



Digital Studios Tool Orientation

Rapid Prototyping Studio

Laser Cutter/Engraver

Version 1.1

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Orientation Summary

This orientation serves as a training on the Laser Cutter/Engraver at CCA. During this orientation you will learn to cut, score, and engrave into sheets of material. Once completed, this orientation will certify you to use the Universal brand laser cutters/engravers at CCA.

In this orientation guide, you will find information on CCA rules and policies and how they relate to the laser cutters. You will also find information relating to the basics of how lasers are to be used, followed by the appropriate software and hardware setups and safe use.

Safety Considerations

- **Fire Danger!** The Laser cutters use a focused laser beam to “burn” through your material. You are setting a “controlled” fire when using these machines. While using the laser cutter you **MUST**:
 - Watch your machine
 - **Stay in the laser room**
 - Use only one laser cutter/engraver at a time
 - Use only laser safe material in the laser cutter/engraver
 - If a fire occurs, **put out the fire immediately** and **report the fire** to shop’s staff
- Additional Safety considerations
 - **Close Toe Shoes Required:** To protect your feet and toes from falling material and debris all shops spaces at CCA (including the RPStudio and Laser room) are closed toed shoe spaces. **You must have closed toed shoes while in the laser room.** You will be asked to leave if you do not have appropriate footwear. No exceptions.
 - **Hearing Protection Encouraged:** The ventilation and compressed air systems used in the laser cutters/engravers can be loud. If you need hearing protection, please use earplugs or earmuffs. Do not use “in ear” or “ear covering” music playing devices. **Music Headphones are not allowed in any CCA shops spaces** including the RPStudio.

Use Disclaimer

CCA shops and studios provide tools and staff to support your projects. However, unforeseen circumstances do occur which can disrupt the making process. Please note the following policies:

- Studio Staff is not responsible for project outcomes
- Reservations prioritize access but do not guarantee machine use

CCA, Shops, and Digital Studios Rules and Policies

CCA Student Code of Conduct

Violations of the Student Code of Conduct

CCA expects its students to uphold the college's values of artistic and academic excellence, compassion, integrity, and global citizenship. The following list, while not exhaustive, illustrates those behaviors that, when determined to have occurred in the judgment of the college, necessarily violate the values of the college; impinge upon the rights, safety, and well being of its constituents; and therefore represent misconduct subject to disciplinary action:

- Attempted or actual theft of or **damage to college property** or property of college community members.
- Conduct that could result in the violation of any federal, state, or local law.
- **Conduct which threatens or endangers the health or safety of any member of the college community** including but not limited to physical abuse, verbal abuse, threats, verbal or nonverbal intimidation, bullying, stalking, or coercion.
- **Failure to comply with the directions of college officials**, law enforcement units, and emergency personnel acting in authorized performance of their duties. **This also includes failure to identify oneself to such persons when requested.**
- Failure of a student to act in a responsible manner to assure that the student's guest is preserving the rights of the college community as outlined within the Student Code of Conduct.
- Forgery, alteration, or misuse of college documents, records, or identification.
- Hazing or conspiring to engage in similar acts that actually or potentially injure, endanger, or humiliate any fellow student or member of the college community, whether the hazing is consensual or not.
- **Interference with, obstruction of, or disruption of the teaching or learning process, administration, or any other college-sponsored activity.**
- **Knowingly furnishing false information to the college.**
- Possession, distribution, or use of any controlled substances on college property or at college-sponsored activities.
- Possession, distribution, or use of alcohol on college property or at college-sponsored activities, except under the conditions specified in the **Alcohol Policy**.
- Possession, distribution, or use of cigarette or vapor products on college property or at college-sponsored activities, except under the conditions specified in the **Smoking Policy**.
- Possession or use of a weapon or a replica thereof, such as a firearm, knife, explosives, or any other instrument used or potentially used to intimidate, threaten, and/or injure any member of the college community.
- Retaliation -- adverse action taken against a person because of the person's good faith opposing, reporting, or threatening to report a violation of the Code of Conduct or for participating in good faith in investigations, proceedings, hearings, or remediation related to college policies, including the Code of Conduct.

- Soliciting, assisting, or inciting another college community member to perform an act that violates the Student Code of Conduct or attempting to do the same.
- **Unauthorized entry or use of college property**, which includes unauthorized residence.
- Unauthorized possession, distribution, use, or duplication of keys or access cards for college property.
- Unauthorized use of electronic or other devices to record any person while on college property, disseminate personal information, or otherwise violate privacy without prior knowledge or consent.
- Unlawful harassment or discrimination based on race, color, religion, sex (including gender identity and pregnancy), national origin, age, disability, genetic information, sexual orientation, or parental status.

The CCA Student Code of Conduct can be read in its entirety at <https://portal.cca.edu/thriving/student-handbook/student-code-conduct/>

CCA Shops Safety Procedures, Community Standards, and Policies.

Please note that repeated violations or any severe violation of the Shops Safety Procedures, Community Standards, and Policies may result in mandatory retraining, interim suspension of shop access, and can be elevated to the Student Code of Conduct Process.

- **Shop users must follow the instructions of staff and student shop monitors.**
- **Shop users must have their CCA ID with them and show it to shop staff if requested.**
- Be respectful to all shop users and shop staff.
- **Training and approval is required to operate equipment.**
 - This training may be provided by shop staff or by your instructors in classes.
- **Do not use the shops while impaired** by substance use, lack of sleep, stress, or other issues.

Impairment due to lack of sleep, stress, or the use of any substance is a severe safety concern. Behaviors associated with this impairment jeopardizes the health and safety of the community and will be referred to the Student Code of Conduct Process and may result in disciplinary action.

- Ask for help or information whenever you need it.
- Wear clothing that is appropriate to the shop and process you are using .
- Wear appropriate personal protective gear for the shop and process you are using. This may include safety glasses, ear protection, respiratory protection.
- **Headphones or earbuds may not be used in shops** where posted.
- Clean up after every process and reset or return your tools.
- Keep walkways clear and safe.
- No distracting other shop users.
- No running, yelling, or rowdy behavior.
- **Report machine or tool problems, or damage immediately to staff.**

- Report injuries and accidents immediately to staff.
- The shops are not responsible for the security of student projects or materials left in spaces.
- Guidelines on material use and disposal must be followed.

