



Workshop handout

# INTRODUCTION TO LASER CUTTING AND ENGRAVING



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# HELLO!

**In this two-hour workshop you will learn how to use a laser cutter.** Laser cutting is a technology that allows you to prototype with different materials by cutting or engraving them.

This handout compiles the most relevant information about laser cutting, as well as some practical instructions on how to use the laser cutters at MotionLab.Berlin. We encourage you to always come back to this material in case you have any questions regarding the use of the technology and the machinery.

## YOUR LEARNING OUTCOME

During this workshop you will learn how to:

- Work at the MotionLab.Berlin's laser cutting lab safely.
- Prepare your vector or image files to cut and/or engrave them.
- Use the laser cutter to cut, mark and engrave different types of materials, like plywood, acrylic glass, leather or sheet metal.





# THE SPACE

**You can find our laser cutting lab below the gallery space, and right next to the 3D printing lab.**

The maximum room capacity is 8 people.

The space is equipped with 2 laser cutters, 1 metal laser cutter, a workbench, and some small hand tools, like rulers, cutters and tape.

It also has a first-aid kit and two CO2 fire extinguishers.

This workshop is powered by



# MACHINERY & EQUIPMENT

[Visit GS Laser Systems webpage](#)



**Laser Catthi  
GS 6090 PR**

**Working area**

900x600 mm

**Power**

100Watt



**Major Laser  
GS 90130 PR**

**Working area**

900x1300 mm

**Power**

150Watt



**Metal Laser  
GS 90130 PR - M**

**Working area**

860x1290 mm

**Power**

300 Watt

You can use the machines by booking them [HERE](#) 



# WHAT IS LASER CUTTING?

Laser cutting machines use a powerful laser beam to cut into materials by melting, burning or vaporizing them.

This non-contact, thermal-based fabrication process is ideal to create intricate parts, allowing precise cuts and smooth finishes.

Laser cutting machines are not only used to cut profile lines, but also for surface treatments, such as engraving and marking.

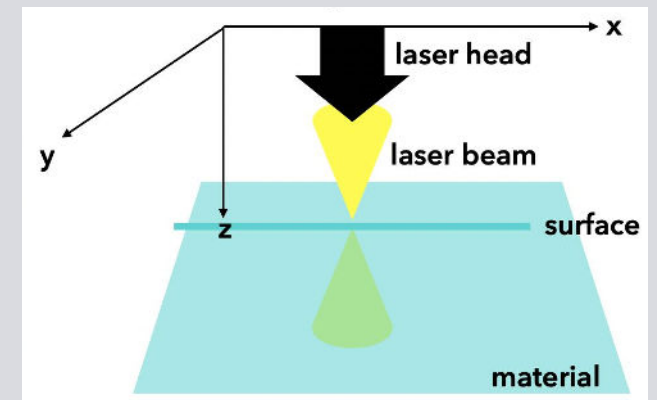
## What can you use it for?

Laser cutting machines are tools that can produce final pieces, ready to be used or to assist other design and manufacturing processes in combination with other tools.

## How does it work?

To simplify the process, a laser beam passes through a lens and is magnified and focused into a single point. It is possible to adjust the beam intensity and the speed of the cutting head.

Thus, the focal point of the lens needs to be on the surface of the material being cut.



# CUTTING VS. ENGRAVING

There are three operations you can perform with a laser cutter:

## Marking

Burns the surface of the material

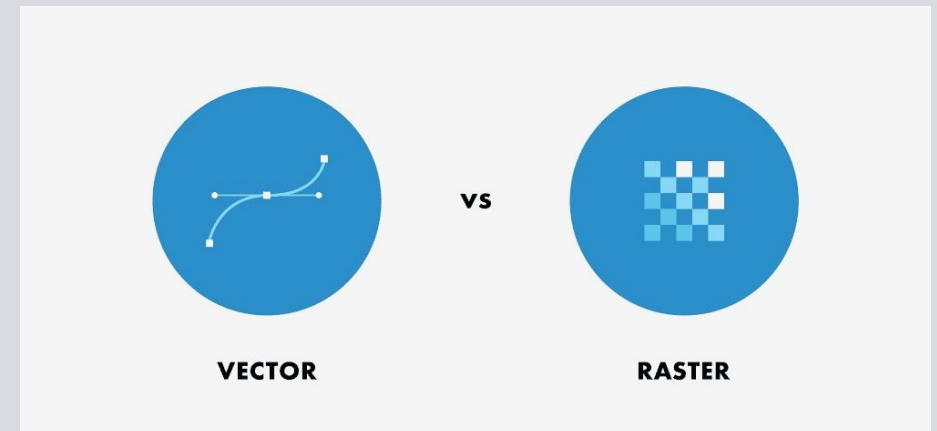
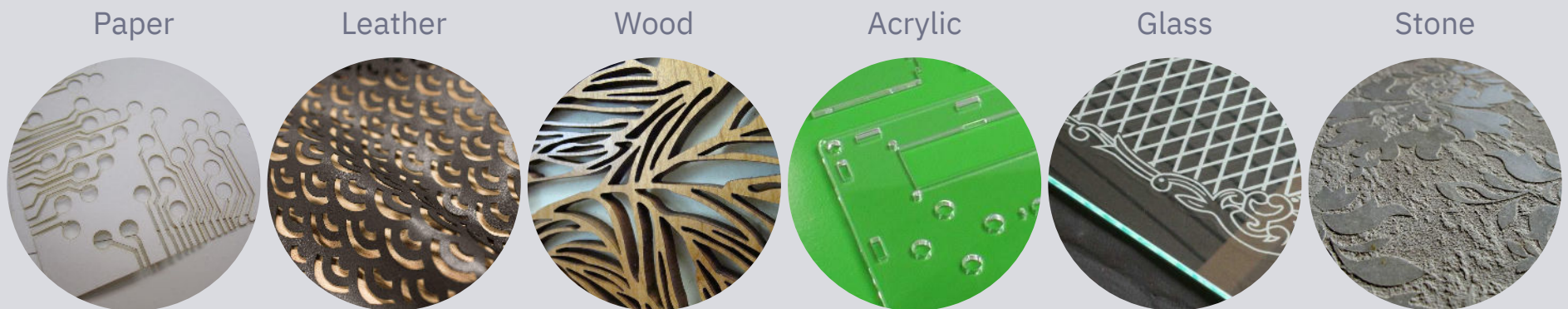
## Cutting

Passes through the material

## Engraving

Removes material from the upper surface

For example, you can cut



**You will need a vector image:** Comprised by paths. They allow resizing and scaling without loss of detail.


**You will need a raster image:** Comprised by pixels. The detail of your image will depend on its resolution,

And engrave

# MATERIALS

Please, follow this chart regarding the materials that can and cannot be cut/etched.

It is better to avoid cutting materials of which you do not know their provenance.

Find the full material library settings [HERE](#) 

## Safe to cut materials

MATERIALS	MAX. THICKNESS	NOTES	WARNINGS!
Many woods	6mm	Avoid oily resinous wood	Watch for fire
Plywood/Composites	6mm	Contains glue, and some may not cut well	
Acrylic/Plexiglass/PMM A	12mm	Cuts very well, leaving polished edges	
Leather/Suede	3mm	The thinner, the better	Cut only real leather!
Non-chlorine rubber			Beware of chlorine!
Cork	3mm	Engineered cork may not cut well	Avoid thicker than 5mm



