

MME Standard Operating Procedure (SOP)

Name	Ultimaker 2+
Description	3D printer
Location	E3 Room 2169
SOP Creation Date	2016-11-21
SOP Created By	Jocelyn van Leeuwen
SOP Revision Date	
SOP Revised By	
SOP Location	usually inv.mme.uwaterloo.ca or an office location
Manual Location	usually inv.mme.uwaterloo.ca or an office location
Equipment Owner	Professor Norman Zhou (x. 36095)
Authorized Trainers	Robert Liang (x.33326)
Support Technicians	Jocelyn van Leeuwen (jcvanlee@uwaterloo.ca)



Significant Hazards	Skin Hazard: <ul style="list-style-type: none"> Thermal: heated bottom plate and nozzle
Administrative Controls	<ul style="list-style-type: none"> Can be used when not in use by someone else (sign up on the Google document) Can be used independently at any time by any student or employee, once trained
Engineering Controls	None
PPE Required	None
Relevant Standards and Codes	None
Relevant MSDS	<ul style="list-style-type: none"> Poly(lactic acid) (PLA) All MSDSs can be found at msds.mme.uwaterloo.ca
Accident Procedure	See Safety Posters in this lab

Emergency Shutdown Procedure	<ul style="list-style-type: none"> • Personnel Injury: <ul style="list-style-type: none"> ○ Turn off the printer with the power switch ○ Call 911 and inform the dispatcher as to what occurred ○ Contact Health Services; first aid services available → 519-888-4096 or Ext.84096 ○ UW Police –assists if the above services are not available → 519-888-4911 or Ext. 22222 ○ Complete incident report • Fire: <ul style="list-style-type: none"> ○ Turn off the printer with the power button ○ Evacuate area as stated in your Building Emergency Plan ○ Active wall mounted fire alarm pull station located at exits. ○ Call 911 for medical assistance (Ambulance). If using a cell/mobile call UW Police at 519-888-4911 ○ Report any information about fire to UW Police and Fire Department.
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Start-up Procedure

Before starting, check that:

- ☐ If filament is already in the tube, check that it is not broken or damaged



i.e.

- ☐ The plate is clean
- ☐ There is a nozzle in place
- ☐ Your SD card is in place with your design (from Cura – slicing software)

Proceed to operating procedure

Operating Procedure

Once you are ready to begin:

- (1) Turn on the 3D printer with the button at the back
- (2) Controller: To scroll through the menu on the display: rotate the button at the front of the printer. To select: push the button
- (3) Calibrate the build plate: go to Maintenance → Buildplate
 - Follow the instructions on the display. It will go through the calibration twice; the first time, positioning, the second, fine tuning. Use a piece of think paper and place it under the nozzle – there should be some resistance.
 - To adjust the height of the build plate at the back of the printer use the button at the front and rotate it either Clockwise: up or Counterclockwise: down.
 - When the nozzle comes to the front two corners of the build plate, adjust the height with the screws in the front two corners twist to the right: down or left: up.
 - Once the nozzle is at the back of the build plate again, calibration is complete.
- (4) Select your material
- (5) Check that the set temperature of your nozzle and build plate correspond to your materials AND the nozzle size:

Materials	Nozzle Size (mm)	Nozzle Temperature (°C)	Build Plate Temperature (°C)
PLA	0.25	195	60
	0.4	210	
	0.6	230	
	0.8	240	
ABS	0.25	245	80
	0.4	250	
	0.6	260	
	0.8	260	
PMMA	0.25	240	100
	0.4	245	
	0.6	250	

	0.8	260	
Wood			
Filament	0.4	215	70

- (6) For polymers: Put a layer of roll-on glue onto the build plate. For silicone or clay: Put down plastic wrap/aluminum foil over the build plate.
- (7) Check that the temperature setting is the correct one go to Tune → Temperature and see if current T/T is the desired temperature in the denominator.
- (8) Heat the nozzle before printing: select Maintenance → heat up first nozzle. Then follow the instructions on screen *Make sure you heat up the nozzle before printing otherwise the material may get stuck* OR to manually extrude select Maintenance → Move material (1) and rotate the controller clockwise to extrude the filament once the nozzle has reached the desired temperature.
- (9) Select Print and your desired design.
- (10) If all is going well: material should come out of the nozzle once it is heated and the printer should start to print the design

Wood filament:

- Before each print you will need to reverse the material and then bring it back in so that it does not clog the nozzle.

Discov3ry extension (for paste i.e. Silicone, clay)

- (1) Put aluminum foil onto the plate and build plate (calibrate)
- (2) Setting up the syringe: Put the paste in the syringe and then insert the plunger. Attach tube to the top of the syringe. Then put syringe onto the Discov3ry extension. The bottom of the plunger should be on the white plastic holder, in place. The bottom part of the syringe (clear) should be between the two white plastic parts at the top and then held in place by a metal piece.
- (3) Once the syringe is in place, put the Allen Key through the hole (in the O of “Discov3ry” on the white plastic piece)
- (4) Go to PRINT → Discov3ry (Paste) → Purge REALLY FAST (to push the material through the tube to the nozzle – some materials may need the “FAST” or “SLOW” purge)
- (5) Make sure that when switching back to plastic materials (different nozzle) ensure that you change the material setting on the printer (from paste mode)

How to:

Remove/retract the filament:

- Return to main menu: select Material → Primary nozzle → Change
- Nozzle will heat up and the printer will reverse the material itself

Insert new material:

- Insert from the backside of printer, above the arrow – make sure that the clip at the right side of the feeder is in the middle to prevent grinding
- Ensure that the filament doesn't have too high a tension, otherwise it may break or get stuck
- Once the filament has been fed most of the way into the tube, rotate the front button clockwise so that it is in the nozzle – material should begin to come out of the nozzle (if it is hot), which indicates that the material is in far enough. Click Ready

Troubleshooting:

Material does not come out of the nozzle:

- Clean nozzle: Remove filament from the tube, let printer cool. Remove with the small wrench provided and loosen counter-clockwise. Clean with a syringe or thin sharp object, and use a solvent.
- Check filaments for any damage – it might be stuck
- Once cleaned, put nozzle back on and put material back into the tube
- Ensure that the nozzle is completely heated up before printing – it may get clogged

Shutdown Procedure

The 3D printer shutdown procedure is as follows:

- Remove your printed object from the build plate
- Clean the build plate (remove any glue left over)
- Turn off the printer with the on/off button at the back.

Clean-up

Once your project has been printed:

- Remove your object from the plate
- Turn off the printer
- Clean off the glue from the plate
- All waste goes into the garbage

Maintenance and Repair

- Lubricating the gears (whenever the printer is making a strange sound)
- Cleaning the nozzle (when necessary)
- Remove glue on build plate
- Contact Rob Liang if 3D printer needs major repair. For minor issues check online first, i.e. on rewrap