



muse

USE

User Manual

7-21-17

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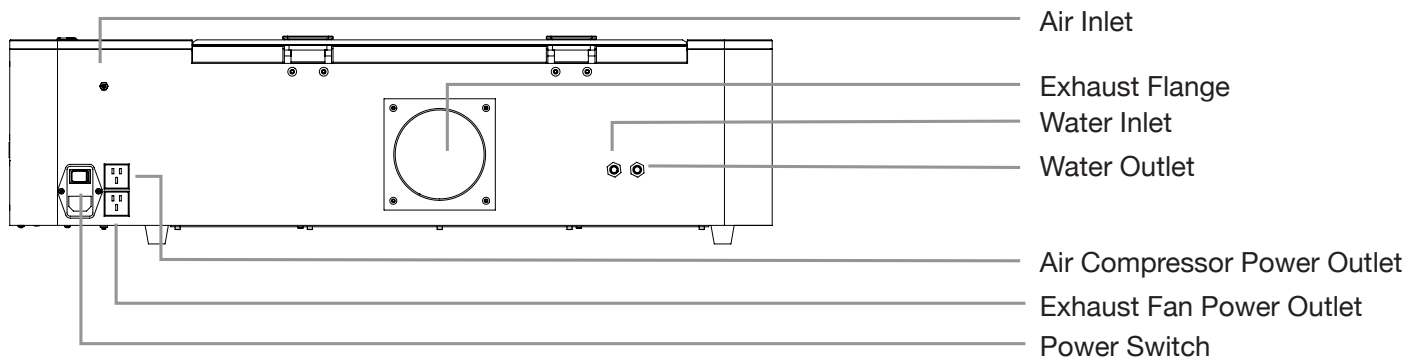
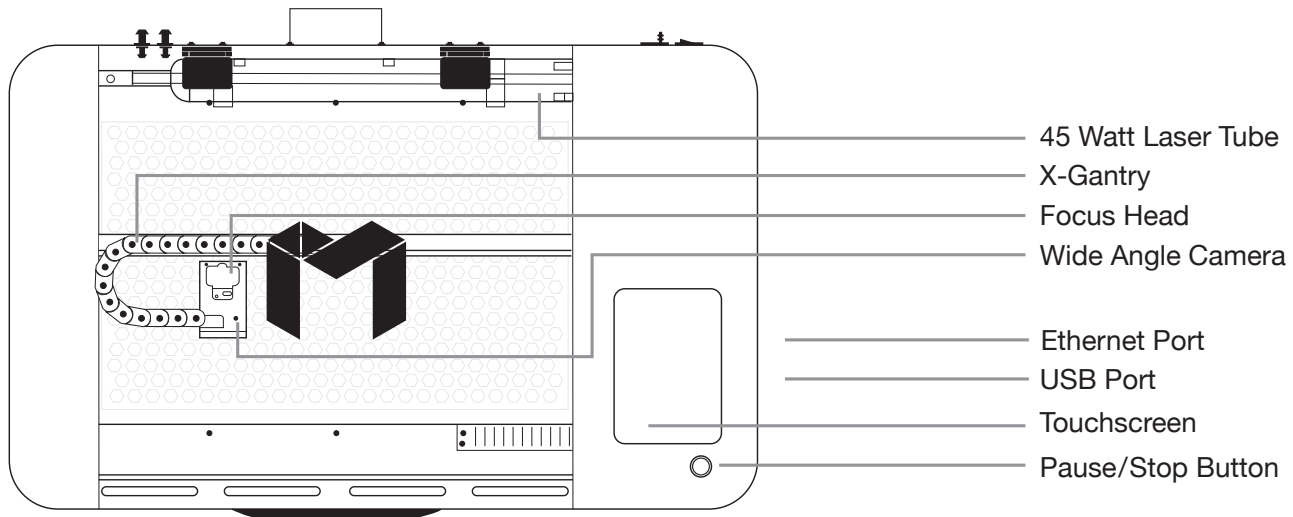
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Muse Laser Cutter User Manual

Congratulations on your purchase of a Full Spectrum Laser Muse Laser System. With proper usage and upkeep, your laser cutter should provide years of productive output. This user manual will guide you through the safety guidelines and operation of your machine. It is recommended that you familiarize yourself with this manual before using your laser cutter.

