Rowe Digital Fabrication Lab

Safety Manual and User Guide

RōFL

The University of North Carolina Charlotte

Department of Art + Art History

Rowe Building Room 124

Table of contents

Notes

RoFL

The Rowe Digital Fabrication Lab (RoFL) is a multidisciplinary studio, where students and faculty of the College of Art + Architecture can translate digital ideas to physical objects. RoFL offers 3D printing, laser processing, CNC machining, and 3D scanning capabilities. This resource keeps UNCC students and faculty up-to-date with current practices in contemporary art while exploring the role that new technologies can have when paired with traditional methods.

This guide is an overview of; safety protocols, lab policies, and the capabilities of the equipment available. It is intended as an accompaniment to; group, and one-on-one training provided by the lab manager and monitors. Orientations are available at the beginning of each semester, and by request of class instructors throughout the year.

Digital Fabrication

At the University of North Carolina Charlotte, Department of Art + Art History digital fabrication refers to a process that begins with an artist using computer-aided design software (CAD) to create a design for an artwork digitally. The digital design can then be turned into a physical object by traditional wood and metal working methods in the 3D Studio, or by using a computer numerically controlled (CNC) machine. At the Rowe Digital Fabrication Lab artists have a variety of CNC machines to choose from, each capable of processing different types of objects and materials. If the artist chooses a CNC process there is an intermediary step, where the CAD design is transferred to computer aided-manufacturing software (CAM) to write a set of instructions for the machine to follow called G-code. Each machine employs its own CAM software for the creation of G-code, most software offers the capability of writing a "recommended" G-code, or allows the artist to manipulate the G-code to produce a wide range of results analogous to seeing evidence of the "artist's hand" in a painting or sculpture.

The Golden Rules

- Sign in when entering the lab
- RoFL is to be used for University projects only
- You must attend the RoFL safety orientation and pass the RoFL safety manual test to use the lab
- Only authorized students may be in the lab afterhours – No guests
- Do not use any equipment for which you have not been trained
- Guests must sign in to the lab and may not use any of the equipment
- Adhere to all posted safety precautions, and instructions given by RoFL staff and/or course instructors
- Always consider the safety of others in the lab
- No food allowed in the lab
- Do not use any equipment while under the influence of alcohol or drugs
- Clean your work space before leaving the lab
- When in doubt, ask

RoFL Policies

Access to the lab: Access to the lab and the use of equipment is limited to faculty, staff, and students currently enrolled in the College of Art + Architecture, who have completed a lab orientation, and passed the RoFL Manual Test. Upon completion of these requirements, a sticker will be placed on your UNCC ID designating you as a certified RoFL user. Certification is valid for one academic year (August-July) and must be renewed each Fall semester to maintain access to the lab.

Certification Renewal: To renew RoFL certification you must re-take and pass the RoFL Manual Test. In person orientation is not necessary for renewal. This can be done at any time of the year during hours that the lab is open.

RoFL Orientations: Open orientations are available during the first 3-4 weeks of the Fall and Spring semesters; a sign-up sheet will be posted outside the lab. Some classes will schedule private orientations during class time so check with your instructors before signing up for an open orientation.

Lab Hours: Lab hours vary each semester. Open hours will be posted on the RoFL door by the second week of each semester. Summer hours may be limited to appointments only.

Afterhours Access: Students enrolled in a Digital Fabrication class may be given 24-hour swipe-card access to the lab if access is deemed necessary by the course instructor and lab manager. Students with this privilege will be instructed on what equipment is available to them outside of open hours. A signed RoFL Afterhours Agreement is required for this privilege. The RoFL Afterhours Agreement outlines specific policies for use of the lab outside of open hours, a copy can be found in the *Agreements* section of this manual.

Guests: Uncertified guests are allowed in the lab only during monitored lab hours. Guests may not use any of the lab equipment.

Food and Drink: No food is to be consumed in RoFL. Drinks must be in a container with a lid.

Materials Use and Storage: Materials brought into the lab must be approved by the RoFL manager prior to their use. All chemicals must be clearly labeled and stored in proper containers (no reused food or drink containers). Space is limited in the lab, staff must approve storage. Materials left in the lab must be labeled with your name, year, and semester. All stored materials must be removed from the lab by the end of exam week each semester, or other arrangements must be made with RoFL staff prior to Winter or Summer breaks.

Payments: All purchases and fees due to RoFL can be paid via 49er card only. Payments may only be made with your own 49er Card.

Revocation of Privileges: Access to RoFL will be revoked to anyone who knowingly fails to comply with lab policies and/or jeopardizes the safety or well-being of other users or themselves.

Material Purchases

RoFL offers *some* materials for purchase (prices posted in the lab). Materials commonly available are; bass wood in various thicknesses, and acrylic sheet in various thicknesses and colors. The inventory changes often so check with staff on availabilities. Additionally, the necessary material for 3D printing is available through RoFL, you are required to pay for the material used to complete your prints. Special permission is required from the lab manager for the use of 3D printing materials not purchased from the lab.

Material costs may change without notice, check with RoFL staff for current pricing

Fees

Some equipment in the lab requires the payment of a fee for its use, or the purchase of material from the lab.

All fees and material purchases must be paid in full before removing laser processed, or 3D printed materials from the lab. RoFL will hold un-paid laser processed materials, and 3D prints for 1 week, after which time they may be recycled.

Laser Processing

- $3.00 per 30 minute block ($3.00 minimum)
- Must be paid in full before removing laser cut/engraved material from the lab

3D Printing

- $2.00 minimum charge for 3D printing
- Must be paid in full before removing prints from the lab
- Material cost:

	PLA	$0.25 per gram
	PVA	$0.35 per gram
	ABS	$0.25 per gram
	SLA Resin	$0.60 per ml

Prices may change without notice, check with RoFL staff for current pricing

Know the Warning Signs

All faculty, and students are expected to read, understand, and follow all posted instructions. In addition to instructional and policy signage, the equipment in RoFL is marked with warning labels for specific hazards associated with the use of each machine. It is the user's responsibility to; look for, read, understand, and follow these warnings when using any piece of equipment in the lab. If you are unsure of specific safety protocol for a machine, ask for clarification before attempting to use it.

Warnings you may encounter

Most warning labels you will encounter are accompanied with a written description of the particular hazard, some will use a graphic only.

Eye Protection Required

Ear Protection Required

Dust Mask Required

Emergency Eye Wash Station

General Warning

Electric Shock/High Voltage

Electric Shock

Hand Entanglement/Gears

Hand Entanglement/Belts

Sharp Instrument

Hand Crush

Rotating Gears

Rotating Blade

Pinch Point/Moving Parts

Flying Debris

Flying Debris and Loud Noise

Corrosive Material

Hot Surface

Laser Beam

Ultraviolet Light

Toxic Material

Flammable Material

Oxidizing Material

Automatic Start-up

RoFL Equipment Inventory

3D Printing

Fused filament fabrication (FFF) is a 3D printing process that extrudes and deposits a continuous strand (filament) of thermoplastic material. The material is loaded into the machine on a spool and extruded through a heated print core to produce a very fine thread of plastic that builds layer upon layer to produce a 3 dimensional object.

RoFL has several different 3D printers that employ this process. Objects can be printed in Polylactic Acid (PLA) or Acrylonitrile Butadiene Styrene (ABS) plastic in wide range of colors. Specialty materials may be used in some machines with the approval and supervision of the lab manager.

FFF filament spools

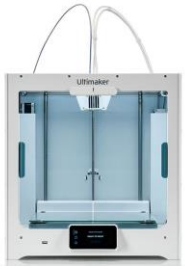
Ultimaker 3

- Dual extruder multipurpose 3D printer
- PLA printing only with PVA available for support material in some instances
- Resolution: 0.2-0.06 mm layer height
- Maximum build volume (x,y,z): 7.67 x 7.67 x 7.87 inches (195x195x200 mm)
- File type supported: .stl .obj
- CAM: Cura
- Large variety of colors available
- **A detailed user guide is included later in this manual**

Safety

- Do not reach into the machine while any parts are moving
- Do not touch the print core, it becomes very hot
- Only RoFL staff may perform maintenance

Ultimaker S5



- Dual extruder multipurpose 3D printer
- Various materials may be printed in combination with the appropriate print core
- Resolution: 0.3-0.04 mm layer height
- Maximum build volume (x,y,z): 12.99 x 9.45 x 11.81 inches (330x240x300 mm)
- File type supported: .stl .obj
- CAM: Cura
- **A detailed user guide is included later in this manual**

Safety

- Do not reach into the machine while any parts are moving
- Do not touch the print core, it becomes very hot
- Only RoFL staff may perform maintenance

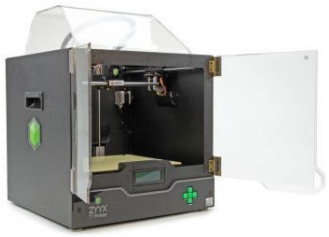
MakerBot Replicator

- Single extruder 3D printer
- PLA printing only
- Resolution: minimum layer height 25 microns (0.001 inch)
- Maximum build volume (x,y,z): 11.2 x 6 x 6.1 inches (285x153x155 mm)
- File type supported: .stl .obj
- CAM: MakerBot Print

Safety

- Do not reach into the machine while any parts are moving
- Do not touch the print core, it becomes very hot
- Only RoFL staff may perform maintenance

ZYYX 3D Printer



- Single extruder 3D printer
- PLA and ABS printing. These machines can be used with experimental materials if approved by the lab manager.
- Resolution: minimum layer height 50 microns (0.002 inches)
- Maximum build volume (x,y,z): 10.63 x 9.05 x 7.67 inches (270x230x195 mm)
- File type supported: .stl
- CAM: Simplify 3D

Safety

- Do not reach into the machine while any parts are moving
- Do not touch the print core, it becomes very hot
- Only RoFL staff may perform maintenance

Axiom Airwolf

- Dual extruder 3D printer
- ABS printing only
- Resolution: minimum layer height 40 microns
- Maximum build volume (x,y,z): 12 x 8 x 9.5 inches (305x203x241 mm)
- File type supported: .stl
- CAM: Cura, APEX, Simplify 3D

Safety

- Do not reach into the machine while any parts are moving
- Do not touch the print core, it becomes very hot
- Only RoFL staff may perform maintenance

Extruded clay printing utilizes the same principles of FFF while substituting thermoplastic filament with clay, allowing for a modern digital fabrication process to be employed with a millennia old medium.

