



LASER CUTTER USER MANUAL



Mako 60W Laser Cutter User Manual - 2024.01.04

WARNINGS

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InkSmith is not responsible for any direct or indirect damages which result from using or working with the products, electrical circuits, or software described herein. The machine must be used only by trained and skilled personnel. This Operation Manual must be read and followed prior to operating the laser machine.

InkSmith reserves the right to change or alter any product described herein without prior notice.

In case of failure, please check the machine first according to section 6.1: Tips for Troubleshooting, as well as [our FAQ page at InkSmith.ca/a/help](https://www.inksmith.ca/a/help) for your specific problem. If unsuccessful, please note any data you have of the device (serial number, error code, etc.) and submit a ticket using <https://www.inksmith.ca/pages/tech-support>.

For queries or technical problems you can also contact InkSmith directly at the above address and phone number.

TABLE OF CONTENTS

1.0 MACHINE OVERVIEW	4
1.1 General Acknowledgments.....	4
1.2 Technical Specifications.....	5
1.3 Machine Info.....	6
2.0 SAFETY	7
2.1 General Safety.....	7
2.2 Laser Safety Precautions.....	8
2.3 Operational Safety.....	10
2.4 Approved/Not Approved Materials.....	11
3.0 INITIAL SETUP	12
3.1 What's Included.....	12
3.2 Location Considerations.....	13
3.3 Electrical Requirements.....	13
3.4 Exhaust Requirements.....	13
3.5 Machine Diagram.....	14
3.6 Connecting Air Filtration.....	15
3.7 Filling The Water Tank.....	15
4.0 CALIBRATION	16
4.1 Powering Machine ON/OFF.....	16
4.2 Calibrating the Laser.....	16
4.3 Calibrating the Light Path.....	17
4.3 Control System Navigation.....	20
4.4 Preparing Files for Print.....	22
4.5 Preparing the Machine for Work.....	33
5.0 MAINTENANCE	35
5.1 Machine Cleaning.....	35
5.2 Maintenance Schedule.....	37
6.0 ADDITIONAL INFO	38
6.1 Tips & Troubleshooting.....	38
6.2 Training Completion Form.....	39
6.3 Technical Support Contact.....	40



1.0 MACHINE OVERVIEW

1.1 GENERAL ACKNOWLEDGMENTS

Please read and follow this Operation Manual carefully before installation and operation of the laser cutter. Damage to people, equipment, and/or material can result from failure to follow the instructions in the manual.

It is important that the laser cutter is only operated after the machine has been properly calibrated. (See Section 4.0: Calibration)

Operation of the machine is only advise with consumables listed in the Approved Materials lists. Use of the laser cutter with unapproved materials is not recommended. The manufacturer is not liable for damage to personnel and/or equipment resulting use of incorrect materials.

The laser cutting machine must only be operated, maintained, and repaired by personnel that are familiar with and trained in the correct operation and potential hazards of the machine.

Failure to follow the operation, maintenance, and repair instructions described in this Operation Manual excludes any liability of the manufacturer if a defect occurs.

Please retain a copy of this manual for reference.



1.0 MACHINE OVERVIEW

1.2 TECHNICAL SPECIFICATIONS

Technical Specifications	
Model	Mako 60W
Price	\$8,299.00
Workspace	500mm x 300 mm
Laser Power	60 Watt
Laser Type	CO2 Sealed Glass Tube, 10.6 μ m
Cooling Type	Water Cooling
Engraving Speed	100-350mm/sec
Cutting Speed	10-100mm/sec
Laser Optical Control	(0-100% set by software)
Min. Engraving Size	English letter: 1 mm x 1 mm
Max Scanning Precision	4000DPI
Locating Precision	\leq + 0.01 mm
Controlling Software	LightBurn, DSP Control System
Graphical Format Supported	AI, DST, PLT, DXF, DWG, LAS, etc.
Compatible Software	Autocad, Coreldraw, Photoshop, Lightburn, Tajima, etc.
Colour Separation	Yes
Drive System	High-precision 3-Phase Stepper Motor
Power Supply	AC110V/220V (or +10%), 50HZ/60HZ
Working Environment	Temperature: 0 - 45°, • Humidity 5 - 95%
Optional Spare Parts	Honeycomb Worktable, Auto-focus device
Air Filtration Unit	Optional Unit, if required +\$1999.99
Stand	Optional, if required + \$599.99

1.0 MACHINE OVERVIEW

1.3 MACHINE INFO

The Mako laser cutters are a series of high precision laser cutting machines capable of delivering professional cutting and engraving results quickly and easily. These lasers are able to cut and engrave on a variety of materials including wood, cardboard, fabric, leather, and acrylic.

Warning labels for your specific machine can be found on the laser cutter itself - do not change or remove the Equipment Name Plate or any warning labels/stickers.



2.0 SAFETY

2.1 GENERAL SAFETY

All persons involved in the installation, set-up, operation, and maintenance of the machine must have read and understood this Operation Manual, with special emphasis on the “Safety” section. It is recommended that organizations generate an internal qualification process for operating the laser cutter. Personnel who complete laser safety training should be recognized with written proof of qualification (see section 6.2).

To ensure the safety of all operators and performance of the laser cutting machine, only those individuals who have read this Operation Manual may operate the laser cutting machine.

Safety Information for Operating Personnel

1. Machine operators must ensure no unauthorized individuals install, set-up, operate, maintain and/or repair the laser cutting machine.
2. It is the duty of the operator to check the machine before operation and to report and tag defects that may affect the safety of the machine.
3. The operator must ensure that the machine is only operated in proper working order.
4. Modifying or removing any of the safety components of the laser cutter will create dangerous conditions for nearby personnel, and may be a violation of OHS regulations. These modifications will also void the warranty of the machine.
5. If the removal or bypass of safety components is required during the repair or service of the machine, the replacement of the safety components must be performed immediately after completion of the service or repair. before any further use.
6. Preparation, retooling, maintenance and repair activities must only be performed by trained personnel, with equipment switched off and/or protections in place.
7. Unauthorized modifications or changes to the machine are prohibited and can result in unsafe conditions, as well as voiding the warranty of the machine.

2.0 SAFETY

2.2 LASER SAFETY PRECAUTIONS

The Mako Laser Cutter contains a powerful 60 watt CO2 laser tube which is used to cut, etch and engrave materials on its cutting bed. Once focused, the Mako has sufficient power to vaporize up to 6mm thick plywood in a single pass.

Laser cutters are powerful machines and must be treated with due care - for this reason, there are interlocks in place to prevent injury by shutting off the power to the laser tube whenever the front cover is open.

With the cover closed and all panels in place, the machine is considered a class 1 laser, as any active beam is fully enclosed. This is a classification that requires no special eyewear or PPE when operated correctly.

WARNING: It is not only dangerous to override or undermine a safety interlock system, it is also an offense under the Occupational Health and Safety Act.

While the laser cutter's power is fully contained within the machine during normal usage, it is possible (through the removal of screws that lock access panel latches on the side of the machine) for users to become exposed to the laser beam or radiation scattered from it. Your laser cutter's latches should be kept secure during normal laser use and should never be accessed by untrained personnel.

As with any type of radiation, the extent of danger to human tissue is determined by exposure time, focus, and power. The far-infrared cutting beam of the laser is not visible to the naked eye, which heightens the risk of tissue damage if the machine is operated with any access panels open or removed.

Unsafe or uncontained use of the machine can result in instant, debilitating, or permanent eye damage. Do not defeat any safety interlocks, and always ensure all covers are securely in place with the lid closed before activating the laser.

The visible red "finder" laser is not as powerful, but remains active when the lid is open. Direct eye exposure to the red beam must still be avoided.

The cutting beam must never be activated while any body parts are inside the machine, while the interlocking door is open, or while the interlock switch on the main door is damaged or disabled in any way.

2.0 SAFETY

Laser Safety Information

- The Mako 60W conforms to the **ANSI+Z136.1-2014** standard. It has a fully enclosed beam path, lockouts on all access panels, and compliant labeling which indicates the relevant safety warnings. Please note that improper operation of the device can override the safety status and can cause the emission of harmful radiation.
- This laser system contains a carbon dioxide (CO2) laser source of class 4 that emits intense and invisible laser radiation. Without safety precautions the direct radiation or even diffused, reflected radiation can be dangerous.
- Without safety precautions, the following risks exist with exposure to laser radiation:
 - Eyes: Burns to the retina from visible red “finder” laser
 - Burns to the cornea from CO2 Laser
 - Skin: All types of burns
 - Clothing: Danger of fire
 - Lungs: Hazardous fumes
- Never try to modify or disassemble the laser on your own, and do not power up a system that has been modified or disassembled.
- **Dangerous radiation exposure can result if the use, operation, or adjustment of equipment is done using methods other than those described here.**
- Dangerous radiation exposure can also result from the use of prohibited materials such as:
 - Blank or polished metals
 - Metals with very high reflectivity like chrome, copper, brass, gold, and silver
 - Materials with highly reflective metallic coatings
- Other highly reflecting materials, especially in combination with high laser power, low speed and/or work pieces with curvy surfaces, might reflect laser radiation towards the protective cover. There is a small chance this cover could be damaged if the reflected radiation is focused onto the surface of the cover. Conduct visual inspection for point-like defects on the cover if these conditions occur.
- If you detect major damage on the protective cover (more than just small surface scratches on the top of the lid), immediately turn off the laser machine and contact InkSmith to request a new cover. Do not operate a machine with a damaged lid.

2.0 SAFETY

2.3 OPERATIONAL SAFETY

No special personal protective equipment is required to operate the laser cutter. The laser cutter's beam is fully enclosed, and the ventilation system protects users from smoke and vapours created during the machine's normal operation

Although it is not required, your organization may suggest the use of safety glasses during operation of the laser cutter.

Regardless of safety glasses use, do not stare directly at the bright light produced where the laser beam contacts the material being cut or etched.

The red dot pointer is a low power visible-light laser that can be on even when the lid is open. Never point the red dot pointer directly at any person's eyes, and be aware of potential surface reflections.

A risk of fire is present when the machine is cutting or etching on combustible materials. Never operate the laser cutter unattended or leave it running without direct supervision of a trained person.

It is mandatory to have a fire extinguisher nearby at all times during operations, and to ensure all operations are performed under the direct supervision of a person trained in fire safety and the use of fire extinguishers.

A tiny flame is normal for some materials during laser operations. Any flame larger than your pinkie, or that continues to burn after the laser has moved away is an indication that the material is on fire - this situation must be addressed immediately.

Very small flames can be extinguished by blowing them out like a candle, by using a small spray-bottle of water, or by smothering with a suitable material. If a flame becomes larger than your fist, immediately notify the nearest trained supervisor. If a fire extinguisher is required, all other lab personnel must immediately evacuate the building and the nearest pull station must be activated.

WARNING: Supervisors must stay alert and aware of the machine and operating environment, and refrain from distractions like mobile device usage. A fire in the machine will not make a sound to attract attention, and due to the inward-drawing ventilation, there may be no smell of smoke to indicate a fire. Supervisors must keep a regular line of sight to deal with any potential fires. If a fire builds to the point where it ignites wiring, paint or plastic in the laser cutter before it is put out, it poses an extreme danger to the operator and the entire building.

DANGER: Only trained and qualified personnel are allowed to operate the laser cutter.

2.0 SAFETY

2.4 APPROVED/NOT APPROVED MATERIALS

Never use the laser cutter on materials that are not on the approved list for cutting, etching, or engraving. The use of prohibited materials, or improper use of permitted materials, may result in toxic fumes and/or a fire.