## Safe to engrave materials

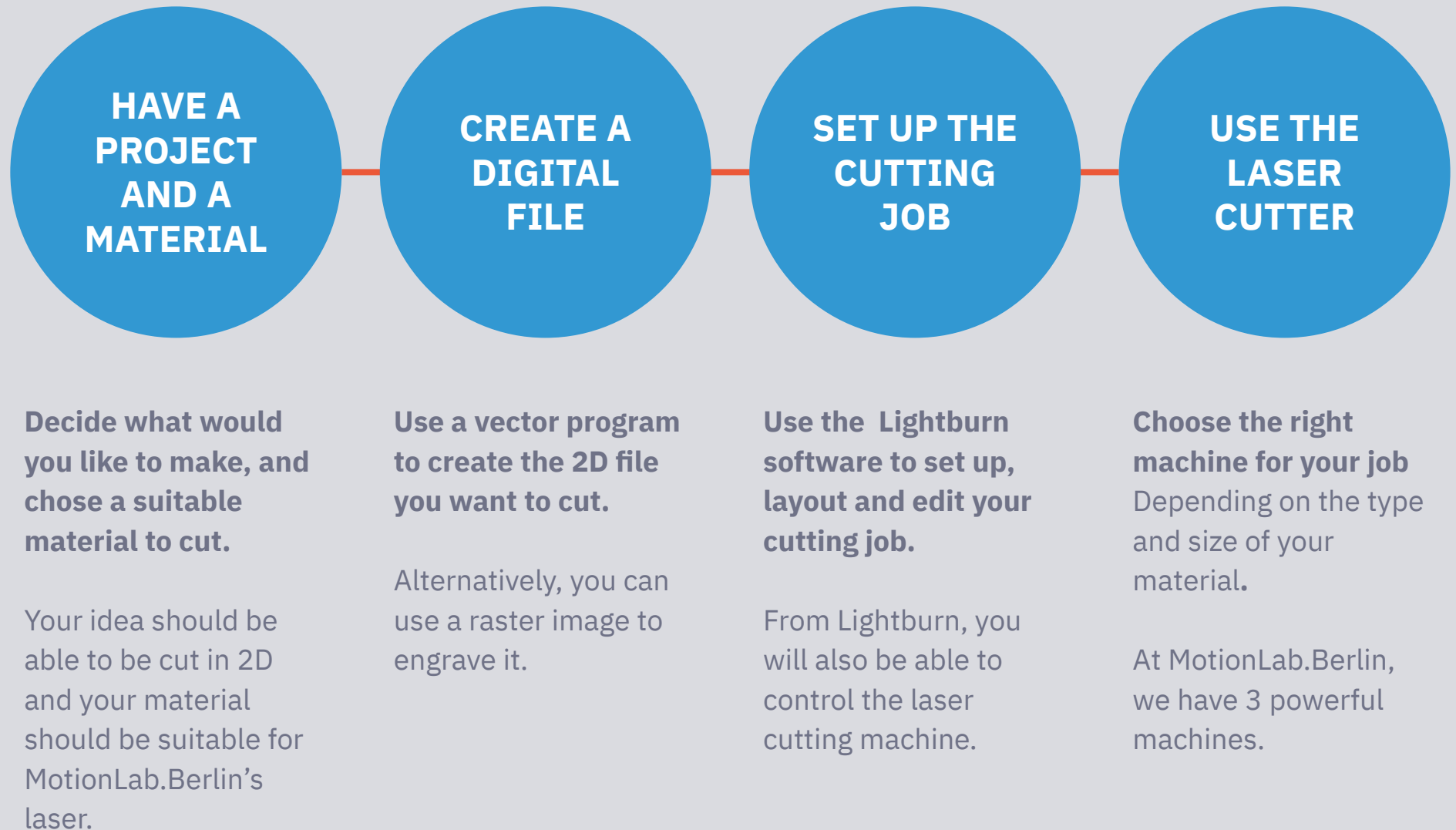
MATERIALS	NOTES	WARNINGS!
Glass	Green seems to work best	It is not possible to cut.
Painted/coated metals	Vaporizes the paint away	
Anodized aluminum	Vaporizes the anodization away	
Stone	Gets a white texture on the engraving	85% power, 50% speed or less

## Never cut this materials

MATERIALS	DANGER	CONSEQUENCES
PVC	Emits chlorine gas	Runs the optics, corrodes machine and may kill you.
ABS / HDPE	Catches fire and melts / Cyanide	Damages the machine, and may kill you.
Fiberglass	Emits fumes	Machine can't cut the material
Epoxy	Burn / Smoke	Creates toxic fumes.

# CREATING YOUR PROJECT

In order to successfully create your project with a laser cutter, you need to master these four steps:



# CHECKLIST BEFORE USING THE LASER CUTTER

Before starting a cutting job, ask yourself the following questions:

**1 Is the laser cutter the right tool for my project?**

Or would it be easier to cut it with a scroll, circular saw, CNC milling machine, or scissors?

**2 Is the material suitable for laser cutting?**

Always check the list on this handout, or ask our staff and the community.

Also, remember that rolled material should always be laid flat.

