



3D PRINTING IN FTC

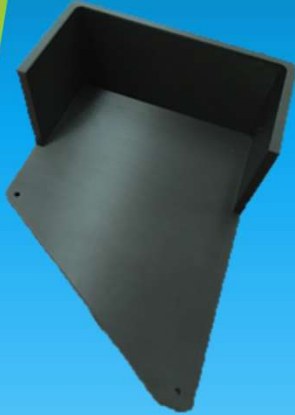
BY: TEAM PARAGON 11311

WHY 3D PRINTING?

- CUSTOMIZED DESIGN
- PROTOTYPING
- EXTRA PARTS
- AFFORDABLE
- CUSTOMIZED COLOR (CHOOSE YOUR FAVORITE FILAMENT COLOR)

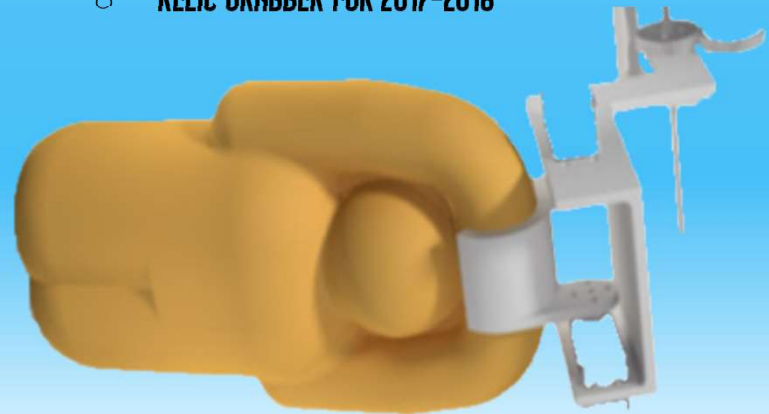


EXAMPLES



COMMON 3D PRINTED ITEMS IN FTC

- TEAM MARKERS
- HUBS & ADAPTERS
- BRACKETS & ANGLES
 - CUSTOM SIZES NOT SOLD IN STORES
- PHONE CLIPS
- BATTERY/MOTOR MOUNTS
- PARTS SPECIFIC TO CHALLENGE
 - MINERAL SORTER FOR 2018-2019
 - RELIC GRABBER FOR 2017-2018



3D PRINTING DESIGN WORKFLOW

CAD → SLICER → 3D PRINTER

 **SOLIDWORKS**



Onshape

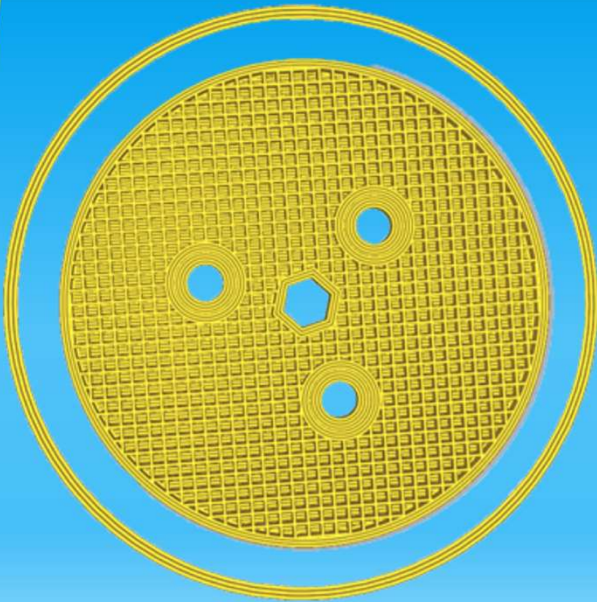
CAD SOFTWARE:

- AUTODESK INVENTOR
- FUSION 360
- ONSHAPE
- SOLIDWORKS

- AVAILABLE FOR FREE BY COMPLETING THIS FORM:

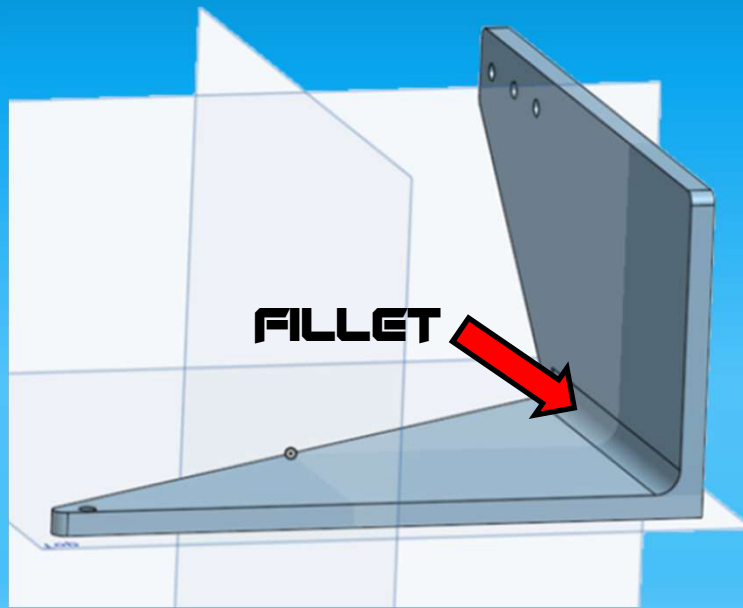
[HTTPS://APP.SMARTSHEET.COM/B/FORM/6762F6652A04487CA9786FCB06884CB5](https://app.smartsheet.com/b/form/6762f6652a04487ca9786fcb06884cb5)

WHAT IS A SLICER?



- TAKES A 3D MODEL (IN STL FORMAT) AND “SLICES” IT INTO LAYERS
- THEN, EXPORTS INTO A G-CODE FILE WHICH YOU CAN RUN ON THE 3D PRINTER
- CAN CONTROL MANY ASPECTS OF YOUR 3D PRINT
 - LAYER HEIGHT
 - WALL THICKNESS
 - INFILL
 - PRINTING TEMPERATURE
 - SUPPORT STRUCTURES

CAD TIPS:



IN CAD:

- **FILLET IN AREAS OF SHARP GEOMETRY CHANGE (90 DEGREE ANGLES), AS THAT WILL MAKE YOUR PRINT STRONGER**
- **WHEN 3D PRINTING, HOLES GENERALLY TURN OUT SMALLER THAN EXPECTED, SO DESIGN YOUR HOLES TO BE SLIGHTLY LARGER THAN WHAT YOU WANT (0.1MM LARGER)**

SLICER TIPS:



- ORIENT YOUR PARTS TO AVOID LARGE OVERHANGS AND BRIDGES; WHERE THIS IS IMPOSSIBLE, ADD SUPPORTS
- GENERALLY, YOU WANT INFILL BETWEEN 20-25%
- TO ADD STRENGTH TO YOUR PRINT, INCREASE THE AMOUNT OF WALL PERIMETERS AND ALSO INCREASE YOUR INFILL TO 30-50%(DEPENDS ON USE OF THE PART)
- YOUR PRINT WILL BE WEAKEST IN THE Z AXIS, SO ORIENT YOUR PARTS SO THAT THE Z AXIS DOES NOT NEED TO TAKE A LARGE LOAD

NOW TO START PRINTING

3D PRINTERS CAN BE VERY DANGEROUS IF NOT HANDLED PROPERLY. THEY MUST BE MONITORED AT ALL TIME DURING USE AND OPERATION. IF NOT CONTROLLED THIS CAN BE THE RESULT.



FILAMENT TYPES



PLA AND PETG:

- DON'T REQUIRE ENCLOSURE
- PETG IS STRONGER THAN PLA, SO IF YOU NEED STRUCTURAL SUPPORT USE PETG
- PLA ATTRACTS WATER AND IS BIODEGRADABLE SO IT WILL DEGRADE OVER TIME

ABS AND PC:

- REQUIRE ENCLOSURE TO PRINT; IF THERE IS NO ENCLOSURE, THE PART WILL CRACK AND WARP
- THESE FILAMENTS ARE STRONG AND PC IS EVEN USED IN BULLETPROOF GLASS
- ABS IS PETROLEUM BASED AND WILL LAST A LONG TIME

TPU:

- TPU IS FLEXIBLE AND USEFUL FOR INTAKES



FILAMENT TEMPERATURES (IN CELCIUS)