Materials over 1/2" thick may take multiple passes and/or have increasingly burnt edges

APPROVED MATERIALS	NOT APPROVED MATERIALS
<p>Some Wood Varieties: Most hardwoods, some plywoods, some MDFs*, cork. Baltic Birch plywood is very good for lasering. (* Formaldehyde free MDF and/or plywood is required by some regulators)</p>	<p>PVCs (PolyVinyl Chloride), Vinyl, Pleather, Sintra: Releases highly toxic chlorine gas, which can damage the laser or fume extractor system, and/or cause serious injury if the fumes escape.</p>
<p>Acrylic (Plexiglass): Cast or extruded, usually in sheets.</p>	<p>ABS: Produces cyanide gas and noxious fumes.</p>
<p>Certain Plastics: Delrin, Mylar, Kapton tape, Corian, melamine.</p>	<p>Polycarbonate (Lexan): Poor cut quality, singed edges, releases large amounts of carbon monoxide</p>
<p>Paper Products: Most types, including paper, cardboard, matboard, cardstock. <i>(Watch carefully, fire risk!)</i></p>	<p>HDPE, Polypropylene, Nylon: Melts and catches fire.</p>
<p>Fabrics: Natural fibers like cotton, silk, and denim. Some synthetics like polyester, acrylic, nylon. NOT vinyl fabric.</p>	<p>Polystyrene & Styrofoam: Highly flammable, prone to drips of flaming plastic, sticks to honeycomb bed.</p>
<p>Leather & Suede: Chrome-tan or veg-tan, NOT pleather or faux-leather, which are usually vinyl.</p>	<p>Fiberglass, Carbon Fibre, and other composites, including PCBs: Toxic fumes, heavy smoke, may damage the laser or harm the user.</p>
<p>Rubber: Stamp rubber, silicone rubber, some other rubbers.</p>	<p>Materials containing halogens (Chlorine, Bromine, Iodine, etc): Some spray paints, stains, and varnishes contain these. When heated, the gases can be highly corrosive to the laser or bystanders.</p>
<p>Certain foams: "EVA" foam, kaizen foam. NOT styro-foam. <i>(All foams: Fire risk! Watch very carefully)</i></p>	<p>Teflon, Goretex, PTFE: Releases highly carcinogenic fumes when burned.</p>
<p>Glass, tile, ceramics, stone: For etching only, be careful of sharp edges, tiny sharp particles, or breakage from thermal stresses.</p>	<p>Mystery Plastic: Never use "found" plastic without knowing what it's made of. Check for a recycling stamp or manufacturer's label to determine what kind of plastic it is before use.</p>
<p>Coated metal: Anodized, painted, or powder-coated metals such as aluminum or stainless-steel can be engraved by removing the coating. <i>Bare, shiny metal should not be used.</i></p>	



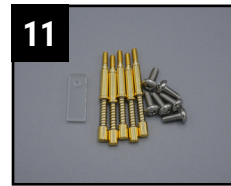
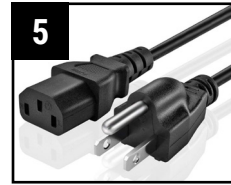
3.0 INITIAL SETUP

3.1 WHAT'S INCLUDED

- 1. Mako Laser Cutter
- 2. CO2 Tube
- 3. Exhaust Hose
- 4. Hose Clamps
- 5. Power Cables and Adapters
- 6. Triangle Key
- 7. USB Cable
- 8. Ethernet Cable
- 9. USB Drive
- 10. Accessories
- 11. Gold Pins
- 12. Water Chiller Valve
- 13. Allen Keys

Optional

- 15. Air Filtration



3.0 INITIAL SETUP

3.2 LOCATION CONSIDERATIONS

Before you install the Mako Laser, it is important to select an appropriate location. To determine the best location, please follow the guidelines listed below:

- Avoid locations where the machine may be exposed to high temperatures, dust, and high humidity. The humidity must not exceed 70% and the temperature must not be close to the dew point. Select a location where the room temperature is between 15 °C and 25 °C (59° – 77° F).
- Avoid locations where the machine may be exposed to mechanical shocks.
- Select a location with good air circulation and, if available, close to an exterior exhaust vent. Avoid locations with poor air circulation.
- Avoid higher ambient temperatures and strong exposure of the machine to the sun. Use window coverings, if required.
- Select a location that is less than 2.5 meters away from your computer (max. USB cable length to avoid interference).
- Select a table or surface that is able to handle the weight of the laser.
- Choose a location where you are able to have access to all sides of the laser.

3.3 ELECTRICAL REQUIREMENTS

Make sure that your electrical outlet is capable of providing the proper voltage, frequency and amperage that the laser system requires. It is highly recommended that you use a surge suppression plug to protect your computer equipment. Machines made for Canada are all 110V 60Hz.

The maximum current draw will depend on the machine model and laser tube power.

- Mako's **60W** tube maximum draw: 7.3Amps

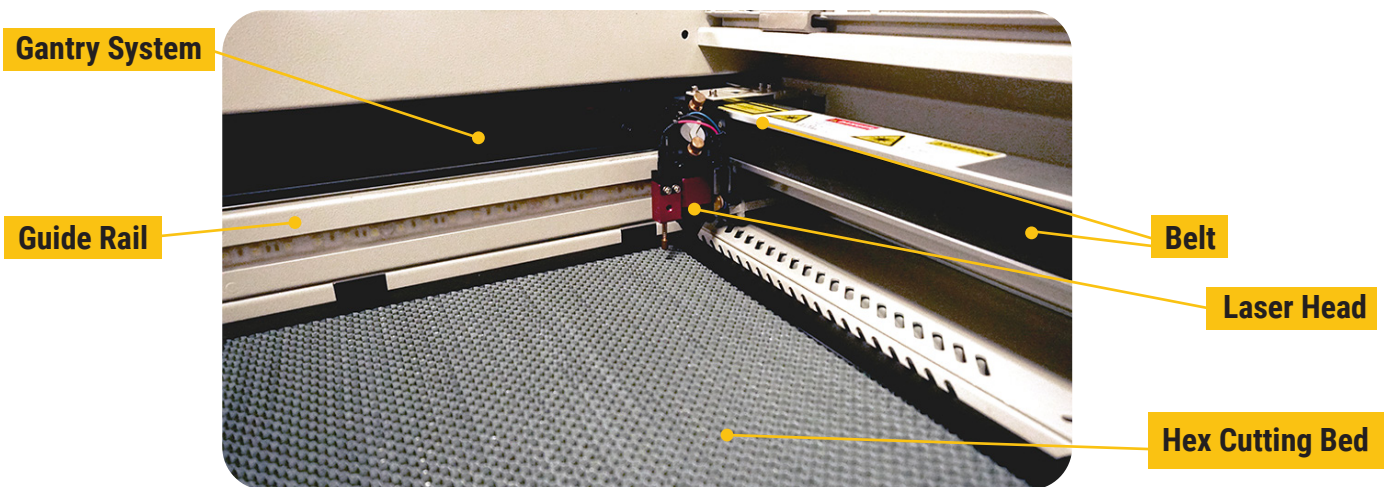
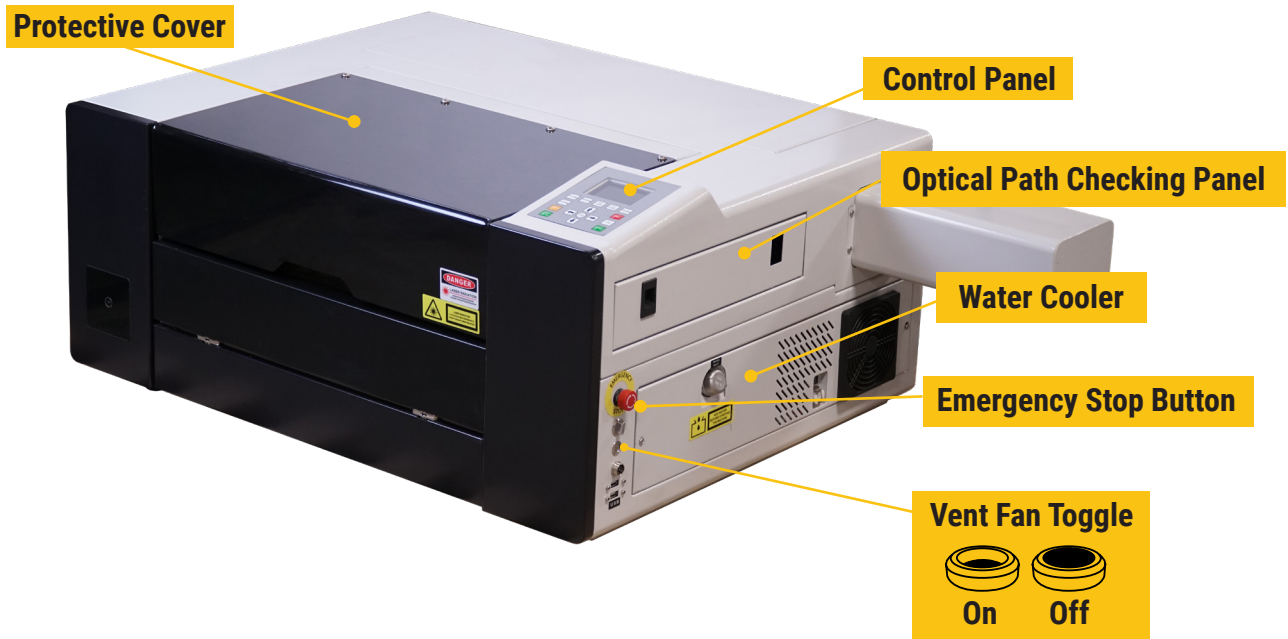
Damages from an inadequate or inappropriate power supply are not covered under the machine's warranty - it is the user's responsibility to ensure an appropriate power supply is used.

3.4 EXHAUST REQUIREMENTS

Please refer to the specific exhaust requirements found in the operation manual included with your air filtration unit. If you are not using a separate air filtration unit it is suggested that the Mako Laser be filtered using flexible aluminum duct piping into an existing exhaust ventilation unit. You can connect to your buildings HVAC system using the flexible aluminum duct piping included in the crate of your laser cutting machine.

3.0 INITIAL SETUP

3.5 MAKO LASER DIAGRAM



3.0 INITIAL SETUP

3.6 CONNECTING AIR FILTRATION TO THE LASER

Start by plugging in your Mako Laser Cutter into a suitable power outlet (as outlined in section 3.3 ELECTRICAL REQUIREMENTS).

Option 1 - Connect to the Mako Laser Cutter Air Filtration System

Follow the instructions included with your Mako Laser Cutter Air Filtration System to install it on your laser machine. To access the instructions please click the link [here](#).

Option 2 - Exterior Exhaust With Booster Fan

Alternatively, some users opt to vent their laser's exhaust directly to the outside by using an inline duct fan.

Please note the fan will need to be a minimum of 150-250CFM (Depending on duct length) in order to be as effective as the extraction unit. If doing this without a filter system, roof or elevated exhaust is recommended to avoid exposing outdoor passersby to fumes.

3.7 FILLING THE WATER TANK

CO2 laser tubes require a steady supply of cool water in order to keep from overheating and cracking. The Mako 60W laser uses a self-contained water chiller, integrated into the main chassis.

The fill spout for the water tank can be found on the right side of your laser, between the red e-stop and the chassis fan.

The water tank must be filled with distilled water. Tap/filtered water is too hard and too conductive, and will drastically reduce the lifetime of the tube, or even cause an "arc" of electricity within the machine.

To fill the tank, simply insert the funnel and slowly add water. The tank holds just under 3L of water. When you've added 2 L, begin adding smaller amounts between using your finger to feel the water level in the fill spout. When the water is a knuckle or two from the top, or if the spout overflows, the tank is full. Replace the cap before continuing.



4.0 CALIBRATION

4.1 POWERING ON

1. Before turning on the machine, check that there are no obstructions in the working area.
2. Verify the emergency stop button is not engaged (if it is, rotate it clockwise until it extends to the non-engaged position).
3. Flip the main power switch on the right side of the machine to the on position. Your machine should start up and “home” itself, moving to the corner.

4.2 CALIBRATING THE MAKO LASER CUTTER

The motion system consists of the motors and linear rails that allow for the laser head to travel during operation.

It's important to make sure that all body parts are out of the travel path of any moving parts.

Once the machine is powered on, use the direction keys on the keypad to move the laser head around. It should move fairly quietly, and at the same speed in all directions. If this is not the case, proceed to Troubleshooting before moving on to the next steps

Checking Water Flow

Next, ensure that the flow of water in the laser tube is in the correct direction and free of large bubbles.

To do this we'll need to open the rear lid while the machine is powered on. Using a flat-head screwdriver, remove the silver screws from both rear latches and keep them somewhere safe. Slide the latches to the sides to open the rear hatch.

