



4.5 Shop Guidelines for Use and Safety

Overview

The School of Design and Construction Fabrication Labs (SDC Shops) offers 3,500 total square feet of space, conveniently located next to Carpenter Hall. Digital fabrication services (CNC milling, laser cutting, 3D printing) are provided by trained shop technicians. Students are encouraged to make reservations for laser cutting through our online system: <https://fablabwsu.youcanbook.me>. Analog machines are available for use by students with appropriate training. Some hand tools are available for short-term checkout. Violation of any of the policies is grounds for revocation of SDC Shops privileges.

Fab Lab I

This lab (also known as the “Big Shop” or the “Wood Shop”) is located in Daggy Hall 253, and is our 2700 sf full-scale prototyping facility, with loading dock access via an 11’ x 10’ x 16’ 10,000 lb. capacity freight elevator. Digital fabrication includes a 3-axis CNC router capable of milling up to 96” x 48” x 6”, in wood, wood-composites, foam, and plastic. The lab features a complete suite of industrial-grade analog machines, for fabricating wood, wood-composites, and plastics. Vacuum forming for plastic, and vacuum pressing for wood is also available.

Fab Lab II

This lab (also known as the “Model Shop”) is located in Daggy Hall 257 is our 650 sf model-scale prototyping facility. Digital fabrication services include laser cutting (up to 36” x 24”); 3D printing (up to 10” x 6” x 6”); and desktop CNC milling (up to 36” x 24” x 4”). The lab is also equipped with model-scale analog machines, for modeling and prototyping work in wood, wood-composite, and plastics. Hot-wire foam cutters are available for short-term checkout.

Usage

The SDC shop fee (paid by all certified and graduate design students) covers the cost of using most of the machines in the Fab Labs. There is a nominal additional charge for 3D printing, which includes materials, and nominal hourly charge for CNC use, which covers the cost of tooling. Students should expect to provide their own materials—a wide selection of model-making materials is available for purchase in the model shop. Plywood, foam, and other materials for full-scale fabrication can be purchased or ordered.

Access to the Fab Labs requires completion of safety orientation, with additional safety training required to use tools and machines. Safety orientation for the model shop is approximately one-hour, offered by appointment throughout the first ten weeks of every semester. Additional training for model shop tools is available on an as-needed basis during regular lab hours.

Access to Fab Lab I requires completion of the SDC 300 Introduction to Fabrication Lab Practice course. This one (1) credit course lasts four weeks, and is offered multiple times during each semester. Some sessions emphasize use of analog tools; other sessions are geared toward digital fabrication. Check with the Fabrication Labs Manager to enroll in the session that best meets your needs. Current lab hours, updates, and regular posts of interest to design students are available on the Fab Lab Facebook page: <https://www.facebook.com/Fab-Labs-at-WSU-672025989475318/>.

Use of shops without trained supervision is not permitted. Unauthorized shop access will be reported to appropriate University authorities. Shop users wanting to operate a tool or machine must have the knowledge and skill to use that tool or machine safely. This is determined by the shop supervisor on duty. Please ask for assistance or training before using any equipment or procedure with which you not be 100% comfortable. Certain tools (e.g., laser cutters, CNC) are to be operated only by shop supervisors.

No one under the influence of drugs or alcohol, lack of sleep, or any other distraction is permitted in the shops. This includes listening to music through headphones/ear buds, or having “visitors” watch you work. Users who appear to be under the influence, distracted, or “in a hurry” will be asked to leave. This determination will be made by the shop supervisor on duty.

Approved eye and ear protection must be worn by everyone in the shops while power tools are in use. Before using a power tool, let others know so that they can put on eye and ear protection. All users must be dressed appropriately for shop work. Long hair must be secured. No dangling jewelry, scarves, ties, loose shirtsleeves, etc. No open-toed shoes, slick soles, high heels, or bare feet.

Dust collection must be used with any tool so equipped. Use portable sanders on the downdraft dust collector (the sanding station). Dust masks are available to supplement the dust collection system. Any injury requiring any treatment (even a Band-Aid) must be reported promptly to the shop supervisor on duty. Any tool damage or unsafe equipment must be reported promptly to the shop supervisor on duty.