To begin, the desired clay body is worked to a suitable consistency for extrusion and loaded into a pressurized cylinder. This clay is then forced through a print head fitted with a fine nozzle that produces a very thin clay coil. Following G-code instructions, the machine builds layer upon layer of coils to produce a clay object. Post-processing involves normal ceramic techniques and processes; the clay object can be manipulated while wet, dried, bisque fired, glazed, and fired.

Note: Proper clay consistency is crucial to successful printing, this is affected by both the artist, and the environment. Several test prints should be run at the beginning of each day the clay printer is used, to determine proper print-speeds and layer heights.

Delta Wasp 20 40

- Single extruder clay printer
- Many clay bodies are suitable for printing, some examples are: porcelain, stoneware, and earthenware
- Resolution: Minimum layer height 0.5mm
- Maximum build volume (cylindrical build plate ø,z): 7.87 x 15.75 inches (200x400 mm)
- File type supported: .stl .obj
- CAM: Simplify 3D, Cura

Safety

- Do not reach into the machine while any parts are moving
- Ensure both ends of the tank are screwed on completely before pressurizing
- Do not pressurize the tank with old or dried material in the tank or tubing
- Do not exceed maximum pressure **8 bar**
- Do not pinch or obstruct flow of material through tubing
- During operation periodically check that all tubing connection points and tank end caps are secure
- Ventilation is required when mixing dry clay
- Clean work areas and machine with wet sponges and mops to avoid dry clay dust from becoming airborne
- Only RoFL staff can perform maintenance

Stereolithographic Apparatus (SLA) refers to a 3D printer and process where a focused light is used to create a reaction with a photo-polymerizing resin causing it to solidify. Like the FFF process thin layers are built one on top of the next to produce the object. However, rather than building up from the build plate, resin printing suspends the build plate over a tank filled with liquid resin, the first layer is solidified in a way that it is attached to the build plate, then the platform is moved up and the next layer is printed, this process continues giving the illusion that the object is emerging from the resin tank. SLA can be applied in variety of ways for use with many different materials. RoFL SLA printers are designed for use with photosensitive resins that range from rigid plastics to soft flexible rubber.

Form 1+

- SLA resin printing process
- Rigid and flexible resins are stocked by RoFL
- Individuals purchasing their own resin must have it approved by lab manager before loading into the machine
- Finished prints must be cleaned of uncured resin with isopropyl alcohol
- Resolution: 25, 50, 100 microns (0.001, 0.002, 0.004 inches) layer height
- Maximum build volume (x,y,z) 125 x 125 x 165 mm (4.9 x 4.9 x 6.5 inches)
- File type supported: .stl
- CAM: Preform

Safety

- Do not reach into the machine while any parts are moving
- Always operate the machine with the lid closed
- Safety glasses, and nitrile or neoprene gloves required when filling resin tank and cleaning finished objects
- To avoid contaminating clothing, an apron is suggested when working with liquid resin
- Keep flames, and heat sources away from isopropyl alcohol
- Dispose of rags, paper towels, and gloves in trash.
- Rags soaked in alcohol should be laid out for alcohol to evaporate before putting in trash
- Clean spills immediately
- Only RoFL staff can perform maintenance

CNC Machining

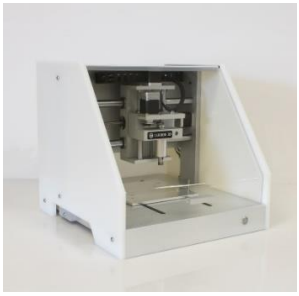
Machining is a subtractive process, objects are created by starting with a block or slab (blank) that is larger than the intended part, then removing material with small successive cuts until all that is left is the desired form. RoFL has both a CNC router and CNC mill, these machines work on the same principles, but have important differences in their intended uses.

Comparatively, CNC routers have a larger horizontal working area than CNC mills, and cut at much higher speeds. This limits the machines to cutting flat, soft materials like wood and foam, but does allow for large shapes to be cut quickly and accurately. CNC mills have greater vertical capacity and cut at slower speeds. This allows for much harder material like metals to be cut and in greater dimension than with a router, but the overall size of finished pieces is much smaller than is possible with a router.

CNC Mill

Milling operations are only to be completed under the supervision of the lab manager or course instructor. End mills (cutters) for exotic materials must be provided by the user, the lab manager will help with tooling selection.

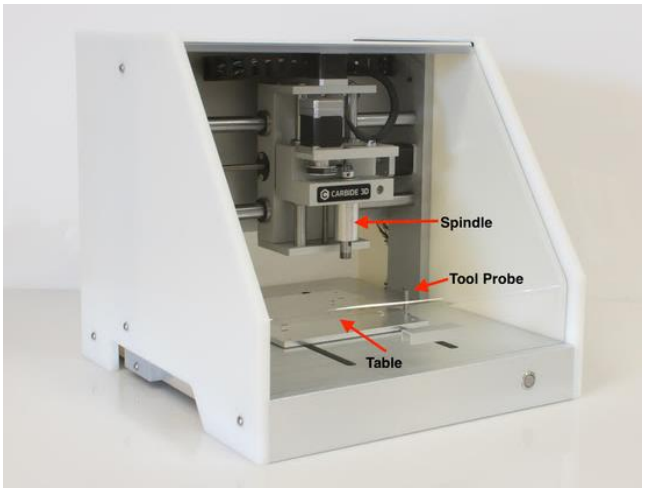
Nomad 883



- 3 axis CNC mill
- Material capabilities: wood, wood composites, plastics, hard wax, aluminum, brass
- Resolution: 0.005 inches
- Maximum cutting area (x,y,z): 8 x 8 x 3 inches
- File type supported: .stl
- CAM: MeshCAM

Safety

- Do not reach into the machine while any parts are moving or any time after an operation has been started
- Always keep the enclosure closed when in operation
- Be sure work piece is secure
- Inspect cutters for damage prior to use
- Monitor cutting until the operation is complete

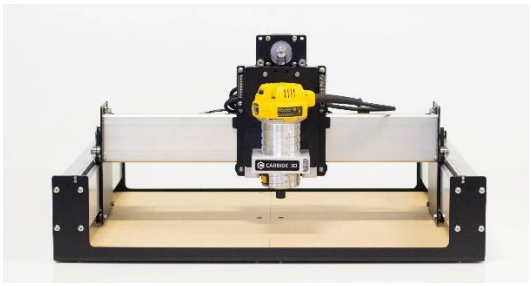


The parts of the mill

CNC Router

Routing operations must be completed under the supervision of the lab manager or course instructor. Routing operations will be conducted in the 3D Studio wood shop only, with dust collection adequate for the material being processed. Specialty cutters must be provided by the user, the lab manager will assist in tool selection.

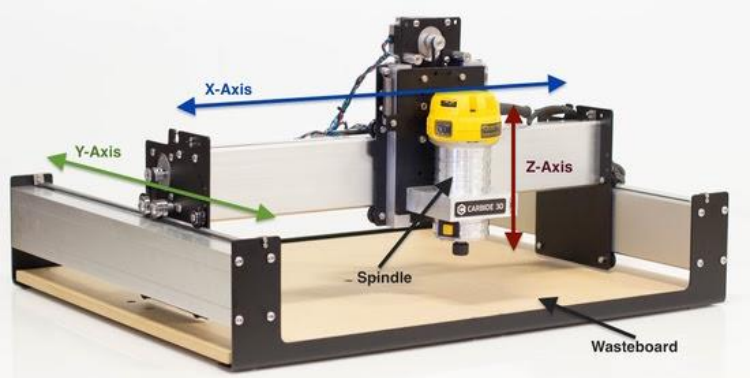
Shapeoko



- Material capabilities: wood, wood composites, some plastics
- Maximum cutting area (x,y,z): 16 x 16 x 3 inches
- File type supported: .stl
- CAM: MeshCAM

Safety

- Do not reach into the machine while any parts are moving or any time after an operation has been started
- Safety glasses required while the machine is running
- Hearing protection required while the machine is running
- Dust collection should be positioned away from moving parts
- Be sure work piece is secure
- Inspect cutters for damage prior to use
- Monitor cutting until the operation is complete



The parts of the router

CNC Embroidery/Sewing Machine

The embroidery/sewing machine available for use in RoFL has the capability of transferring digitally produced designs to a variety of fabrics. This machine is also capable of functioning as a traditional sewing machine. This machine can be used alone, or in combination with other processes in RoFL.