**3 Does the job fit the machine's working area?**

First, organise your file in the vector software you are working on and in the right machine size. Don't hesitate to ask for support from our staff if you need it.


**4 Does the job fit in the material?**

It is a good idea to measure first your stock material and compare it to the size of your job.



# CREATING A DIGITAL FILE

It is possible to create a vector graphics file in one of these apps:

- Adobe Illustrator
- Corel DRAW
- Sketch
- Affinity Designer
- Adobe Capture
- DesignEvo
- [Inkscape \(Free\)](#) 

Alternatively, you can use a CAD drawing software like Fusion 360, Autodesk Autocad or Rhino and export it as a .DXF file.

## Setting up a vector file

- Create a 2D drawing, even if you want to create a 3d object
- Make sure all your elements are contours, including texts, and without any color fill
- Make sure your file is in RGB color mode
- Make sure that all lines have a thickness (stroke) of 0,077mm
- Color and group lines by job task:
  - Black: Engrave
  - Red: Cut inner contours
  - Green: Carve contours flat
  - Yellow: Scratch contours deeply
  - Blue: Cut outer contours
  - Other color: Special jobs, like engraving
- **Remember! The color order is important because it will determine what job does the laser do first.**



# PREPARING YOUR FILE

Remember these 4 simple steps when designing your file

1

## Cutting or engraving?

If you are going to cut, make sure your file is made out of vectors. Then, export it as a .DXF, .EPS, .AI, .PDF, .SVG

2

## Use the right settings

Remember to make your file in RGB color mode.

Also, check the max. Cutting dimension to choose the right machine.

3

## No text, only contours

ORganise your file in the vector software you are working on. Don't hesitate to ask for support from our staff if you need it. Use the appropriate path stroke (0.077mm)

4

## Does the job fit in the material?

It is a good idea to measure first your stock material and compare it to the size of your job.



# USING LIGHTBURN

This laser cutting control software allows you to:

- Import artwork in a variety of common vector graphics and image formats (i.e. .AI, .PDF, .SVG, .DXF, .PNG, .JPG, .BMP)
- Arrange, edit and create new vector shapes.
- Modify cutting settings like power, speed, number of passes and, cutting order, among others.
- Send the result directly to the laser cutter.

All the computers at the Lab are equipped with this software, and you can use it as long as you have a reservation for the machine.

You can download a free trial [HERE](#) in case you want to test it on your personal computer.

You can find tutorials about the software [HERE](#)

[This tutorial](#) shows you how to master the software quickly.

Lightburn works in Windows, MacOS and Linux.





# USING THE LASER: STEP-BY-STEP INSTRUCTIONS

## LASER CATTHI - GS SYSTEMS

### TURN ON AND PREPARE THE MACHINE

- 1 Turn on the bog switch
- 2 Home the machine by pressing the **<RESET>** button.
- 3 If the key on the board is off, turn it to **<ON>**
- 4 Open the lid of the machine
- 5 On the panel, press the **<Z DOWN>** button to lower the cutting bed until you see that your material fits under the laser head.
- 6 Place your material in the cutting bed. We suggest you use one of the corners to align it. The material should not exceed 600x900 mm