All shop users are responsible for cleaning up after themselves. Work surfaces and tools are to be thoroughly cleaned, including removal of all glue. Stationary tools are to be thoroughly swept/vacuumed. Jigs, bits, etc., are to be removed and properly stored. Hand tools and portable power tools are to be returned to the proper location. Air hoses are to be properly stored. Floor areas are to be swept/vacuumed. Garbage is to be properly disposed of—if you create a large volume of trash, take the can to the dumpster. Ear and eye protection is to be returned to the proper location.

Use glue ONLY on approved surfaces (e.g., not the table saw). Store clamped assemblies out of the way, and unclamp as soon as possible. Flammable materials must be stored in the flammables cabinet. Rags or other materials contaminated with flammables (especially oil or oil-based finishes) MUST be disposed of in the flammables can, NOT the garbage can.

Most exotic wood species, a few domestic species, and many engineered wood products present health hazards and/or damage tools and equipment. Check with the Fabrication Labs Manager before bringing any unusual materials into the shops. Sustainable use and reuse of materials is encouraged. However, reclaimed/recycled lumber can present health and safety issues and damage tools and equipment. Check with the Fabrication Labs Manager before using any reclaimed/recycled material.

Most solvent-borne finishes and paints are toxic and present unnecessary health and safety hazards. This includes almost all spray paints and finishes, and certain glues. Use waterborne finishes whenever possible. Check with the Fabrication Labs Manager before bringing any paint, finish, solvent, etc. into the shops.

No storage of materials or projects-in-progress is permitted without prior approval from the Fabrication Labs Manager. Materials approved for storage must be marked with user's name. Materials not approved for storage will be thrown away or treated as shop property. Tool check-out requires up-to-date orientation session, a valid WSU ID card, and local contact info. The person checking out the tool is responsible for any loss or damage. Late check-in is grounds for loss of check-out privileges. Not all tools are available for check-out.

Guidelines for Universal Laser Systems Laser Cutters (X-660 and ILS 9.150D)

- Students are allowed no more than one (1) hour laser time per day, and no more than 3 hours per week. This includes reserved time, walk-in time, or a combination of both.
- All files must be on USB or portable hard drives—make sure your file is easy to find! No emailed or Dropbox files.
- Avoid stacked or double lines—they cut twice and burn materials. The commands 'Join' and 'Selectduplicate' in Rhino or 'Overkill' in AutoCAD may help. Your file will be rejected on the basis of double lines.
- Colors must be assigned by layer (cyan layer, magenta layer, etc.). Turn off layers that will not be cutting. Simple files with fewer layers are easier to work with!
- Only materials on the Approved Material List may be cut or engraved.
- Students are responsible for clearing away and disposing of waste material.
- Maximum cutting area of the X-660 is 32" wide by 18" high (landscape), and 36" x 24" for the ILS. When possible, prepare your file for the smaller cutter.
- All files must be properly prepared by the student or they will not be cut. Employees of the shop are not AutoDesk, Rhino, or Adobe instructors.
- Autocad file format (.dwg) is strongly preferred. These files can be generated in AutoCAD, Rhino, Adobe Illustrator, or other vector-based design programs. Vector cutting is also possible with editable .pdf or .ai files. Raster cutting must be approved in advance.
- Files created in Rhino and exported as a .dwg need to be verified by you before you bring them in for cutting. Check line weights, colors, view orientation, etc. Be certain that you are presenting a 2D file for cutting! Export your Rhino files as 2D .dwg.
- Draw a box in your model space that represents the size of material that you will be using so that you are certain that the parts all fit on your material.
- The line bounding this box should be black or white. The box will need to be in scale. The laser cutter leaves an uncut area of 1/4" around the edge of the material.
- Use of the online reservation system is strongly encouraged <http://fablabwsu.youcanbook.me>. Missed appointments still count against your laser time for the day/week—frequently missing appointments (without canceling) may result in loss of shop privileges.
- Outside of reservation hours, there is always a sign-up sheet/waiting list for laser cutting. Sign the list when you want to use the machine. We will cut only your files. No grouping up.
- The Universal Laser cutter is for academic projects only. Anyone attempting to engrave gift items, personal items, or other non-academic projects will lose shop privileges for a month.
- Lines for vector cutting or engraving must be drawn in .000 line weight or they will not work at all. "Default" line weights simply will not work.
- Vector engraving is used for engraving lines, such as brick pattern onto the surface of the material. It is also used for small text, numbers, or other markings used to identify parts.
- Files presented for cutting within 30 minutes of closing time may be rejected based upon the judgment of the shop tech.