Brother SE400

- Multipurpose embroidery and sewing machine
- 67 built-in stitches
- Maximum dimensions (embroidery): 4 x 4 inches
- CAD & CAM: Sophiesew

Safety

- Keep long hair, jewelry, and loose clothing clear of moving parts
- Turn power off when loading thread or changing needles
- Keep hands clear of the needle when running the machine

Laser Processing

Laser processing is a CNC process that uses focused laser energy to cut and mark various materials. The ability to adjust the intensity of the laser beam, and the speed at which it travels over a material provides the user with a wide variety of mark-making options. While not all materials are compatible with laser processing many are, the RoFL staff is continually evaluating new materials for efficacy and safety.

VLS 6.60

- 60 watt laser cutter/engraver
- Engraving field dimensions: 18 x 32 inches
- Material capabilities: Hardwoods, paper products, acrylic, plus many more
- Maximum Material thickness: 0.25 inches (cutting)
  9 inches (engraving)
- Resolution: 83-1000 dpi
- File type supported: .ai .dwg .cdr
- CAM: Universal Control Panel (UCP)
- **A detailed user guide is included later in the manual**

Safety

- Never leave the machine unattended while running
- Only operate the machine with the exhaust system on
- Only use approved materials
- Do not stare at the light produced by the laser
- Do not attempt to operate the machine with an access door open
- Do not reach into the machine while any parts are moving
- Only RoFL staff can perform maintenance

3D Scanning

3D scanning is the process of using a device (scanner) to examine an object with the goal of gathering information about its shape. The information is collected in the form of data points that can then be used to construct a 3-dimensional digital model. The 3D scanner available at RoFL is a versatile, hand-held device that can be used in the studio or in the field. 3D scanning offers artists many possibilities in how artwork is created and viewed. Scanned 3-Dimensional models can be manipulated to create new objects, spaces and structures can be digitized in order to aid in the planning of large-scale installations, or scanned objects and spaces can be used to create augmented reality experiences.

Successful 3D scanning takes time, practice, and patience. When planning a project allow for set-up and break-down of equipment in addition to the time needed for scanning (1 ½ hours minimum for a small object). 3D scanning in RoFL will be done under the supervision of the RoFL manager or trained course instructors. Scanning to take place outside of the lab will require endorsement of the proposed project by course instructor **and** permission of the RoFL manager.

EinScan-Pro+

- High definition 3D scanner, with or without color
- Fixed scanning of small objects with turntable, 5kg (11.02lbs.) maximum weight
- Handheld scanning of large objects at RoFL or in the field
- Scan speed: 550,000 points per second (maximum quality)
- File type generated: .stl .obj .ply .asc
- Files are compatible with: Rhinoceros, MeshMixer, etc.

Projection Mapping

Projection mapping is a technique where an object, room, or landscape is turned into a display surface for video. By generating a 3-dimensional scan of the desired display surface AI driven software is able to crop and contour a projected image, video, or visual effect to that surface. Projection mapping can be applied in many settings; from events and performances, to architectural wayfinding, art installations, and more.

Projection mapping requires a fair amount of pre-planning and time for installation. Additionally, hardware will need to be set up in a secure and safe way, and must be left undisturbed throughout the duration of the project. Arrangements must be made with RoFL manager well in advance of project installation. A project proposal that includes the location of the project and a detailed plan for securing the equipment while it is in the field is required.

RoFL is equipped with the following hardware for projection mapping projects. Additionally, your site must have electricity available, and an unsecure WIFI network (5.0 or 2.4 GHz)

Lightform LFC

- Scan camera and processor

BenQ MH733

- 1080P
- 4000 Lumens
- 1.15-1.5:1 Throw Ratio

Dell XPS Laptop

- Running Lightform Creator software

User Guides

The user guides that follow are intended to aid in the understanding and safe use of RoFL's Ultimaker 3D printers and Universal Laser Systems VLS 6.60. The information in these guides is far more detailed than the descriptions earlier in this manual. They outline: the proper set-up and safe use of the machines, the use of CAM software specific for each machine, acceptable materials, tips for successful results, and more. It is the responsibility of all operators of these machines to be familiar with this information and to be up-to-date with any changes to procedures by periodically checking in with RoFL staff.

* *A note about 3D printers in the lab*: RoFL has several different types of 3D printers. This user guide looks specifically at the set-up and use of Ultimaker 3 machines. The principles of printing are consistent for all of the machines in the lab however some machines require the use of different slicing software and loading/unloading procedures will be slightly different. Additionally, some machines are capable of printing with materials not suitable for the Ultimaker 3's. Check with staff if your project will require a specialized material.

** *A note about Cura slicing software*: Cura is the preferred CAM software for use with Ultimaker printers. This software is updated on a frequent basis so the screenshots in this guide may not match with current versions of the software. This guide will be updated if a major change to the user interface occurs.

These guides are not a substitute for in-person training

LASER CUTTER USER GUIDE

The Rowe Digital Fabrication Lab is equipped with 1 Universal Laser Systems VLS 6.60 laser engraver. This machine employs a class II CO_2 laser to engrave and cut a variety of materials. A list of acceptable materials appears later in this guide. Over the past several years machines like ours have changed the way students and faculty at UNCC have approached creating architectural models, presentations, and artwork, by speeding up laborious processes and expanding the possibilities of various materials. As you read on please remember that the information in this document pertains to the correct and safe use of the machine and does not detail the creation of the files used with the machine. Your professors will be able to provide you with the best instruction on using CAD and illustration software.

Safety

- The laser is only to be used during monitored lab hours.
- Exposure to the laser beam can cause burns and severe eye damage. Never disable access door sensors or try to operate the laser cutter with access doors open.
- Never leave the laser cutter unattended while it is operating. Most of the materials used with the laser cutter are combustible and can ignite when in contact with the laser beam. If a fire should start inside the machine turn off the power to the machine, turn off the compressed air, turn off the exhaust system, alert those around you to the fire. If it is safe to do so try to extinguish the fire with the fire extinguisher and call 911.
- Do not reach into the machine while the focusing carriage and x axis gantry are moving.
- The laser cutters use high voltage. Never touch or tamper with the wiring inside the machine.
- Always operate the laser cutter with the exhaust system on. RoFL staff is constantly evaluating the materials being cut with the machine in order to ensure potentially harmful materials are not being used. That being said you should assume that the smoke produced by cutting could be harmful. Almost all of this smoke is expelled safely when the exhaust system is on. If the amount of smoke being produced seems abnormal stop using the machine and check with shop staff.
- Do not stare at the light produced while the machine is cutting.

Reservations

There is often high demand for the laser cutter, especially around mid-terms and finals. To ensure that projects get finished on time it is advisable that you make reservations for laser use.

- Reservations for the laser cutter can be made at https://teamup.com/ks9jfqintu2j454oh7
- Reservations can be made for 30 minute blocks
- Reservations are limited to 1 hour per day and 2 hours per week per person/group.
- Be on time and ready to cut. If you are late you forfeit your time.

Fees

- $3.00 per 30 minute block (minimum charge is $3.00)
- RoFL can only accept payments through 49er Card.
- You may only make a payment with your own card.
- Laser cutting fees are charged by the minute. Have your files ready to cut before you arrive. Charges begin when you open your cut files on the laser computer.
- If revisions to files are necessary, use one of the iMacs not connected to the laser so others may work while you make your changes. **You will be required to pay for all of the time you are using the laser computer.**

Terminology

Vector and Raster engraving - These terms apply to how the laser will cut your drawing, understanding them is very important in achieving the results you desire.
Vector cutting/engraving means that the laser will follow each line from beginning to end. This method of cutting is advantageous when you are cutting out parts because it produces a smooth clean cut at a fast speed.
Raster engraving means that the laser will move back and forth firing 1 dot at every pixel in your drawing. This method should not be used to cut out parts but is the only way to engrave solid areas, text, intricate patterns, and textures.

Compressed Air - This refers to the pressurized stream of air used to assist the laser cut as well as cool the focus lens

Focus Lens - This is the lens that focuses the laser beam onto the material you are cutting. It is important that this lens is focused correctly to achieve accurate cuts and reduce the risk of damage to the machine. It is also important to keep this lens clean because a dirty lens will retain more heat and eventually melt and crack (These are very expensive, be good to them)

Focus Tool - A tool calibrated specifically to the lens in our machine. It is used to set the correct distance between the material to be engraved and the focus lens. This tool is not easily replaced, **ALWAYS PUT IT BACK IN ITS PROPER PLACE**.

Engraving Field - This is the space inside the machine where the laser will operate.

Set up and Use of the Machine

The following highlights the most important steps of setup and operation of the laser cutter. More detailed instruction is provided during orientation. The laser cutter is controlled by UCP software on the laser computer. Almost all adjustments to the machine will be made through this software.

Processing your files

Save your file to a USB drive as .dwg or .ai**,** the laser in RoFL can process files created in AutoCAD, and Adobe Illustrator. Print screens for each of these programs vary slightly, once you have sent the file to the laser the procedure is the same regardless of the software used to create it. RoFL staff are always available to assist you.