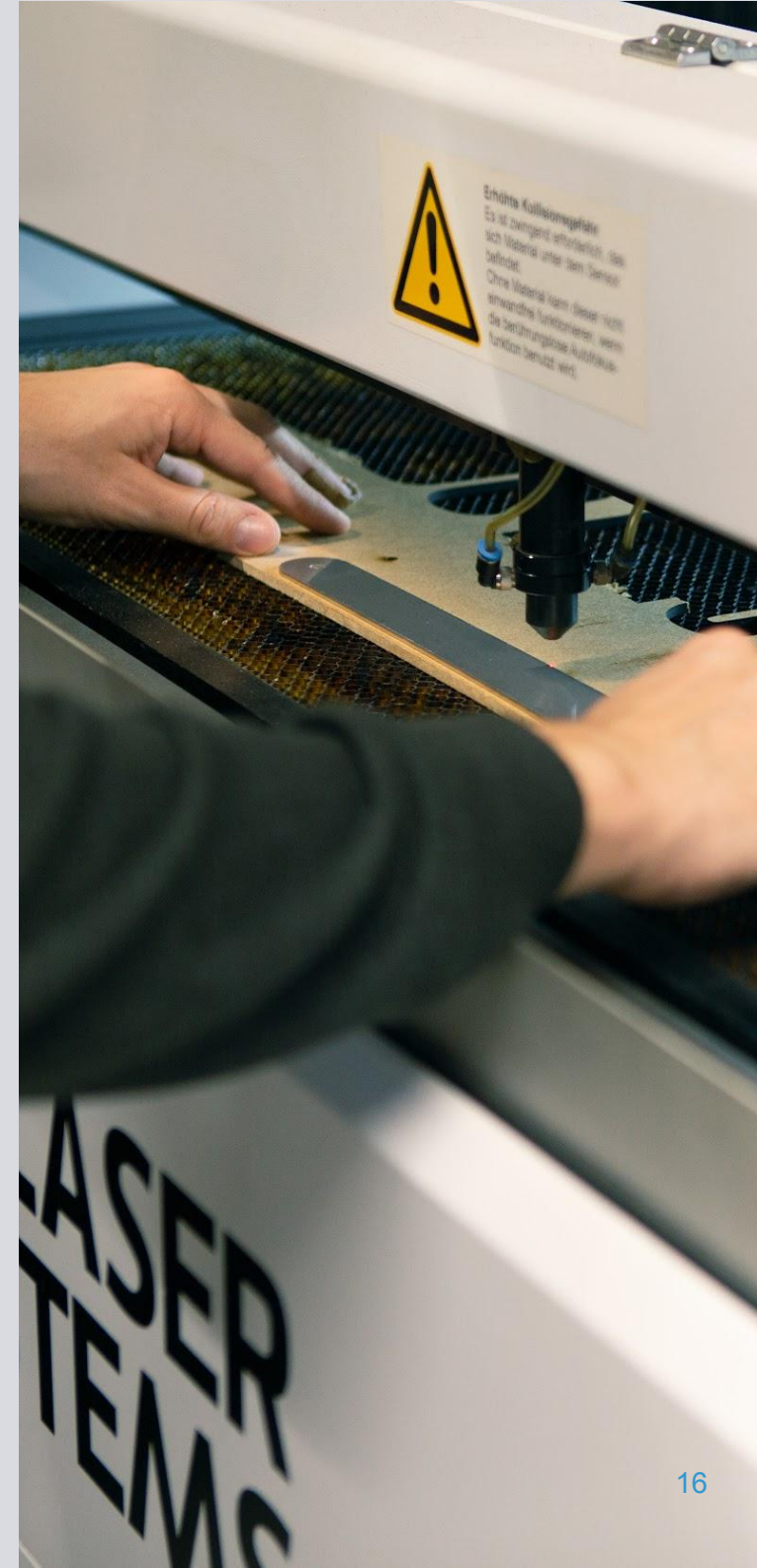
LASER CATTHI BOARD



MAJOR LASER BOARD

## CALIBRATE THE MACHINE

- 1 With the **<X>** and **<Y>** arrows in the panel, move the laser head so that it is above and in the middle of your material.
- 2 In the panel, press the **<Z UP>** or **<Z DOWN>** button until the laser head stops moving and beeps. This is the correct distance to cut.
- 3 Press the **<ESC>** button. Now, with the arrow keys in the machine, move the laser head to a reference point where you would like the cutting to start.
- 4 Close the lid and press the **<RESET>** button. You should do this every time you open and close the lid. The light on the back of the laser head should be green. If so, everything is set up and good to go.



## SET UP THE FILE IN LIGHTBURN 1.0.06

1

Open the software. Now, create a new board by clicking on **<FILE> <NEW> <DON'T SAVE>**

2

Open your file by clicking in the **<OPEN>** button. If you are cutting, you should have a vector file. You can use a PNG image too in case you want to engrave or etch. Drag and drop also works.

3

If you are working on Inkscape or Adobe Illustrator, it is a good practice to divide your work into different layers: outer shapes, inner shapes and/or engraving.

Alternatively, you can do the same in Lightburn by selecting different elements and creating a different layer for each group.

4

It is also possible to create basic shapes for test cuts by dragging them to the board from the bar on the left side.

