

# Ylab laser cutter guide and policies

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## 1 Pre-requisites to laser cutter usage

1. Ylab 2D design class - pass a test with Richard
2. Pass the Ylab laser cutter class

If you haven't passed the above, don't touch

Recommended software: Draftsight (downloadable for free)

- Requirement: DXF output

## 2 General usage rules and regulation

### 2.1 Overall rules

Usage of the equipment is governed by:

- The ylab membership rules, disclaimer and waiver of liability and other associated agreements
- The contents of this document and associated checklists
- Information posted on the equipment.

Usage of all the checklists for each procedure is mandatory, and any failure to follow the checklist sequences and other rules will result in:

1. Suspension of all privileges and rights to use the equipment
2. Reinstatement of privileges only after all of the following:
  - a. Repeat of the full certification class at user's own expense
  - b. Recommendation by 2 members for re-instatement

Serious violations that result or could result in harm to the equipment or people can be referred to the ylab Directors. Penalties imposed by Directors can extend up to long-term or permanent revocation of usage rights to any or all equipment, access to the ylab facility and events, and membership suspension or revocation.

## 2.2 Usage certification requirement

Ylab's laser cutter and other designated equipment can only be used and operated by members and non-members who have passed ylab's laser cutter certification class. A list of users who have passed the training is posted on the machine and in the ylab google docs membership folder.

## 2.3 Usage times

Certified Ylab members can use the system during all ylab opening hours.

Certified non-members may only use the equipment during designated open house times.

Usage may be pre-empted with or without notice by:

- **Scheduled ylab classes and special events requiring use of the equipment pre-empt all other usage** - i.e. if a class is scheduled during normal ylab operating or open house hours, then the equipment is not available to other users during the class.
- Preparation of material for other ylab events or activities
- David Dunlap Observatory events where noise or other activity from the equipment is deemed by the RASC members to interfere with their activities
- Usage of the DDO workshop by DDO/RASC personnel

## 2.4 Commercial usage restriction

Except with permission of at least one director, commercial usage of the equipment is not permitted. There are plenty of local shops that will do that for you. Permission may be granted by a director for prototype development by a member for single item. If you need a production run or you intend to sell or resell what you're making, go to a commercial shop.

Usage of the equipment by members to produce parts for volunteer, non-profit groups is encouraged but subject to approval and revocation by directors. Examples of such groups include Scouts and Guides and the DDO. Work required must be within reasonable limits. 12 for a single group is fine. 200 for a large area camp must go to a commercial shop. You can only charge the group for the materials.

## 2.5 Fair time allocation and usage priorities

To put it mildly - don't hog the equipment. Common sense, not being a jerk, and fairness should always apply. Your lack of foresight and advance planning that creates an urgent situation for you does not give you any priority in any way.

Priorities, from highest to lowest:

- Amount of usage (i.e. if you've been using it a lot, let someone else). We hope it doesn't come down to having to do usage logging and sign-up sheets.
- Fast, single-piece personal jobs

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- Slow, single-piece personal jobs
- Multi-piece personal jobs
- Same order as above for volunteer/non-profit jobs
- Commercial jobs (with permission)

On open house nights, members should endeavor to help and prioritise visitor /non-member jobs. After all, it's the only time they get to access the equipment. For non-members, the following additional criteria should apply within the priorities above.

IF YOU ARE CUTTING FOR A VISITOR, THEN THE VISITOR MUST HAVE SIGNED A WAIVER.

Visitor priorities on open house nights - highest to lowest:

- First-time users/visitors
- Repeat visitor
- Really repeat visitor

### 3 Physical Machine and Components

Do not open the equipment to check this stuff out. We'll cover it in the class. After all, if you haven't passed the class, you're not allowed to touch it.

#### 3.1 Laser tube:

- In back of machine under cover
- NEVER TOUCH IT
- YOU HAVE NO REASON TO EVEN OPEN
- Laser delivered to cutting head by mirrors!
- Beam is focused to cutting point – and fans out after passing cutting point. That's why area underneath is not damaged.



#### 3.2 Chiller for laser tube

- Required to be running before and after operation – including sufficiently long to let laser tube cool off after operation.
- Always leave switch on. We'll control on/off at the power plug level

#### 3.3 Compressor/air pump for cutting head:

- Ensures gases and debris from combustion are blown out of the way of the laser to keep cuts clean



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- Keeps positive pressure inside
- CAN BLOW YOUR MATERIAL AROUND. If your material is light, tape it down.



