



# MAKER LAB Safety Instructions

## Specialty Tool Training:

### Fused Deposition Modeling 3D Printers

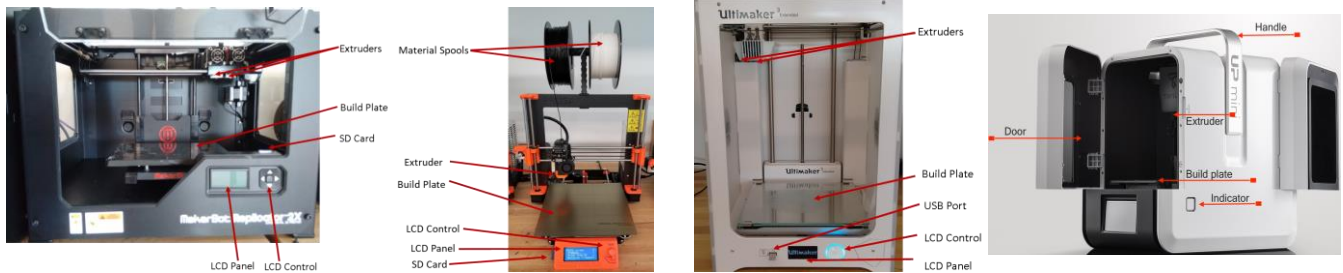


**Note:** All the instructions from Basic Training apply to Specialty Tool Training. If you have not completed Basic Training, do so before you complete Specialty Tool Training.

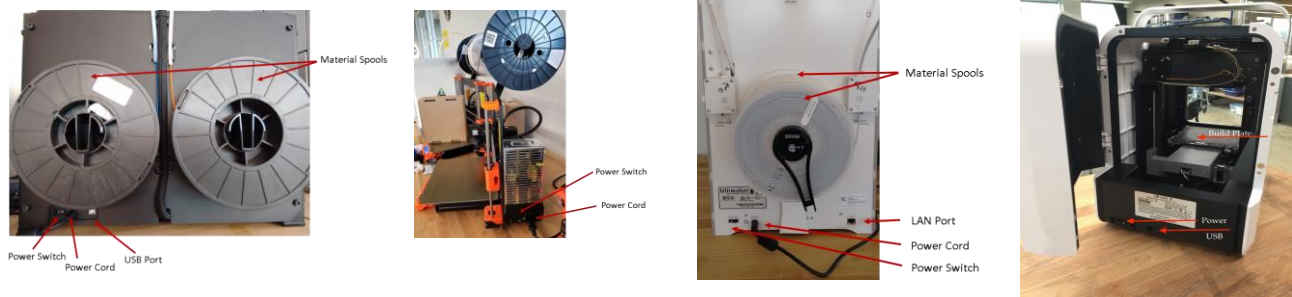
#### Fused Deposition Modeling Rapid Prototyping Machines

The MakerBot 2X, Prusa, Ultimaker, and UP Mini 2 Rapid Prototyping Machines are used to print 3-Dimensional objects using plastic. They are a hobby class 3-D printer. They heat up the solid material and lay it out on the platform to build the object. These 3D printers are controlled by a computer.

Front View



Back View



This Maker Lab Safety Instructions and Safety Training module only covers the use of the MakerBot 2X, Prusa i3 MK3, UP Mini 2, and Ultimaker Rapid Prototyping Machines. Individual equipment training is performed for usage of Specialty Tool Training equipment. The full list of Specialty Tools can be found on the Maker Lab Website.

**Disregarding lab rules or working unsafely will result in suspension or revocation of lab privileges depending on the severity of the infraction.**

**In an Emergency:**

**Call 4444 from the lab phone (or 408-554-4444 from a cell phone), or 911 from a cell phone.**

The Maker Lab is located in Guadalupe Hall, 3<sup>rd</sup> Floor, Room 301

**Maker Lab Website:** scu.edu/engineering/makerlab

**Maker Lab E-mail:** scumakerlab@gmail.com



# Specialty Tool Training: Fused Deposition Modeling 3D Printers Safety Guidelines

## Emergency Information

1. **Injuries:** For immediate help notify Campus Safety at x4444 (408-554-4444) and follow their direction. Do not attempt to remove foreign objects from the eye or body; it is better to have trained medical personnel remove foreign objects from the eye or body.