For more information and product selection, please visit www.fslaser.com.



Compliance Statement The Full Spectrum Laser MUSE Laser System is a class 3R laser product, as defined in International Standard IEC 608251. The Full Spectrum Muse complies with 21 CFR 1040.10 and 1040.11, the Federal Performance Standards for LightEmitting Products, except for deviations pursuant to Laser Notice No. 50, dated July 16, 2001. The Center for Devices and Radiological Health of the US FDA issued Laser Notice No. 50 to permit manufacturers to classify and manufacture their products in accordance with the International Standard. 21 CFR 1040 and IEC 608251 require that certification, identification and warning labels be placed on laser products. Reproductions of the labels found on the Full Spectrum Hobby Advanced Laser System follow, with locations specified:

SECTION I. SAFETY FIRST

Familiarize yourself with these icons. They indicate areas that require special attention.



Pro Tips:

Watch for this icon to receive valuable advice in getting the most from your machine.



Shock Icon:

Warns of potential electrical hazards.



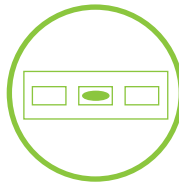
Fragile Icon:

Warns of fragile parts or materials, such as glass.



CO2 Gas Icon:

Warns of potential gas leaks and associated hazards.



Level Icon:

Indicates the need for a level surface.



Safe Disposal Icon:

Calls attention to proper disposal of waste materials.



Laceration Icon:

Warns of potential sharp edges that could cause cuts or injury.



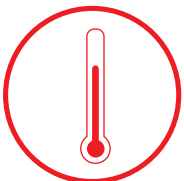
Fire Icon:

Warns of potential fire hazards.



Laser Icon:

Warns of potential dangers associated with laser usage.



Temperature Icon:

Warns of potential temperature issues with your machine.



Caution Icon:

Warns of important area of caution not covered by other icons.



Attention Icon:

Calls attention to an important point.

General Safety

Read and be familiar with all safety protocols and procedures before operating any machinery. It is the responsibility of the operator to ensure all safety precautions are correctly followed and the machine is properly assembled and in working order.



ALWAYS inspect the laser cutter for damage or breakage before each use. Do not operate machinery that is damaged or defective in any way.



ALWAYS have a clean, level, and open work space to unbox and place your laser cutter.



ALWAYS be aware that the laser tube is made of glass and is therefore extremely fragile and can cause severe lacerations if broken.



ALWAYS be aware that the laser tube is filled with CO₂ gas. While carbon dioxide is a class 2.2 gas (nonflammable and nontoxic), release of this gas from the laser tube will render your laser inoperable.



NEVER modify, disassemble, or in any way alter the construction of the laser and never start up a system that has been modified or disassembled.



NEVER leave the laser system unattended during operation.



KEEP YOUR LASER SYSTEM CLEAN – A build up of cutting and engraving residue and debris is dangerous and can create a fire hazard. Keep your laser system clean and free of debris. Regularly remove the cutting grid to clean any small pieces that have gotten stuck or fallen through.



DO NOT disassemble the machine or remove any of its protective covers.



NEVER place hands or fingers into moving parts such as cooling fans.



Laser Safety

The output of the CO2 engraving laser is fully contained in a Class 1 enclosure during normal operation. The laser cabinet has a safety interlock switch that deactivates the laser if the door is opened during operation, and no special precautions are necessary to operate the high power laser safely. However, the output beam of the Alignment Laser (visible red diode laser) is accessible to the operator during normal operation, giving the total system an overall rating of Class 3R. Class 3R lasers have minimal safety concerns when used properly and handled with care.