The laser tube operates at ~20,000 volts, NEVER fire the laser while the rear cover is open or while any body parts are inside the machine.

Ensure that nobody touches or is able to touch the control panel if a cover is open while the machine is powered on.

With the main power switch on, open the rear lid and inspect the water flow within the tube. The water should be flowing from left to right when viewed from the back. (**from** the end with the red connector **to** the end with the black connector).

If you can't see the water clearly, gently pinch the left silicone water line and see which direction the bubbles are moving.

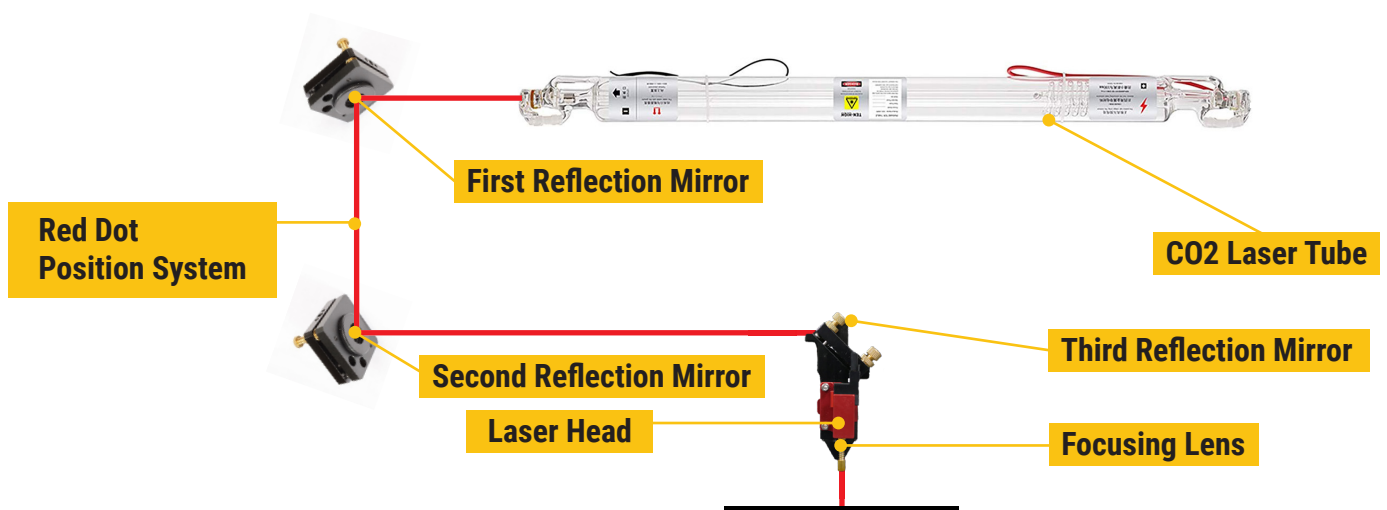
Check the entire tube for any bubbles larger than a fingertip, and clear them by squeezing and releasing the silicone tubing. If bubbles persist, check to ensure your laser is on a level surface, and that the “this side up” sticker on the tube is at or near the top.

4.3 CALIBRATING THE LIGHT PATH

4.3 CALIBRATING THE LIGHT PATH

The light path of the laser tube is calibrated during the manufacturing process, but it's important to recalibrate the laser after shipment or moving to ensure the safety and performance of the machine.

The optical system of the laser cutter consists of a CO2 laser tube, three reflection mirrors, 1 focus lens, a laser head, and a red dot position system. Please refer to the diagram below.



The Mako Laser cutter works by emitting a beam of light from the laser tube, which is then reflected and by the first, second, and third mirrors. After reflecting off of the three mirrors the light beam passes through the focus lens and reaches the work table.

It's through the process of reflecting and focusing that we're able to achieve the best cutting and engraving results. If the light path isn't properly calibrated it may result in poor cutting and engraving outcomes, or even cause damage to the components of the machine.

NOTE: The red "finder" laser does not need to be as precise as the cutting laser, and may not line up precisely with the burnt marks on the tape. This is normal and can be ignored for now, as the final lens will join the two beams unless they're very badly out of line.

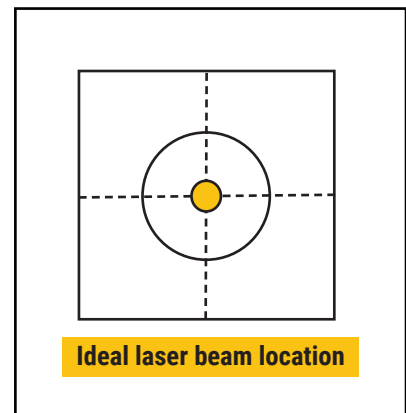
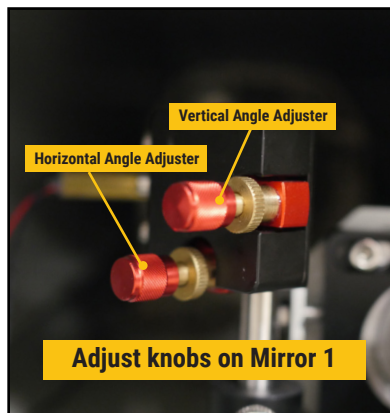
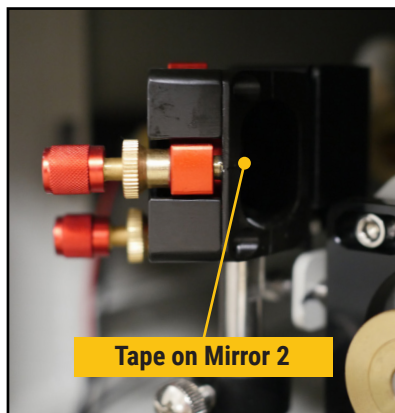
For now, we're only worried about the path of the invisible far-infrared CO2 cutting beam.

Please calibrate the mirrors using the steps in the next section.

4.3 CALIBRATING THE LIGHT PATH

STEP ONE: Mirror 1 Adjustments

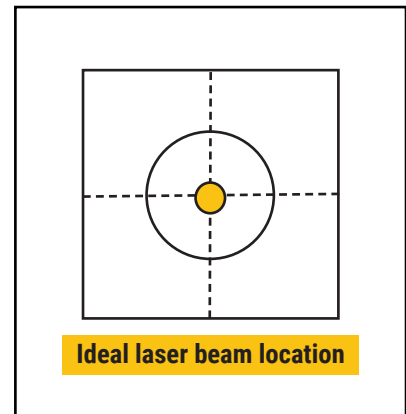
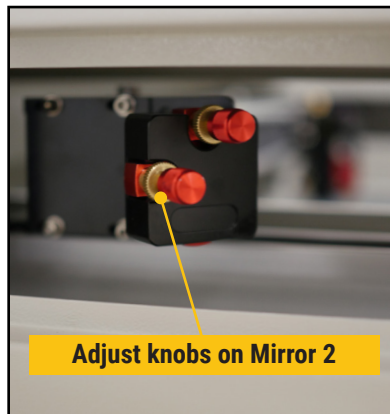
1. Open the machine lid and move the gantry system to the back of the machine.
2. Use a flat-head screwdriver to open the side panel of the machine and access the laser mirrors.
3. To align the reflection of Mirror 1, place a small piece of masking tape over the oval opening on Mirror 2. With the cover and side panel closed, quickly press the white Pulse button on the laser's control panel to send a beam of light from the laser.
4. After as brief a pulse as you can manage, open the lid or side panel to examine the location of the burn mark on the tape of Mirror 2. **(If there is a flame, blow it out)**
5. Use the brass knobs on Mirror 1 to make small adjustments as needed in order to align the laser beam according to the diagram below. The red dot doesn't line up with the burn mark, but does help visualize which direction to turn the brass alignment screws in order to move the right direction.
6. Next, (without removing the tape from Mirror 2) move the gantry to the front of the machine and, with the machine fully closed, hit Pulse again. If the previous burn mark is unchanged or still round, that means Mirror 1 is properly aligned along the entire "Y" axis.
7. If the burn mark becomes elongated, or if there are now two marks, laser alignment is not yet complete. Adjust the Mirror 1 screws again until you're hitting the center of the tape at both the front and the back of the machine – this may require you to go back and forth a few times with new tape.
8. Finally, tighten the small brass locking nuts at the base of the knobs to lock alignment in place, then do one final test to confirm they are still aligned. If locking has put the mirror out of alignment, you should be able to adjust a small amount without un-locking the nuts, completing mirror 1's alignment.



4.3 CALIBRATING THE LIGHT PATH

STEP TWO: Mirror 2 Adjustments

To align the reflection of Mirror 2, repeat the previous steps but place the masking tape on Mirror 3. Adjust the knobs on Mirror 2 as necessary in order to align the laser beam at both the left and right edges of the machine.



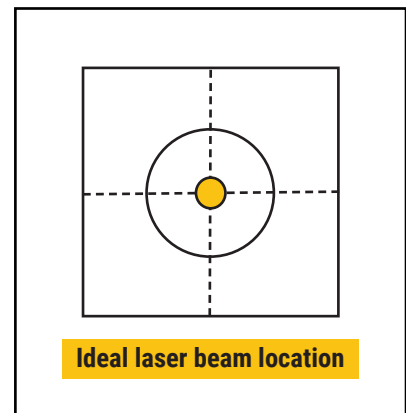
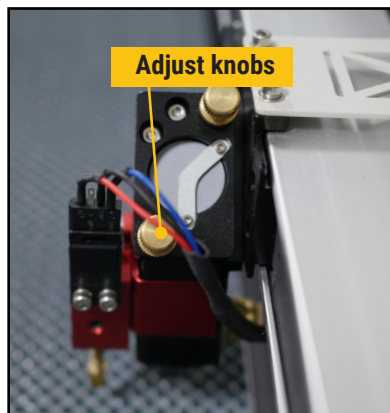
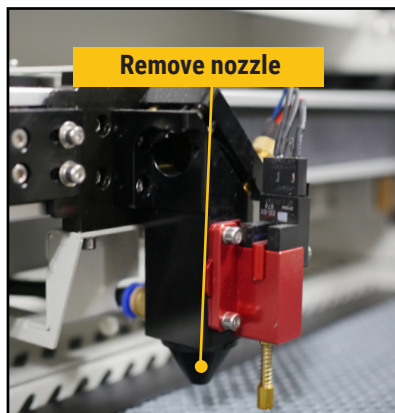
4.0 CALIBRATION

STEP THREE: Mirror 3 Adjustments, cleanup

1. To align the reflection of Mirror 3 you will again use the masking tape, but placed on the bottom of the laser head.
2. Bring the laser head to the front of the machine using the control panel.
3. Remove the nozzle from the laser head by screwing it clockwise - lower the bed if necessary with Z/U
4. Place tape over the round opening uncovered by the nozzle, and press an impression into it with your thumb.
5. Use Pulse again briefly to burn a mark in the tape, and duck down low to see where the burn mark is on the tape. You may need to open the lower door in the front of the machine to see.
6. Adjust the knobs on the top of the laser head accordingly to align with the center of the opening, and lock them in place.

The repeated burning of tape for the alignment process sometimes leaves a residue on the mirrors, which we don't want to "bake in" when we use the laser.

1. Using a q-tip and 99% isopropyl, gently wipe off all three mirrors before proceeding – if your q-tip comes back clean, the mirror is clean enough to use.
2. With the nozzle removed, use a fresh q-tip to gently swab the bottom of the lens before screwing the nozzle back on.



4.4 INSTALLING LIGHTBURN SOFTWARE

4.4 Installing LightBurn Software



LightBurn is a powerful layout, editing, and control software for your laser cutter. With LightBurn you can:

- Import artwork in a variety of formats
- Arrange, edit, or create new vector shapes
- Apply machine settings like power, speed, number of passes, cut order, brightness & contrast, dithering mode, and much more

WARNING! If a file is prepared using a table size setting larger than your bed size, it may cause the axis to attempt to travel beyond their physical limitations, resulting in damage to the machine.

Minimum Computer System Requirements

LightBurn will run on Windows 7.0 or later, 32 or 64 bit, MacOS 10.11 or later, or 64 bit Linux. LightBurn does not require a powerful computer for most work, although if your designs contain a lot of images, more memory is helpful.