These shop specific policies and standards are set in each studio by the Studio Manager. **They cannot conflict with the rules above or the Student Code of Conduct.**

- Specific attire and PPE rules
- Storage of materials or projects in shops
- Food and drink guidelines
- Material use procedures
- Access times
- Cleanup procedures

Please ask the studio manager if you are not clear on any of the policies or procedures in the shop you are working in. We want the shops to be safe, efficient, and easy to work in for all of the community.

Digital Studios Orientation Policies

The CCA Shops including the Digital Studios and the RPStudio **require all users attend an orientation** to learn how to safely operate our shop equipment **before use**. To facilitate access to our tools, the Digital Studios run numerous orientation trainings throughout the semester. A full orientation schedule of the RPStudio can be viewed here: <https://portal.cca.edu/learning/shops/rps/>

- When attending an orientation:
 - **Be on time.** Attendees arriving more than 10 minutes late after the scheduled start time will have missed essential safety information and will be asked to leave and will not be “certified” for tool use.
 - **Participate and pay attention.** These orientations are your safety in addition to increasing your knowledge. You are encouraged to ask questions while attending the orientation. Do not engage in disruptive behavior while attending the orientation.
 - **Sign in and fill out the attendance sheet.** Without this information we will not have a record of your attendance for the orientation. Tool certification will not be granted to anyone who has not signed in on the attendance sheet.
- “Open” orientations are:
 - Available to any “active” CCA user including enrolled students, active staff and active faculty.
 - Scheduled approximately once (1) a week until the final four (4) weeks of the semester.
 - **NOT scheduled during the final (4) weeks of the semester to accommodate student use during finals.**
- “Class” orientations may be requested to train entire class groups on Digital Studios Tools. Class orientations:
 - Must be requested by the **faculty** member teaching the course.
 - Must be scheduled with the appropriate Digital Studio Manager via email with at least 1 weeks notice to schedule “ahead” of student reservations.
 - Must provide a class syllabus to the appropriate Digital Studios manager at least 1 week in advance of the orientation.
 - Will be scheduled in the order they are requested.
 - **Must be attended by the requesting faculty member.**
- Only CCA Digital Studios management staff can train you on Digital Studios Tools.
 - Other students or faculty cannot certify other users on Digital Studios machines.
 - Only certifications performed by Digital Studio Managers will be honored.

Laser Cutter/Engraver Rules and Policies

Use Disclaimer:

- Studio Staff is **not** responsible for project outcomes
- Reservations prioritize access but **do not guarantee machine use**

Laser Cutter/Engraver Use and Access Policies

The Following Rules apply to ALL users at CCA. Violation of these rules and policies may result in immediate suspension of access to the Laser cutters and RPStudio. Reinstatement of access will be at the discretion of a Digital Studios Manager.

- **All users must be a current CCA student or active staff or faculty member.**
 - CCA alumni or other outside users are NOT allowed to use ANY of the shop's equipment at CCA including the RPStudio.
- All users must attend a recent Laser Orientation before using any of the Laser Cutters.
 - **Laser cutter/engraver orientations attended by ANY and ALL users before 9/2/2019 are no longer valid.**
- Users may not leave a machine that is running unattended.
 - Do not leave the laser room while the laser cutter is running under any circumstances.
 - **If you leave the room while the laser cutter is running Digital Studio Staff will be forced to stop your job, remove your material, and immediately suspend your access to the laser cutters and RPStudio.**
- Users may use only one (1) laser cutter/engraver machine at a time.
 - Multiple machines cannot be used by the same person at the same time in a safe manner.
 - Simultaneous reservations for the same user will not be honored.
- Only approved Laser Safe Material may be used in the laser cutters.
 - Laser Safe Materials are covered in detail in the material policies section of this orientation guide.
 - Some Approved Laser Safe Materials can be purchased from ARCH.
- Do not use any “Prohibited Materials” in the laser cutters/engravers.
 - “Prohibited materials” are flammable, poisonous, carcinogenic, or a combination of these hazards.
 - “Unknown” or “mystery” are prohibited materials and cannot be used under any circumstances.
 - **Use of “Prohibited Materials” will result in immediate suspension of access to the laser cutters and RPStudio.**
- Any material not listed on the “Laser Safe Materials” poster must be approved by the Digital Studio Manager and must have a Safety Data Sheet (SDS) on file.
- Cut only single (1) sheets of material at a time!
 - Do not attempt to cut self-laminated or stacked materials. Stacked sheets of material will catch on fire.
- If a fire occurs, **put out the fire immediately** and then report the fire to the shop's staff.

- Unreported damages to the tools result in increased and significant damage to our machines. Early reporting usually means we can quickly fix the machines.
- **Failure to report fires or machine damage will result in “tool abuse/repair fine” for the value of the parts damaged in addition to suspension of access to the laser cutters and RPStudio.**
- Users must clean the laser bed and work areas when done.
 - Place large cut offs in the trash. Vacuum small pieces out of the bed.
 - Please donate usable material to the “free use” scrap.
- Users must remove all material from the laser promptly at the end of the appointment.
 - The RPStudio does not offer any storage options. Materials left in the studio will be removed or absorbed into “free use” scrap.
- **Users must Follow all staff instructions.**
 - If you do not understand something, please let us know!

Laser Cutter Reservations Policies and Procedures

All Users are encouraged to reserve time on the laser cutters so that ALL users at CCA plan accordingly for their projects. The reservation schedule is one of the key ways CCA communicates the availability of the machines and RPStudio. Due to unforeseen circumstances such as broken or damaged machines reservations may be cancelled without notice.