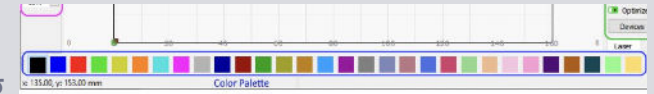
5

On the **<CUT/LAYERS>** window in the right side, modify this elements from each layer:

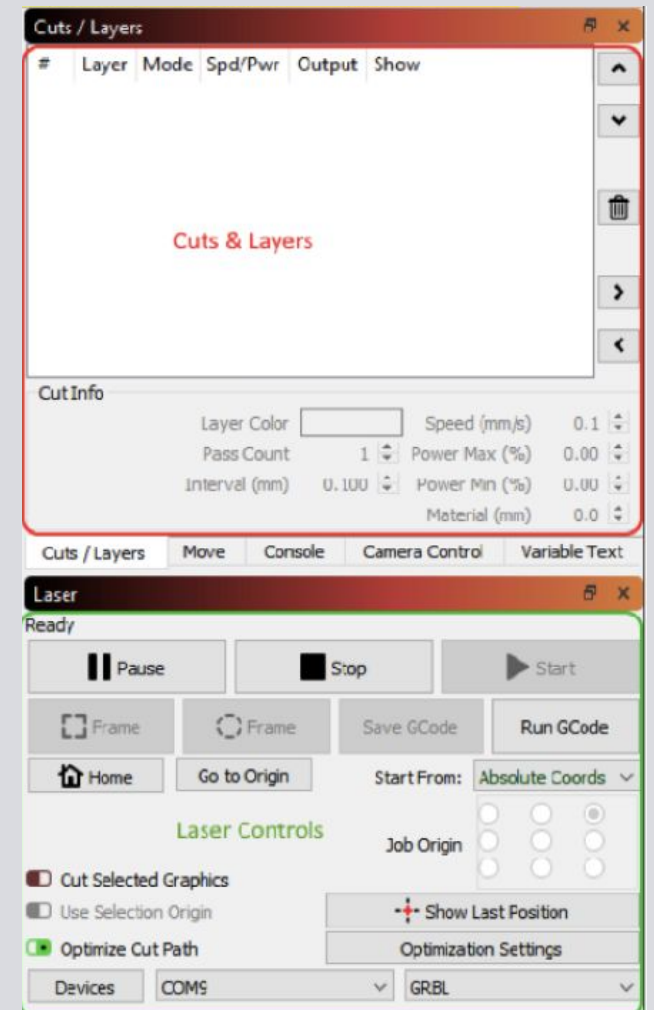
**MODE:** If you are cutting, then select **<LINE>**, if you want to etch or engrave, select **<FILL>**.

**SPEED/POWER:** You can change these settings in the bottom right corner of the window. We have built a list of presets for different materials and thicknesses, but we always suggest you make a test with the material you want to cut.

### Color swatch B=board



### Cut/Layers and command board





6

Note: the power range should be between **15%** and **85%**. If the power is outside of that range, the power will be inconsistent and it could lead to machine damage.

7

As a general rule:

- More power and less speed, with thinner and harder materials (i.e. Plexiglass, MDF) = Less passes
- Less power and more speed with thicker or sensitive materials (i.e. Plywood, rubber) = More passes
- Remember! You will find material samples next to the laser. You can use those as guides.

8

In the **<LASER>** window, make sure **<CUT SELECTED GRAPHICS>** and **<USE SELECTION ORIGIN>** are activated. Now, select with you mouse the lines you would like to cut: the green square on the corner of you lines represents the work origin, meaning, where your job will start cutting or engraving.

9

In the same window, click on the button **<OPTIMISATION SETTINGS>**. In the pop-up window activate: **<Cut Inner shapes>**, **<Remove overlapping lines>**, and optionally, **<Reduce travel moves>**, chose best starting point, reduce direction changes and chose best direction.



# CLEANING AFTER FINISHING

## 1 Throw the trash / remaining material in the right container

Make sure you use the black bin for wood, yellow for plastic, blue for paper, and the small one for other trash.



