

# dFab Manual

Academic Year 2017-2018

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## Welcome to dFab!

Welcome to dFab! The Digital Fabrication Studios at MICA (dFab) is a campus wide resource, which offers access to computer aided design and manufacturing workflows. This is an experimental space that is a little tricky to define. It's a blend of fabrication, programming, engineering, ceramics, fibers, wood, steel, printmaking and whatever other skillsets you bring to the table. It is a place where failure leads to success through iterations and perseverance. We encourage you to defy traditional boundaries and think outside the box.

With this privilege comes the added complexity and responsibility of maintaining a safe and effective work environment. To do this we must be honest with ourselves by admitting our strengths and weaknesses, while communicating effectively.

## What to Expect

As a participant in this environment, you are not expected to know how to do everything, but you are expected to know what a machine will do prior to pressing play. Follow good work habits by keeping your work area tidy, using the right tool for the job, documenting your work, and employing logical methods of deduction when troubleshooting problems on your own. Sometimes it takes repetition to attain a working knowledge, students should reach out for assistance in learning this equipment from dFab staff. Don't "just wing it." You should be sure EXACTLY what will happen when you press "start."

We are committed to offering a welcoming environment for beginners. This is complicated stuff and can be a bit overwhelming when you are new to digital fabrication. Seek out advice from our knowledgeable staff. Beginners are encouraged to start out with laser cutting.

Scheduled dFab courses have priority on equipment during their meeting times. Check the schedule and ask a technician for permission to work while a class is in session. Faculty and staff are welcome, but cannot impede on student work.

We understand that mistakes sometimes do happen. In the event that you damage equipment, do not attempt to recover on your own. Stop, make sure everyone is ok and assess why the mistake happened in the first place. Work through the issue with a student tech, and then contact the Digital Fabrications Studio Manager ([rmckibbin@mica.edu](mailto:rmckibbin@mica.edu)). You are not in trouble, but we want as much information as possible to avoid making the same mistakes in the future.

You should only use equipment that you have been trained on by an instructor or qualified shop technician. All our equipment is taught through coursework. It is your instructor's responsibility to discuss proper procedures with the class.

Information about equipment is on the dFab website <http://staff.mica.edu/rmckibbin/>.

## dFab Code

An adaptation of 10 bullets by Tom Sachs + Van Neistat

### Work to Code

- "Adhere to the systems already in place, inventions and developments must happen within the existing vocabulary," "don't jump ahead, stick to what has been defined for you."

- This is meant with the most positive of connotations, this structure allows for creativity. Understanding the process allows you to become inventive.

### Sacred space

- The studio is sacred space; this includes all surfaces in the shop, office, classroom, computer lab and patio.
- Respect of this space is essential
- Personal items should be discretely stowed out of the way, in the tech locker or placed on hooks
- All horizontal surfaces should remain swept and clean when not in use
- Do not become distracted with the work of others unless you are invited to do so.
- All respect should be given to a worker completing a task, this includes the restriction of abrupt actions and loud noises not related to work.
- Cellphones must be kept in silent or vibrate mode and calls should be restricted to work related issues only. When possible, calls should be handled outside.

### Be on time

- Come prepared and commit yourself entirely
- Refers not only to being punctual at the start of the day, but an “on the clock” mentality that should carry throughout all things.
- Your present task is your highest priority and it must command your focus
- Care for yourself mentally and physically so that you are well prepared for work
- Get sufficient sleep
- Maintain a healthy diet
- Proper hydration is essential
- There is time for work and time for play, finding time for each is paramount, work hard and play hard.

### Be Thorough

- If you notice that the studio is low on something, write it down on your list
- Thoroughness applies to the steps preceding and following a task as well as the task itself.
- Perform task to the precise exacting standards. Aka the code.
- Once the task is complete, test your work
- Re-set the work station, put everything away
- Clean work station
- Inform studio manager of what we were low on. Now it becomes their problem.

### Give Feedback or Acknowledgement (I understand)

- Sent does not mean received. Always get confirmation.
- “I understand” insures that the sender and receiver are on the same page
- Take out the trash at the end of the night “I understand”
- Be sure to lock the doors when you leave tonight. “I understand”
- Turn off the exhaust fan when you are finished. “I understand”
- Occasionally you may find a directive confusing. In such an instance the preferred terminology is “I don’ t understand”

## Keep a list

- Keep a prioritized list with you
- Keep track of details pertaining to your project such as phone numbers, part numbers, cut lists, quantities, hours worked etc.