Approved Materials for Use with Universal Laser Systems Laser Cutters

Materials in red may be purchased from the shops using your Cougar Card. The materials we sell are optimized for laser cutting, and usually less expensive than other sources. These are the most commonly cut/engraved materials:

- **1/16" Chipboard** (or thinner). We can cut 1/8" chipboard, but discourage it unless absolutely necessary. Cuts in 1/8" are much slower, and edges tend to burn.
- **1/16" Mat Board/Museum Board** (or thinner).
- **1/32"-1/16" Task Board**. This material cuts well, with minimal burning. It is also a little less expensive than mat board, and can be damp-formed into permanent curves.
- **Basswood**, up to 1/8" thick. The shop hopes to have some sizes for sale in the near future.
- Plywood, up to 1/8" thick.
- **Acrylic sheet (Plexiglas), up to 1/4" thick**. 1/8" cast acrylic sheet (best for laser engraving) is stocked in the shop; 1/4" acrylic is available with advanced notice.
- Most papers (watercolor paper, **milk carton paper**, Bristol board, etc). Thin papers (eg, printer paper) can be difficult to hold down.

These are materials we usually can cut/engrave, but check first (you will need to allow extra time and material to test cut settings):

- Polypropylene sheet, up to 1/16" thick.
- Laser-engrivable sign plastic.
- Cloth, leather, cork, solid woods other than basswood. Most of these materials can be cut with no problems, but check with us first.
- Mirrored Plexiglas. Cuts from non-reflective back side.
- Corrugated cardboard, up to 1/4" thick. This material is potentially flammable and requires careful monitoring. For the time being (and on a case-by-case basis), we are willing to cut it, but it may be a banned material in the future.

We DO NOT/ CANNOT cut the following:

- Styrene plastics, including Styrofoam and foam core.
- Any reflective material.
- Any metal (some metals can be engraved, but require special procedures).
- Polycarbonate plastic (unless you understand and accept the poor quality of cut).
- Glass, stone, etc.
- Any other material that creates a safety hazard, risks damage to the laser cutters, or unnecessarily slows shop procedures. This judgment will be made by the Fabrication Labs Manager or shop technician on duty.

Guidelines for ShopBot PRS-Standard CNC Router

- Allow at least one week lead time for CNC jobs. This is one week from the time we receive your clean, ready-to-cut file, plus materials (also ready for cutting)
- Check current semester shop hours for available CNC times—CNC setup, cutting, and technical assistance is not available during all shop hours.
- You must monitor your job while it is cutting. We will not cut jobs if you aren't there for the entire cut time. Cutting may take hours—we'll give you an estimate of the cutting time when your job is programmed for the ShopBot.
- Assume your file needs fixing. You are responsible for this. Remember: we are not Rhino, Autodesk, or Adobe tutors.

File formats:

- Rhino files strongly preferred—the ShopBot is programmed using a Rhino plugin. AutoCAD is okay for 2D files. All other file types must be converted and cleaned up by you.
- If you are inexperienced making files for CNC fabrication, talk to us first. We can help you avoid common mistakes.
- Use layers to organize your files.
- We accept files on USB or portable hard drives only. Put your file in an easy-to-find location. Give your files short descriptive names. Include your last name.

File geometry:

- Use 2D drawings for 2D cutting (thru cuts, engraving, dadoes, etc).
- 2D geometry should be closed or made into polylines wherever possible. Generally, points are used to program location of drilled holes. Single lines are usually (not always) used to program location of cuts or grooves.
- Use 3D modeling for carving only (e.g., site models).
- 3D models must be a closed polysurface (watertight).
- It is NOT possible to cut square interior corners with a CNC router.