Reservation Policies

- Reservations may be made on a laser cutter/engraver by clicking on the “Digital Fabrication Studios” group at: <https://cca.webcheckout.net/sso/patron#/>
 - Users are limited to three (3) reservations per week.
 - Reservations are 1 hr long.
 - Student users may make reservations up to one (1) week in advance.
- Users may reserve (and use) only one (1) laser cutter/engraver machine at a time.
 - Multiple machines cannot be reserved (or used) by the same person.
 - Simultaneous reservations for the same user will not be honored.
- Be on time for your reservation. **Users who “No Show” or are 15 minutes late will forfeit their reservation to “walk in” users.**
 - 3 “late/no show” reservations will result in suspension of Laser Cutters and RPStudio access.
- **Reservations are non-transferrable.** Do not share your laser reservation with anyone including friends or studio classmates. If you are signed up, you must be the one using the laser.
 - The CCA RPStudio creates a safe working environment by verifying all laser users have received the laser cutter/engraver orientation. Sharing your reservations makes this safety check impossible.
 - **If you are caught sharing your account or reservation, your use of the laser cutter will be immediately stopped. Both the person whose name is listed on the reservation as well as the current/active user will have their access to the laser cutters/engravers and RPStudio suspended.**

Walk in Policies

There are times when making reservations is not possible, such as when you have used all 3 of your reservations per week or if there are no appointments available during “high use” times. During these times, you may have to “walk in” to the lab. Please follow the following policies when walking into the lab.

- “Walk in” users must be a current student, staff, or faculty member who has attended a recent laser cutter orientation and whose access to the RPStudio and Shops is active.
- **“Walk in” user MUST check in with the lab monitor before using a laser** to sign in to be given a place on a laser
- “Walk in” users will gain access to the laser cutters on a “first come, first served” basis.
 - Walk-in users' requests for a particular machine will not be honored. Please format your files assuming you have access to the smallest machine (18”x24”).


- “Walk in” users may:
 - Use the remainder of late/no show reservations after waiting 15 minutes after the initial start time for the remainder of the appointment hour.
 - Use the remainder of a user’s reservation who has finished early for the remainder of the appointment hour.
 - Use an “unreserved” laser cutter for the remainder of the appointment hour.

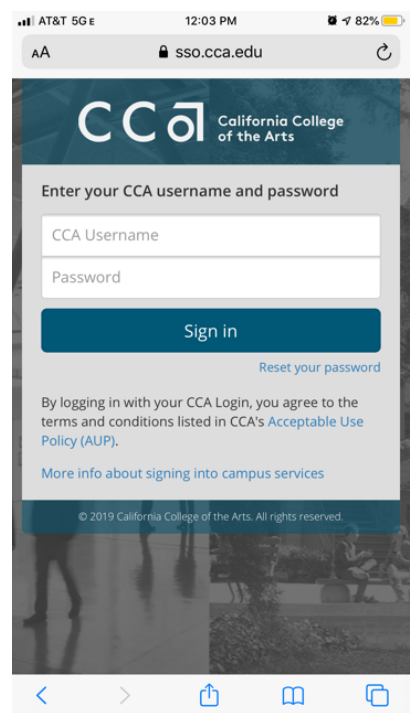
Faculty and Staff Reservation Policies

To accommodate preparations for classes and CCA projects CCA faculty and staff have additional privileges for reserving time on the laser cutters. Faculty and Staff are encouraged to reduce their use of the equipment during peak student use times such as finals. Normal user reservation policies apply to faculty and staff in addition to the following policies.

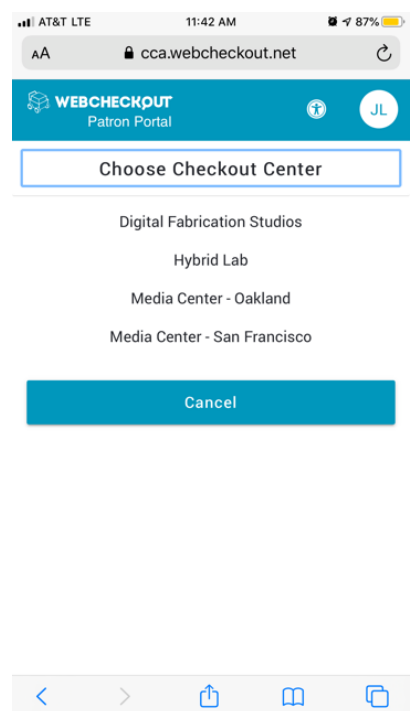
- **Faculty and Staff may make reservations up to two (2) weeks in advance.**
- All user reservations including Faculty and Staff reservations are non-transferable.
 - Faculty may NOT make reservations for their students. All users MUST make their own reservations.
 - The CCA RPStudio creates a safe working environment by verifying all laser users have received the laser cutter/engraver orientation. Sharing your reservations makes this safety check impossible.
- The laser cutters are NOT available for “class use reservations”.
 - The laser cutters are not tied to a specific program and are set up to not give priority access to any one class or program.
 - **Please encourage your students to reserve time on the equipment with their own reservation appointments.**
 - The laser cutters may only be reserved for classes or groups for “orientations” or “advanced training” to teach a specific technique.
 - If you would like a demo on a particular material or process, please request it as part of your class orientation.

How to: make a reservation

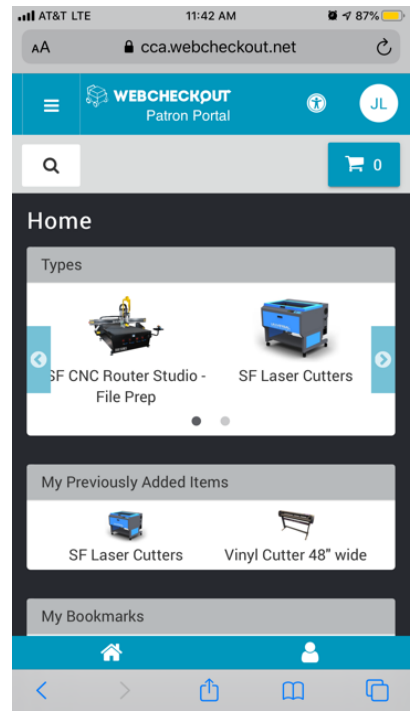
1. **Navigate to <https://cca.webcheckout.net/sso/patron#/>** in a web browser.
2. **Log in to CCA Single Sign-On.** If not prompted to log in, refresh the page to display the CCA SSO prompt for username and password. To log in to a different user account, click on the initials in the top-right corner, select “ Log Out ”, exit the web browser, and return to Step 2.