AutoCAD Set Up

- Open drawing and select plot
- Select printer (VLS6.60)
- In pop-up select “Use the default paper size User-Defined LANDSCAPE”
- In the “What to plot” dropdown select window. Now select the drawing you want to cut by dragging a box around it.
- In the plot scale menu either check “fit to Paper” or “Custom” if custom select your desired scale in either inches or millimeters
- Under the Plot Options section of the screen be sure that the only box that is checked is “Plot stamp on”
- Now select “Preview…”
- If everything looks correct click “plot”

Adobe Illustrator Set Up

- Open the drawing and select print
- Select the printer (VLS6.60)
- Use the media size drop-down to select “user-defined LANDSCAPE”
- In the preview box to the left of the screen, drag your drawing to the correct part of the page.
- Click “Print”

UCP

- Open the UCP software by clicking this icon (this software controls the laser, diagrams of the main screen and important tabs appear at the end of this manual)
- Your drawing should appear in the engraving field part of the UCP main screen
- Click “settings” at the bottom right of the screen
- You will now be able to adjust the power, speed, and type of processing for each color present in your drawing. This can be accomplished either manually (recommended) or by using the material database to select these values for you.

Manual set-up

- Select the first color in the list that appears in your drawing, enter values for; power, speed, and ppi. Then select between; raster (rast), vector (vect), or skip in the drop-down on the upper right of the settings tab. **Click “set”.**
- Repeat for all of the colors that are in your drawing
- When finished click “apply” then “ok”

Remember to click SET after adjusting each color

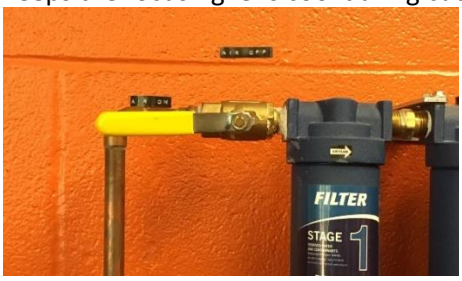
Material database

- From the list of materials select the material that you are working with. The list begins with broad categories that drill down to more specific materials. Once you see your material select it.
- Now enter the material thickness in the field at the bottom left of the tab. Thicknesses must be entered in Imperial measurements using a decimal format (e.g. ¼” = 0.25”)
- When finished click “apply” then “ok”

Starting up the Machine

- Turn on the machine (click on this icon in the upper right of the UCP main screen)
- Turn on the exhaust (switch on the wall to the right of the machine)

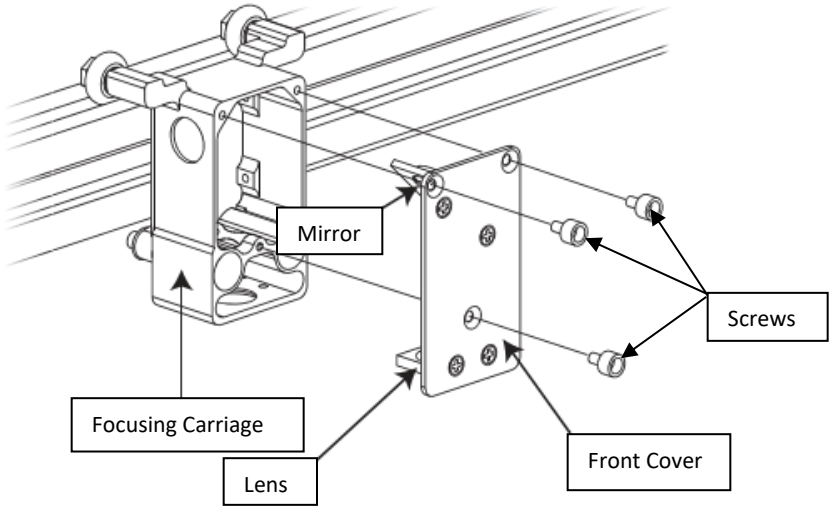
- Turn on the compressed air. (Yellow gate valve behind the computer) The compressed air keeps the focusing lens cool during cutting as well as blows debris away from the cutting area.

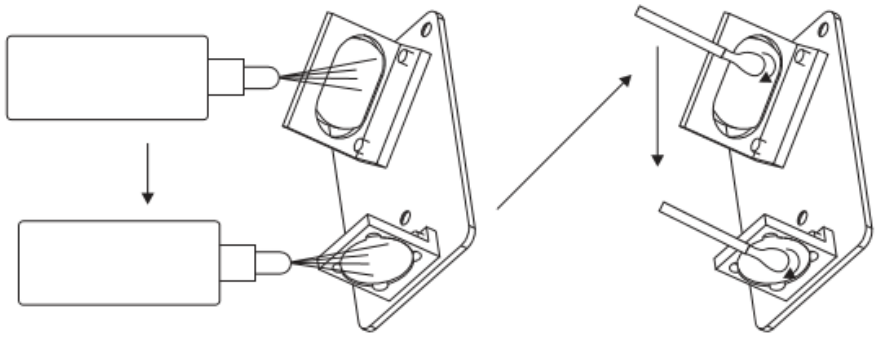


These 3 steps must always be complete before proceeding

Set-Up of Laser Cutter

- Check that the focus lens is clean. To do this, unscrew the 3 screws on the front of the black focus carriage. Remove the front cover and inspect the lens and mirror that are attached to its inside face. **Never touch the lens or mirror with your fingers.** If the lens or the mirror is dirty clean them with lens cleaner and lens paper or cotton swab.
  Never use paper towels or clothing to wipe the lens.
  When finished replace the cover to the focus carriage tighten screws finger tight only.
  Only clean the lens if it is dirty.

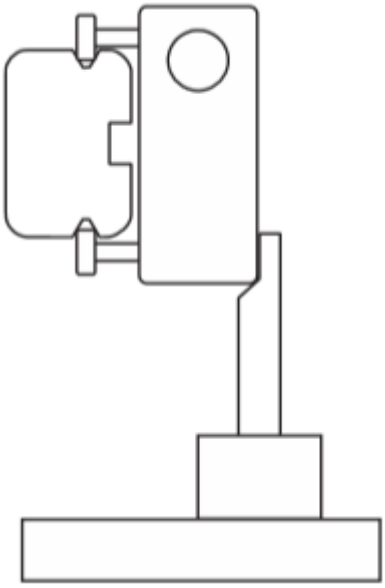


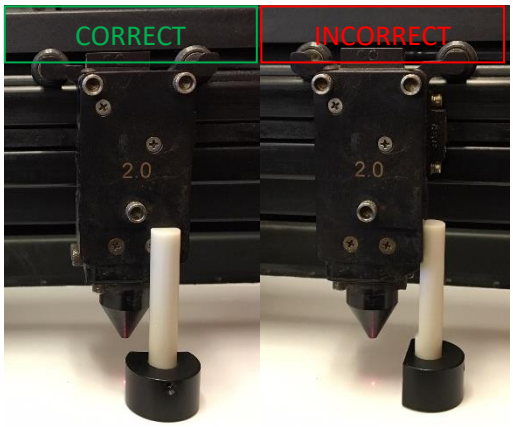


- Place material to be cut on to the cutting bed. The maximum size of the cutting field is 18 x 32 inches. Material must lay completely flat on the bed otherwise it cannot be cut.

- Focus the laser beam.
    - Click the focus icon in the upper right of the UCP screen, then select a spot in the cutting field where you want to focus the beam. Once you pick a spot the focus carriage will move to that position.
    - Now place the focusing tool in **front** of the carriage with the flat side of the tool touching the front plate of the carriage.
    - Using the up and down arrows raise and or lower the bed until the bottom edge of the front plate is aligned with the notch cut into the focus tool.
    - Remove the focus tool and put it back in its place next to the computer **this tool has been calibrated to this machine and is not easily replaced**

Laser cutting is very sensitive to focus
so pay close attention to the fit of the focus tool





- Close the top access door.
- Now click the green start button.

Clean Up

When each cut is complete, wait 30 seconds before opening the access door so smoke remaining in the machine can be expelled. When you are finished clean all parts and debris from the cutting bed. Pick up all scraps from the floor around the machine. Check that the focus lens is clean. Turn off the compressed air, exhaust, and laser cutter. Check out with shop staff.

Important tips for good results

- The maximum size of material is 18 x 32 inches
- Colors are important. **Always create your files using the RGB color mode.** If not the laser cutter may not recognize the colors in your drawing resulting in missing parts or files that will not work. You tell the laser cutter how to cut your drawing by making each different type of cut with different colors. The laser cutter cycles through the different colors in your drawing by processing all colors in the order below, it will engrave all colors set for raster first, then move through all vectors. It is best to set your drawing up using these colors from the shallowest cuts to the deepest cuts. This way small pieces will not be cut free and blown around while you are asking the laser to engrave them. When setting up your print job you should always set the laser to skip colors that are not being used.
- The order of colors is:

BLACK (raster engraving with Illustrator but should not be used with AutoCAD)
RED (recommended for vector engraving)
GREEN (recommended for cutting)
YELLOW
BLUE
MAGENTA
CYAN
ORANGE

By using different colors you are able to produce multiple types of marks. With this file the laser will first raster engrave all of the black text, images, and outlines. Next it will raster engrave the cyan objects with different settings to produce a deeper engraving. Next the red outline will be engraved as a vector. Finally the green outline will be cut through the material.

Important tips for good results (continued)

- The depth of cut is determined by the power and speed that the laser is set at for each color. Example: for a cut through thick material the power will be very high and the speed very slow or for a light engraving line the power will be low and the speed will be fast. We have samples and recommended settings for the most commonly used materials in the lab but it is always best to plan to do some test cuts to make sure you get the results you want.

- Line weight for cuts must be as small as possible AutoCAD = 0.00, Adobe Illustrator = 0.001

- Leave a very small space on cut lines so small parts stay attached to the larger sheet. This makes removal from the machine easier, and will help you not lose small parts.

- Draw an 18 x 32 inch box around your drawing with a color that you will not cut. This is useful for organizing your parts before cutting.