## 2 Store / give away your material

- Make sure you label your material as follows:
  - Last name, first name / Date
- Only store material within the designated rack below the staircase
- If you want to share leftover material, leave it in the designated shelf. Make sure it is at list A4 size
- **Remember!** Only store safe to cut material

## 3 Return the tools to the right place

Do not take any tools outside of the lab, and leave them in their place on the tool board next to the staircase.



**Remember to always clean up after yourself!**

# RISKS AND SAFETY INSTRUCTIONS

Laser systems use a high intensity beam of light that can produce extremely high temperatures when it comes into contact with the materials being cut or engraved. Flammable materials can easily ignite and burst into an open flame, setting the machine afire.

In order to avoid a fire accident, please follow these recommendations:

- Locate and **familiarise yourself with the safety elements** of the machine and the room: Emergency stop switch, fire extinguisher and fire blanket.
- **Stay with the laser at all times.** Never operate the laser cutter while unattended.
- **Keep the area clear** and free of volatile solvents and combustible materials, like acetone or alcohol.
- If the material you are cutting emits too much smoke, press the emergency stop button immediately.
- **Remember!** Keep the hatch closed for at least 10 more seconds after your cutting job is done.

## In case of fire

- Press the emergency stop button.
- Do not open the laser cabinet door.
- Bring the fire extinguisher next to the machine.
- Carefully, and keeping some distance, open the machine's hatch. Be aware of the smoke or flames coming out of the machine.
- Use a quick fire extinguisher burst to suffocate the flames.

## Fire extinguishers



**Both are located next to the shelving unit**



# DO'S AND DON'TS

## DO

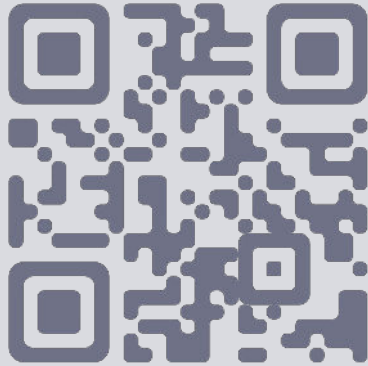
- Pay attention to what you are doing and to the people working around you
- When in doubt, ask our staff. We are happy to help
- Keep the area around the machine clear from obstructions
- Ensure that your material can be laser cut
- **Turn off the machine** and **close the oxygen bottle** when you finish working with it
- Report any faulty equipment to the staff
- Clean after yourself and keep the lab tidy
- Know the location of the fire protection gear

## DO NOT

- Disassemble or repair the machine, or remove its protective covers
- **Ever leave the machine unattended**
- Attempt to to defeat the door interlocks, guards or any other safety feature of the machine
- Use paint, glue, resin silicone or aerosol in the Lab space
- Sand any type of material. Doing so can cause a fire
- Cut/engrave wet material or wet paint, as well as forbidden materials like PVC or polycarbonate
- Work with open-flame equipment



# ADDITIONAL ONLINE RESOURCES



MotionLab.Berlin Slack channel - [#12 laser-cutter](#) 

Join our laser cutting lab slack channel and the community of experts!

Experience projects from coworkers, ask questions and help others and stay up to date about news and changes at the lab.

Also, let us know what exciting things you developed at the lab. Simply, post it in the slack channel and tag @Geri

- Epilog laser cutters [material database](#)
- MotionLab.Berlin online [material settings library](#)
- [Booking system](#) for the machines at MotionLab.Berlin
- Trotec laser cutting [templates](#)
- MotionLab.Berlin WIFI guest access  
Network: Motionlab-Guest  
Password: motionlab.guest
- Lightburn [software documentation](#)



# ALMOST THERE!

NOW, PARTICIPATE FROM  
THE LIVE WORKSHOP AND START  
WORKING ON YOUR PROJECTS!

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DID YOU LIKE THE CONTENT OF THIS WORKSHOP  
AND YOU ARE STILL NOT A MEMBER?

Join our ecosystem and make your ideas come to life!

Reach out to our colleague [Matthew](#)

Or sign up for our [newsletter](#) to learn about the upcoming  
workshops and events.

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## Note:

This is a living document, which  
may experience changes as our  
labs evolve.

If any of the links don't work,  
please report it to

[info@motionlab.berlin](mailto:info@motionlab.berlin)