## Reset

- Reset your workstation when you finish with a group of tools, or are about to do something that requires a clean environment like gluing up or taking apart a bearing.
- This reset is referred to as Knolling after the modernist industrial design and office furniture manufacturing company. Knolling can prevent mistakes and improve your work. ABK.
- How to knoll
  - Scan your environment for anything not in use
  - Put away anything not in use, if you aren't sure leave it out
  - Group all like objects
  - Align all objects to the surface they rest on or the studio itself
  - At the end of each step, in a process, reset.
  - A brief stretch is advised at this point.

## Iterate (persistence)

“Press on: Nothing in the world can take the place of persistence. Talent will not; nothing in the world is more common than unsuccessful men with talent. Genius will not; unrewarded genius is almost a proverb. Education will not; the world is full of educated derelicts. Persistence and determination alone are omnipotent. - Ray Kroc”

# dFab Policies

## General

### Access

All currently enrolled MICA students in good standing with dFab have access to this space during shop hours. Anyone wishing to use this facility must read this entire document, print and sign the dFab User Agreement and turn it in to the Digital Fabrication Studios Manager.

Use of this facility is a privilege. Access to dFab is revoked for the following reasons:

- Not cleaning up after yourself/putting tools away
- Repeated misuse of tools
- Repeated unsafe conduct
- Failure to immediately report a mistake leading to damage of our equipment
- Accessing dFab outside of posted hours without prior approval from the dFab Manager
- Repeated failure to comply with the guidelines outlined in this document
- Removing tools or equipment from dFab without permission from the dFab Manager

## Hours of Operation

Current Hours of Operation are posted on our website (<http://staff.mica.edu/rmckibbin/>). dFab is closed outside of our posted hours. A qualified technician must be present for dFab to be open. Only dFab

Technicians and advanced users may complete work outside of shop hours with pre-approval from the dFab Manager. The guards are instructed not to open dFab. If you are found working in dFab outside of the shop hours without prior approval from Ryan McKibbin, dFab Studios Manager, you will lose access to this facility.

## Software

We use Rhino3d extensively in this shop. A basic understanding of this software is a prerequisite for using this space. Primary sources for learning are the Rhino Level 1 Training Manual, available for download at [www.rhino3d.com/learn](http://www.rhino3d.com/learn), pressing F1 to access help from within Rhino, and video tutorials like what is offered at [www.Lynda.com](http://www.Lynda.com). The lab is a great place to learn because you can shout out questions to one another, which fosters a collaborative work environment. Be cool help a friend!

## Materials

We do not provide any materials for student or faculty use with the exception of glue, screws and 3d printing filament. These materials are provided for convenience, not for production. If you will be using a box of screws, a pint of glue, or are printing a run of objects, buy your own!

Scrap is provided for convenience too, do not steal scrap! It may be tempting to take nice pieces out of the scrap bin, do not take anything you will not be using immediately. Leave it there for later, we will all have what we need if we all have this mentality.

If you order materials from a local vendor for delivery, you must be present at the time that the delivery arrives at MICA. We will not accept delivery on behalf of any student, faculty or staff and will turn the driver away. Most vendors will take a cellphone number and have the driver call you half an hour prior to delivery.

Certain processes should not be performed in dFab (for example: melting wax, plaster casting, mixing concrete, epoxy/heavy fumes). Please discuss options with the Digital Fabrication Studios Manager, Ryan McKibbin.

## Attire

Proper shop attire is required at all times in the Machine Shop (S125). This includes:

- Closed Toe Shoes, no flip flops, shoes must have a back, no ballet slippers
- No headphones, you are welcome to share your music on our radio
- No loose or baggy clothing
- Long hair must be tied back
- Use eye, ear, and respiratory protection when necessary
- No long jewelry or rings on fingers when using tools in the machine shop

The above attire is expected only for the Main Shop (S125). The Computer Lab (S121), Classroom (S120), laser cutters and 3d printers (S124, S122) do not inherently necessitate this attire, however you are expected to have appropriate attire for the job you are performing. Improper attire is cause to be cited for unsafe conduct.