PLA: 190-220 HOT END, 55-70 BED TEMPERATURE

**PETG: 220-250 HOT END, 50-75 BED
TEMPERATURE**

**ABS: 210-250 HOT END, 110 BED TEMPERATURE, 0%
FAN SPEED**

**PC: 260-310 HOT END, 80-150 BED TEMPERATURE,
0% FAN SPEED**

TPU: 210-230 HOT END, 20-60 BED TEMPERATURE

Remember these are just references.*

PRUSA RESEARCH MMU V2.0



GOOD PRACTICES

VACUUM BAG



SILICA GEL

STORING FILAMENTS:

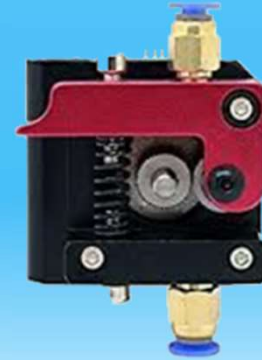
- CERTAIN FILAMENTS ABSORB WATER (PETG, PC, TPU ETC.), AND THAT CAN RUIN PRINTS
- TO AVOID THIS, STORE FILAMENTS IN A BOX WITH SILICA GEL PACKETS/ CONTAINER WITH SILICA GEL. CUT A HOLE IN THE BOX TO RUN THE FILAMENT OUT WHILE PRINTING.
- ANOTHER OPTION IS USING A VACUUM BAG WITH SILICA GEL INSIDE
- ONCE YOUR SILICA GEL HAS TURNED FROM YELLOW/ORANGE TO GREEN YOU WILL NEED TO BAKE IT IN AN OVEN FOR 3 HOURS AT 120 DEGREES C
- DEHYDRATE YOUR FILAMENT IF IT HAS ALREADY ABSORBED MOISTURE. BE CAREFUL NOT TO MELT YOUR FILAMENT, SO KEEP IT AT A LOW TEMP.

EXTRUDERS

DIRECT →



BOUDEN →



HOT-ENDS NOZZLE DIAMETER

E3D V6 HOTEND



HOTEND — HEATS UP TO EXTRUDE THE FILAMENT.

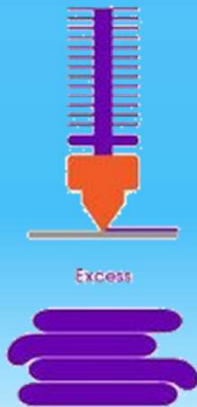
The relationship
with layer height
and pressure



Common nozzle
0.4mm

Optimal layer
height between
0.1 and 0.2mm

Too low



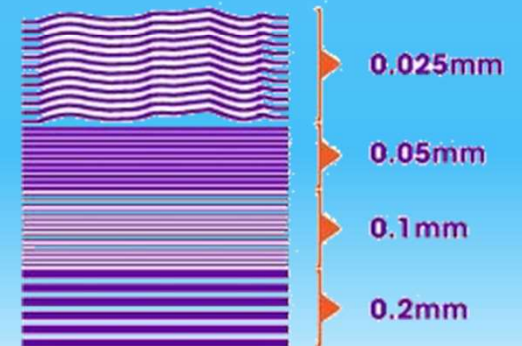
Too high



Correct



Different nozzle layer heights
with a fixed nozzle size (0.4mm)
PLA 60mm/sec - 190°C



COOLING

THE APPRIATE AMOUNT OF COOLING WILL
KEEP YOUR PARTS COMING OUT CLEAN AND
SHARP.



**PROPER
COOLING
FOR PLA**



**IMPROPER
COOLING
FOR PLA**



COOLING ELEMENT FOR PLA

SPECIAL EXTRUDERS HOTENDS

DUAL EXTRUDER



3D PRINTER BED

- THE SURFACE THAT YOU PRINT WILL BE ON.
- MAKING SURE THIS SURFACE IS LEVEL OR IF YOUR 3D PRINTER HAS AUTO-LEVELING.
- ALSO MAKE SURE YOUR BED HAS PROPER ADHESION.