Follow these safety guideline at all times:

NEVER operate the machine with any of the panels removed. Be aware that removal of any portion of the cabinet will expose the laser system and greatly increase the risk of injury and/or fire. Personal injury and fire risks are especially pronounced if the machine is operated with the bottom panel removed. Remember that the CO2 laser beam is invisible!

NEVER engrave or cut any material containing PVC or vinyl. These materials (along with other chlorine/ chloride containing materials) produce a corrosive vapor that is extremely harmful to humans and will destroy your machine. Your warranty will be void if your machine is damaged by corrosion from engraving or cutting PVC or vinyl.

NEVER engrave or cut any unknown material. The vaporization/melting of many materials, including but not limited to PVC and polycarbonates, can give off hazardous fumes. Please refer to the MSDS sheet from the material manufacturer to determine the response of any work material to extreme heat (burning/fire hazard).

ALWAYS use the air assist, especially while vector cutting. Vector cutting movements are relatively slow and apply an extremely large amount of heat to the workplace. This buildup of heat can create a significant fire risk.

NEVER run laser with lid open. Always be sure the lid is closed and never tamper with lid safety mechanism.

NEVER operate the machine without a properly operating ventilation system. Most materials produce an irritating smoke when engraved. Some materials, including but not limited to: paint, varnish, composition board, and plastics, produce compounds that can be harmful if concentrated.

NEVER look into the beam of the Alignment Laser (visible red diode laser).

NEVER aim any laser towards an aircraft or vehicle that is in motion. The bright light can flashblind, cause glare, or distract the pilot or driver.



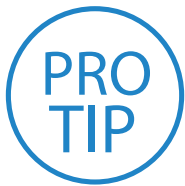
Laser Safety (Cont.)

The standard reference for laser safety is the American Standard for the Safe Use of Lasers, Z136.12000, developed by the American National Standards Institute (ANSI). This reference is the basis for many of the federal regulations for laser and laser system manufacturers, and for the Occupational Safety and Health Administration (OSHA) laser safety guidelines. It contains detailed information concerning proper installation and use of laser systems. While the ANSI standard itself does not have the force of law, its recommendations, including warning signage, training, and the designation of a laser safety officer, may be compulsory under local workplace regulations when operating laser systems above Class I. It is the operator's responsibility to ensure that the installation and operation of the Full Spectrum Laser Hobby Laser System is performed in accordance with all applicable laws. Copies of ANSI Standard Z136.12000 are available from: LASER INSTITUTE OF AMERICA 12424 RESEARCH PARKWAY, SUITE 125 ORLANDO, FL 32826 (407) 3801553.



Fire Safety

Laser cutting and engraving systems can present a significant fire hazard due to the extremely high temperatures generated by the laser beam. While the objective of most cutting and engraving operations is to vaporize material without burning, most materials capable of being cut or engraved are inherently combustible and can ignite. Usually this is a small flame of burning material issuing from the cut zone which self extinguishes due to the air assist or depowering of the beam. However, it is possible for the flame to propagate and set fire to the machine and its surroundings.



PRO TIP! *Experience shows that vector cutting with the laser has the most potential to create an open flame. Acrylic in all its different forms has been shown to be especially flammable when vector cutting with a laser.*

ALWAYS keep a properly maintained and inspected 5lb or larger fire extinguisher on hand. Full Spectrum Laser recommends a Halogen fire extinguisher or a multipurpose dry chemical fire extinguisher. Halogen extinguishers are more expensive than a dry chemical, but offer certain advantages should you ever need to use an extinguisher. The Halogen extinguisher discharges a clean, easily removable substance that is not harmful to the mechanics or wiring of the laser system. The dry chemical extinguisher discharges a sticky, corrosive powder that is very difficult to clean up.

BE AWARE that stacking materials (especially organic materials such as paper) can lead to increased risk of flame propagation or work piece ignition.

NEVER operate your machine unattended. There is a significant risk of fire if the machine is set improperly, or if the machine should experience a mechanical or electrical failure while operating.

ALWAYS keep the area around the machine clean and free of clutter, combustible materials, explosives, or volatile solvents such as acetone, alcohol, or gasoline.

