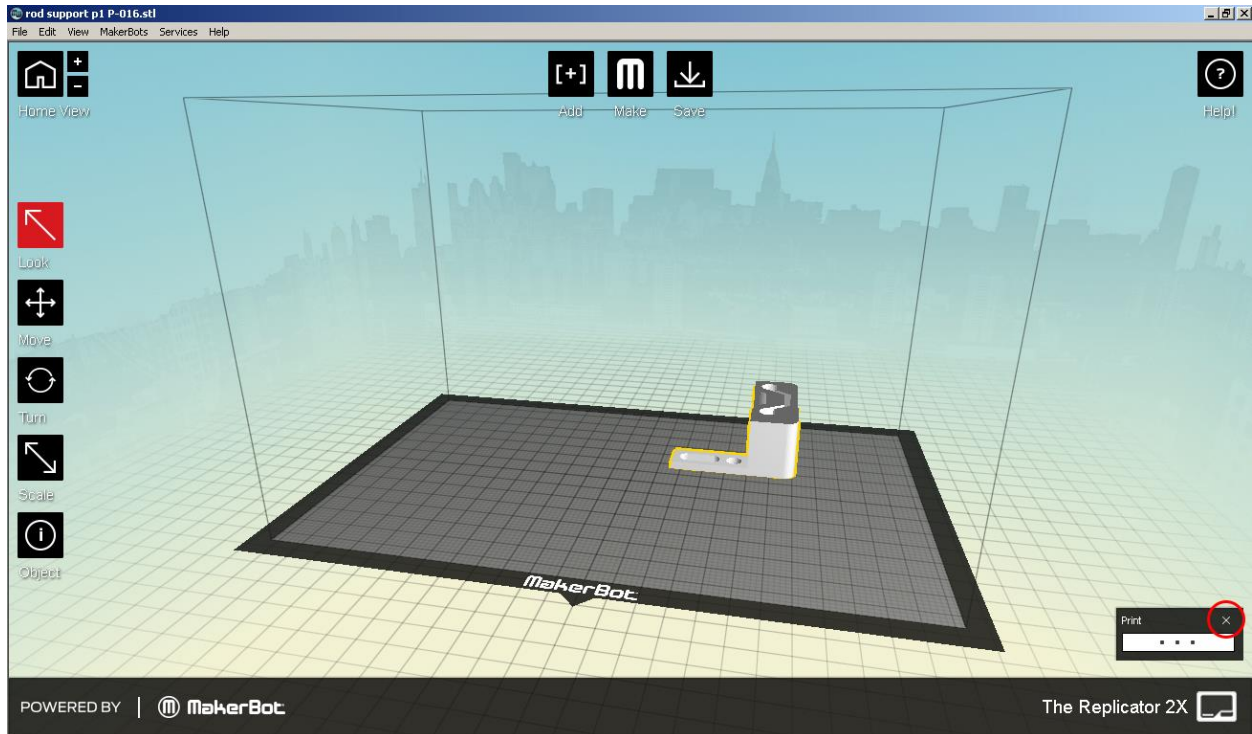
Select 'Make it Now'.

Change your build settings as desired, according to section 'Creating your build file', and Select 'Make It!'



DO NOT DISCONNECT YOUR COMPUTER OR CLOSE OUT OF MakerWare until printing is completed!

To cancel print select the 'X' in the small printing window in the bottom right corner



When printing is completed, use the white rubber “scraper” to remove the object from the platform.

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## DOs and DON'Ts

**Don't** use sharp tools to remove objects from the build plate – using a knife or a razor blade to remove prints is just as likely to hurt you as well as damage the build plate film

**Don't** turn your MakerBot Replicator 2X off immediately after finishing a print. Give the extruder fans time to cool the extruder first. Return after at least 20 minutes to shut it off.

**Don't** leave the MakerBot unattended for more than 30 min

**Do** make sure small and medium-sized prints work well before leaving your MakerBot Replicator 2X.

**Do** use only MakerBot Filament with your MakerBot Replicator 2X

**Do** be careful with the ceramic insulation on your extruders' thermal cores. Hitting with pliers might break off parts of the ceramic insulation

**Don't** put any liquids into your extruder. Whether its boiling water or acetone or anything in between, it's not going to help and it could do a lot of harm.

**Don't** overheat your extruder. Temperature limits in the software are set for your safety and for proper operation of the extruder, so don't use anything other than the installed heaters to heat your extruder –

**Don't** use blowtorches on the extruder.

**Don't** detach parts of the extruder and put them in the oven.

**Don't** drill out your extruder nozzle or drive any kind of metal tool through the nozzle. If you change the shape or size of your nozzle, the slicer will not be able to create accurate tool paths

**Don't** try to replace your extruder nozzles. The nozzles are very securely attached to the extruder, and trying to remove them might result in the threaded portion of the nozzle shearing off and remaining inside the thermal core.



## Troubleshooting

### MakerWare

#### **MODEL NOT AT THE SCALE WHEN OPENING FILE IN MAKERWARE**

Check to ensure your 3D model was defined in **mm**

#### **OCCASIONALLY WHEN OPENING MAKERWARE, A Background Service Unavailable or No Connection to Background Service notification pops up.**

in MakerWare, go to the “Services Menu” and select “Restart Background Service”.