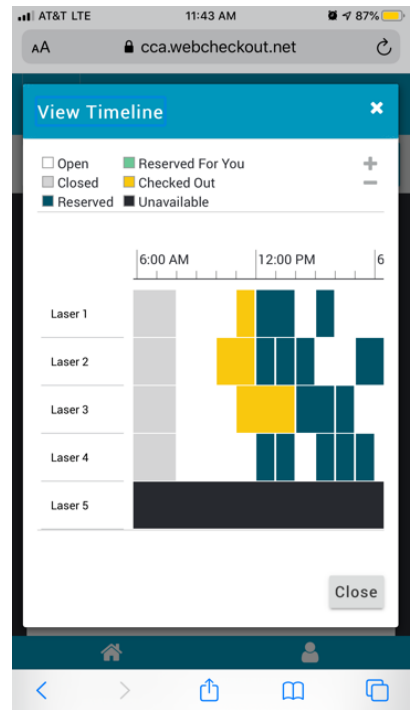
3. **Select “Digital Fabrication Studios”** from the list of checkout centers.





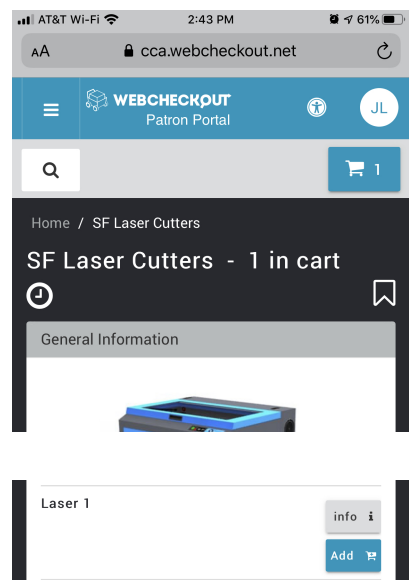
4. **Select the appropriate digital fabrication tool from the “Types” menu.** As an example, this guide will continue with “SF Laser Cutters.”



5. **Click the “” icon near the top of the page to view a timeline of equipment availability and make a note of the date and time when you would like to reserve your desired machine.** For the laser cutters, details such as bed size and material thickness can be shown by clicking the “” icon next to each laser cutter.



6. Click the “” icon next to your desired equipment when you are ready to start making your reservation.
7. Click the “” icon near the top of the page and then click “Create Reservation”.

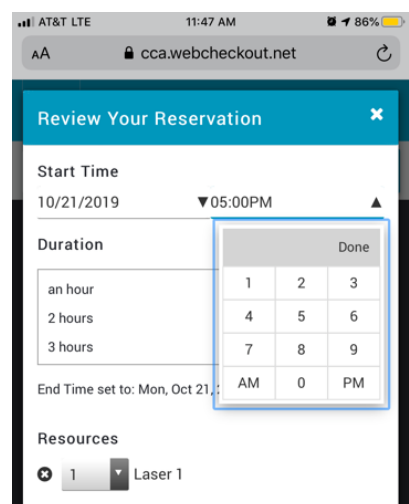


8. Enter the “Start Time” you noted in Step 6 and choose a duration for your appointment.
9. Click “Submit Reservation” to finalize your appointment. If the “Submit Reservation” button does not appear, read the notes under “Reservation has errors.” You must correct any errors in order to continue.

Common mistakes include:

- Reserving equipment when it is already booked
- Booking too many appointments in a single week
- Attempting to book more than one machine during the same time period
- Attempting to reserve equipment when you have fines or holds on your Patron Portal account

Please refer to our official reservation policies for details.

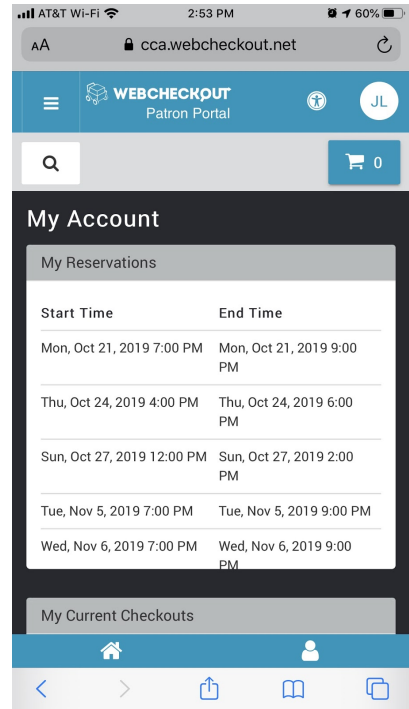


You’re all set! Please be on-time and remember to check in with the lab monitor at the beginning of your appointment.

How to: cancel a reservation

Reservation Cancellations can only happen to “upcoming” reservations, or reservations that have not occurred yet. Please cancel your reservations before your appointments start.

1. Log in to the Patron Portal.
(<https://cca.webcheckout.net/sso/patron#/>)
2. Click the “☰” button at the top of the Patron Portal page and select “My Account”.
3. Under “My Reservations”, click on the appointment you would like to cancel. (You may need to empty your shopping cart in order for the page to load.)
4. Click “Cancel Reservation”.



Material policies

The laser cutters/engravers use a focused laser beam to “burn” through your material. When you are using the laser cutter/engraver, you are setting a “controlled” fire causing your material to combust, changing it at a chemical level. When cutting or engraving “safe” material, common combustion products are carbon dust and carbon dioxide gases which are sucked away through ventilation systems. Some materials are not safe to burn. These unsafe materials are labeled “Prohibited” because the gases created when combustion occurs are typically flammable, poisonous, or carcinogenic. These materials when burned will continue to “offgas” for up to a week, exposing everyone at CCA to harmful gasses and unsafe conditions. Please use the following guidelines when choosing your material for the laser cutters:

- Only approved Laser Safe Material may be used in the laser cutters.
 - Some Approved Laser Safe Materials can be purchased from ARCH.
- **Do not use any “Prohibited Materials” in the laser cutters/engravers. EVER!**
 - Use of “prohibited materials” exposes everyone at CCA to harmful gasses and unsafe conditions.
 - **Use of “Prohibited Materials” will result in immediate suspension of access to the laser cutters and RPStudio.**
- Any material not listed on the “Laser Safe Materials” poster must be approved by a Digital Studio Manager and the RPStudio must be provided a Safety Data Sheet (SDS) by the user to have on file.