Common Problems

The following are some of the most common problems that occur during cutting. If trying one of the suggested solutions does not work alert shop staff, the problem may be a symptom of a mechanical problem.

-*You press start on the machine but nothing happens or the carriage is moving but not cutting.*
One of the access doors is not completely closed; make sure that the top and front doors are securely closed

-*Cuts are not going all the way through material.*
Always check that the lens is clean first. Only if the lens is clean you can increase the power and decrease the speed

-*You click plot but nothing is sent to the laser cutter.*
AutoCAD users make sure that the only plot option checked is “Plot stamp on”
Adobe Illustrator users be sure that color and line weights are set correctly.

-*Parts are not cutting correctly and/or some parts are missing.*
You did not click “set” after making changes to power and speed settings and/or some colors are checked as “skip”

-*Some or all of your drawing is not appearing in the UCP screen.*
Check that your original file is set to RGB color mode and vector line weights are correct

Tips for AutoCAD users

- Line weight should be 0.00

- If you are using an educational version do not use black lines so you can avoid having the "Educational product" stamp included on your parts. Also the way the laser reads that text can confuse it with other parts of your drawing

- We occasionally have problems with files created using the Mac version of AutoCAD, if possible use a PC

- Intricate textures should be engraved in raster mode even if the texture is composed of lines

- Text should always be set as its own color

Tips for Adobe Illustrator Users

- Be sure to create your file using RGB mode. Colors usually cause the most problems with the laser cutter, Use the guidelines below to adjust your colors

COLOR	RED	GREEN	BLUE
BLACK	0	0	0
RED	255	0	0
GREEN	0	255	0
YELLOW	255	255	0
BLUE	0	0	255
MAGENTA	255	0	255
CYAN	0	255	255
ORANGE	255	102	0

- Line weight should be set to 0.001

Materials

The laser is capable of processing many different materials safely. However, some materials pose serious risks to your health and can cause damage to the machine and building. RoFL staff is constantly researching new materials and evaluating those that we currently work with to find the safest practices and best results. It is not always possible to tell if something is safe to cut or not only by looking at it, so it is required that you are able to identify any material brought into the lab. For example, Plexiglas and Lexan look and feel identical however, they are very different types of plastic. Plexiglas is safe to laser process, but Lexan can easily catch fire and produces both hydrochloric acid and chlorine gas as part of its fumes.

Materials suitable for the Laser Cutters

all cutting is limited to ¼ inch thickness
Paper
Chipboard
Matte board
Museum board
Corrugated cardboard
Bristol board
Foam core (poor results with small pieces)
Acrylic (cast acrylic is recommended) Plexiglas and Lucite are acrylic
    Leave protective paper on while cutting and engraving
Woods: Bass, balsa, maple, cherry, poplar, walnut, oak, birch are the most common
MDF
Plywood
Hardboard (Masonite)
Leather (dyed leather requires approval)
Cork
Non-Chlorinated Rubber (engraving only)
Glass (engraving only, ¼ inch minimum thickness)

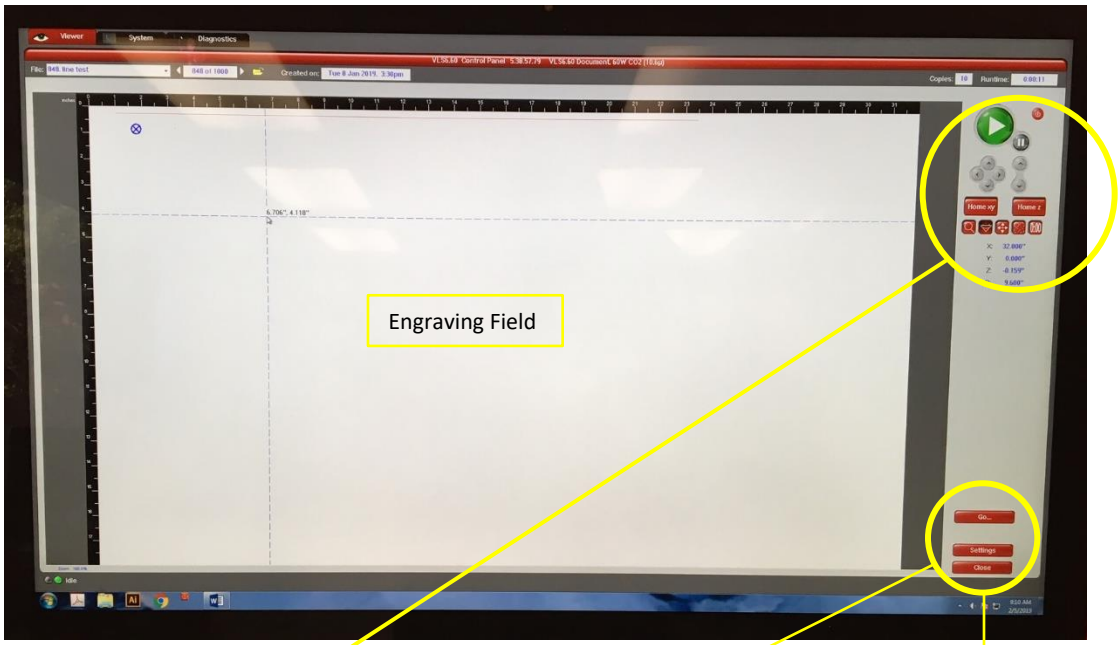
This list is comprised of only the most commonly used materials. **Any materials not on the above list that you want to cut must be approved by the Fabrication Lab manager prior to cutting. This is strictly enforced failure to follow this policy will result in immediate loss of lab access.** To gain approval bring a sample of the material and/or MSDS (if available) to the lab between the hours of 8:00a and 5:00p Monday thru Friday for inspection. Or send an email to Jonathan at jpellitt@uncc.edu with a description of the material and a link to where you will be purchasing it.

Materials That Are Not Allowed

Polycarbonates (Lexan, Mylar, acetate, etc.)
Soft woods and some hardwoods with high resin content
    Examples: Pine, cedar, spruce, fir, cypress
ABS plastic
Vinyl (this includes PVC and PCV)
HDPE (milk bottle plastic)
Synthetic fabrics (nylon, polyester, pleather, etc.)
Fiberglass
Polyester resin
Polystyrene foam
Polypropylene foam
Mirrored materials

These materials are strictly prohibited because they are hazardous to both your health and the equipment. Anyone knowingly using these materials in the laser cutters will immediately lose lab access and be held liable for any damage caused to equipment. No exceptions will be made.

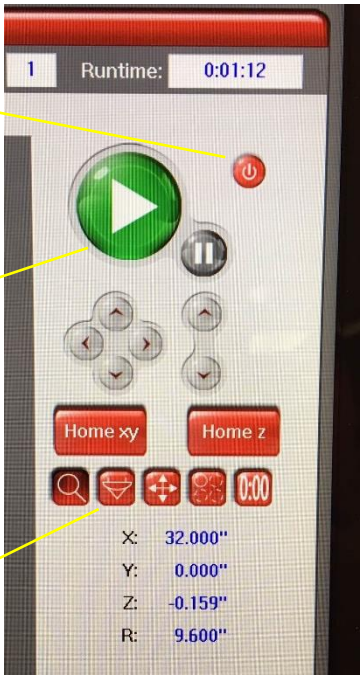
UCP Main Screen



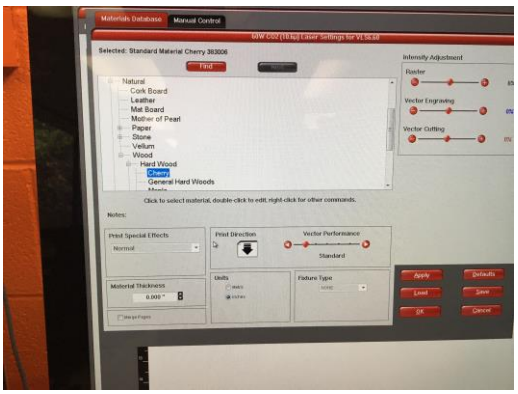
Power

Start

Focus



Manual Settings Tab



Material Database Tab

3D Printer User Guide

The Rowe Digital Fabrication Lab has several 3D printers with varying capabilities. This guide will detail the set-up and operation of the Ultimaker 3 machines. Similarities exist between all the 3D printers in RoFL, this guide will form a foundation for training on other machines as your projects require them. The Ultimaker 3 is a fused filament fabrication (FFF) printer, meaning a continuous strand of heated thermoplastic is extruded in thin layers, one on top of the next, to build a 3-dimensional object. As you read on please remember that the information in this document pertains to the correct and safe use of the machine and does not detail the creation of the files used with the machine. Your professors will be able to provide you with the best instruction on using 3D modeling software.

Safety

- Do not touch the print core (hot end) or build plate for a few minutes before and after a print job has been initiated. These surfaces become very hot
- Do not reach into the machine while any parts are moving
- Only use filament supplied by RoFL
- Do not tamper with wires or mechanical components
- Do not attempt any maintenance, this is only to be performed by RoFL staff
- Models printed in RoFL are not considered food safe, do not use objects made with these machines for food preparation or service

Printer Status and Reporting Problems

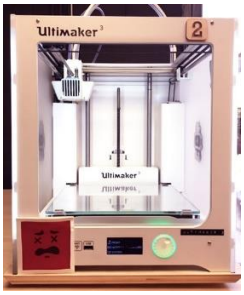
The operational status of each printer is displayed using green, yellow, and red cards. If you encounter a problem while printing you are responsible for alerting RoFL staff as soon as possible.