## Being ready to work

2. **Do not operate** equipment unless you have been properly trained to do so. If you're unsure about the safe operation of a tool or any aspect of a job – ask for help. **If you can't do a job safely, don't do it!**
3. **Never work when you are impaired.**
4. **Be prepared** and have your 3D model already designed before coming to the Maker Lab.
5. **Long prints must be scheduled to start in the morning.** For help scheduling, contact Maker Lab Staff, [scumakerlab@gmail.com](mailto:scumakerlab@gmail.com).

## Personal Protection

6. **Must wear safety glasses with side shields.**
7. **Heat gloves** are also required for some operations with the Rapid Prototyping Machines.

## Shop and Tools

8. **Always keep aisles, exits and access to emergency equipment** (fire extinguishers, fire alarms, first aid kit) clear at all times.
9. **Become familiar** with how the MakerBot 2X, Prusa, Ultimaker, and UP Mini 2 works and the dangers before using it. Ask for help!
10. **Verify** the overall condition of the equipment (e.g., damaged power cord, visible cracks, or defects in the tool housing or anything that would compromise the safe use of the 3D printers).
11. To avoid burning, or model deformation, **do not touch the model, nozzle, or the platform** by hand, or any other part of the body, while the printer is working or immediately after it has finished printing.
12. Keep the floor around the machines clean, dry, and free from trip hazards.
13. Be careful when adjusting any part of the machine (kapton tape replacement, recalibration, switching spools, etc.). Ask for help if needed.
14. The MakerBot, Prusa, Ultimaker, and UP must be shut off from the hours of 10 pm and 7 am unless granted special permission by Maker Lab Supervisor.

*Sign and date in space provided, verifying you have received a copy of and have read and understand the safety instructions.*

**Name:** \_\_\_\_\_

**Maker ID:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_



## Specialty Tool Training: MakerBot 2X 3D Printer

You may not operate the MakerBot 2X Rapid Prototyping Machine without the requisite training and approval from the Maker Lab Staff.

1. Always wear safety eye protection (safety glasses).
2. Wear heat gloves whenever you have a chance of coming into contact with the hot platform or nozzle.

### Specifications

- Print size: 250x160x150mm (approx. 9.8x6.2x5.9 inches)
- Input Format: STL, OBJ, THING
- Approved Materials: ABS (Acrylonitrile butadiene styrene), PLA (Polylactic acid), HIPS (High impact polystyrene)

### Operation

A User Manual is available which goes into more detail about the operation and settings.

1. Load model(s) into the *Prepare* window of the *MakerBot Desktop* software by selecting the *Add File* button at the top of the window
  - a. Models can be rotated, scaled, and arranged using the buttons on the left of the window
  - b. Verify the MakerBot 2X Replicator is selected by going to *Devices* and then *Select Type of Device*
2. Select desired print settings by selecting the *Settings* button at the top of the window
  - a. Specify raft, support, layer height, infill, number of shells, and material
3. Export the file by selecting *Export Print File* at the top of the window
  - a. Confirm settings, print time, material, and print preview
4. Save the file on an SD Card by selecting *Export Now* and saving with your desired file name
  - a. File names must be less than 26 characters
5. Insert the SD Card into the MakerBot and select *Print from SD* and then select your file
6. Verify the condition of the platform. Check that the Kapton tape is not scratched or torn
7. Power on the MakerBot 2X
8. Verify there is enough material on the spools
9. Calibrate the nozzle height if necessary
10. Once the print is complete, power off the MakerBot 2X.
11. Remove the model from the platform. **You must wear heat gloves during removal.**
12. Verify the condition of the platform and clean up

Material for printing with the MakerBot 2X Rapid Prototyping Machine will be provided for a fee based on the amount of material used.



## Specialty Tool Training: Prusa i3 MK3 3D Printer

You may not operate the Prusa i3 MK3 3D printer without the requisite training and approval from the Maker Lab Staff.

1. Always wear safety eye protection (safety glasses).
2. Wear heat gloves whenever you have a chance of coming into contact with the hot platform or nozzle.

### Specifications

- Print size: 250x210x210mm (approx. 9.8x8.3x8.3 inches)
- Input Format: STL, 3MF, OBJ
- Approved Materials: ABS (Acrylonitrile butadiene styrene), PLA (Polylactic acid), Flex PP, Ninjabflex, Nylon, and more.

### Operation

A User Manual is available which goes into more detail about the operation and settings.