## Conduct

- Say hi to the tech on duty when you arrive. Check out with the tech on duty when you leave.
- No food is allowed in dFab. At your instructors discretion, food may be allowed only in the classroom (S120) only. No food should ever be in the computer lab. Drinks in a non-glass sealed bottle are permitted anywhere in dFab. Be mindful of where you set your drink, cold drinks sweat and can cause damage.
- If you have any questions or if something seems wrong, say something to the tech on duty
- Only use tools that you have had the proper training.
- Wear clothing for the task you are performing
- Clean up after yourself. You are responsible for cleaning up the shop, putting all tools away and putting tables back where they belong. If you need to store a project while in process, organize your project in such a way that it will be easy to move by someone else and discuss with the tech on duty.
- The tech on duty is in charge. What they say goes. Often when things are new to us, we remember them differently than intended. If you feel unsafe with what the tech recommends, just stop work and come by tomorrow to discuss with Ryan McKibbin. No one will get in trouble; these are fun hiccups that we like to identify to help keep everyone safe.
- Don't force anything, use the right tool for the job.
- Work together, if you see someone who needs help, help them.
- Put tools and equipment back where you got them.
- We do not check out tools. All equipment from dFab should be used in dFab.

## Laser Cutter

### Access

The laser cutters are a great place to get started and are open to the entire MICA community. We can generally accommodate independent projects from students across the campus, however please be conscious of large time consuming projects. If you have a huge laser cutting project discuss the project with Ryan McKibbin and we will come up with a plan. Start with vector cutting something small until you are familiar with the workflow and can work independently.

### Software

While it is possible to cut from a variety of software, as a shop we only provide support using these machines with Rhino. This is an easy to learn and inexpensive software that is very capable well rounded and very well suited for digital fabrication work. You must demonstrate proficiency on the lasers with Rhino before cutting from other software.

### Student in dFab class

Your faculty will schedule time for the class to learn these machines and practice in class. Faculty should review student files and bring any questions to the dFab Manager. Faculty should schedule time for students to demonstrate proficiency after instruction and practice time.

### Student not in dFab class

First watch the video on laser cutting which can be found by referring to the website. These videos are available only on the server and should be watched in the dFab computer lab. Once you have watched the video, prepare a simple file and come in during shop hours for help cutting the first time. Please check in with the tech on duty and make them aware that this is your first time. After you have demonstrated proficiency with the laser cutters, you will be able to operate them independently.

## Testing Settings

Always start with a setting that is too low, and run a series of tests on your actual material increasing power or (decreasing speed to increase the effective power) until you reach a setting that cuts through but does not start a flame.

## Materials

Anything on the Power Settings Sheet: Paper, mat board, card stock, Cardboard, chipboard, Plexiglas, organic fabrics (spray lightly with water first), solid wood, plywood (fewer plys is better), cork.

If you would like to cut a material that is not on this list, please stop in during office hours, or contact the Digital Fabrication Studios Manager, Ryan McKibbin.

Banned materials include: Foam Core, Glass, Lexan, Metals, Polycarbonate, PVC, Styrene, Vinyl

## CNC Router

### Access

Students wishing to use the CNC routers should take a class in dFab that covers the use of this equipment. We do not train students on this equipment outside of coursework. Your first project with this machine must be to cut a circle or rectangle 12" in diameter.

### Software

We use RhinoCAM to write the toolpaths for all of our CNC equipment. RhinoCAM is a plugin for Rhino which aids in the creation of gCode, a human readable text file which is actually sent to the machine. Essentially gCode is a list of x, y and z coordinates which tell the machine where to go. You must know how to draw and work in Rhino prior to attempting to use RhinoCAM.

### Student in dFab Class

For the first few times you use our CNC machines, you will work closely with your faculty while using our equipment to ensure that the proper procedures and safety measures are followed. Once you have demonstrated competency on the use of this equipment you should review any files you would like to cut with your faculty bringing any questions to the dFab Manager. Once both of you are satisfied with the file, post the \*.nc file to our server. After this meeting, your project will be added to the schedule and you can purchase material. You (the person who programmed the toolpaths) must stay and watch over your file as it cuts, verifying that the machine is doing exactly what is expected.