<u>Approved Materials</u>	<u>Material Notes</u>
Paper/Cardboard/Wood	<i>Wood based fiber materials</i>
Cardboard (single corrugation)	Easy to cut, easy to set on fire, watch closely. Use “mat board” settings. DO NOT USE Double Corrugated Cardboard!!!
Paper	Easy to cut, easy to set on fire, watch closely
Cardstock	Easy to cut
Chipboard	Easy to cut, produces lots of dust/soot
Matboard	Easy to cut, some “browning” on the edges
Bass wood	Easy to cut
Birch wood	Easy to cut
Balsa wood	Easy to cut
Masonite	Leaves lots of black soot/dust on the edges
<i>Interior Grade Plywood</i>	Plywood laminated with “clear” water based glue. Easy to cut, leaves some soot when cut. Use “general medium wood” settings

“stained/painted” wood	Use water based stain or acrylic paint. Make sure paint or stain is completely dry before cutting/engraving
“Natural” MDF	Arch sells “formaldehyde free” MDF that is safe to cut. Use “general Medium Wood” settings.
“Natural” Cork	Use “natural” cork only, no synthetic cork.
Masking Tape	Use “paper” based tapes only. Blue painters tape or white masking tape is recommended. <u>DO NOT USE plastic tape!!!</u>
Fabric	<i>“soft” fabric materials</i>
Real Leather and Suede	Leather made from animal hide/skin. Cuts well, smells bad. Leave some charring.
Natural Wool and Felt	Wool and felt made from animal hair. Cuts well, smells bad. <u>DO NOT USE synthetic felt/wool!!!</u>
Cotton	Cuts well, watch for “flash” fires
Denim	Cuts (and engraves) well
Silk	Cuts well, watch for “flash” fires
Polyester fabric	Automatically heat seams the edge for you. Watch for “flash” fires. Smells “strong”, store recently cut fabric in a well ventilated place.
Plastic	<i>Polymer sheet material</i>
Polypropylene	Cuts easily but leaves a slightly melted edge
Mylar/polyester plastic	“Thin” sheet, great for stencils. Can easily melt from too much heat. Tends to leave black “spots/burns” on the cut area. Releases some CO, CO2. Smells “strong”, store recently cut plastic in a well ventilated place.
Cast Acrylic	Cast acrylic can be identified by being (usually) coated in a paper film. You can also cut “Extruded Acrylic”; however it smells strongly and has reduced cutting quality compared to cast acrylic. Store recently cut acrylic in a well ventilated area.
Mirrored Acrylic	Only “single sided” mirrored acrylic can be cut or etched. Can only be cut when reflective surface of mirrored acrylic face downward.
Painted acrylic	Use acrylic paint, do not use oil based paint. Make sure paint is completely dry before cutting/engraving
Raster/Engrave only materials	Materials that are too dense to cut. Surface treatments only

Anodized Aluminum	Anodization will be “bleached” out of the colored metal leaving “white” engraved areas.
Painted/coated metal	Acrylic or enamel paint over metal is safe to be engraved.
Mother of Pearl	Etches fine
Ceramic	You can etch both leatherhard or fired clay. Very slow to engrave. Allows for high detail image transfer.
Cement	Very slow to engrave
Stone	Very slow to engrave. Smooth river stones work best.
Brick	Very slow to engrave
Glass	Very slow to engrave. The finer the quality of the glass, the better the texture.
“Other” Materials	Materials that do not fit into an existing category.
Natural Rubber	Great for stamp making! Easy to cut <u>DO NOT USE chlorinated (synthetic) rubber!!!</u>
Buttercut	Laser Safe “foam” used for sandblasting glass. Great for stencils for 3d dimensional glass objects.

Prohibited Materials

These materials are extremely flammable, poisonous, carcinogenic, and usually a combination of the 3. They are not to be used in the laser cutters under any circumstances. **Use of prohibited materials will result in immediate suspension of access to the laser cutters and RPStudio.** If you have a material that you are unsure about, find an SDS (safety data sheet) from the manufacturer of your material and a Digital Studio Manager will review it.

<u>Prohibited Materials</u>	<u>Prohibited Material Notes</u>
“Unknown”, “Found” or “Mystery” material	“If you cannot identify a material, neither can we!” For instance, many safe plastic materials are visually identical to dangerous plastic material. Found fabric cannot be identified and cannot be used. You must have identification on all of the fibers contained in your fabric blend. If you do not know what a material is, then an SDS is impossible to identify.
Paper/Cardboard/Wood Material	<i>Wood based fiber materials</i>
Cardboard (Double Corrugation)	catches on fire, always!!!
Medium Density Fiberboard (MDF)	made with resin and formaldehyde, does not cut well and will damage laser focal lenses
Exterior Plywood	Made with resin, it does not cut well. Likely to catch fire. Can be identified by black/dark lamination lines in the plywood.
Melamine	When burned releases Nitrogen oxides, carbon monoxide, carbon dioxide, cyanide fumes.
Plastic	<i>Polymer sheet materials</i>
Polycarbonate plastic	Looks nearly IDENTICAL to acrylic! Shock resistant, Bullet proof at higher thicknesses. Has a “gray/dark” edge. Releases massive amounts of CO and CO2 gas, enough to be corrosive to the laser lens. Leaves yellow/brown burned edges when cut.
PETG plastic	Looks nearly IDENTICAL to acrylic! Used for “food safe” plastic packaging. Primarily used in vacuum former. Releases benzene when cut/etched (a carcinogen). Leaves yellow/brown burned edges when cut.
Styrene/Polystyrene	Plastic sheets used for vacuum forming as well as electronics packaging. Forms of hydrogen cyanide gas when burned.
ABS	Toys, Legos and phone cases are typically made out of ABS. This material when burned creates a form of hydrogen cyanide gas.