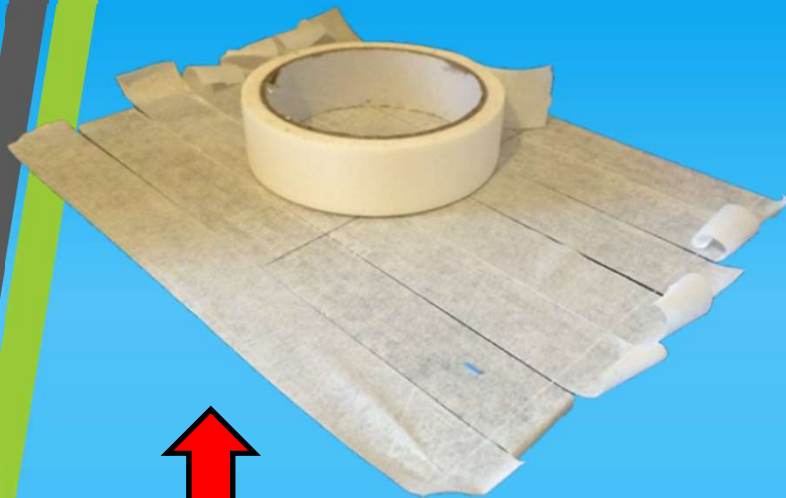
BED LEVELING KNOB



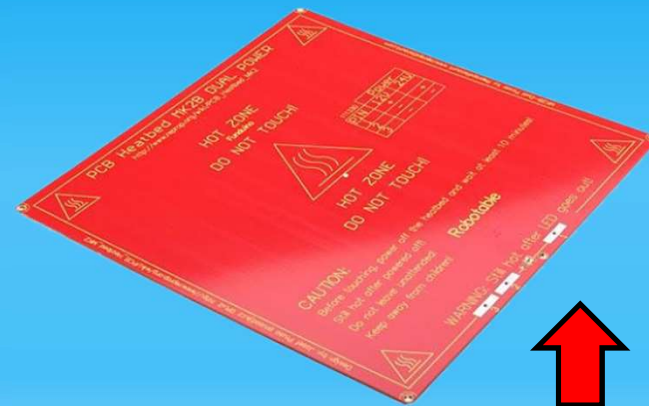
PROPER ADHESION TO PREVENT WARPING HEATED BEDS



← EXAMPLE OF WARPING



USING MASKING TAPE ON YOUR BED TO MAKE SURE YOUR PRINT WILL STICK AND PREVENT WARPING.



HEATED BED WILL ALSO MAKE YOUR PRINT TO STICK TO THE BED AND PREVENT WARPING.

OCTOPRINT



OctoPrint Settings System foosel

Connection

State

Machine State: **Printing**
File: **CuteOcto.gco**
Timelapse: **Timed (2 sec)**
Filament (Tool 0): **2.22m**
Approx. Total Print Time: **00:44:04**
Print Time: -
Print Time Left: **44 minutes**
Printed: **5.2KB / 2.0MB**

Print **Pause** **Cancel**

Files

Search...