### 3.4 Ventilation pump:

- Sucks everything out. This is the main exhaust for the system.
- Connected to insert board for window behind the laser cutter.

### 3.5 Power supplies & Controller

Right side (when facing front)

Power Supplies

- o High voltage for laser
- o 48V for stepper motors
- o 5V/12V for controller boards

Controller boards: X, Y, Z



### 3.6 Cutting head - laser head and depth sensor

- Must always be above (higher than your material)
- Move cutting surface down BEFORE starting anything
- If the cutting head impacts the material, shut it down and contact maintenance crew
- Gold piece that looks like a pen on the side of the cutting head is the **depth sensor**. When setting the cutting height, the systems automatically raises the working shelf and material until it sets it off, then lowers to focal height for cutting
- The Red Laser pointer shows where the laser is pointing too. But, if your Z-Axis is not adjusting to the material, it will be offset.



### 3.7 Mirrors and Lens

- There are 3 mirrors and 1 lens that guide the laser beam to the material surface.

## 4 Equipment usage

## 4.1 Technical usage instructions overview

This is a laser cutter. It has a laser. It can burn things. It can blind you. It can start fires and emit toxic smoke. Even though you've signed a waiver, the instructions must be followed:

- For your safety
- For the safety of others
- For the safety of the equipment
- To avoid interfering with the use and enjoyment of the full facility by others.

Laser cutting can stink up the whole building. Follow the rules, and we won't have complaints.

## 4.2 Initial power up.

### 4.2.1 Room preparation

- CLOSE THE DOOR BETWEEN THE HALLWAY AND THE WASHROOM/STAIRS.
- CLOSE ALL ROOM DOORS AND WINDOWS . Required to maintain positive air pressure and ensure all combustion gas blown out of room.
- Note the location of the fire extinguisher and ensure that it is charged (dial on front)
- NEVER GO BEHIND LASER UNLESS YOU ARE TRAINED ON MAINTENANCE
- Place exhaust cutout in window and close window on insert
- Place sandbag at top of lower window sash of window with exhaust cut-out
  - Feel with your hand that no air is coming through
  - This makes a huge difference in keeping the exhaust from coming back in

### 4.2.2 Laser cutter initial power up

We control the power to the different components with our power console that sits on top of the laser cutter



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It's like Apollo 13. Must be done in sequence, or you can blow a fuse.

- Open unit and check for exhaust obstructions under cutting grills
- CLOSE ALL LASER CUTTER PANELS AND DOORS. If they're not shut and locked, interlocks will prevent the unit from operating.
- ENSURE ALL WORK MATERIAL REMOVED FROM WORK SURFACE
  - o Machine will automatically move head on power up, so there should be nothing in the way.
- All keyed doors must be locked (top cover is not keyed)
- Turn on the MASTER switch on the power console (red will show)
- Turn on the LASER switch on the power console
- Power on by turning master key clockwise
  - o Retrieve key from tool box
  - o Turn on
    - Wait about 10 seconds - until machine beeps and re-positions cutting head.
  - o At this point, fans, computer board and lights are on – but not the laser itself
    - Little red dot under cutting head is just a pointer. Won't hurt you.
    - If light appears to be coming from back of unit where laser is, that's just the interior light – like an oven light. Switch for that is on the right side of the unit.
- Turn on Chiller on power console
  - o The chiller is under or slightly behind the table on the left side of the laser cutter
  - o It's normal for the ALARM to sound and light to flash for a few seconds on power up – until coolant flow is established
  - o Ensure NORMAL green light on the front is on
  - o Takes about 30 seconds to start – you can hear the fan
  - o Test flow and flow restriction by pinching coolant hose with fingers to see if alarm sound



At this point, the laser cutter can be used to place your work on the cutting bed and adjust the cutting head and other settings - but not to cut. There's a secondary sequence for that.

### 4.3 Preparing for the cut

#### 4.3.1 Acceptable material check

Ensure your material is on the approved list. No exceptions. Using unauthorized material:

- Can result in toxic fumes that will kill you
- Can result in damage to the laser cutter



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The manual that accompanies the laser cutter has lists of approved and prohibited materials at the back of the guide. If the guide is missing, you can check it on the ylab google drive.