4.4 INSTALLING LIGHTBURN SOFTWARE

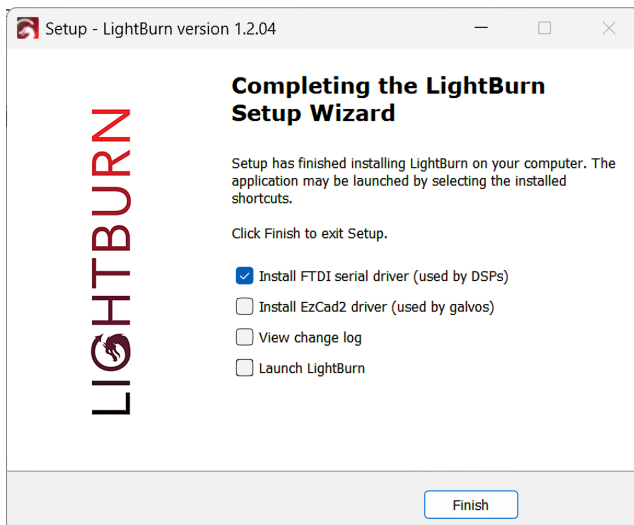
Installation

Download

Download the latest release version that matches your computer.

- Windows 64-bit
- Windows 32-bit
- Mac OSX
- Linux 64-bit

Windows Installation



1. Launch the installer executable
2. Windows may ask if you trust the software, as LightBurn is not currently digitally signed
3. Select if you would like to create a desktop icon
4. Click Install
- 5. Check the box for "Install FTDI serial driver"**
6. Click Finish.
7. Allow SerialDriver.exe to make changes to the computer and follow the prompts to install the driver.

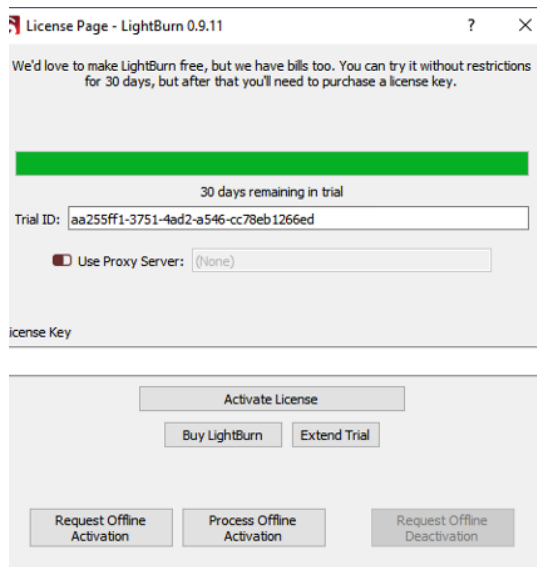
That's it! Use the LightBurn shortcut on your desktop or in the start menu to launch the program

4.4 INSTALLING LIGHTBURN SOFTWARE

Mac/OSX Installation

1. Download the Mac/OSX version
2. Double-click the .zip file to extract the DMG (disk-image) file
3. Double-click the LightBurn.dmg file to mount it
4. Drag the LightBurn application into your applications folder
5. Launch LightBurn from the launcher as normal
6. You can now eject the DMG file (drag it to the trash bin)

Activating LightBurn



If you've never used LightBurn before, you'll be shown the License and Trial page first. Here you can either enter and activate a license key if you have one, or you can activate a free 30 day trial by clicking "Activate Trial". If you do have a license key, be sure to enter it exactly, including the dashes, then click the 'Activate License' button. We recommend just copying the key and pasting it into the License Key box. You can purchase a License Key through Inksmith.

You can get back to this screen in LightBurn at any time by going to the menu and clicking Help > License Management.

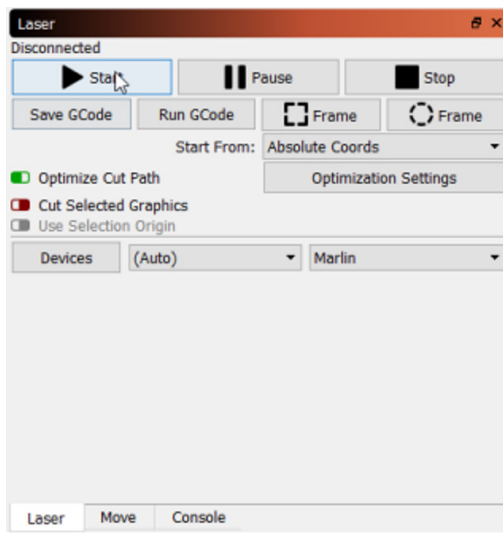
Once you have activated your license or the trial, click 'OK'

The next thing you'll see is the 'General Usage Notes' page - this is a brief help page just to get you going. You can get back to it any time in the Help menu, under Help > Quick Help and Notes. Click OK.

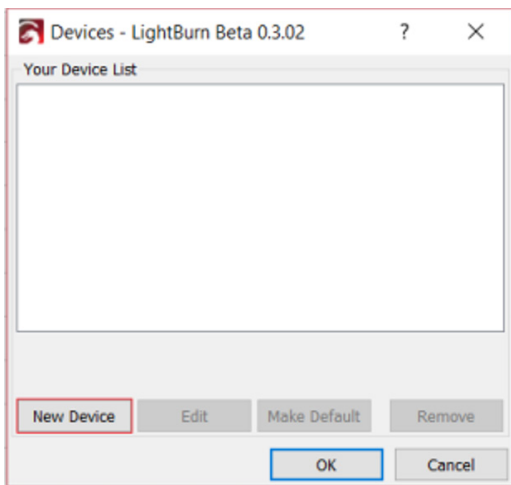
4.4 INSTALLING LIGHTBURN SOFTWARE

Device Setup

If you've never used LightBurn before, you'll need to give it some information about your hardware to get started.

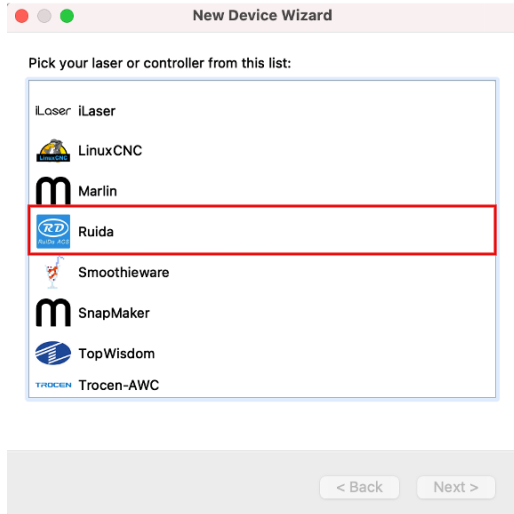


1. In the lower-right of the display is a box called "Laser" - on the bottom of it is a button labeled "Devices". Click it.

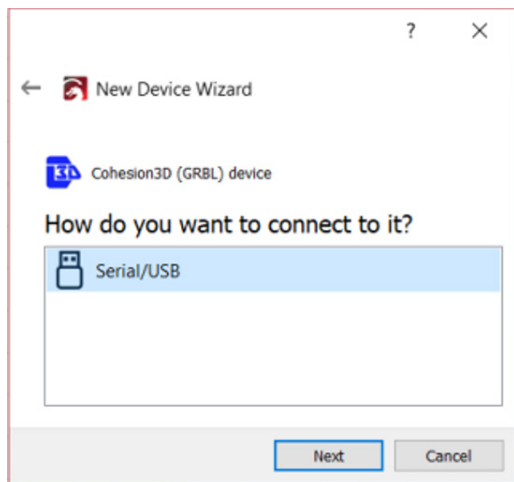


2. Click the "New Device" button (highlighted in red, on the left)

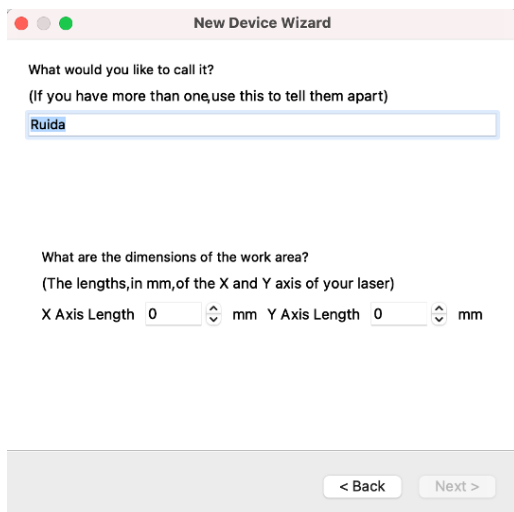
4.4 INSTALLING LIGHTBURN SOFTWARE



3. Choose the Ruida Laser .



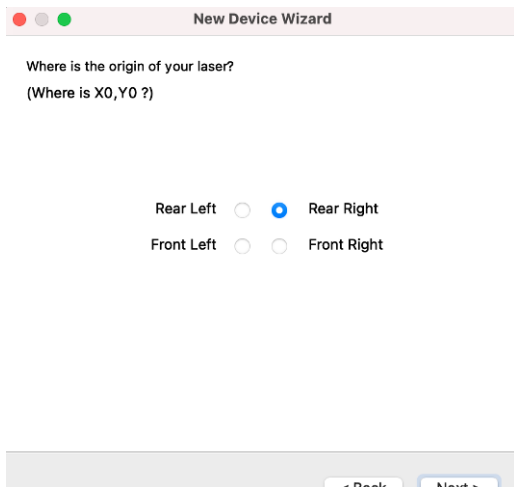
4. Choose connection method Serial/USB



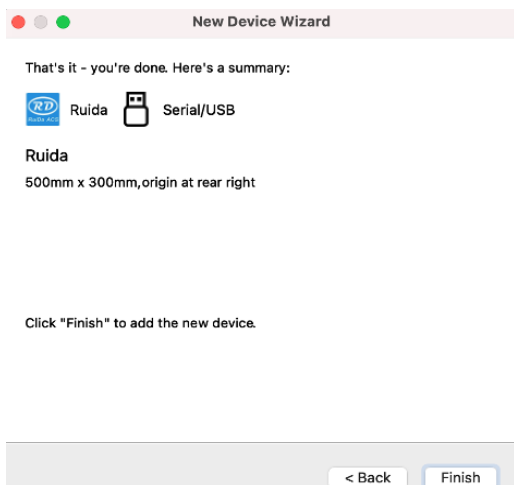
5. Set your machine's bed size for X and Y.

Mako 60W - X Length = 500mm, Y Length = 300mm

4.0 OPERATION



6. Choose the Rear Right origin point to match your machine.



7. Click "Finish" to save your laser setup.

If your laser is connected to the computer, LightBurn will try to establish communication. For some systems this will **home** the laser, for others it will simply show "Ready" in the status box at the top of the laser tab, (or the bottom status bar).

If you are adding multiple devices, repeat the steps above for each Mako Laser Cutter. When you are done, you can set the default connection by clicking on a name in the device list and clicking the "Make Default" button.

If your device does not connect, refer to <https://www.inksmith.ca/a/help/article/55669> for further details and troubleshooting steps.

4.0 OPERATION

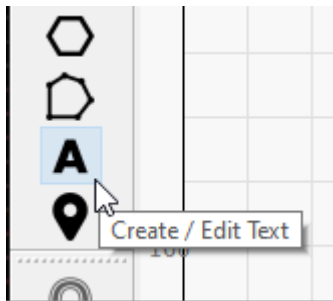
Example Project

We're going to go step-by-step through creating a small, simple project in LightBurn, to show you how to use a few of the basic editing tools and give you a feel for how things work.

Before you start, make sure you have your laser set up in LightBurn (see previous section).

This project will be a simple name tag, cut out around the letters, ideally made from thin wood or acrylic, but a piece of cardboard will also work for this project.

Adding text to your file in LightBurn

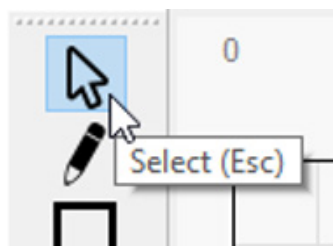


With LightBurn running, and an empty project, click the “Create Text” button. It normally lives along the left side of the main window.