ALWAYS use air assist when vector cutting.

BE CAREFUL when vector cutting. Many materials have the potential to burst suddenly into flames – even materials that may be very familiar to the user. Always monitor the machine when it is operating.



Fire Safety (Cont.)

NEVER CUT PVC (polyvinyl chloride) under any circumstances: fumes are highly toxic and potentially lethal.

NEVER store any flammable materials in the inside of the device or in the immediate vicinity of the device. Debris and leftover produced materials within the machine must to be removed to prevent fire hazard.

ALWAYS have on hand a first-aid kit designed for the initial treatment of burns and smoke inhalation. Be sure to store this kit in an area that is outside risk areas.

Woodshop Dust Fire Safety Considerations*

Before processing materials the user must verify whether harmful materials can be generated and whether the filter equipment of the exhaust system is suitable for the harmful materials. We emphasize that it is the responsibility of the user to consider the national and regional threshold values for dust, fogs and gases when selecting the filters and the exhaust system. (The values for the maximum workplace concentration must not be exceeded.)

Be mindful of large quantities of fuel in the form of wood and wood products, sawdust, and flammable materials such as paints, oil finishes, adhesives, solvents, and liquid propane for internal combustion engines.

Preventing the buildup of dust is one of the key means for controlling fire and explosion hazards. The principal engineering control technology for control of dust is exhaust ventilation. The primary work practice control is good housekeeping.

Dust collection is best accomplished at the source-at the point of operation of the equipment, if feasible. For many pieces of equipment, well-designed ducts and vacuum hoods can collect most of the dust generated before it even reaches the operator.

Very fine dust that manages to escape point-of-source collection can be captured from above by general exhaust points located along the ceiling. These control technologies are effective for most equipment, excepting machines that commonly produce the very finest dust or large quantities of dust.

*These guidelines come from the U.S. Department of Labor



Electrical Safety

The power supply is capable of outputting DC 20,000V at up to 20mA. This power is also provided to the discharge terminals on the laser tube itself. Your laser shipped with silicone terminal covers that prevent access to bare wiring—notify Full Spectrum Laser support and immediately cease operations if these covers ever slip and expose bare wire.

DO NOT open any of the machine's access panels while the unit is plugged in. Opening a panel may expose the operator to the unit's AC input power. The AC input power is potentially lethal and is located on the far right within the cabinet.

NEVER make or break any electrical connections to the system while the unit is turned on.

NEVER access the electronics area with hands or tools unless the unit is disconnected from power for at least one hour.

NEVER replace the installed 10 amp fuse with a fuse of a higher rating. This will void your warranty and the electronics will not be adequately protected from surges or short circuits.

POWER ON/OFF is controlled by the switch at the back of the machine. To power the machine on, press the (-) side down. To turn power off, press the "o" side down.

IN CASE OF A BLOWN FUSE always contact Technical Support before replacing any fuses.

SECTION II. UNBOXING YOUR MUSE

When your Muse arrives, it will require careful unboxing and examination of parts. Follow these instructions for best results.



FRAGILE PARTS! *Be gentle in removing the foam packaging and accessories. Never pull or force the packaging loose from the laser cutter. Be particularly aware that the water inlet and outlet nodes protrude from the tube and are extremely fragile when unboxing your laser tube.*

Unboxing Steps

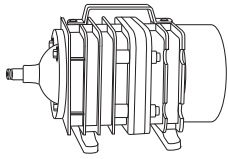
Now that your Muse has arrived, it will require careful unboxing and examination of parts. You will need two able-bodied adults to lift and place the machine.

