3D Printer SOP

1 Document Details

SOP Title	3D Printer SOP		
Revision	A	Approval date	
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2 Introduction

2.1   Purpose

This standard operating procedure (SOP) covers the operation of the Ultimaker series 3D printers.

2.2   Table of Contents

2.3   Background

This 3D printer uses fused filament fabrication (FFF) technology to produce 3D shapes from STL Files. This process utilizes a continuous filament of a thermoplastic material pushed through a heated nozzle in layered deposition.

3 Preparation

3.1   File Preparation – Orientation

This section assumes your model is saved as an STL file.

3.1.1   Bring your STL file to the computer using a USB.

3.1.2   Open Ultimaker Cura (the icon looks likes a blue cube with a white "C").

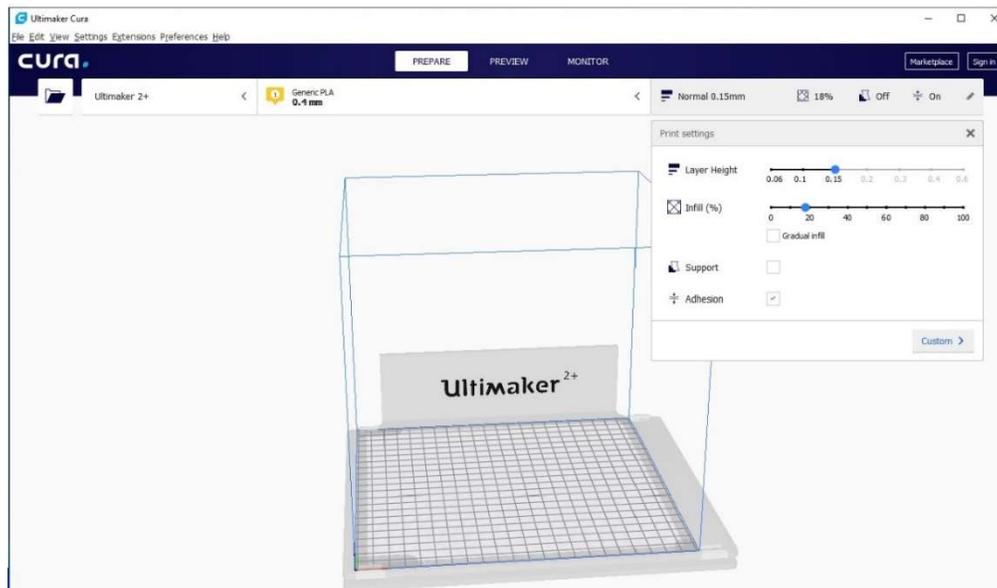Figure 1

3.1.3   In the upper left corner, select the machine you plan to use.

    3.1.3.1.   Ultimaker 2+ uses a single filament of thermoplastic material while Ultimaker 3 and S5 use two filaments.

    3.1.3.2.   Typically, one filament is a thermoplastic for building the model and while the other is a support material.

    3.1.3.3.   NOTE: Ultimaker 3 and Ultimaker 2+ both output .gcode files, but the files are not interchangeable.