Next, click the mouse somewhere in the middle of the “Edit” window (the workspace) to get a cursor, then type your name.

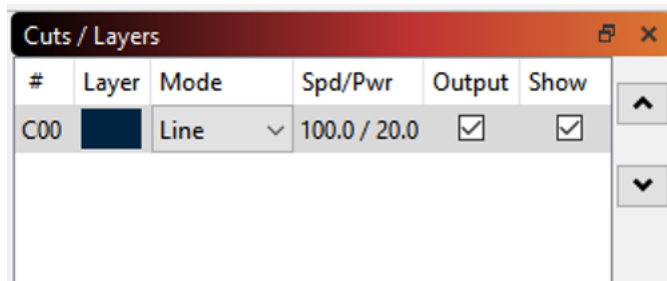
Click the ‘Select’ tool button on the top left of the edit window, or press ‘Esc’ twice (once to finish entering text, and again to exit text entry and go back to selection mode).



Click the “Select” tool button on the top left of the edit window, or press “Esc” twice (once to finish entering text, and again to “exit text entry” and go back to selection mode).

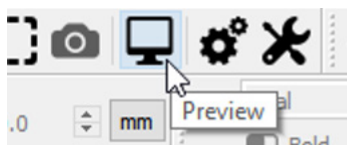
4.0 OPERATION

When you finish the text, you'll see an entry appear in the "Cuts / Layers" list on the upper left of the display. This is the "layer" that your text is on, and it holds the settings that will be sent to the laser for all the objects on this layer:



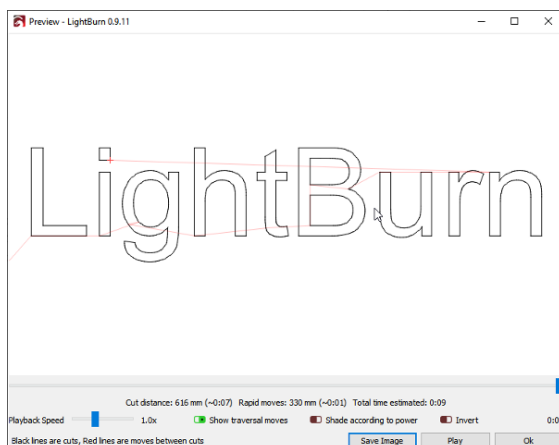
This tells us that the shapes on this layer will be drawn as lines, with 100 mm/sec speed, and 20% power. Depending on your settings, the speed might be different.

Previewing



To see how the laser will run your project, click the "Preview" button in the middle of the main toolbar.

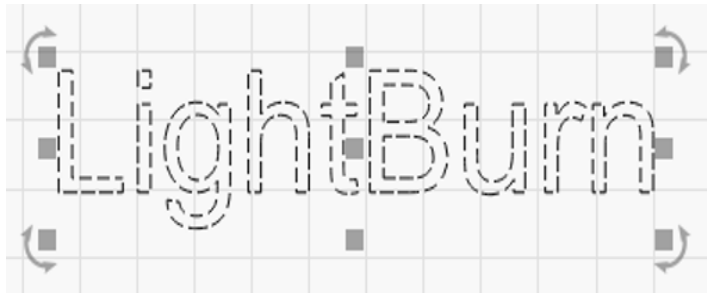
The preview window will pop up, showing the completed job, like this:



The lighter red lines are showing the laser moving between the shapes (traversal moves), and the black lines are where the laser will burn. Click the "Play" button and you can watch a simulation of how the laser will run the job. You can also grab the slider and drag it around to see the cut at different points in time. Spot checking the output like this is a good habit to get into, because you'll likely spot mistakes before you burn the project for real, saving time and material. Click the "Ok" button to close the preview.

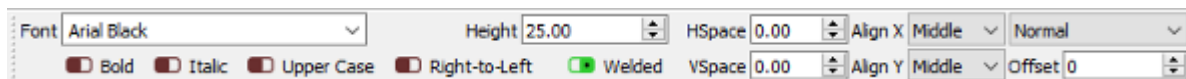
4.0 OPERATION

Changing text properties



Make sure you're still in "Selection" mode - the "Select" tool should be highlighted. Click the name, or click and drag a rectangle around it to select it. When it's selected, it will be drawn as animated dashes instead of solid lines, and handles will appear around the selection to let you change the size, position, or orientation.

The options in the Text Toolbar at the top will activate, like this:



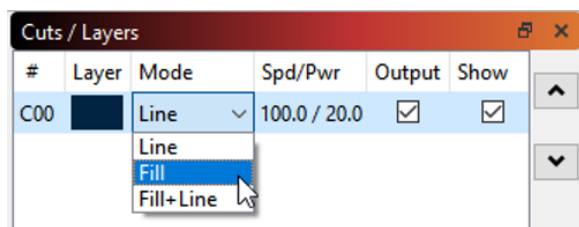
Click the drop down for the font, and change it to anything you'd like. While you are choosing your font, the changes will be displayed in real time in the edit window. You can change the height, make it bold or italic, and adjust spacing here too.

Undo / Redo

If you make a change you don't like, you can undo it by clicking the "Undo" button on the toolbar (or pressing "Ctrl+Z", or "Edit" > "Undo" in the menu). If you decide you liked it after all, you can also "Redo" ("Ctrl+Shift+Z"). "Undo" and "Redo" in LightBurn are unlimited, the undo system doesn't reset unless you create a new file or close the program.

Changing the Layer settings

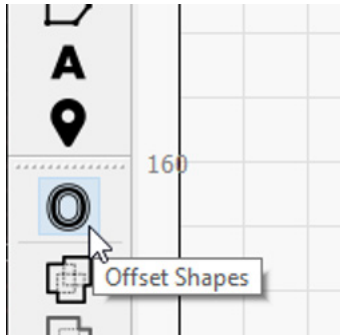
Rather than outline the text, we're going to change it to be solid filled. In the "Cuts / Layers" window, click "Line" and change it to "Fill", like this:



You'll notice that the display in the edit window hasn't changed, but if you run the preview again, it looks quite different. By default, the view in LightBurn shows outlines only, not fills, because it's much faster, and it prevents things from being hidden behind solid shapes that might still be run on the laser.

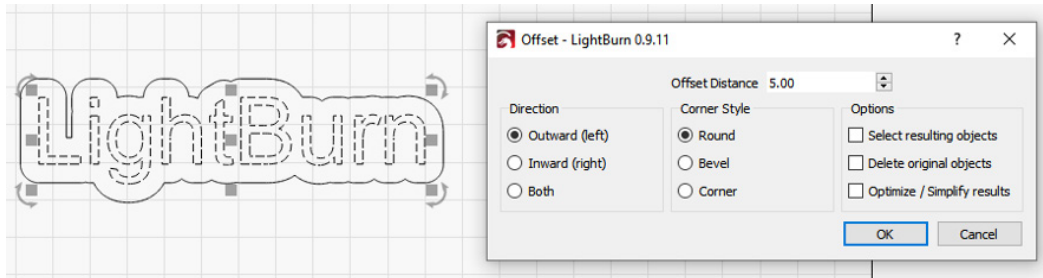
4.0 OPERATION

Adding an outline: The Offset tool



With the text selected, click the “Offset” button on the left toolbar, shown on the left:

The Offset options window will appear, and you should see something like this:



The Offset tool creates a new shape by outlining the shapes in your selection at a given distance, either inward, outward, or both, and merging the result. If you point the mouse at the “Offset Distance” value, you can scroll the mouse wheel to change the number and watch the result change in real time. You can also click the box and enter your desired number as well.

Make the “Offset Distance” value large enough so that there are no internal gaps in the outline. Notice the gap above between the “L” and the “i” is gone in the version below:

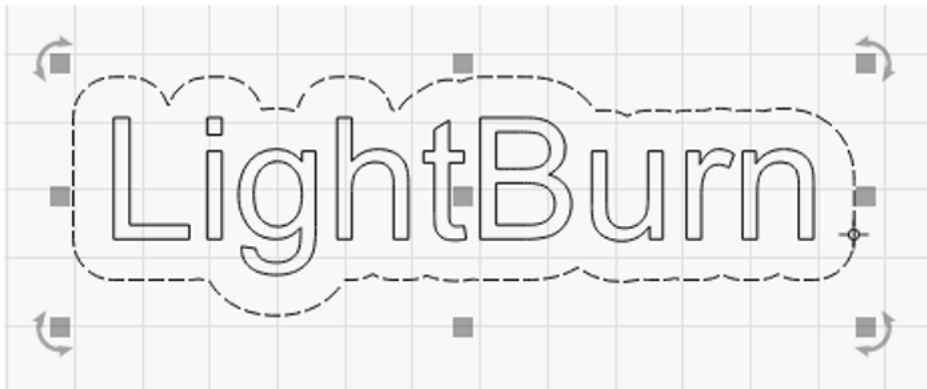


When you’re happy with the result, click “OK”.

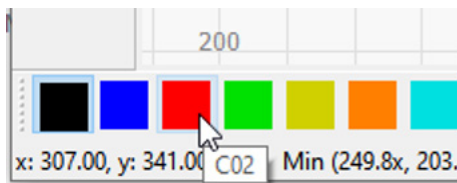
4.0 OPERATION

Changing Layers



Now, use the left mouse button to click the new outline you just made, so it is the only thing selected, like this:



Then, click the "Red" square in the color palette at the bottom of the display:



The outline will turn red, and you should see two entries in your "Cuts / Layers" list, like this:

#	Layer	Mode	Spd/Pwr	Output	Show
C00		Fill	100.0 / 20.0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C02		Line	100.0 / 20.0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

The first layer (C00) is black and is the fill for your text. The second layer (C02) is red and is the outline cut.

4.0 OPERATION

Speed and Power

When using the laser, arguably the most important two settings are:

- **Speed** (measured in millimeters/second)
- **Power** (measured as a percentage of max power)

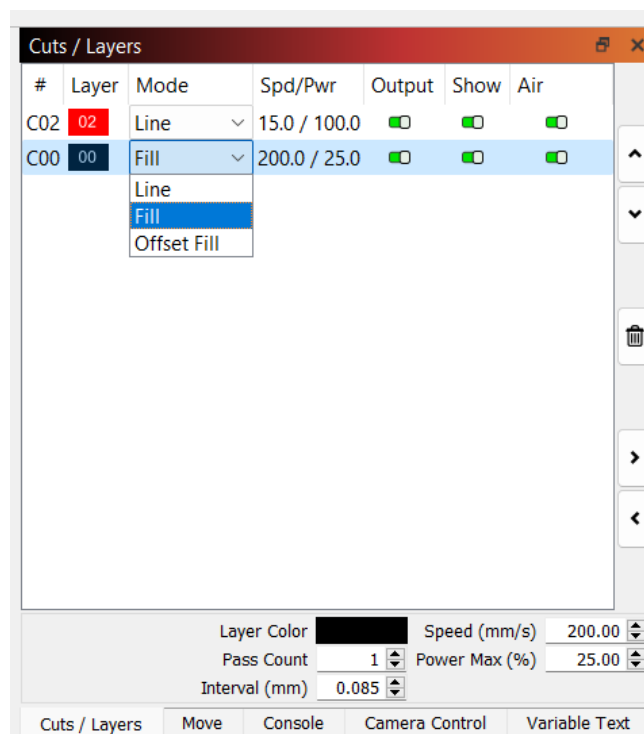
These are the settings you most often need to modify when switching between materials.

If you want to cut or engrave deeper into material, you'll need to increase the power, decrease the speed, or both.

As an example, when *cutting* (Line) into 1/8" birch plywood, you can generally start at Speed 15, Power 100, and do a small test cut to make sure it's getting through.

For *engraving* (Fill) objects without going too deeply into the material, it's a good idea to start with higher speed and low power, roughly Speed 200, Power 25
(Note these are rough starting points, and you will probably need to change them later.)

To get started setting these up, we need to set the black layer to "fill" and the red layer to "line" here:



4.0 OPERATION

Next, highlight the black color entry in the “Cuts / Layers” window by clicking on it. Below the list of layers you’ll see the “Cut Info” window, containing something like this:

Layer Color		Speed (mm/s)	200.00
Pass Count	1	Power Max (%)	25.00
Interval (mm)	0.085		

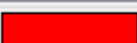
For the text fill, you want enough power to engrave into the material you’re using, but not so much that it goes too deep or through.