CuteOcto.gco
Uploaded: 5 days ago
Size: 2.0MB

Webcam_cover_-_Part_1a.gcode
Uploaded: 10 days ago
Size: 1.1MB

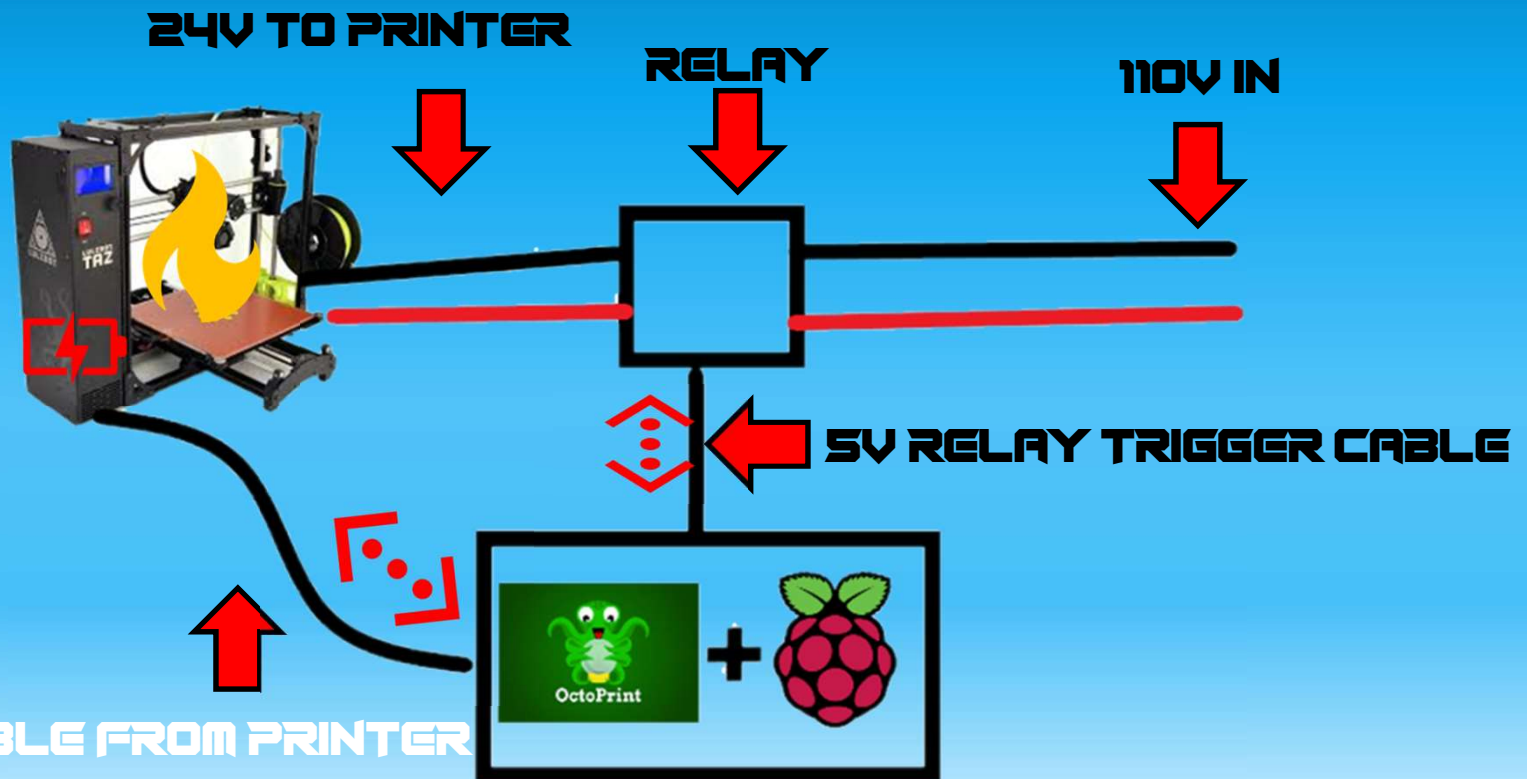
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Size: 1.2MB

Temperature **Control** GCode Viewer Terminal Timelapse

The graph displays temperature control for the Hotend. The y-axis represents temperature in degrees Celsius, ranging from 0 to 300. The x-axis represents time, with a -1 min mark. A red line shows the actual temperature, which rises from approximately 25°C to 209.0°C. A horizontal red line indicates the target temperature at 210.0°C. A faint octopus watermark is visible in the background of the graph.

	Actual	Target	Offset
Hotend	209.0°C	210 °C Set	0 °C Set

OCTOPRINT SAFETY

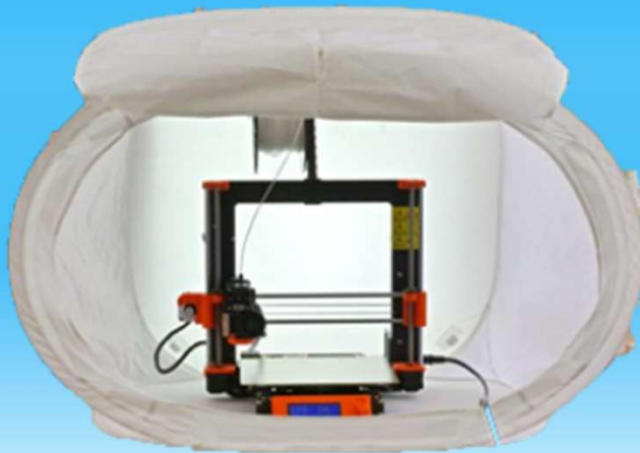


3D PRINTER ENCLOSURE

ENCLOSURE:

A BOX TO PUT AROUND YOUR 3D PRINTER TO:

- PROTECT FROM DUST,
- KEEP HEAT IN (STABLE TEMPERATURE)
- REDUCE NOISE



A PHOTO TENT

- PSU can be kept inside
- Very cheap
- No assembly

IKER LACK TABLES

- Customizable
- Good aesthetic
- Can stack multiple tables for storage/more printers.
- Somewhat cheap
- Very long assembly

3D PRINTERS OUT THERE



PRUSA I3 MK3-\$749 USD,\$999 USD PREBUILT

1. **BEST 3D PRINTER**
2. **250X210X200 PRINT VOLUME**
3. **AUTO CALIBRATION AND CRASH DETECTION**
4. **SLICER IS EASY TO USE**
5. **CAN PAUSE AND RESTART PRINTS**
6. **VERY STURDY**
7. **POWER LOSS RECOVERY**
8. **[HTTPS://WWW.PRUSA3D.COM/ORIGINAL-PRUSA-I3-MK3/](https://www.prusa3d.com/original-prusa-i3-mk3/)**

3D PRINTERS OUT THERE



CREALITY ENDER 3-\$369 USD

1. BEST LOW PRICE 3D PRINTER
2. 220X220X250MM PRINT VOLUME
3. CAN PRINT FLEXIBLE FILAMENTS (TPU)
4. REQUIRES MANUAL CALIBRATION
5. EASY TO ASSEMBLE (10 MIN WITH ONLY 20 SCREWS)
6. PROBLEM: UNEVEN BASE MAKES IT DIFFICULT TO LEVEL
7. [HTTPS://WWW.CREALITY3D.SHOP/PRODUCTS/CREALITY3D-ENDER-3-PRO-HIGH-PRECISION-3D-PRINTER](https://www.creality3d.shop/products/creality3d-ender-3-pro-high-precision-3d-printer)

DISADVANTAGES OF 3D PRINTING

- NOT AS STRONG AS OTHER WAYS OF MAKING PARTS
- BECAUSE OF THIS, 3D PRINTED PARTS USUALLY HAVE TO BE LARGER THAN THEIR SHEET METAL AND SHEET PLASTIC COUNTERPARTS
- CAN'T BE USED IN EVERY SITUATION (DRIVETRAIN, HANGING, AXLES)
- YOU CAN MAKE STRONGER PRINTS USING STRONGER FILAMENTS, BUT THEY COST A LOT MORE
- PRINTS CAN BE INCONSISTENT (BAD TOLERANCES)
- LIMITED MATERIALS THAT YOU CAN PRINT IN

REFERENCES:

[HTTPS://WWW.PRUSA3D.COM/ORIGINAL-PRUSA-3-MK3/](https://www.prusa3d.com/original-prusa-3-mk3/)

[HTTPS://WWW.CREALITY3D.SHOP/PRODUCTS/CREALITY3D-ENDER-3-PRO-HIGH-PRECISION-3D-PRINTER](https://www.creality3d.shop/products/creality3d-ender-3-pro-high-precision-3d-printer)

[HTTPS://BLOG.PRUSAPRINTERS.ORG/CHEAP-SIMPLE-3D-PRINTER-ENCLOSURE/](https://blog.prusaprinters.org/cheap-simple-3d-printer-enclosure/)

[HTTP://3DPRINTINGFORBEGINNERS.COM/HOW-TO-STORE-3D-PRINTING-FILAMENT/](http://3dprintingforbeginners.com/how-to-store-3d-printing-filament/)

[HTTPS://ALL3DP.COM/](https://all3dp.com/)

**BUGGING PEOPLE ON THE
FTC DISCORD:**

[HTTPS://DISCORD.GG/FIRST-TECH-CHALLENGE](https://discord.gg/first-tech-challenge)



THANKS FOR WATCHING!

Any Questions?

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Instagram: [@ftcparagon11311](https://www.instagram.com/ftcparagon11311)