If unsure, ask a supervisor (contact info at end of this document)

### 4.3.2 Preparing the work area

The first thing you need to do is set up the work surface.

**CRITICAL: ALWAYS LOWER THE WORK SURFACE BEFORE DOING ANYTHING TO ENSURE IT IS BELOW THE CUTTING HEAD.**

Decide whether or not you need to use the honeycomb bed.

#### 4.3.2.1 Lowering the cutting surface - Z-Axis Operation

In preparation for your work, always lower the cutting surface before loading material or the honeycomb platter

If Z-AXIS OPERATE, then in Z-Axis adjustment mode

To go to Z-axis mode

- Hit the Z key
- Only key you should hit in this mode is the down arrow
- To exit: Hit Z key again. Returns you to LASER mode



#### 4.3.2.2 Choose your cutting surface

- Base grill: you can cut rigid material on it.
- Honeycomb: for flexible material or cutting pieces that could fall through base grill
  - o Some materials are heat sensitive and will re-absorb heat from honeycomb, resulting in marks on the material. Test on a small piece first.

-



#### 4.3.2.3 Taking honeycomb rack out:

- Lower work surface until it's safely below cutting head
- It's going to be dusty. Be prepared to sweep up.
- CAREFUL NOT TO HIT THE CUTTING HEAD

#### 4.3.2.4 To insert the honeycomb:

- Go to Z-Axis Operate
- Drop cutting surface at least 2 inches below cutting head

- Don't worry about front/back or upside down. It's all good.

### 4.3.2.5 Material placement on cutting surface

- If appropriate, use masking tape to cover material engraving area
  - See materials guide
- Use z-axis adjustment to ensure there's enough clearance between the cutting head and the material
- Place your material on the surface
- If lightweight, tape it down.

DO NOT RAISE THE CUTTING SURFACE - This will be done during the pre-cutting stage.

### 4.3.3 Start the laser cutter software on the PC

- Software to use is LASER CUT 5.3.
  - The installation files can be found on the Ylab Google Drive:  
  
Shared with me > Ylab Public > LC6090 Laser Cutter > Laser Cutting Software
    - Includes drivers for everything you need
- Main usage is to import Drawing in the DXF format
- You can Draw manually with the program, but it is not a great interface

#### 4.3.3.1 Set up and order your engraving and cutting layers

- Based on the colours/layers in your CAD drawing
- ENGRAVING FIRST, CUTTING AFTER

#### 4.3.3.2 Scale your cut

- Use the Draw -> Size menu to bring up the scaling function
- Grid is in cm
- Scale sizing input is in mm
- Type in one (x or y) , then hit the ... on the opposite co-ordinate (y or x) to adjust the other automatically

#### 4.3.3.3 Select your origin point for the cut

You can cut relative to the starting point where you will move the cutting bed, or absolute coordinates on the cutting bed. We recommend Relative to starting point

- From the menu: Laser -> Set Laser origin
- Relative to starting point you set by adjusting using the front panel x-y controls

- Pick where you want the red dot to start relative to your design (top right corner, bottom left corner, etc.)

### 4.3.3.4 Configure the laser settings for the material and cut type

- 3.7 Set laser: speed, power and frequency/pulses per inch
- All will be based on material and its thickness (CHECK OUR TABLE)
  - Click on Speed value on LAYER blue line on tip right
    - Click on the ... button to get to frequency
  - Example MDF 3 mm to cut:
    - Laser Frequency: 900 (it's actually dots per inch)
    - Power: 100
    - Inner-to-outer best because small bits fall out and move plate less than bigger
    - Set OPTIMISE and GAP OPTIMISE
    - Corner Power: 20 (lower, because laser moves slower on corners)

### 4.3.3.5 Enable optimal cut settings - to minimise cut time

- Tools -> Unit Lines: makes it much faster and less traveling by keeping cut as contiguous as possible (otherwise, sees line segments as individual and can go all over the place to different line segments)
- Tools -> Data Check: checks for overlapping lines/cuts.
  - If you get errors, you need to fix your design.
  - If you don't know how to fix it, **get help to fix it or cancel your cut.**
- Select IMMEDIATE for relative to current point. Otherwise, does it relative to full surface.