Styrofoam	White, pink, and blue foam. Forms of hydrogen cyanide gas when burned.
Foamcore	Extra super flammable! Primary combustion products are carbon monoxide, carbon dioxide, styrene, sulfur oxides, and hydrogen sulfide. Other undetermined hydrocarbon fractions could be released in small quantities.
Vinyl (PolyVinyl Chloride) <ul style="list-style-type: none"> ● PVC Pipe/PVC Sheet ● Fake Leather/Pleather ● Vinyl “fabric” ● Vinyl Stickers ● Vinyl Records ● Duct Tape 	All Vinyl products when burned releases chlorine gas. Chlorine gasses are highly corrosive to the laser optics as well as harmful to breathe.
EVA Foam	EVA foam is a common foam used in cosplay and costumes. The “V” in EVA foam is vinyl and creates chlorine gas when burned.
High Density Polyethylene (HDPE)	Primary ingredient of cutting boards and plastic liquids containers such as milk cartons. Releases benzene (a carcinogen) when burned, also melts and catches on fire. When used in a laser, it may release carbon dioxide, carbon monoxide and small amounts of other organic vapors.
Fibers and other materials	<i>Fiber based materials and miscellaneous materials</i>
Resin set fibers <ul style="list-style-type: none"> ● Fiberglass ● Carbon Fiber ● Printed Circuit Board 	Resin does not cut well and create noxious gases. Any cut “fiber” (glass or carbon) will be aerosolized, resulting in users breathing in small needles.
Synthetic rubber	Tires, Dense rubber. When burned, it releases thick smoke and toxic tar/gas that will damage lenses. Often contains chlorine.
Gore-Tex Fabric	Outdoor waterproof material. Based off of a tetraflourine material. Very toxic to breathe.

Polyurethane foam	Modeling foam used in modelshop. Extremely flammable, harmful to breathe. May explode in a fire.
Neoprene	Burning produces noxious and toxic fumes
Oil based paint	flammable

Machine Use Guide: How to use the Laser Cutter/Engraver

Use Disclaimer:

- Studio Staff is **not** responsible for project outcomes
- Reservations prioritize access but **do not guarantee machine use**

Laser Cutter Basics: concepts, machine capabilities, limitations

The laser cutter/engraver is a CNC manufacturing tool that can “cut” and “engrave” flat sheets of combustible material. The lasers at CCA use a laser beam generated by an energized tube of CO2 gas which outputs a high-power laser “beam”. This beam is directed towards your material through a series of mirrors and then is focused with an optical lens to create a small, thin, high powered beam capable of cutting through many materials with high accuracy.

This machine is a “CNC” tool, meaning it is in effect controlled by a computer. The user makes designs on a computer which when sent to the laser are converted to code which move motors to position the cutting head appropriately to recreate your digital designs on your physical media. This allows for designs to be quickly and accurately mass produced instead of them being slowly and inaccurately cut by hand.

The laser cutter/engraver is very easy to use and “program”. Users need only to design in a vector drawing software. **At CCA our staff are trained and our machines are set up to accept files primarily from Adobe Illustrator (.ai file type)**. Should you choose to, you could also design with other CAD software such as Rhino, Autodesk 360 and CorelDraw but keep in mind that user support for these other file types will be limited. When designing for the lasers, please keep these following basics in mind:

- **Red Vector Lines - Cut**
- **Blue Vector Lines - Score**
- Any other color or grayscale Vector line -or- pixelated image - **Raster Engraving**

*note: all vector lines (red and blue) must have a lineweight of .00001 to cut or score, otherwise they will raster engrave.

Laser Cutters Available at CCA

At CCA, we currently use Universal brand laser cutters/engravers. We choose this brand because of their reliability, durability, and accessibility for replacing damaged parts. This is ideal in our student based environment where we have many users with a variety of skill levels and project types. While the lasers we have all function nearly identically, there are some differences in the machines, mainly in size (working area and maximum material size) and power output (ability to cut through material faster or thicker). Please consult this chart for specific machine information:

Machine #	Laser 1	Laser 2	Laser 3	Laser 4	Laser 5
Color	Blue	Blue	Blue	Red	Red
Bed size	18" x 24"	18" x 32"	18" x 32"	24" x 48"	24" x 48"
Power Output	60 watt	75 watt	75 watt	100 watt	150 watt
Max Cut Thickness	1/4"	1/4"	1/4"	1/4"	1/2" (1/4" recommended)
Max Material Thickness for Engraving (with cutting bed)					
Max Material Thickness for Engraving (without cutting bed)					
Rotary Attachment Compatible	Yes	No (soon to be compatible)	Yes	No	No

Fire safety

ATTENTION: Fire Danger!

As stated at the beginning of this document, the Laser cutters use a focused laser beam to “burn” through your material. You are setting a “controlled” fire when using these machines. While using the laser cutter you MUST:

- Watch your machine
- **Stay in the laser room**
- Use only one laser cutter/engraver at a time
- Use only laser safe material in the laser cutter/engraver
- If a fire occurs, **put out the fire immediately** and **report the fire** to shop’s staff

Fires in the laser cutter are very common; they happen to all laser users and will happen to you. Small fires are easy to put out and if a user quickly and calmly puts out the fire then there will be no permanent damage to the laser cutters.

A “fire” is defined as a sustained material burn. You will occasionally see a small flame while using the laser cutters. A small fire (up to one inch high) is a “flare up” and burns off of dust or oil on top of your material and/or the plasma gas of your material burning off. This “flare up” is technically OK, you do not have to stop the laser. You also may see a large “flame” (several inches tall). This is not necessarily a fire but instead is a sign that the machine is malfunctioning or that the incorrect material settings are being used. Users should stop the laser, check material settings, and ask a staff member for assistance.

An actual “fire” that requires the stopping of the machine is “sustained” burning of material. If you see continuous flame or embers on your material, you have a fire and you must put it out! Typically, if the fire is put out within one (1) minute then no permanent damage will occur to the machine. **Fires that burn longer than one (1) minute will cause damage to the laser bed and/or the laser optics and will have a “tool abuse/repair fine” charged to the user for the value of the parts damaged (typical fine amounts range from \$300-\$500).** **Failure to report fires or machine damage will result in immediate suspension of access to the laser cutters and RPStudio.**

Once the fire has been put out please get an RPstudio staff member to inspect the laser cutter. RPStudio staff need to inspect the machine for damage and clean the laser optics. Once this has been done we can work with you to figure out why you had a fire in the first place and then discuss methods for preventing a future fire. If you have a fire, follow this guide to put it out:

How to put out a fire: A step by step guide

1. Press the Pause button
 - a. Pressing pause will finish the “vector that the laser is cutting” and then the laser head will return to the machine home position
 - b. The Pause button is located physically on the **red button on the front of lasers 1,2 and 3** as well as on the **“top left” triangle button on lasers 4 and 5**. The pause button is also located on the top right corner of the “UCP” (universal control panel) software interface.