1. Open model(s) into the window of the Cura software by selecting the *Open File* button at the top-left of the window. (For more advanced setting options, use Slic3r instead of Cura.)
  - a. Ensure that the printer selected is the i3 MK3
  - b. Using left panel you can: move, scale, rotate, mirror and select customized settings for each individual part on the platform
2. Select desired print settings by selecting options on the right-hand panel
  - a. Specify: material, quality, infill pattern, build plate adhesion
  - b. For more advanced settings, select custom to change additional parameters
  - c. Check the print time and the amount of filament used
3. Export the file to an SD card by selecting *Save To Removable Device* at the bottom of the window
4. Insert the SD card into the Prusa
5. Verify the condition of the platform
6. Verify there is enough material on the spools (Only a supervisor can change spools).
7. Power on the Prusa using the switch on the right side of the printer.
8. Auto-Calibrate the nozzle height if necessary
9. Using the selection wheel, start your print.
10. Once the print is complete, power off the Prusa using the switch on the right side of the printer.
11. Remove the model from the build plate. **You must wear heat gloves during removal.** Lift the build plate off the printer, flex slightly, remove model, and return to the build plate to the printer.
12. Verify the condition of the platform and clean up.

Material for printing with the Prusa Rapid Prototyping Machine will be provided for a fee based on the amount of material used.



## Specialty Tool Training: Ultimaker 3D Printer

You may not operate the Ultimaker Extended 3D printer without the requisite training and approval from the Maker Lab Staff.

3. Always wear safety eye protection (safety glasses).
4. Wear heat gloves whenever you have a chance of coming into contact with the hot platform or nozzle.

### Specifications

- Print size: 215x215x300mm (approx. 8.5x8.5x12 inches)
- Input Format: STL, 3MF, OBJ
- Approved Materials: ABS (Acrylonitrile butadiene styrene), PLA (Polylactic acid), Nylon, CPE (Co-Polyester), PVA (Polyvinyl alcohol).

### Operation

A User Manual is available which goes into more detail about the operation and settings.

13. Open model(s) into the window of the Cura software by selecting the *Open File* button at the top-left of the window
  - a. Models can be rotated, scaled, and arranged using the mouse buttons
  - b. Ensure that the model selected is the Ultimaker Extended
  - c. Using left panel you can: move, scale, rotate, mirror and select customized settings for each individual part on the platform
14. Select desired print settings by selecting options on the right-hand panel
  - a. Specify: print core, material, quality, infill pattern, plate adhesion, build plate adhesion
  - b. For more advanced settings, select custom to change many more parameters
  - c. Check the print time and mass of filament used
15. Export the file to Ultimaker USB by selecting *Save To Removable Device* at the bottom of the window
16. Insert the USB into the Ultimaker
17. Verify the condition of the platform
18. Verify there is enough material on the spools (Only a supervisor can change spools)
19. Auto-Calibrate the nozzle height if necessary
20. Using the selection wheel, start your print on the Ultimaker.
21. Watch the first few layers of the print to ensure a successful start
22. Once the print is complete, power off the Ultimaker
23. Remove the model from the platform. **You must wear heat gloves during removal.**
24. Verify the condition of the platform and clean up Ultimaker

Material for printing with the Ultimaker Rapid Prototyping Machine will be provided for a fee based on the amount of material used.



## Specialty Tool Training: UP Mini 2 3D Printer

You may not operate the UP Mini 2 3D printer without the requisite training and approval from the Maker Lab Staff.

1. Always wear safety eye protection (safety glasses).
2. Wear heat gloves whenever you have a chance of coming into contact with the hot platform or nozzle.

### Specifications

- Print size: 120x120x120mm (approx. 4.7x4.7x4.7 inches)
- Input Format: STL and UP3
- Approved Materials: ABS (Acrylonitrile butadiene styrene), PLA (Polylactic acid)

### Operation

A User Manual is available which goes into more detail about the operation and settings.

1. Open model(s) into the window of the UP Studio software by selecting the *Open* button on the left
  - a. Models can be rotated, scaled, arranged, mirrored, duplicated, and errors fixed using the menu on the top right
2. Initialize the printer using the *Initialize* button on the left
3. Check the printer for type of material, amount of material, and build plate
4. Confirm correct material and build plate in software by selecting the *Maintenance* button on the left
5. Select desired print settings by selecting *Print* button on the left
  - a. Specify: layer thickness, infill, and quality
  - b. Under *Preferences* you can select raft and support settings
  - c. Check the print time and mass of filament used by selecting *Print Preview*
  - d. Start print by selecting *Print* at the bottom of the Printer Settings window
6. Once the print is complete, power off the UP and carefully slide the build plate out of the printer
7. Once the build plate is removed, use a spatula to carefully remove the part then slide the build plate back into the printer
8. Verify the condition of the platform and clean up

Material for printing with the UP Mini Rapid Prototyping Machine will be provided for a fee based on the amount of material used.