The Mako 60W is a powerful laser source, so for engraving we can use 200 mm/sec, 25% power, and leave everything else as default.

(Note this is a general starting point, and you will probably need to fine-tune this to get the best results.)

Now, click the red entry in the “Cuts / Layers” window. This is going to be the layer that cuts through the material to cut out the shape. Cutting requires more power and much less speed.

As a starting point, set 15 mm/sec, 75% power for cutting 1/8” MDF, birch, or acrylic, and make small test cuts on scrap material. If it doesn’t cut through, decrease the speed to 10 and try again.

Layer Color		Speed (mm/s)	15.00
Pass Count	1	Power Max (%)	100.00
Interval (mm)	0.085		

For more details on this section of LightBurn, you can view their tutorial at:
<https://docs.lightburnsoftware.com/UI/CutsAndLayers.html>

For a list of material details and starter settings, see page (BLANK) of this manual.

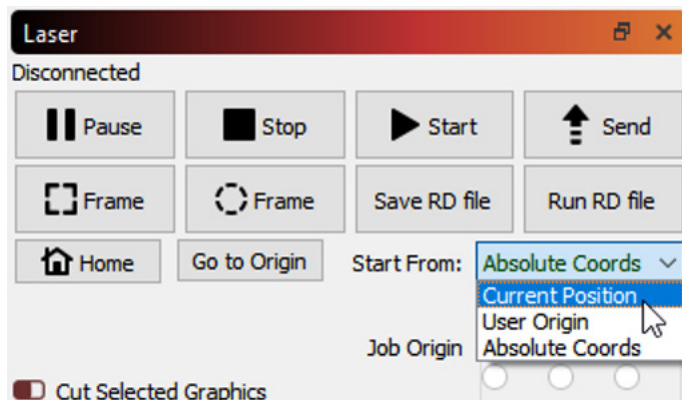
4.0 OPERATION

Open the “Preview” window again (“Alt+P”, or click the “Preview” button), then drag the progress slider from left to right to watch how the laser head will move. You’ll see the text engrave first, followed by the outline cut. If you don’t see those things, check the settings again, and verify that you have the first layer (black) set to “Fill”, and the second layer (red) set to “Line”.

Use the up/down arrow buttons on the right of the layers to change their order. It’s a good idea to engrave before cutting, since material can shift or drop slightly when it’s cut out.

Positioning the Job on the Laser

When sending this to the laser, there are a couple of different ways that it can be positioned, and the one you choose may depend on your needs.



Absolute Cords: Will cut the object in the position on the grid that the design occupies.

User Origin: Will cut the object wherever you set origin to. Which should default to the top right (X0, Y0).

Current Position: Will cut the object where the laser is currently positioned on the bed.

In the Laser window, in the lower-right of the main window by default, look for the ‘Start From’ drop down box, and choose ‘Current Position’ or ‘Absolute Coords’.

For this exercise, choose ‘Current Position’.

4.0 OPERATION

If you used 'Current Position' mode, you'll see the 9-dot "Job Origin" control under it activate, and you should see a green square on your design in the same spot indicated by Job Origin control, like this:

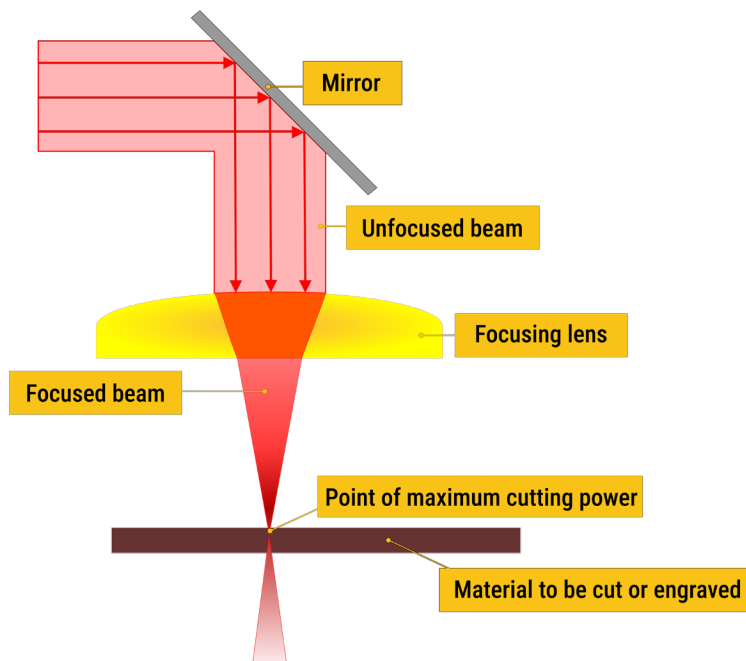


In the above image, the Job Origin is set to the lower-left, and that's where the green origin square is on the design. That green square represents the position of the laser before you start the job, so the design is going to end up above and to the right of wherever the laser dot is when we press Start.

Focusing the laser:

CO2 laser engravers emit a fairly wide (5mm diameter) beam, which needs to be focused through the final lens in order to be concentrated powerfully enough to burn through material with precision.

Like a magnifying glass in sunlight, there's an optimum distance from the lens at which the beam is as small and as powerful as possible – this is the **focal point**, or point of maximum cutting power.

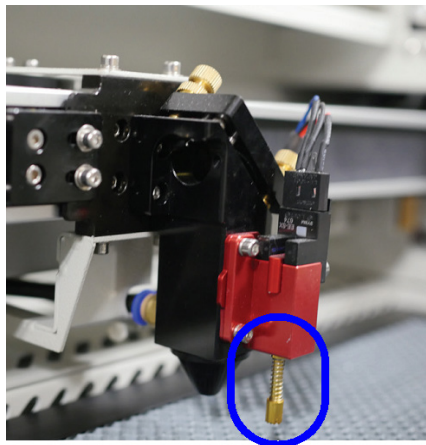


4.0 OPERATION

InkSmith lasers use a lifting mechanism (or 'Z-axis') to move the material the correct vertical distance from the nozzle. The Mako 60W is equipped with an auto-focus sensor to automatically raise the material up to the brass pin (on the front of the laser head, see below) before lowering it to the correct distance from the lens.

You can use Auto-focus via the machine's control panel menu.

1. Clear the machine's "honeycomb" bed of any obstructions
2. Power on the machine and wait for it to finish startup "homing"
3. Place your material on the honeycomb bed.
4. Press Z/U and use the up and down arrows to move the Z axis.
5. Lower the bed until you're certain your material is below the level of the laser head's brass pin. (Press Z/U again or ESC on the laser to exit Z axis)
6. Use the arrow keys again to move the laser nozzle so that the brass pin is positioned directly above the highest point of your material.



6. Press Enter on the laser's control panel and use the arrow keys to scroll down to 'Auto Focus', then press enter again.
7. The laser will raise the material up until it presses the pin, then lower it to the correct position.

After the material is focused, and when it's lined up to the corner of your material, press the button in LightBurn labeled 'Frame'. The head of the laser will move in a rectangle to indicate where the content of the file will go. If you need to move the material or the laser head to stay on the material, do so then hit Frame again.

When everything is focused and framed up, close the lid on the laser and press the Start button to begin. Watch the laser carefully and hit the e-stop if there is any fire larger than your fingertip.

4.0 OPERATION

Results and Next Steps

When it's done, hopefully it looks something like this:



Large or Critical Jobs

While the above process is quite reliable for most graphics, the serial communication between the laser and PC can be corrupted when using the quick “Start” button for highly complex designs - this can result in artifacts or double-lines in the result.

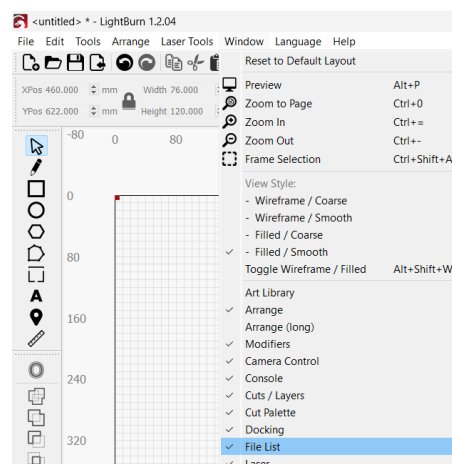
When using the laser for a large and complex design, or when the material being engraved is expensive or otherwise valuable, it's often a good idea to send the entire file over to the laser *before* beginning the job, then start it from the laser's control panel.

To do this, you can use a USB key or the USB connection between your computer and laser - it's usually easiest to use the cable.

(For USB key instructions, see page 46: Transferring Files to the Laser Cutter using USB flash drive)

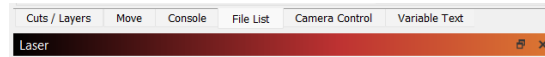
USB cable:

At the top of your screen, select Window and make sure “File list” is checked.

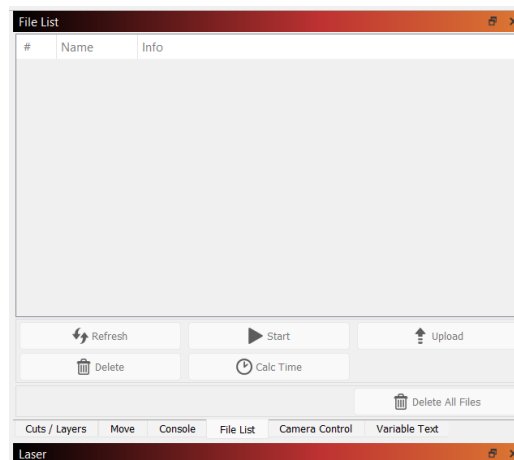


4.0 OPERATION

Now you can see File List in the list of tabs under the Cuts/Layers window - click it.



Here you can view all the files currently stored on the laser's internal controller:



To avoid confusion, either delete any older files still in the laser (if not needed) or name your project something easy to recognize. Click Upload to send the current LightBurn project over to the laser.

(Remember to hit "Frame" on the laser's control panel before proceeding and confirm it lines up with your desired position.)

Before using specialty or valuable material, we recommend that you:

1. Run the entire file on a piece of scrap material (often cardboard) at low settings first to ensure it cuts, engraves, and fits as expected.
2. Run a small test of speed/power on the material itself, either on a cutoff or somewhere easily concealed on the final result. This will allow you to make sure your cuts will pierce through, as well as dial in the desired level of burn or engrave depth, before committing the entire piece of material to it.

With all of that completed, and after double-checking your focus, you have everything lined up to give you the best chance of getting your desired result on the "first" try.

Note: Even with these steps, do not process anything sentimental or irreplaceable in the laser.

Some materials can react unpredictably to the laser and may melt, char, or catch fire, despite having done small tests. InkSmith is not responsible for damage to, or loss of, any material processed in the laser.

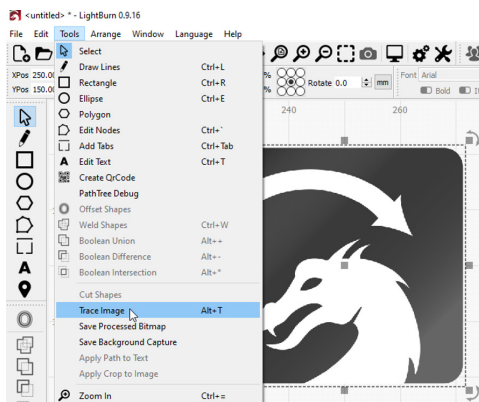
5.0 File Creation

While LightBurn will easily **'engrave'** a **raster** image file (jpg, png, bmp), it requires a **vector** (svg, ai, eps) file to be able to **'cut'**.

LightBurn is a fairly capable design software, and it's fully possible to design files inside LightBurn alone, and use the laser cutter without any other software or resources - however, there are a number of free online resources, like Instructables or Thingiverse, for downloading pre-made laser files, as well as [a number of online generators](#) for parametric designs.