Follow these instructions for best results:

- 1. Prepare Work Space:** You will need an open, level work space to place your laser cutter. A solid table with adequate room for the machine is recommended (the machine's dimensions are 32" x 20" x 8.75"). Be sure the table is free of clutter and can support a minimum of 100 lbs (the machine weighs 70 lbs on its own).
- 2. Place Box:** Set the box on a flat space near where you will place the machine (such as the floor). Open the box carefully from the top. If you use a cutting tool to open the box, be careful not to allow the cutting edge to cut past the cardboard box. Always use all tools with caution and only as specified by the manufacturer.
- 3. Remove Packaging:** Gently remove the following from the box: the honeycomb plate, the Quick Start Guide and the top (4) foam pieces securing the machine.
- 4. Remove Accessories:** Nestled in packing foam, inside the interior of the machine, are the following parts and accessories: a plastic bag with cords and small accessories, the water pump and the air compressor. Inspect these parts to insure they are accounted for and intact.
- 5. Place Muse:** This will require two adults as the machine weighs approximately 70 lbs. Standing on both ends, grip the machine from the bottom and gently lift the machine out of the box, leaving the bottom foam still inside the box. Place on the clean, flat table you plan on keeping it. Your Muse is now unboxed.
- 6. Inspect your Muse:** If have any questions, contact your sales representative or customer support. Refer to your Muse Quick Start Guide or download the Muse User Manual for assembly instructions.

Unpacking List

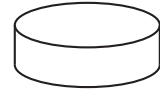
Your laser shipped with the following included parts and accessories:



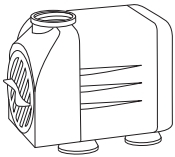
(1) Air Compressor



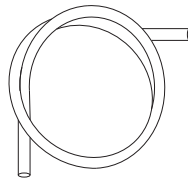
(1) Air Assist Tube



(1) Focus Billet



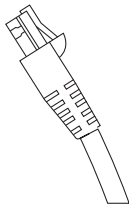
(1) Water Pump



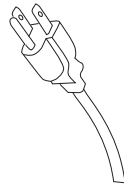
(2) Water Tubes



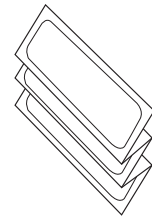
(1) 2.5mm Hex Key



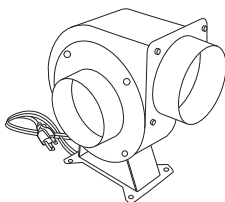
(1) Ethernet Cable



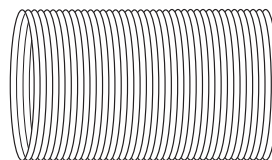
(1) Power Cord



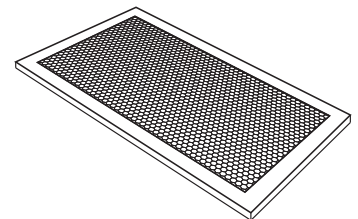
(1) Thermal Paper



(1) Exhaust Fan



(1) 10' Ducting



(1) Honeycomb Tray



(2) 4' Ducting Clamps

Additional Requirements

In addition, you will need the following tools and accessories (not included with your machine purchase):

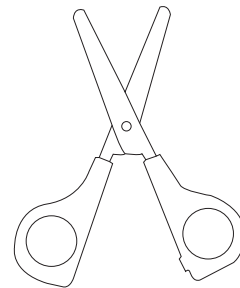
- **3-5 gallons of distilled water**
- **A five gallon bucket**
- **Small Scissors**



Distilled Water



Water Bucket



Small Scissors



CAUTION! *You should never operate your laser without a working exhaust. Full Spectrum recommends exhaust systems capable of 232 CFM. Keep in mind that exhaust systems with high flow rates may require fixtures for thin materials.*



FIRE WARNING! *It is important that either rigid or flexible metal ducting be used in the exhaust system. Any type of "soft" ducting is potentially flammable and should not be used under any circumstance.*

SECTION III. INSTALLATION & ASSEMBLY

With your laser cutter unboxed and placed in its permanent work space we can now prepare it for use. This is a simple process that should take less than half an hour to complete.