Stock and part setup:

- The 'part' is what you design. The 'stock' is the material that is cut to make the part.
- Site models require glued-up stock. You will have to make this before your file is cut.
- Remember, stated material thickness is usually a nominal (not actual) dimension. (E.g., 3/4" plywood is rarely actually 3/4" thick.) You need to know actual dimensions for successful CNC fabrication.
- ShopBot limits are 96" x 48" in X and Y; 6" in Z. In practice, it is usually impossible to cut to the full Z limit. Small parts can be difficult or impossible to cut.
- Part finish and cut time is dependent on cutter type, length, and diameter. We will select appropriate cutters (the 'tooling') for your job. 3D carving usually uses 1/2" diameter cutters. We use 1/4" diameter cutters for 2D cutting/engraving if at all possible; for small parts we will occasionally use 1/8" diameter cutters.
- Parts need a margin to edge of stock greater than 1 cutter diameter.
- Nest parts with spacing between 1.5 and 2 times the cutter diameter.
- Round holes work best when drilled. Drilling means hole diameter equals cutter diameter.
- For 3D carving, stock must be taller than the part, but shorter than the ShopBot Z limit.
- For jobs with extensive or specialty cutting, you may be asked to purchase tooling for the job.

Approved Materials for use with ShopBot PRS_Standard CNC Router

Materials in red may be purchased from the shops using your Cougar Card—we keep a small inventory, so there may be a few days lead-time if we don't have the materials in stock. Samples are available for most of materials we sell. Materials need to be as flat as possible. Parts should be laid out with respect for grain direction (when cutting materials with a grain). These are the most commonly cut/engraved/carved materials:

- **ACX Plywood** 1/4"-3/4" nominal thickness (actual thickness usually less). ACX has softwood plys, one good, sanded side, and few interior voids. Good water resistance. Max. sheet size: 96" x 48".

- **Baltic Birch Plywood** 1/8"-3/4" nominal thickness (actual thickness usually less). Baltic Birch has hardwood plys, two good, sanded sides, and virtually no interior voids. Fair water resistance. Max sheet size: 60" x 60" (note ShopBot max. width is 48").
- **Medium Density Fiberboard (MDF)** 1/4"-3/4" thickness (actual thickness is very close to this). MDF is smooth, uniform, and relatively inexpensive. NOT water-resistant. It tends to split into layers, making some carving operations difficult. A good choice for vacuum molds and inexpensive site models. Max sheet size: 97" x 49".
- **Doorskin** 1/8" nominal thickness. Thin, relatively inexpensive plywood. Lauan is the cheapest; hardwood veneer including birch and oak are also available. Max sheet size: 96" x 48".
- Most other wood and wood-fiber products can be cut, including other grades of plywood, melamine, chipboard, OSB, LVL, and strawboard, although finish may be rough in some of these. Natural wood (softwood/hardwood) can be cut. Finish will vary and special jigs or fixtures may be needed depending on the size/shape of the stock.
- Many plastics can be cut, including acrylic, polycarbonate, polypropylene, corrugated plastic, cellular pvc/abs, phenolic board, paperstone, and others. Specialty tooling may be required. At this time, we DO NOT plan to cut EPS foam (blueboard, pinkboard), or any other Styrofoam-type material.
- We may be able to cut other materials as long as they doesn't present a hazard to human health and safety, or risk damage to the ShopBot. Talk to us if you have any ideas (well in advance). Documentation of successful use of the proposed material in university shops with similar equipment will likely be required.

We DO NOT/ CANNOT cut/engrave/carve the following:

- Any metal, including aluminum.
- Stone, glass, masonry, concrete, or similar.
- Most foams, as outlined above.
- Fiberglass, or any other material that poses an unacceptable inhalation hazard.
- Any unacceptably abrasive material (e.g., drywall).
- Any other material that creates a safety hazard, risks damage to the ShopBot, or unnecessarily slows shop procedures. This judgment will be made by the Fabrication Labs Manager.
- We plan to purchase a **drag knife** in the near future. This tool allows CNC cutting of cardboard, paper, cloth, thin plastics, etc. at much larger size (but with less precision) than is possible with the laser cutters. Stay tuned.