- Report the issue to the RoFL manager or monitor on duty
- If using the lab after hours, change the status card on the machine and leave a note either on the machine or dry erase board. Include a short description of the issue and your contact information.

Maintenance may only be performed by RoFL staff

Working fine

Something might be wrong



Not working

Reservations

Demand for 3D printing can be high around mid-terms and finals. It is advisable to always reserve a printer in advance to ensure you will get the time you need with a machine.

To make a reservation: Go to this web address https://teamup.com/ks9jfqintu2j454oh7

Select the printer you wish to use if it is available block out the time needed to complete your print be sure to allow for enough time to remove it from the machine as well. If you are unsure of how much time you will need, RoFL staff can assist you. When making your reservation you will need to enter your name in the required field and include contact info in the description box.

Fees

- PLA $0.25 per gram
  PVA $0.35 per gram
- RoFL can only accept payments through 49er Card
- You may only make a payment with your own card
- Prints must be paid for in full before removing them from the lab

Printer Log

A printer log is kept with each machine. This helps track usage and allows RoFL staff to contact you if a problem is encountered during your print.
Each time you start a print enter in the log:

- Your name
- Contact info (email or cell number)
- Start date and time
- Estimated finish date and time
- Amount of material to be used (in grams)

Terminology

CNC – Computer Numerically Control is the automated control of a machine by a computer.

CAM – Computer Aided Manufacturing is the term used to describe software that writes instructions that CNC machines can follow.

G-Code – the instructions that are produced by CAM software.

Slice – in 3D printing refers to the process writing G-code. This term is used because the 3-dimensional model to be printed will be converted into thin layers stacked on top of each other. Sometimes CAM software will be referred to as a slicer.

Filament – is the long continuous strand of plastic that is melted and extruded to print an object.

Print Core – the part of a 3D printer that heats up to melt filament. The print core is one part of many that make up the *hot-end* of a 3D printer.

Extruder – this is the mechanism that moves filament through the hot-end. Although often this term is used interchangeably with *hot-end* and/or *print core.*

Build chamber – the space inside a 3D printer where the printing takes place.

Build plate – sometimes referred to as the *stage*, this is the part of a 3D printer that an object is attached to while printing.

Materials

The Ultimaker 3 printers are reserved for PLA and PVA printing only. Due to variations in formulation and quality control of different manufacturers only filament supplied by RoFL should be used in the lab. This allows us to ensure consistent quality, predictable results, and proper machine calibration.

PLA (polylactic acid) is a biodegradable plastic that is derived primarily from corn. It is the most commonly used thermoplastic with FFF printing because it offers moderately strong prints, preforms reliably, releases few fumes, and is less sensitive to temperature variations during printing than other plastics.

- Used only with AA 0.4 print core
- PLA can be used to print 3-dimensional models and support structures
- Available in a wide variety of colors (check with lab staff for current inventory)
- Can be sanded, drilled, and machined

PVA (poly vinyl alcohol) is a water soluble plastic used for the printing of support structures that are difficult to remove. When printed with PVA a support system can be dissolved away after printing, this is especially useful for objects that require supports on interior surfaces.

PVA does not print as cleanly as PLA and has a higher incidence of clogging in the print core. Therefore it should only be used for support structures and the machine should be monitored frequently when using PVA.

- Used only with BB 0.4 print core
- PVA is used to print support systems only
- Water soluble

Requests for special colors can be made through the RoFL manager.

For projects that will require a large volume of material (more than 250 grams) check with the RoFL manager on availability. You may be given permission to purchase filament directly from the manufacturer with the aid of the manager.

The loading and unloading of material is covered during orientation. Only attempt to change filament spools after you have been trained by RoFL staff and feel comfortable completing the task. Failure to load filament correctly will result in failed prints and could damage the machine.

Set-up and Use of the Machine

The following highlights the most important parts of preparing a file to print and starting the machine, more detailed instructions are given during orientation. This guide does not cover the software used to create printable models, your instructors will be the best source for information regarding the use of 3D modeling software.

Cura is the CAM software used to turn your digital model into instructions the Ultimaker can follow, a detailed diagram of the main screen is included at the end of this guide.

Open your file

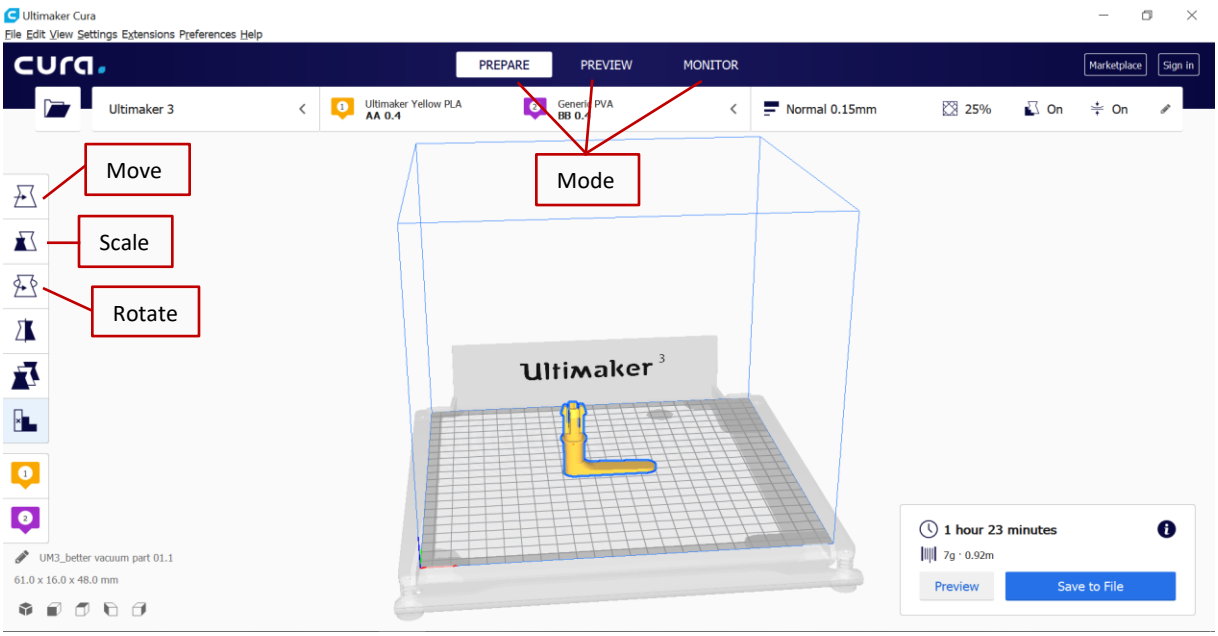
Open Cura on one of the iMacs in the lab by clicking this icon, put Cura in "prepare" mode by highlighting prepare at the top of the screen PREPARE, then use the folder button to select and open your file

- Files to be printed should be saved as .stl or .obj before bringing them to RoFL

Adjust scale, position, and orientation

The toolbar on the left side of the screen will allow you to adjust the scale and position of your object on the build platform.

- Scale can be changed both uniformly (all 3 axis proportionately) or each axis can be changed individually (this will distort the original model).
- Cura will only use millimeters (mm) as a unit of measure, models created with other units of measure will be changed (not converted) to mm when opened in Cura. This means an object that is originally 2.5 inches tall will be 2.5mm tall when imported to Cura.
- When printing multiple objects placement of each part on the build platform can be done using the move tool and rotate tool. Always be sure your object is resting on the build platform, otherwise the machine will need to print an unnecessary support system.
- The rotate tool allows you to orient your object.



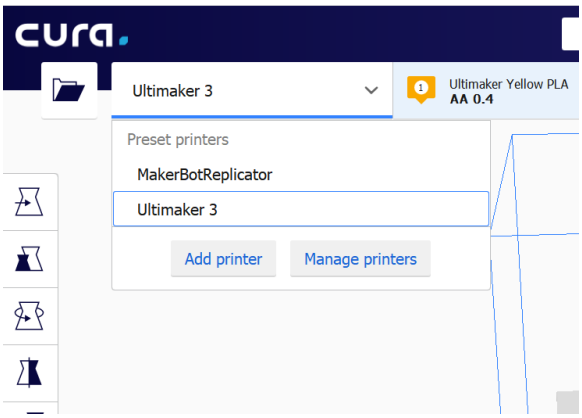
Select printer, assign extruder/s, and set specifications for your print

Using the tabs on the top of the screen you will choose between Cura recommended settings (usually pretty good) or custom settings. These tabs allow changes to be made to most aspects of the printing process. This allows the opportunity to affect the final appearance and functionality of the printed part. **Some settings are calibrated and set for compatibility with the Ultimaker 3 and the filament used, these settings should not be changed.**

Select Printer

The first tab on the left of the menu bar at the top of the screen allows you to select a printer. Cura can be used with the Ultimaker 3 and MakerBot Replicator 3D printers.