Filetype	Raster	Vector
Extensions	.png, .jpg, .webp, .bmp	.svg, .dxf, .eps, .ai, .cdr
Modes	"Image" (Fill)	Line, Fill, Offset Fill

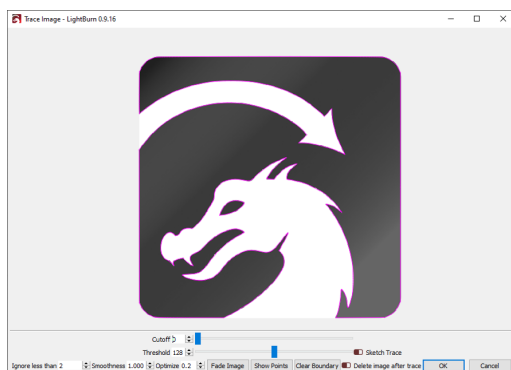
Below we'll cover the process of converting a raster image to a vector image in LightBurn



Tracing an image in LightBurn

To start, drag or import an image object into LightBurn, select it, then choose Tools > Trace Image from the menu (or press "Alt-T"). You can also select an image, then right-click and choose "Trace Image" from the pop-up menu.

You'll be presented with the "Trace Image" dialog, with your image showing in the window, as shown on the left.



In this image, the purple lines are the vectors that LightBurn has produced from the image being traced. If you want to be able to see them more clearly, click the "Fade Image" button, and the image will dim. You can also zoom and pan using the same controls as the preview window (mouse wheel to zoom, and click-drag the view with either left or middle mouse).

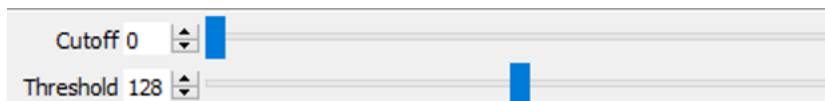
4.0 OPERATION

Controls

The preview window can be panned and zoomed just like the edit window, using the middle mouse button to pan and the mouse wheel to zoom. Double-clicking the middle mouse button resets the view.

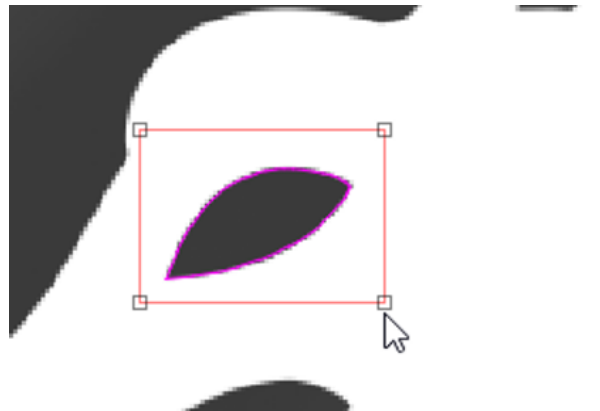
The “Cutoff” slider controls the lower end of the range of values that LightBurn will outline with vectors, and the “Threshold” slider sets the upper end. The default is 0 to 128, which traces around all values in the range of 0 to 128 brightness, excluding lighter values in the range of 129 to 255 brightness.

By adjusting these two controls, it is possible to trace around a narrow range of the image.



SELECTION RANGE

By clicking and dragging within the trace window you can specify a portion of the image you would like to trace. Once the area is defined, you can grab and drag a corner of it to adjust, or just single-click to reset it.



IGNORE LESS THAN

This setting tells the vectorizer to ignore anything smaller than this many pixels in area. If you are trying to vectorize a noisy image, increasing this may help.

4.0 OPERATION

SMOOTHNESS

Bitmap images are made of pixels, and pixels are rectangles. Image tracing tries to infer shapes from these arrangements of rectangles, and has to smooth out the results or everything would appear jagged. Part of the process is trying to recover smooth shapes from jagged lines, and this number controls how aggressive the smoothing is. A value of 1.333 is the maximum, and will make almost everything into curves. A value of 0.0 will produce all straight lines. The difference is shown above on the right.



Notice in the left image, with a “Smoothness” of zero, the area highlighted in red is made of several line segments, whereas the same area in the right image is a continuous curve. The area shown in blue is also sharp in the left image, but with the “Smoothness” value set to maximum, the image at right shows how even sharp corners become smoothed, and this is rarely desired. The default value of 1.0 is a good mix between producing smooth curves while still maintaining sharp corners.

OPTIMIZE

After generating lines and curves, the image trace feature will attempt to merge similar lines and curves together to reduce the node count of the result. The “Optimize” parameter controls how aggressive this is. 0 means no merging. The default of 0.2 is a nice balance between accuracy of the result and node count.

FADE IMAGE

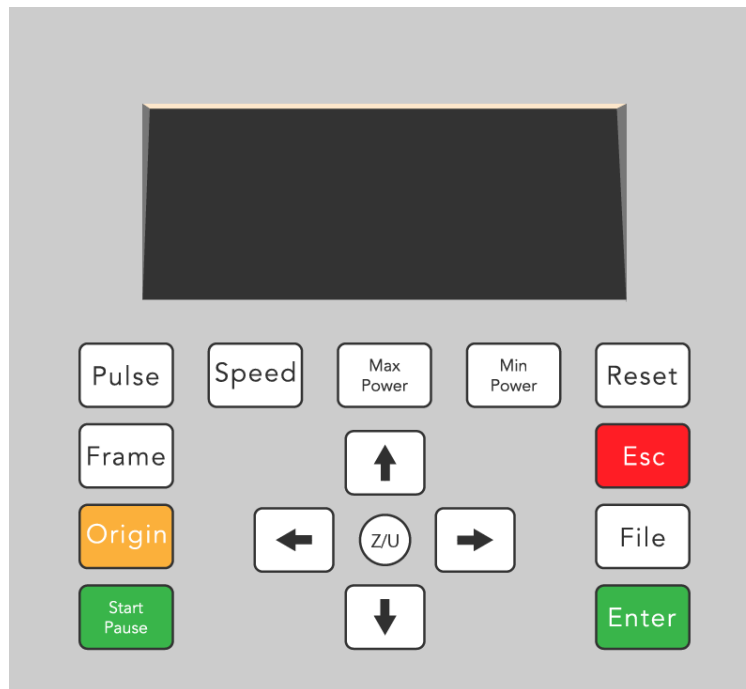
The “Fade Image” function, dims the image to make it easier to see the resulting vector shapes.

SHOW POINTS

The “Show Points” function enables the display of the points (nodes) of the resulting vector trace. Enabling this is useful when you are tuning the Optimize parameter to see the resulting points.

4.0 OPERATION

4.3 CONTROL PANEL NAVIGATION



Reset

The **Reset button** will reset the laser head back to the last set X,Y coordinates if the laser head has been moved.

Pulse

The **Pulse button** will temporarily activate the laser and create a short burst of laser power. Will not activate when front lid is open. **Caution: Will still activate with maintenance panels open. Never activate the laser with any panels removed.**

Speed

The **Speed button** allows you to change the speed at which the laser cuts. This is useful to make changes to an existing file on the laser. To change the speed, press the Speed button, then use the Min-Power and Max-Power buttons to adjust the speed. Press Enter to confirm. **Note that LightBurn overrides this when sending the file to the laser** - it is generally best to set speeds and powers in LightBurn where possible.

Min
Power

The **Min-Power button** is used to set the minimum power that the laser will output. This is useful when you are engraving an image and need a variety of powers for the different depths. **Note that LightBurn overrides this when it uploads a file.**

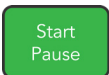
4.0 OPERATION



The **Max-Power button** is used to set the maximum power that the laser will output. This is useful for when you are engraving an image and need to set an upper limit of power. **Note that LightBurn overrides this when sending a file to the laser.**



The **File button** pulls up all the available files and file folders on the laser machine. Use this button to find and select the stored files that you would like to cut, etch, engrave. To move through these files, use the arrow buttons and press Enter to select a file.



The **Start-Pause button** is used to start a file or to pause a file during operation. Start Pause



The **Origin button** is used to set a particular X and Y starting point. This can be done by using the arrow buttons to move the laser head to where you want it, and then pressing Origin. This will override the laser's "home" and set it to the current position.



The **Frame button** allows you to see whether or not the current file will fit on the material in use. When pressed, the laser head will show you the rectangular boundaries of the file. **Note:** The Frame button on the machine will only frame a file that's stored on the laser, not the current LightBurn window. Click Frame in LightBurn to see the current preview.



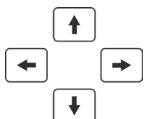
Pressing the **Esc (Escape) button** will allow you to exit or cancel the current operation. This is useful if you would like to cancel the current job, clear an alert, or leave a menu.



Use the **Enter button** button to select files, variables, folders, etc.



The **Z/U button** will bring up all the sub menus, and allow you to raise and lower the bed. This is needed to properly position the bed depending on the material you are using.



The **Arrow buttons** are used to navigate through the various menus and settings, as well as to "travel" the laser head around the working area.

4.0 OPERATION

4.4 PREPARING FILES FOR PRINT

Laser Cutting

The first step to preparing a laser cutting project is to prepare the CAD file that will create the shape that is to be cut out on the laser.

Drawing CAD Files for Laser Cutting

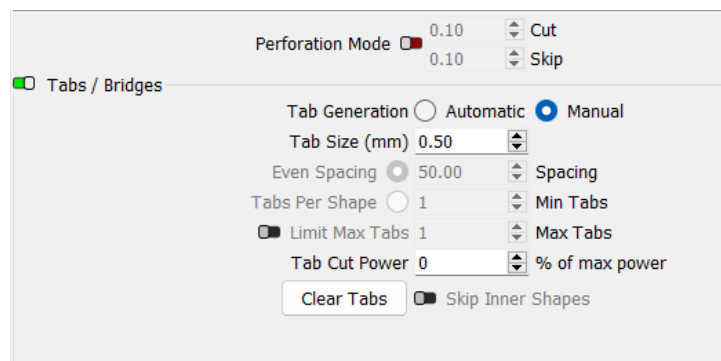
Laser cut CAD files are usually simple 2D line drawings that represent the outline of the parts you want to create from stock materials. The final product will have a thickness that is determined by the thickness of the material you are cutting.

Note: For materials that need to interlock, it is a good practice to measure the thickness of the material first, as the advertised thickness may not exactly match the measured thickness.

Another design consideration is whether the parts should fall free, or should remain in the stock wood held by small tabs. “Kit” style projects can be easier to keep organized when tabbed together.

If parts are set up to remain “tabbed” into the stock materials, they won’t fall free immediately. Tabs allow you to have many individual pieces cut out while remaining organized and protected. Tabbed designs can be removed from the laser much faster, while many individual parts are harder to pick up.

Tabs are easily created using the “Tabs/Bridges” section in the Cut Settings Editor for any “line” layer in the design.



Any pieces that fall beneath the honeycomb will require access to the trap underneath the cutting table. To do this, move the laser to the back of the machine and lower the bed with Z/U, then gently lift and remove the honeycomb bed.

Buildup of debris beneath the honeycomb table is a fire hazard.

Be sure to clear all flammable material away from beneath the bed regularly by lifting the honeycomb and using a vacuum or brush.

4.0 OPERATION

4.4 PREPARING FILES FOR PRINT

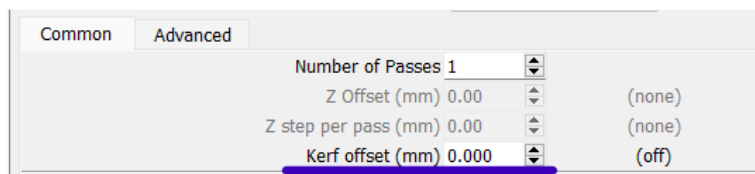
Kerf

When designing parts for creation in the laser, keep in mind that the kerf (amount of material lost to the cut) is approximately the thickness of a piece of paper (0.2-0.5mm) depending on the thickness and type of material being cut. Therefore, any designs that have lines closer together than the kerf will result in a larger, more burnt hole, rather than two individual cuts. The laser removes around 0.1-0.2mm from either side of the line drawn. The thickness of removed material is called the **Kerf** of the laser.