3.1.4   Select File/New project from the Task Bar ("Top left")

    3.1.4.1.   This will clear any current project.

3.1.5   Select File/Open Files then Navigate to and open your STL file.

    3.1.5.1.   Your part will appear on the squared build plate in the graphics area.

    3.1.5.2.   You may load more than one part on the build platform in the graphics window.

3.1.6   Click anywhere on your part to activate the move options and manipulate your part.

3.1.7   Once you select your part, vector lines and arrows will appear on the part and the move options will be activated as shown in Figure 2.
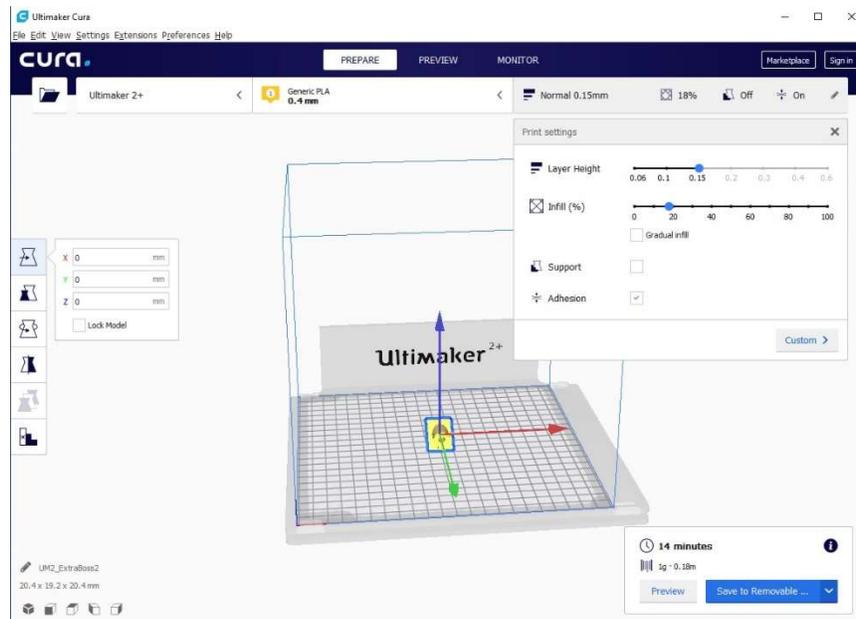

Figure 2

3.1.8   Manipulate your part using the menu on the left and use "Lay Flat" to place the model on the base of the build area.

3.1.8.1.   The orientation of the part will affect the build time depending on cavities or protrusions on the model. Significant undercuts may require support material.

3.1.8.2.   If you have multiple parts, do not overlap any edges and maintain a reasonable distance from the edge.

3.2 File Preparation – Build Parameters

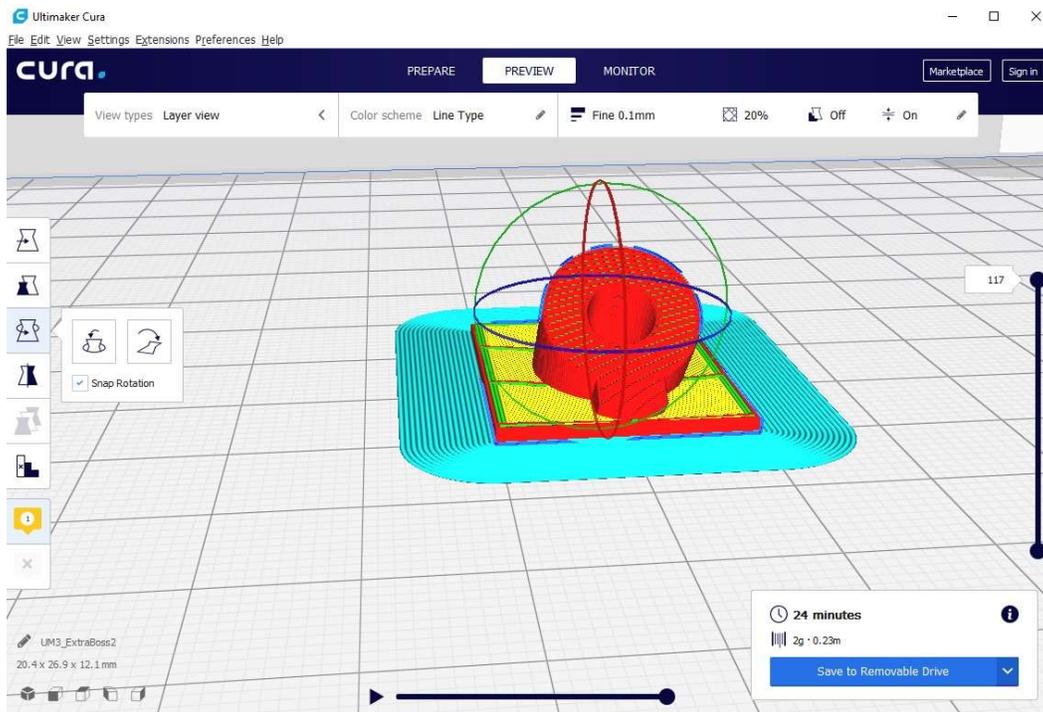3.2.1   Preview the part by clicking on "Preview" in the top center of the screen (Figure 3).