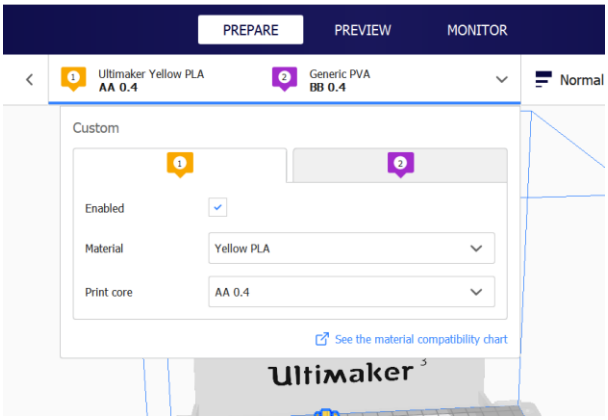
- Be sure **Ultimaker 3** is selected before proceeding



Select Extruder

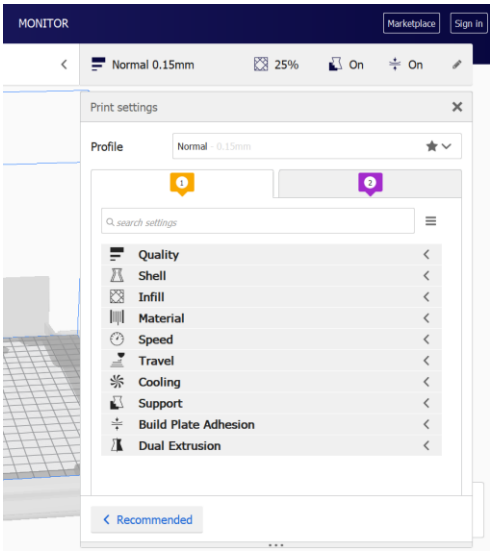
The next tab asks you to select an extruder, material, and print core.

- Click on the extruder you want to use to print your part/s (extruders are numbered 1 and 2)
- Using the dropdown select the type and color filament to be used (ex. Yellow PLA)
- Select print core with the second dropdown: PLA = AA 0.4 PVA = BB 0.4 **If the incorrect print core is selected a meltdown could occur in the machine.**
- After selecting a material, you will be prompted to "keep" or "discard" customized settings. **Always KEEP customized settings** (the customized settings refer to RoFL default settings)



Print Settings

After selecting the printer, and assigning the material and print core, you can adjust more aspects of your print or move forward with Cura recommended settings by clicking the recommended button at the bottom of the print settings dropdown. The recommended settings will produce prints that are very good quality. However, after a few prints you will become familiar with what the machine is good at and aspects that could be tailored to your needs.



By opening the print settings tab, you will be able to make changes to the following.

- **Quality** – under this tab layer height can be adjusted, this is the thickness of each extruded layer. The Ultimaker 3 can produce layer heights that range from 0.2mm-0.06mm. Small numbers produce finer detail but take longer to print, while larger numbers print faster the final surfaces are not as smooth.
- **Shell** – this tab contains details pertaining to the thickness of the surfaces of your object. 1mm is adequate for most applications.
- **Infill** – this section allows you to adjust the density of the object to be printed along with other attributes of the material deposited inside the print. Density is selected by entering a percentage for how much interior space will be filled (lower values will result in hollower objects, while higher values will create a denser print. 100% infill density will result in a solid object). You may also choose between several infill patterns, and select which extruder will deposit the infill material (these are useful options when printing in clear PLA, the infill will be visible so you could consider highlighting it with a different color).
- **Material** – this tab allows for printing temperature changes to be made. **Do not make adjustments to these settings.** The default settings have been calibrated for our machines to produce the best quality prints while minimizing the occurrence of meltdowns in the print cores.
- **Speed** – this tab shows the speed at which material is deposited. **Do not make changes to these settings.** The default settings have been calibrated for our machines to produce the best quality prints while minimizing the occurrence of meltdowns in the print cores.

Print Settings (continued)

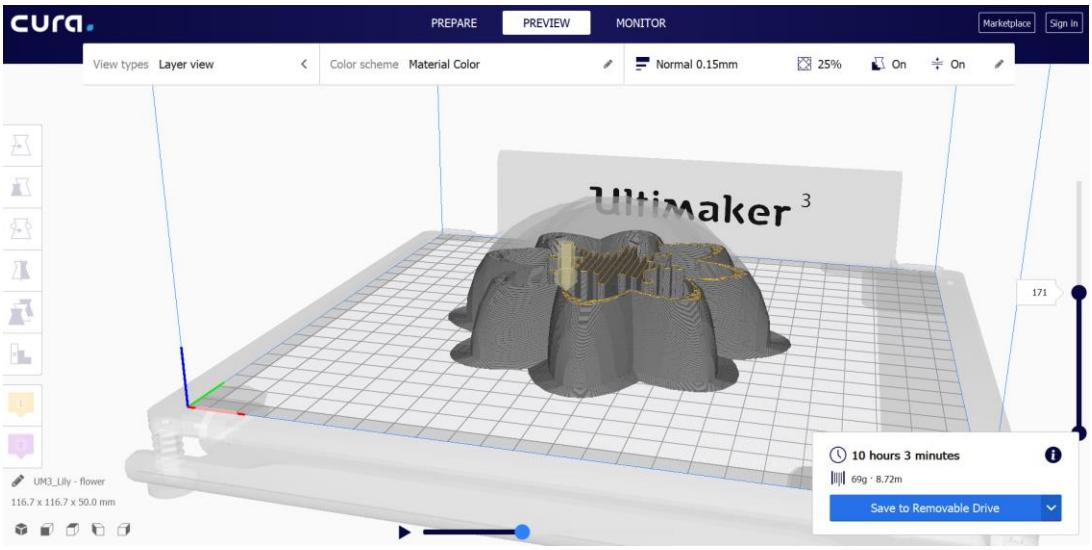
- **Travel** – this refers to how the print head moves around the machine while printing. **Do not make changes to these settings.** The default settings have been calibrated for our machines to produce the best quality prints while minimizing the occurrence of meltdowns in the print cores.
- **Cooling** – while printing the freshly deposited PLA needs to cool so that it will be sturdy enough to hold subsequent layers on top of it. This is achieved by blowing air from small fans mounted inside the print head. **Do not make changes to these settings.** The default settings have been calibrated for our machines to produce the best quality prints while minimizing the occurrence of meltdowns in the print cores.
- **Support** – under this tab you can select how, where, and with what type of material your object will be supported during the printing process. It is important to use supports for objects that have dramatic overhangs or are oriented in a way that there is not much of the object in contact with the build plate. Supports are generally easy to remove when printing is complete.
  There are 3 support attributes that can be manipulated:
  Support Extruder – this should be the same as the extruder you are using to print your object unless your supports need to be printed with a different color filament, or the supports are to be printed with PVA. **If using PVA be sure the printer you are using is equipped with a BB 4.0 print core.**
  Support Placement – select if the supports will be built off of the build plate and the object (everywhere), or from the build plate only (touching build plate). The touching build plate option will leave you with less clean-up however some parts of your object may not print correctly due to being unsupported.
  Support Overhang Angle – not every overhang will require supports. Use this tab to set the minimum angle at which a support will be generated. 60° is our default setting, this means that supports will only be printed for portions of an object that project over the build plate at an angle of 60° or greater.
- **Build Plate Adhesion** – it is important that your object stays well secured to the build plate during printing. Extra material can be used to aid adhesion to the build plate if your object or part/s of your object does not have enough surface area to hold itself in place. Should you need extra material to ensure adhesion to the build plate, there are 3 options:
  Brim – this is a single layer of material that extends out from every part of the object (and supports) that are touching the build plate. This option adds to the surface area of an object that is in contact with the build plate.
  Raft – this is several layers of material that are printed first onto the build plate, then the object is printed on top of this structure. A raft is ideal for objects that do not have much surface area in contact with the build plate (objects with small legs benefit most from the raft).
  Skirt – this is a line that is printed around the object but not connected to the object. A skirt can be used to monitor printer settings before printing of an object begins.
- **Dual Extrusion** – this tab is used to turn on/off the printing of a prime tower when the machine will switch between extruders throughout the printing process. Printing a prime tower allows the machine to extrude a small amount of material next to the object every time printing switches between extruders, this helps ensure material is at the correct temperature and flowing correctly when it is applied to the object.

Slice, Preview, and Save

Once you are finished adjusting print settings click the “Slice” button 

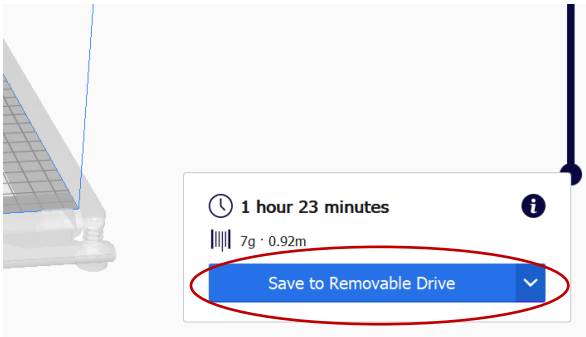
at the bottom right of the screen. This operation will prompt Cura to write G-Code for the Ultimaker 3. You will now see details such as; printing time, how much material will be used, and cost. *This process can take a few minutes to complete, be patient especially with large and/or complex objects.*

Next, switch from “Prepare” to “Preview” mode. In this view you will see the path that Ultimaker 3 will follow to build your object/s. In addition, if you will be using supports and/or a build plate adhesion method you will now be able to see them. Use this mode to verify that the machine will print your object correctly (i.e. the object is touching the build plate, all parts of your object are present, supports seem adequate, etc.).



Preview view

If everything looks correct save the file to one of the blue RoFL USB drives by clicking “save to removable drive” at the bottom right of the screen.



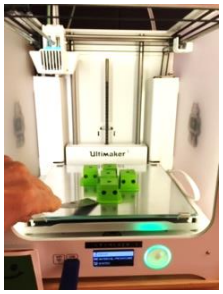
Printing

Take the USB drive to the printer you intend to use, if the printer is powered off turn it on with the switch in the back of the machine. Plug the USB drive into the machine.