Slots and Tabs

Many laser-cut designs use slots and tabs to fit together. Because of kerf, if you create a design with 3mm wide slots, and use a 3mm material "tab" that fits in it, the fit will be loose, because the kerf of the laser has made the 3mm wide slot 3.1-3.2mm in actual width. This difference is too small to see easily, but will cause the fit to be slightly loose. In order to make these tabs and slots fit snugly, we need to compensate for the kerf.

This can be done by using the Offset tool in LightBurn to enlarge the tabs/slots in the design itself, but is most easily done using the Kerf Offset setting in any Line layer's material settings:



It's a good idea to make small tab/slot test pieces while changing the Kerf offset by 0.1mm at a time or less, until you find the setting that suits your material and fit needs.

Double Lines and Hidden Details

Some SVG files downloaded from the internet or auto-traced in a program like Illustrator or Inkscape may contain 'artifacts', small or hidden details that are hard to notice in the preview, but which contain incorrect information that the laser may have trouble interpreting.

A 3mm circle made up of hundreds of lines, for example, may look solid but will cause the laser to stay firing at one area for too long, potentially causing scorching or even fire.

Some vector graphics may appear to be made of single lines, but actually contain many overlapping ones. This will cause the laser to cut some portions of the design twice, or engrave erratically.

If you run into odd behavior like this when cutting a file, zoom in and inspect the file's fine details, and check for double lines. (Usually by deleting line segments and making sure there's nothing "behind" them, then using Undo to put them back if not.)

4.0 OPERATION

4.5 PREPARING THE MACHINE FOR WORK

Powering the Machine On

Before powering on the machine ensure that the protective cover is closed. Verify the red safety Emergency Stop is not engaged (if it is, rotate it clockwise and it will extend to the non-engaged position). Turn the main power switch below the e-stop if disabled.

Optional: Transferring Files to the Laser Cutter using USB flash drive

- Insert the USB stick into the lower of the two USB ports on the right side of the laser cutter.
- On the control panel of the laser, press the “file” button. The files currently stored in the internal memory in the laser will be displayed in a box with a series of smaller boxes to the right
- Use the white arrow keys on the keypad to navigate over to the smaller boxes and navigate down until you reach the box called “UDisk+”
- Press the “Enter” button on the keypad.
- The display will refresh with an empty window on the left and a new group of boxes on the right. Select “Read UDisk File”. The left window will populate with the names of all of the laser files stored in the parent directory of the USB stick. • Use the arrow keys to highlight the file you want to use.
- Use the left and right arrow keys to toggle back to the boxes on the right side of the screen. Navigate down to “Copy to Memory” and highlight it. Press the “Enter” button. • Press the “ESC” button on the interface twice. This will exit the machine from file displaying mode.
- Press the “File” button once more. The file that was copied will now be displayed in the list of files in the box at the left of the display screen. Use the cursor to scroll up or down until the file that is needed is highlighted.
- Press “Enter” – the file is now in the active memory of the machine and is ready to run.

Note: There is a limited number of file names which can be displayed on the screen at one time, so other files in memory may only become visible when the cursor keys are used to scroll up or down through the list. The menu option displayed on the screen will cycle from the bottom. It is not necessary to reverse scrolling direction – the list will simply loop. Caution: Do not leave too many files loaded in the machine at one time. It will slow the process of file selection and may completely fill the limited memory space of the on-board computer. To delete files, select them in the left window then navigate in the right boxes to highlight the “Delete” option. Then press “Enter”.



5.0 MAINTENANCE

5.1 MACHINE CLEANING

To ensure the safety and performance of your Mako Laser, it is important to perform cleaning and maintenance on a regular basis. The Mako Laser Cutter should always be kept in an environment that is between 18°C and 30°C. Please also be mindful of the amount of dust and air pollution in the operating environment as this can affect the various electronic parts of the machine. Power off machine before cleaning.

General Cleaning Tips

1. The cutting bed and interior of the machine should always be kept clean and free of scraps or other material. Loose material scraps can cause a head crash, machine jam, or fire.
2. The top surface of the machine should never be used as a table or working surface. The acrylic machine cover should be free to open and close at all times.
3. Warm water and a sponge can be used to remove charred markings on the work table. It is not recommend that cleaning products be used on the machine, especially products that contain flammable substances.
4. The lenses and mirrors on the machine may need to be cleaned periodically. To do this, use a small amount of 99% isopropyl alcohol on a Q-tip to gently wipe the surface.

PLEASE NOTE: After using isopropyl on the lens or mirrors, wait at least 15 minutes before operating the machine. The isopropyl must be fully dried before being exposed to the laser beam.

Changing Water

The type and age of the water used will often affect the lifespan of the laser tube. It is recommended that only distilled water is used for the machine. Water that is stored open or is not distilled may create unsafe conditions or impact the lifespan of the machine.

The water cooling system is built into the Mako 60W. We suggest changing the water and cleaning the water tank every six months. Look in your laser's toolkit for a short pigtail of hose with a white fitting on one end. (item 12 on the Page 13 parts list).

Place a large bucket next to the laser and put the plain end of the hose into it. With the machine powered off, insert the fitting into the drain hole found on the right side of the machine, just to the left of the chassis fan - the water will begin to drain immediately, so make sure you're ready with the bucket before doing this.

When finished, remove the pigtail by pressing down on the metal clip, and add the new distilled water via the fill spout. Replace the cap before finishing.

5.0 MAINTENANCE

Cleaning The Lens and Mirrors

If you find your laser is cutting poorly the lenses and mirrors may need to be cleaned. If the mirrors or lenses are smudged or dirty the laser beam will have a difficult time transmitting through the lens. Follow the steps below to properly clean your Mako Laser Cutter's lenses and mirrors:

1. Soak a cotton swab or lint-free lens cleaning tissue in Isopropyl (rubbing alcohol) of 99% purity.
2. Gently wipe the lens or mirror with the swab, using a brushing motion in the same direction. Avoid "swirling" the swab as this can cause scratches.
3. You may need to do this several times to get a lint-free result. A lens-cleaning "puffer" is helpful for this stage.
4. Make sure all debris and dust is gone and the lenses and mirrors are fully dry before using the laser cutter again.
5. Any debris, lint, or dust left on the lens surface will be "baked into" the lens if it's not cleaned off before use, and will impact the efficiency of the laser.

WARNING: After using any flammable liquids on the machine, you MUST wait at least 15 minutes or until dry before operating the machine. The flammable substance in rubbing alcohol must be fully dried before being exposed to the laser beam.

Gantry Maintenance

After extended use of the laser it is not uncommon for the gantry system to accumulate dust and debris. It is suggest that you clean the gantry system in your machine once to twice a month.

Ensuring it is kept clean will allow the gantry system to move freely, maintaining high precision and performance.

To clean the rails, turn off the machine and use a damp (but not dripping) cloth to remove any excess dust or debris.

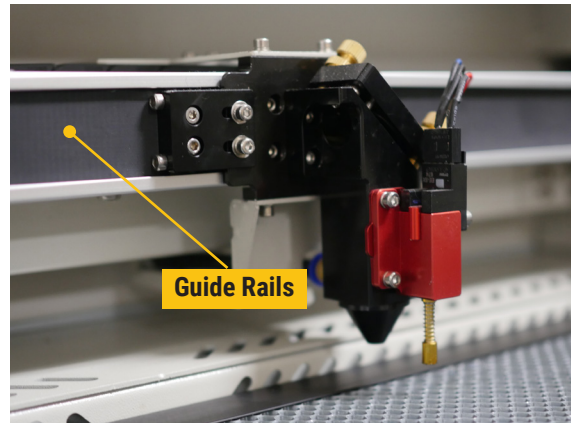
Do not remove any parts (other than side panels) or disassemble the laser in order to clean, and always have the laser powered off when cleaning. Move the gantry or laser head gently by hand in order to clean the entire belt.

Never clean or otherwise touch the electronics inside the laser or behind access panels, as residual power could be present in some components.

5.0 MAINTENANCE

Guide Rails Cleaning

The guide rails, which are covered by a metal protective cover, will occasionally need to be cleaned and lubricated. To clean the guide rails on the Gantry system, wipe them down with paper towel (no solvents) and lubricate them with a few drops of shredder performance oil. Move the laser head back and forth several times to ensure the oil is evenly distributed.



5.2 MAINTENANCE SCHEDULE

Below is our recommended maintenance schedule for each part to help ensure the safety, performance, and longevity of your Mako Laser Cutter.

	DAILY	WEEKLY	MONTHLY	ANNUALLY
MIRROR 1		Check/Clean*		
MIRROR 2		Check/Clean*		
MIRROR 3	Check/Clean*			
LENS	Check/Clean*			
TABLE	As Needed			
WATER COOLING UNIT			Check Levels	Replace Water
ENTIRE WORKING AREA		As Needed		
BELTS				As Needed
TUBE			As Needed	
LINEAR RAILS			As Needed	
AIR NOZZLE		As Needed		
INTERNAL MEMORY				As Needed

***Note: If a mirror or lens looks clean, you don't need to clean it.**



6.0 ADDITIONAL INFO

6.1 TIPS FOR TROUBLESHOOTING

If the machine does not turn on:

- Check all power cables to ensure that the machine and all components are connected to a working outlet. Make sure the e-stop is not pressed. (Twist clockwise to disengage)

If the machine loses some cutting power:

- Usually the result of a loss of mirror alignment.
- Test to see if laser power is consistent at all four corners, or if results look very different between locations.
- Calibrate the laser mirrors as per the instructions in section 4.0 (Page 17-20)

If the machine loses all cutting power:

- Check the machine's water level, the laser will not fire if it runs out of water or isn't flowing properly.
- Check layer power settings in Lightburn, and ensure that "Output" is checked for the layer you're cutting.
- Power off the laser using the e-stop, then open the rear lid and inspect the laser tube for obvious cracks or damage. **If there is any liquid outside of the tube, immediately disconnect the power at the wall outlet and [contact tech support](#) for next steps.**
- Be sure to include your laser's model and serial number, so our team get you back up and running as soon as possible.

If the machine does not cut all the way through the material after the first pass:

- Take care not to move the material or the laser, as this will make it very difficult to line back up.
- With one hand, firmly hold down the material, taking care not to shift it.
- With your other hand, poke at the cut-out pieces to see if they are loose. If they are, they are cut all the way through.
- If your cut did not get through, you can restart the cut job immediately after the first one is finished. (To skip any engraving layers and only do the cut again, simply uncheck "Output" next to the engraving layers)
- Increase the power or lower the speed the next time you cut that file (keep record for commonly used materials). Note: When the laser cuts completely through a material, smoke can usually be seen coming from the bottom of the bed. Smoke will be visible through the cracks of the fresh cut material when looking through the honeycomb. If no smoke can be seen coming through the bottom, more cutting may be necessary.
- For best results, make sure to always use the "Z auto level" before each cut job, to ensure that the laser is focused correctly.

If your issue is not listed above, [see our FAQ page](#) for additional troubleshooting tips.

6.0 ADDITIONAL INFO

6.2 TRAINING COMPLETION FORM

Employee/Trainee: _____

Trainer: _____

Date of Training: _____

The above mentioned employee/trainee received instruction on the operation of the Mako Laser Cutter. The following topics were covered during the training:

- Machine Overview
- General Safety
- Laser Safety Precautions
- Operational Safety
- Approved/Not Approved Materials
- Powering ON/OFF the laser machine
- Debugging the Light Path
- Control System Navigation
- Preparing Files for Print
- Preparing the Machine for Work
- Machine Cleaning
- Maintenance Schedule
- Tips for Troubleshooting

Signature of Trainer

Signature of Trainee

6.0 ADDITIONAL INFO

6.3 TECHNICAL SUPPORT CONTACT

If you are having issues operating your laser machine and have gone through the Tips for Troubleshooting section in this manual please contact our Technical Support line.

InkSmith Technical Support

Phone: 1-844-465-7684 ext.4

E-mail: tech@inksmith.ca

<https://www.inksmith.ca/pages/tech-support>

Technical Support Hours:

Monday-Friday
9:00am-5:00pm EST

NOTE: For complex problems please provide photographs or video via email (tech@inksmith.ca) in order to help us better diagnose your issue.



QUESTIONS?

tech@inksmith.ca
1-844-465-7684
(ext.4)

www.inksmith.ca/pages/tech-support