Figure 3

3.2.2   Select a build quality/speed by selecting one of the default profiles.

    3.2.2.1.   The "Visual" profile prioritizes surface quality.

    3.2.2.2.   The "Engineering" profile prioritizes functionality.

    3.2.2.3.   The "Balanced" profile is a compromise between the "Visual" and "Engineering" profiles.

    3.2.2.4.   The "Draft" profile prioritizes speed of the build.

3.2.3   Select the Resolution.

3.2.4   Select the Strength parameters.

    3.2.4.1.   Infill refers to the percent amount of an inner volume that is to be filled. Higher infills generally produce stronger parts, but take longer to print.

3.2.5   Select Support if your part has undercuts or overhanging features.

    3.2.5.1.   The Ultimaker 2+ cannot print from a second extruder, so the support material will be the same as the structural material.

3.2.6   Select Adhesion if your part needs to stick to the platform

    3.2.6.1.   In general, this applies to parts that are so wide that the first layers begin to curl upon curing.

3.2.7   See Appendix for information on custom parameters.

3.2.8   In the bottom right, click on "Slice" to generate a layer-by-layer preview of the build.

    3.2.8.1.   The scroll bar on the right allows you to see each individual layer.

    3.2.8.2.   The playback button on the bottom will simulate the build for that layer.

3.2.9   If build parameters are changed, the model must be re-sliced.

3.2.10   Finally, save the file on the dedicated USB drive or SD card by clicking on "Save to Removable Disk" and then eject.

4 Operation

4.1 Machine Check

4.1.1   Make sure the platform is clean and free from debris.

    4.1.1.1.   If the platform requires extensive cleaning, remove it by pulling on the forward metal clips.

    4.1.1.2.   Next, wash the platform with water.

4.1.1.3.   Dry with a paper towel and install the platform back into the machine.

4.1.1.4.   Secure the platform with the metal clips.

4.1.2   Make sure the roll of filament on the printer matches that of the build.

4.2   Printing

4.2.1   Insert the removable drive (SD card or USB stick) into the appropriate 3D printer.

4.2.2   If the printer is off, turn it on using the switch in the back.

4.2.2.1.   Screen should display "PRINT" "MATERIAL" "MAINTENANCE" (Figure 4)

Figure 4

4.2.3   Select the file to be printed

    4.2.3.1.   On the Ultimaker 2+ or 3, rotate the white knob select Print" and press the white knob again. A list of available print files will appear on the screen. Scroll to your file as displayed on lcd screen and select by pressing the white knob.

    4.2.3.2.   On the Ultimaker S5, use the touchscreen to click on "Select from USB" then find and select the file.

4.2.4   The printer will warm up and begin printing. Do not leave the printer alone until you have confirmed that the printing has begun successfully.

5 Appendix

5.1   Custom Parameters

Here is a list of custom parameters that can be changed for printing

5.1.1   "Quality" refers to the layer height. This dimension drives the resolution in the Z direction.

5.1.2   In "Walls," you can change the number and thickness of the walls. Numerous walls and thicker walls will result in stronger, but slower prints.

5.1.3   "Top/Bottom" refers to the thickness of the top and bottom layers.

5.1.4   "Infill" is the same for recommended settings (density, shapes).

5.1.5   In "Support," you can adjust where the support materials comes from, the shape of the support, its placement, and how much of the part is supported (overhang angle)

5.1.6   In "Build Plate Adhesion," you can adjust the shape and source of adhesion layers.

5.1.7   For all other parameters, DO NOT adjust without the approval of a super user.

5.2   Troubleshooting

5.2.1   If the part is not sticking to the platform, better adhesion can be achieved by applying a thin layer of glue

   5.2.1.1.   Be aware: too much adhesive applied by the glue stick may introduce difficulty in detaching the model from the glass plate once it has cooled down.

5.2.2   Large Flat Surfaces should be monitored during first couple of layers to ensure that they are well bonded to the Glass and not buckling or peeling up. It may be necessary to restart the Build if this occurs as there is no easy fix for this although sometimes rotating the part to a new orientation may help.

5.3   Changing the Filament (Ultimaker 2+)

5.3.1   Rotate white disk so that "MATERIAL" is highlighted on the display as shown below and press disk.

5.3.2   Click on "Change."

5.3.3   The machine will heat the filament, then back it out of the Canula.

5.3.4   Replace the roll of filament on the back once filament is fully backed out.

5.3.5   Insert the material into the canula as directed by the arrow (Figure 5).

Figure 5

5.3.6   Once the Press the end of the new filament firmly upward to ensure that it is engaged in the feed gears.

5.3.7   Press "Ready" on the display.