### Student who has taken a dFab Class or has used our Machines

You must first prepare your file in Rhino and create toolpaths in RhinoCAM. Once you think your file is ready to go, contact the dFab Manager to review the operations, tooling and machining practices you have used. Once we have agreed on a finalized file, we will add you to the calendar. You (the person who programmed the toolpaths) must stay and watch over your file as it cuts, verifying that the machine is doing exactly what is expected.

### Tooling/materials

Students will provide all materials, dFab provides a limited tool library. Students wishing to perform operations that necessitate tooling beyond our library purchase their own tooling.

If you break a tool, you are responsible for replacing that tool. The cause must be known and properly addressed prior to running the file again. A discussion of the cause involves the tech on duty and must

involve the dFab Manager if both you and the tech are not 100% certain that the problem has been resolved. The tools we use range from \$25 to \$65 each.

Generally, all wood and wood products are acceptable to use on our CNC router, with the exception of woods and treatments, which are toxic (such as pressure treating).

## **3d Printer**

### **Access**

Students currently enrolled in a dFab course are permitted to use these machines after class instruction. Watch the video and prepare your file accordingly prior to asking a tech if you can run a print. Longer or overnight prints must be approved; unapproved prints will be stopped by the tech on duty

Our printers are always set up for 1.75 mm PLA. Do not work on the printer yourself. You may change filament provide that you have been instructed on the process and that the filament is 1.75mm PLA.

We have many old rewrap machines. These machines may be checked out to students who want to modify them, print with ABS or print with 3mm plastic. Contact Ryan McKibbin if you would like to check one out.

## **Computer Lab**

### **Access**

Please check with the tech on duty if you would like to use the lab while a class is in session. This lab is intended for students currently enrolled in a dFab class to work on dFab coursework. This is not a space for writing papers, checking email or Facebook. Students who are not enrolled in a dFab class may use our lab to prepare files for our equipment, provided students currently enrolled in a dFab course are not waiting for a computer.

### **Conduct**

No Food and drink are allowed in the computer lab at any time, with the exception of a sealed non glass bottle. Do not unplug or touch the Ethernet jacks on the floor, for any reason! Please refrain from rolling around on the chairs, especially along the outer isles. This could destroy the thin ribbon cable which conveniently powers your workstation and delivers the world wide web.

## **Machine Shop**

### **Access**

All Potentially dangerous hand held and stationary power tools must be reviewed with a qualified technician before you use them.

The first stage after instruction is demonstrating competence. The second is demonstrating proficiency with the ability to articulate safety concerns and proper use of the tool. Until a student demonstrates proficiency, they must have the setup approved by another person who has demonstrated proficiency on that tool.

Upon completion of these steps, your name is recorded on the checkoff list for that machine and you are considered “checked off.” Students must check off on each tool before unsupervised use. You can be removed from the list due to improper conduct, aka. “a strike.” After a strike, you will need to go through the check off procedures again.

Faculty and Student Techs check off with Ryan McKibbin, Students can check off with proficient Faculty, Student Techs or McK. Faculty should consider the tools they want their students to use and organize check off time as part of class time.



## Materials

Students provide all materials with the exception of glue and screws. If you are using a ton of glue or screws you should provide them too.

Acceptable Materials:

Plywood, all domestic species of solid wood, OSB, Acrylic

All materials must be dry and free of foreign objects such as nails, staples and screws.

## Banned Materials

Insulation foam, MDF, Homasote, metal, pressure treated (green in color)

## Conduct

No Food and drink in the machine shop at any time, with the exception of a sealed non-glass bottle.

Do not remove tools from the machine shop without approval from Ryan McKibbin.

The Fabrication Studios Department (Ben Kelley, Ann, Mike, Ryan) reserves the right to revoke or suspend access for any student, faculty or staff member. No explanation is expected or required at the time of access refusal. The time for discussion may not be right now. It is your (student, faculty or staff user) responsibility to make contact and set up a time to talk.

## Attire

Do not use gloves while operating any equipment. You must wear closed toe shoes, short sleeves. Nothing can be hanging from your body such as a necktie, scarf, lanyard, or headphones. You must wear your own safety glasses. Hearing protection and a dust mask are discretionary.