#### **FOR OTHER ISSUES GO TO:**

<http://www.makerbot.com/support/makerware/troubleshooting/>

### MakerBot Troubleshooting

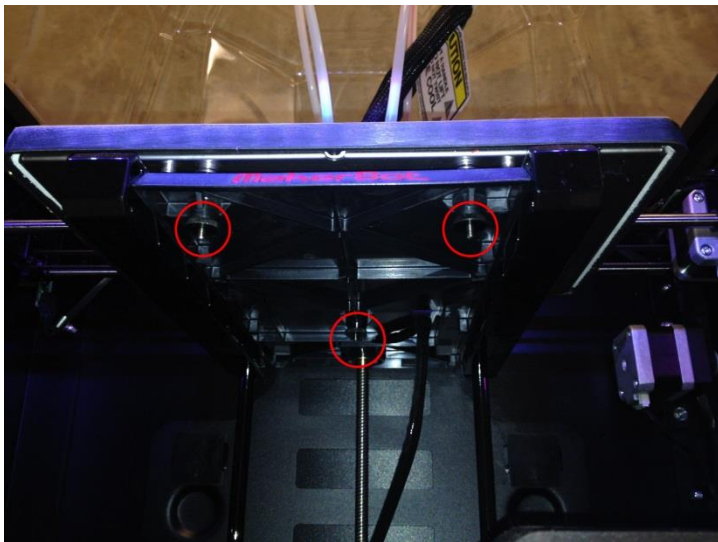
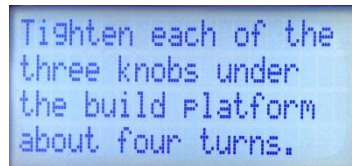
#### **OBJECTS DO NOT STICK TO THE BUILD PLATE:**

- 1) Clean the build plate (wipe off with a towel) and check the film on the build plate for bubbles, if there are bubbles, try moving the model in MakerWare to a different location or change the film on the build plate
- 2) Increase build plate temperature by increments of five degrees in the printing properties of MakerWare.
- 3) Try adding a raft to your model in MakerWare print properties.
- 4) Level the build plate (see below).

## Leveling Platform

Go to 'Utilities' and select 'level bed platform.'

Tighten the knobs under the build platform, by tightening you are pulling the leveling spring down, therefore lowering the platform



Press 'M' after the completed task(s)

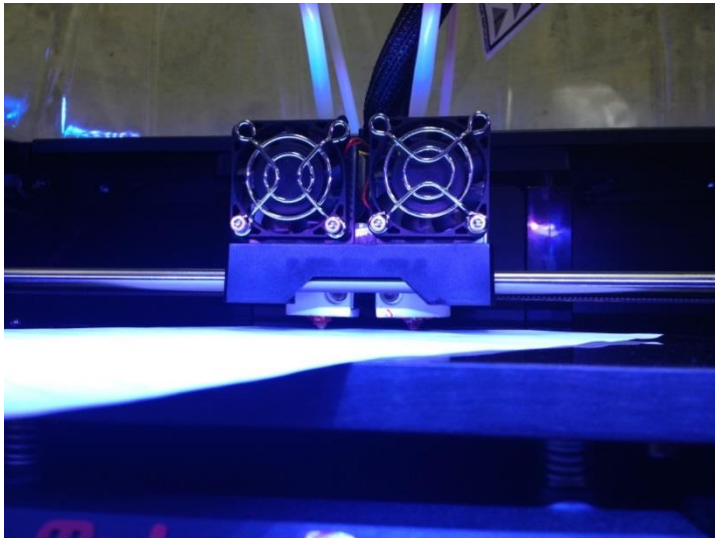
The extruder will move to the central back portion of the platform.

Adjust the back central knob by loosening and tightening the spring.

Take a thin piece of paper and slide it under the extruder. Adjust the knob until paper is easy to slide under the extruder but there should be some friction.

**NOTE:** the three springs under the bed are the levelers; you will adjust these to level the bed. When tightening the springs, the bed lowers, when loosening the spring, the bed is being raised.

Press 'M'



Paper inserted between the extruder nozzle and the build plate.

I'm going to move my extruder around to different points so you can check...

the height. At each point, loosen the specified knob until the nozzle almost...

touches the build plate. The nozzle is at the right height when a thin piece...

of paper will slide between the nozzle and build plate with some friction.

Adjust the rear knob until paper just slides between the nozzle and plate

Repeat for all locations

## **CANNOT REMOVE FROM BUILD PLATE:**

Wait for the build plate to cool down, or use a spatula to lift one corner of the object. (no sharp objects!)

## **AXIS SHIFT IN MODEL LAYERS:**

If the model seems to shift in axis, check to see if build plate is level.

If that doesn't work contact someone with expertise, who knows how to:

- 1) Check if all pulleys are tight
- 2) Check if the gantry belt is straight
- 3) Make sure the belts are not hitting the motors

**(Kris Peterson \$10/hr \$15 minimum)**

## **INCONSISTANT MODEL PRINT**

Tape the door shut to help trap heat in the build area.

The top cover should be on at all times during printing.

## **STICKING TO EXTRUDER HEAD AND NOT TO BUILD PLATE**

Clean extruder tip gently with something plastic and non -abrasive. Be VERY careful not to harm the ceramic surrounding the extruder.

## **EXTRUSION STOPS:**

Verify that the filament is rotating and feeding smoothly.

Verify that the build plate is not too close to extruder.

Note: Under Utilities in **JOG MODE** you can manually move the build plate

## **Try unloading and reloading the filament**

## **SHAKING WHILE PRINTING:**

Check to make sure **acceleration** is on: Go to 'Info and Settings' to 'General Settings' find 'Accelerate' make sure it is selected 'on'

## **CRACKING IN MODEL:**

Increase extruder temperature in MakerWare (see section on "Temperature Settings")

## **FILAMENT NOT LOADING:**

Unload and load filament, make sure a clean fresh cut is made at the end of the filament.

## End of document

Notes:

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