2. Open the laser lid
 - a. The laser will stop being projected into the cutting area
 - b. Once the lid is open, the laser (may be moving) but the beam will no longer be engaged
 - c. **90% of fires will go out immediately once the lid is opened**
3. Put out fire (use any of the following fire stopping methods)
 - a. Try blowing on the fire
 - b. Pat it out
 - c. Smother it with other material
 - d. Use a spray bottle of water (hanging on the computer stand)
 - e. Take the material out of the laser and stomp on it
4. If at any point you are struggling, ask for assistance from the room monitor

5. WORST CASE SCENARIO - USE THE FIRE EXTINGUISHER!

Note - if you need a fire extinguisher, it is likely that you were not paying attention to your machine. If you pay attention, you should not need to use a fire extinguisher to put out the fire.*

- a. There is a fire extinguisher located on the wall by the front entrance door to the laser room inside the laser room slightly behind Laser 3
- b. Follow fire extinguisher instructions. Point the fire extinguisher at the fire and squeeze the lever to put extinguishing media onto the fire.

Note The extinguisher in the laser room is a halotron fire extinguisher (a special extinguishing media that is non corrosive to the electronics in our machines). Please use the fire extinguisher in the laser room first to put out laser fires before using any other fire extinguisher.*

6. Always report the fire to RPStudio staff immediately.

7. Safely dispose of your “burnt” material with the assistance of Shop Management Staff.

Note “Burnt” material should be disposed of safely. “Burnt” material should be extinguished completely by being sprayed or soaked in water before being put in a trashcan to prevent a trash fire. Consult a staff member for more information.*

Common causes of a laser fire

To reiterate: Fires in the laser cutter are very common; they happen to all laser users and will happen to you. As you become more experienced with the laser cutters you will be able to avoid fires which may damage your material. Here is a list of common causes of laser fires:

- Using incorrect/too much power settings
- Incorrect material settings
- Not knowing the thickness of your material
- Attempting to cut “prohibited materials”
- Cutting “safe” thin/lightweight material such as paper, cardboard or thin fabric.

Software: Setting up and Sending up your files

With these machines you can use almost any vector drawing software such as Rhino, Autodesk 360 or Corel draw. However, **the RPStudio primarily supports Adobe Illustrator**. If you are having trouble with your files and are using software other than Adobe Illustrator, the first thing we will tell you to do is to import your file into illustrator so we can assist you.

When designing for and using a laser cutter/engraver you should always place your material closest to the source of the beam as possible to minimize the amount of beam degradation. On a universal brand laser cutter/engraver you should **set up your material in the top left corner of the artboard/working area** which will translate to the top left corner of the laser bed. The laser beam is the most in-focus in the top left corner on these machines and you will have the best quality engravings and will be more likely to cut through your material. In addition, give yourself an 18" margins (.125in minimum) around the exterior edge of your material to your designs. The laser bed is designed to shift and may be slightly out of alignment.

File setup within Adobe Illustrator

1. Set up the File and Artboard
 - a. **Set artboard to the size of the laser bed** you are working on (not your material)
 - b. Under the advanced tab, or in document color mode, **set the colors to RGB**
2. To **CUT**
 - a. Set the lines to **255 Red** and 0 for green and blue.
 - b. Set your lineweight to be .00001
3. To **SCORE**
 - a. Set the lines to **255 Blue** and 0 for red and green.
 - b. Set your lineweight to be .00001
4. To Raser use any pixel image or fill. Colors will automatically shift to grayscale.
 - a. Change "white" (0% black) fills to "no fill" color as often as possible. The laser will see white fills and will waste your time.

Cutting with the Laser

Sending your file through the Universal Control Panel (UCP)

Universal laser cutter interface is where you will be able to input the thickness of your material and the type of material you are using. This step is crucial as it calibrates the intensity of the laser beam. If the measurements imputed are incorrect then it is likely that the laser will not cut all the way through or the line that that laser cuts will be thicker or potentially cause a fire. These settings will always be applied from what was last sent from adobe illustrator, so always use adobe illustrator to “print and apply” these settings.

Once your illustrator file is all set up. Within adobe illustrator **click file and print.**

In the printer menu **click setup.**

In the setup menu **click preferences.**

This will take you to the Material Library. In the material library, follow these steps to apply your material settings:

- a. Starting in the top left corner of this window, **select the material you are using** in the tree of materials.
 - Example: for plywood, select “natural” then “wood” then “medium wood” then “general medium wood”
- b. In the bottom left corner of the window **enter the thickness of the material.**
 - The laser has a tolerance of .005”. For every .005” you are off, the laser is twice as wide and half as powerful at your cut site.
 - You are more likely to start a fire if your thickness measurement is incorrect.
 - It is best to use calipers to measure your material. Calipers can be checked out from the tool center.
 - **When using lasers 4 and 5, there is a minimum thickness of .06”.** Setting material thickness less than .06” will result in collisions with the cutting bed.
- c. In the top right corner of the screen you can **adjust the intensity of the laser if necessary.**
 - Always start on 0 and adjust in increments of 10% if deeper results are needed or decrease if shallower results are needed.
 - Always test on a scrap piece before cutting out your final product.Click **apply** then **ok** in the material library screen.
- d. Click print in the **setup** menu
- e. Click print in the **printer** menu

- f. Now you are ready to start cutting. Please **open “UCP”** (universal control panel) software. The software should be located on both the toolbar and the desktop and has a small red square for its icon.
- g. Proceed to “manufacturing your design” step

Manufacturing your Design

Once you are in the “UCP” software, follow the following steps.