## Electronics

The electronics desk is out for everyone to use, please do not remove any of the resources from this desk.

## Spray Booth

Check in with a tech before using the spray booth. You must clean out the booth immediately after your project has dried. Arrange with the tech when you will come back to clean up. We are required by law to keep a record of all chemicals used in the booth, inside the booth there is a binder where you must record your name, date, time student ID, material and amount used.

- No flames/smoking, No food, No drinks
- You must clean before you use the space and after you use the spray booth
- No personal materials are stored in the booth
- This room is left empty at all times. Cleaning staff is instructed to dispose of anything in the booth daily.
- One hour is permitted to allow your project to dry
- Approved materials
  - Water based products
  - Certain oil based products (no VOC above 1000 grams/liter)

## Safety

The fan must be running whenever anyone is spraying in this space.

“Volatile organic compounds (VOCs) are organic chemicals that have a high vapor pressure at ordinary room temperature. Their high vapor pressure results from a low boiling point, which causes large numbers of molecules to evaporate or sublime from the liquid or solid form of the compound and enter the surrounding air. For example, formaldehyde, which evaporates from paint, has a boiling point of only -19 °C (-2 °F).” “Health effects include eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system. Some organics can cause cancer in animals; some are suspected or known to cause cancer in humans. Key signs or symptoms associated with exposure to VOCs include conjunctival irritation, nose and throat discomfort, headache, allergic skin reaction, dyspnea, declines in serum cholinesterase levels, nausea, vomiting, nose bleeding, fatigue, dizziness” - Wikipedia

## **Environmental Health and Safety**

### **Emergency Procedures**

- Call 911 and give them the exact location of your emergency (911 from black phone).
  - 1400 Cathedral St. (Corner of Mt. Royal and Cathedral)
  - MICA Campus, Mt.Royal Station Building (stone building with clock tower)
  - dFab - First Floor
- You are calling from 410 225 3245
- Give your name
- Describe the nature of the emergency (injury, fire, etc.)
- Stay near the phone if possible to receive additional instructions
- Call campus safety at 443 423 3333

Campus Safety should be notified of all injuries. They can provide assistance with First-Aid, injury assessment, and reporting. Minor injuries not requiring attention from a medical professional can be treated using the First Aid kits mounted above the sink in the Machine Shop.

## Personal Protective Equipment

Tasks	Potential Hazard	Type of PPE Required	Discretionary PPE
Use of any hand held or stationary power tool	Airborne particles, Loud noises	Safety Glasses, Closed toe shoes	Hearing Protection Dust Mask
Material handling	Cuts/abrasions	Closed toe shoes	Gloves
Changing tooling or blades	Cuts/abrasions	Ensure machine is unplugged or electronically disabled	Gloves
General cleaning	Airborne particles	Close toe shoes	Dust mask, safety glasses
Laguna CNC	Airborne particles Loud noises	Safety glasses, Closed toe shoes	Hearing Protection
Haas CNC	Loud noises	Safety Glasses when doors are open	Hearing Protection
All Woodworking tools	Airborne particles, loud noises	Safety Glasses Closed Toe Shoes NO LOOSE CLOTHING, HAIR TIED BACK	Hearing Protection Dust Mask
Prusa 3d printers	Burns, Fire	Do not run overnight (without approval) don't touch hot end	
Overhead Gantry with Trolley Chainfall	Drop part, overload	Hard hat, close toe shoes, weigh object if there is any question	Steel toe boots
Laser cutters - operation	Lasers	Ensure hood is closed. Never operate with hood open	Leave hood closed for 1 min after cutting acrylic
Laser cutters - cleaning	Airborne particles	Use Vacuum	Dust mask
Metal Lathe and Mini Mill	Caught in, minor cuts	Ease edges before handling, safety glasses/face shield NO LOOSE CLOTHING, HAIR TIED BACK	Hearing Protection
Computer Work	Long term cervical and nerve problems	Take a break every 15-30 min for 5 min. Sit up straight with feet flat on ground. Don't hunch over. Take the time to position the monitor at a good height	Stretch, do physical exercises on your break.
Mixing lubricant for Haas	Splash in eyes	Goggles, gloves	
Using Soldering Station	Lead Fumes (we only stock Pb free)	Use provided ventilation system	Respirator