### 4.3.3.6 Download your design to the cutter

Select DOWNLOAD to start it

- delete existing files before starting (user DEL ALL)
  - Rule: don't expect your file to be saved on the laser cutter
- Select DOWNLOAD CURRENT.

### 4.3.3.7 Position cutting head over material

If LASER highlighted, in LASER mode

- Hit ESC to go to XY mode

If LASER not highlighted, in XY mode

- Hit enter to go back to LASER mode





### 4.3.3.8 Adjust cutting height, position and cut area test

- Go to Z axis and lower work surface to ensure clear of head
- Go to XY mode and move head near cutting area – BUT MAKE SURE GOLD DEPTH GAUGE ABOVE MATERIAL
- Go to Z mode and hit DATUM to set cutting head height
- Go to XY mode to set origin of cut based on read dot and relative setting you selected. At this point, the depth gauge does not need to be over material
- Hit TEST to see if outline is completely over material (track contouring)
  - o If not:
    - Hit ESC to return to XY mode
    - Reset position
    - Hit test again
    - Repeat until you get it right

### 4.4 Making the cut

- Re-verify that doors and windows are closed
- Re-verify that chiller is on
- Turn on FAN on power console
- Turn on COMP on power console
- RE-NOTE LOCATION OF FIRE EXTINGUISHER
- Test cut area again
- Hit START to cut
- DO NOT LEAVE ROOM!
- DO NOT STARE DOWN AT LASER CUTTING THROUGH TOP WINDOW. Shiny material like aluminum can reflect laser at your face
- Pay attention to the cutting, if you notice anything amiss - like a lot of smoke or flames - ABORT THE CUT BY PRESSING THE BIG RED BUTTON.

### 4.5 AFTER CUT IS COMPLETE

- Wait 30 seconds before opening hood for cutting fumes to evacuate
- Power off FAN on power console

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- Power off COMPRESSOR on power console
- Make sure you can remove the material without knocking the laser head. If so, lower the Z, or verify that the pat is clear and hit Datum button on laser to move the laser head out of the way.
- Remove material.
- IF CUT-OUT MATERIAL DROPPED DOWN THROUGH THE GRILLS:
  - Check exhaust under grills for blockage

### 4.6 EMERGENCY STOP:

1. Smack the red button
2. If safe to do so, pull burning material away from under cutting head
3. If any doubt, fire extinguisher
4. DON'T JUST TURN BACK ON!
  - a. If in doubt, leave off and contact technical supervisors, See appendix for contact names.
  - b. If turning back on, follow FULL SHUTDOWN and FULL STARTUP PROCEDURE

### 4.7 POWERING DOWN THE UNIT FOR THE EVENING

- Ensure chiller has been run for at least 2minutes without any cuts happening to ensure the laser tube is cooled
- Remove all materials
- Lower work surface
- Check exhaust port under grill for obstructions from cut materials
- If removed, replace honeycomb plate in unit. This prevents it from being damaged.
- On power console, turn off fan, compressor and chiller
- Power down laser cutter using key
- On power consoler, turn off laser and master switch
- Power down PC
- Return key and dongle to tool box
- Open front doors using the key in the laser tool box and empty tray of combustion bits
  - **MUST BE EMPTIED BEFORE LEAVING EVERY NIGHT** – to ensure no combustion materials in there
- Remove exhaust hose cut-out and close windows
- Move any unused materials to the storage room
- Clean up
- Lock all windows

## 5 2D CAD File preparation

- If your project requires engraving and cutting, do them as separate jobs
- Always do the engraving first.
- DO NOT TRUST THE SOFTWARE TO GET IT RIGHT
  - Treat both as separate jobs
  - Tape down your work to prevent material movement between steps
- From your favourite CAD program:
  - Explode any text in your diagram (i.e turn it into raster form). The laser cutter software does not handle text import
  - ALTERNATIVE: re-enter your text on the program
  - Export file into DXF format

## 6 Supervisor Contact Information

If for any reason, there is a chance that the laser has been compromised, please contact the following personnel before continuing using the laser:

Richard Rolland @ 416-788-7424      416-788-RICH

R.J. Juneau @ 416-897 6682 (416-TYPO-OUCh)

Key reason:

- Had to hit the Emergency stop button due to a serious level of fire.
- Rammed the laser head into a workpiece or tray.

We will inspect the system to make sure that the laser is still in a calibrated state, and that the system is still functioning.