Steps for preparing the machine and starting the print

- Prepare the build plate by removing the glass plate from the machine and cleaning it with glass cleaner, then reinstall the glass plate.
- Ensure there is enough material loaded to complete your print, and that it is the color you wish to use.
- If a different color or more material is needed ask a RoFL staff member to unload the existing material and load the correct material. **Hands on training with RoFL staff is required before attempting material changes yourself.**
- Select "Print" from the display screen. A list of printable files on the USB drive will be displayed. Select yours to start the print.

- Enter; your name, start date and time, expected finish date and time, and amount of material used in the printer log.
- Periodically check that your object is printing correctly. **RoFL is not responsible for failed prints caused by user error or poorly designed models.** You will be responsible for the cost of wasted material.
- When your print is complete, remove your object from the machine promptly and clean any debris left on the build plate and/or inside the machine.



Post Processing

After removing your object from the printer some degree of finishing work should be expected, tools and supplies for post processing are available at RoFL. Supports, brims, stringy material, etc. should be carefully removed with; fingers, pliers, tweezers, and/or x-acto knives. Surface defects can be sanded or filed. PLA can be left natural as a final surface, or it can be stained or painted (RoFL does not provide paint). Experimentation with finishing techniques is encouraged at RoFL, we are always learning something new.

Tips for Good Results

- Consider the orientation of your model carefully. The direction of layer lines will affect the final strength and appearance of your object. Orientation will also influence the number and placement of supports.
- Narrow vertical prints may require an extra-large brim and additional supports to keep the model stable during printing.
- Large and/or especially complex objects can be broken up into multiple parts to simplify the printing process, then the pieces can assembled after printing.

Common Problems

The following are some of the most common problems that occur during 3D printing. If trying one of the suggested solutions does not work alert shop staff, the problem may be a symptom of a mechanical problem.

- *Part or all of my model will not appear in Cura.*
  Your model is not a closed object. Repair the model in the CAD software used to create it.

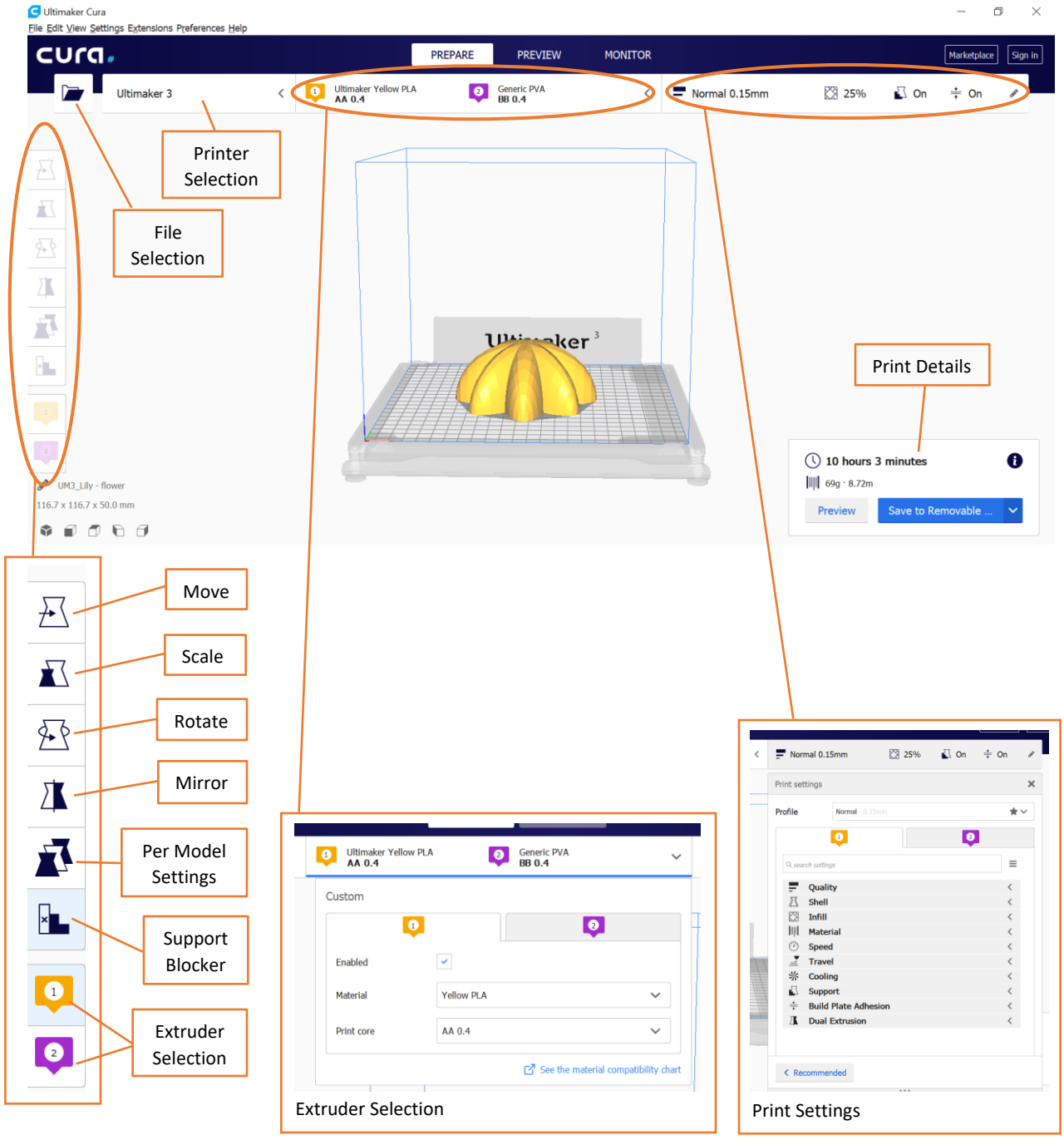
- *Part of my model does not print, or looks like "spaghetti".*
  Use supports to aid in the printing of overhanging objects.

- *Nothing printed but the build chamber is full of extruded filament.*
  Poor bed adhesion. Use a brim or raft to give your object a larger footprint. Be sure that the build plate is clean before beginning the print.

- *The printed surfaces are rough and there is a lot of stringy material attached to the model.*
  The extruder is starting and stopping several times (jumping) on each layer. Enable "retraction" in Cura settings to help minimize stringing. Consider reorienting the object to reduce the number of jumps. Reduce the number of individual parts on the build plate.

- *The extruder is moving but nothing is coming out.*
  Be sure material has been loaded into the proper extruder. If material is loaded correctly there is a filament jam or nozzle clog. Alert RoFL staff to correct the problem.

Cura 4.0.0 Main Screen



Agreements

After completing the Rowe Digital Fabrication Lab Safety Orientation and passing the RoFL Safety Manual Test all students wishing to use the lab must sign a RoFL Pledge. Additionally, students enrolled in a digital fabrication course necessitating 24-hour access to RoFL will need to complete the RoFL Afterhours Agreement. These forms will be kept on file by the RoFL manager. The documents in this manual are informational only, forms will be provided when all requirements for access are met.

RoFL Pledge

- **I pledge that I will adhere to all rules in the Rowe Digital Fabrication Lab.**
- **I pledge to have successfully completed a RoFL orientation.**
- **I pledge not to operate any equipment without first having the proper instruction from RoFL personnel.**
- **I pledge to use RoFL for school projects only.**
- **I pledge to wear proper personal protective equipment at all times while working in the lab.**
- **I pledge to always be alert and consider the safety of all while working in the lab. I will always practice safe procedures to not put myself or others in danger.**
- **I pledge to report all accidents to studio personnel.**
- **I pledge not to operate any equipment while under the influence of any drugs, alcohol, or medication.**
- **I pledge to pay for all material purchases and fees.**
- **I pledge to clean up my work area before leaving the lab.**

I,_____ have attended a basic Rowe Digital Fabrication Lab orientation and have had the lab safety procedures and policies explained to me. I pledge to abide by all of the above rules as well as instructions given by RoFL personnel. I understand that failure to do so will result in a loss of privilege to the Rowe Digital Fabrication Lab.

Major:_____

Print name:_____

Signed:_____ Date:_____

RoFL Afterhours Agreement

By enrolling in a digital fabrication course you are given the special privilege of 24 hour access to the Rowe Digital Fabrication Lab.

While using RoFL afterhours I agree:

To follow all RoFL policies and procedures.

To follow all written and verbal instructions from RoFL staff.

To keep doors closed, and be sure the doors are locked when leaving

To only use RoFL afterhours for digital fabrication projects.

To only use fused filament 3D printers.

To sign in and out of the lab.

To pay for materials used.

To not allow unauthorized guests into RoFL.

To not perform any maintenance or modification of any machine.

To inform the RoFL manager of any problems or concerns at the earliest possible opportunity.

To report any accidents.

I,_____ am enrolled in a digital fabrication course, have completed a RoFL Safety Orientation, and have been given instructions pertaining to the use of RoFL afterhours. I agree to abide by all of the rules above, as well as those that are not listed but where explained during RoFL orientation. I understand that while using RoFL afterhours I am responsible for the security of the lab, and my own safety. I understand that RoFL afterhours access is a privilege that can be revoked at any time for failure to follow lab rules and policies.

Course Name:_____ Course #:_____

Instructor:_____ Semester/Year:_____

Print Name:_____ UNCC ID #:_____

Signature:_____ Date:_____