1. You should see your image in UCP with red cut lines, blue score lines and everything else in grayscale.
 - a. If you do not see red/blue lines, it is a sign you have incorrect line weights or are not set to RGB colors. Go back to adobe illustrator and correct your file.
2. Place your material on the laser bed.
 - a. Load your material into the **top left corner** of the laser bed.
 - b. Tape down your material if needed.
3. Close the lid **gently**.
4. Press the large greeplay button and watch the laser until it has completed its task.
 - a. If you need to leave the laser cutter room for any reason the machine must be paused until you return to watch the machine. Ask the monitor for assistance

Other Helpful Tools in UCP

“Estimated Manufacturing time”

You can run a simulation of your job to estimate how long it will take on the machine. Estimate View can be selected by clicking the “0:00” button or the far right button in UCP. The estimate feature approximately calculates the amount of time it will take the laser system to process the selected job. For more complex jobs, the estimate feature can take a while to estimate the job completion time. This function can only be used before or after a job not during a cut cycle. The estimated number can be referenced against the run time clock which will display the live manufacturing time of your cut in the top right corner of the screen.

“Align your designs on your material”

To make sure your designs are aligned on the material the way you desire you can use Focus View (cone shaped image on red button, second from the left. The Focus View allows you to quickly manually move the focus carriage to a desired position in the material processing field.

- To have full range of motion, verify that you are zoomed out in the preview window by right clicking on the mouse before entering the manual focus window.
- In the focus view the cursor changes to a blue target symbol with trailing X-Y coordinates. Clicking the mouse in the preview window moves the focus carriage to the selected position. Selecting another feature from the drop down list terminates the focus feature and moves the focus carriage back to the home position.
- To move the focus carriage to a specific location, select the GO button. Type in the X and Y coordinates and press the GO TO button and the focus carriage will move to the specified location. You can also move the engraving table to a specific Z-height using the GO feature.
- When the lid is open, a red dot laser pointer will appear making the alignment of your job easier.

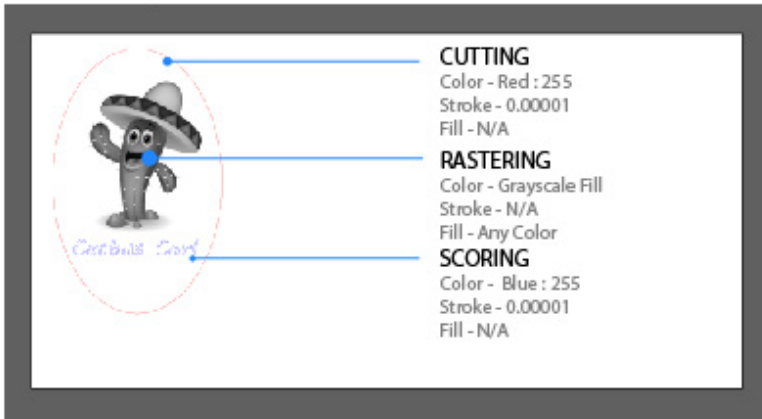
What to do once your project is completed

- Show students how to test if their pieces have cut through
- Clean up/remove your material

Quick Print Guide:

LASER FILE SET UP

STEP ONE



DOCUMENT SET UP

ARTBOARD SIZE

Set Artboard size to match the Laser bed

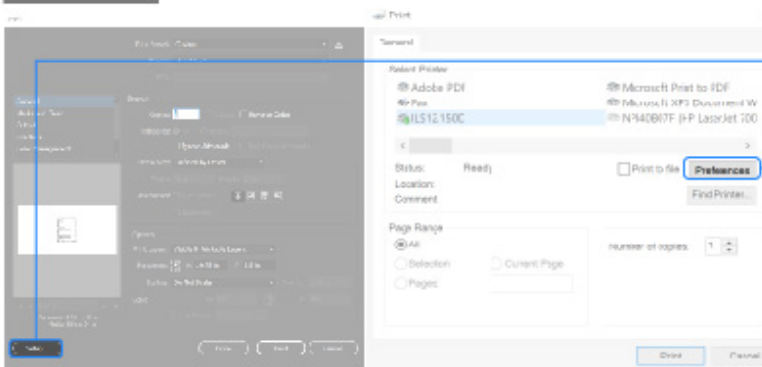
- Laser 1 - 24" x 18"
- Laser 2 - 24" x 18"
- Laser 3 - 24" x 18"
- Laser 4 - 24" x 48"
- Laser 5 - 48" x 24"

COLOR DOCUMENT

Set color document mode to RGB

File Tab > Document Color Mode > RGB Color

STEP TWO

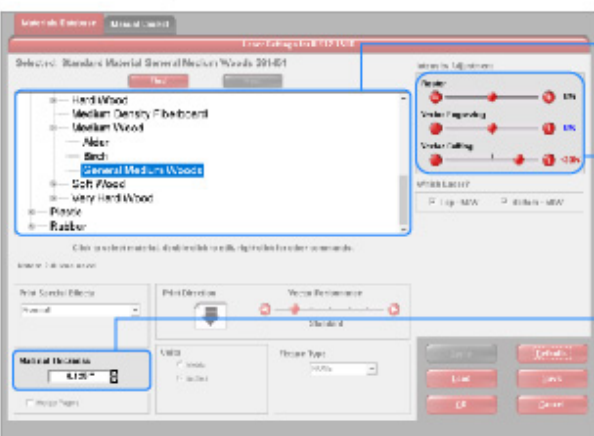


DOCUMENT PRINTING

Send to print when ready. In the print dialog, click on **SETUP**.
File Tab > Print

To setup your material setting, click on **PREFERENCES**.

STEP THREE



MATERIAL SETUP

Choose your **MATERIAL**.
If you can't find your material, talk to the monitor.

Always run a "test" with 0% adjustment.
Increase or decrease power accordingly for your material

Add in Material **THICKNESS**.

- 1/2" = 0.5" 1/32" = 0.013"
- 1/4" = 0.25" 3/8" = 0.5"
- 1/8" = 0.125" 3/16" = 0.1875"
- 1/16" = 0.063" 3/32" = 0.09375"

Other Resources (in development)

Advanced Techniques

- Using manual control for colors
- Setting head speed, power, and frequency
- Using the “rotary” attachment

Licence and Credits

This document was produced by and for the “Rapid Prototyping Studio”, a fabrication studio within the “Digital Studios” of the “Instructional Fabrication Unit” at California College of the Arts in San Francisco, California. This document was created as a supplement and aid for the instruction and use of the equipment in the Digital Studios at CCA. This document does not serve as a substitute for an “in person” training or orientation with a Digital Studio’s manager when attempting to access the equipment at CCA.

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