Assembly Stages:

1. Locate & Remove Zip Ties
2. Connect the Exhaust System
3. Assemble the Water System
4. Assemble the Air Compressor
5. Connect Electrical Power
6. Connect the Ethernet Cable
7. Connect to RetinaEngrave 2.0 Software

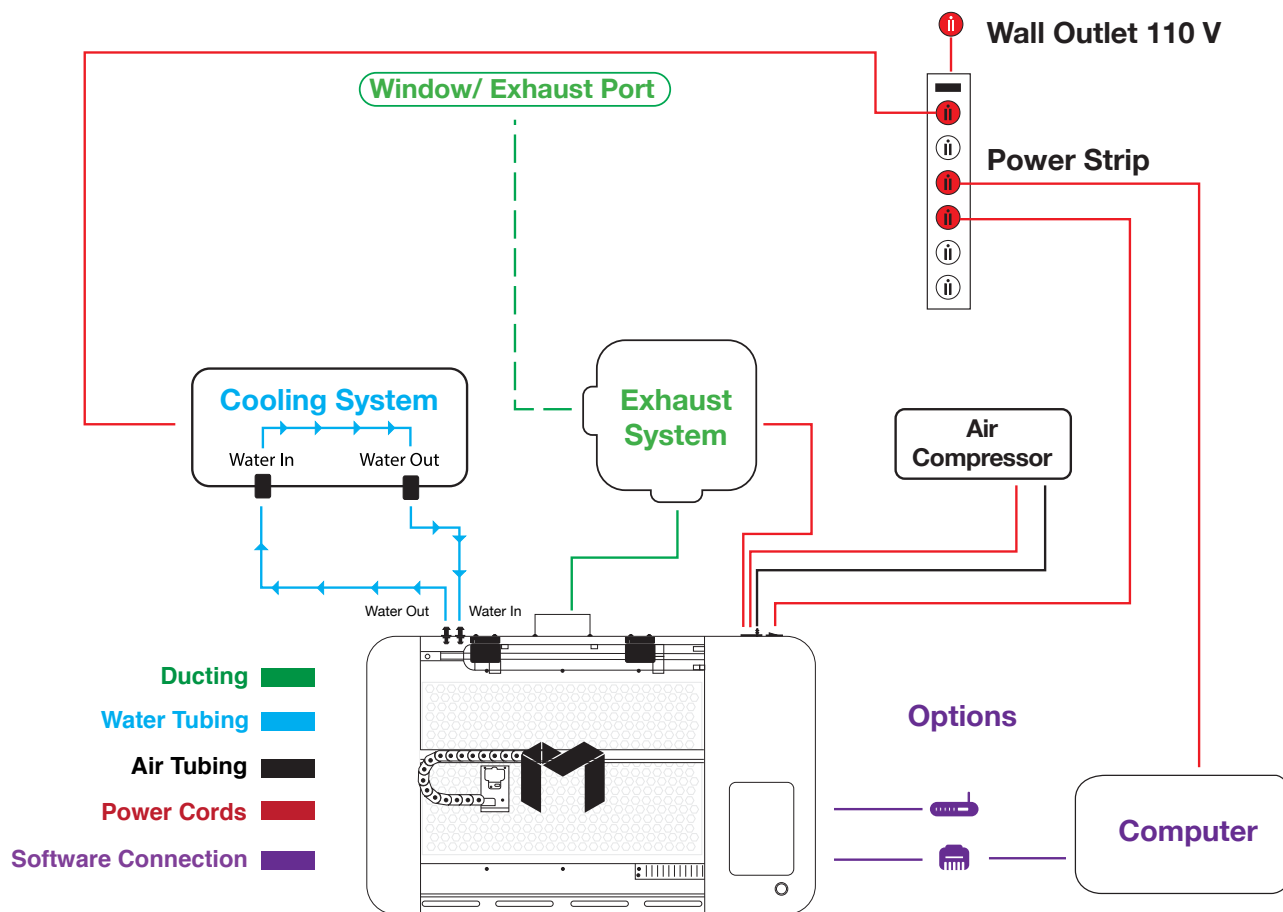


Figure 3.1

Assembly Stage 1: Locate & Remove Zip Ties

To secure the machine during shipping, yellow zip ties are used to hold the laser head assembly and the x-gantry. These zip ties must be removed before operating your laser cutter for the first time.

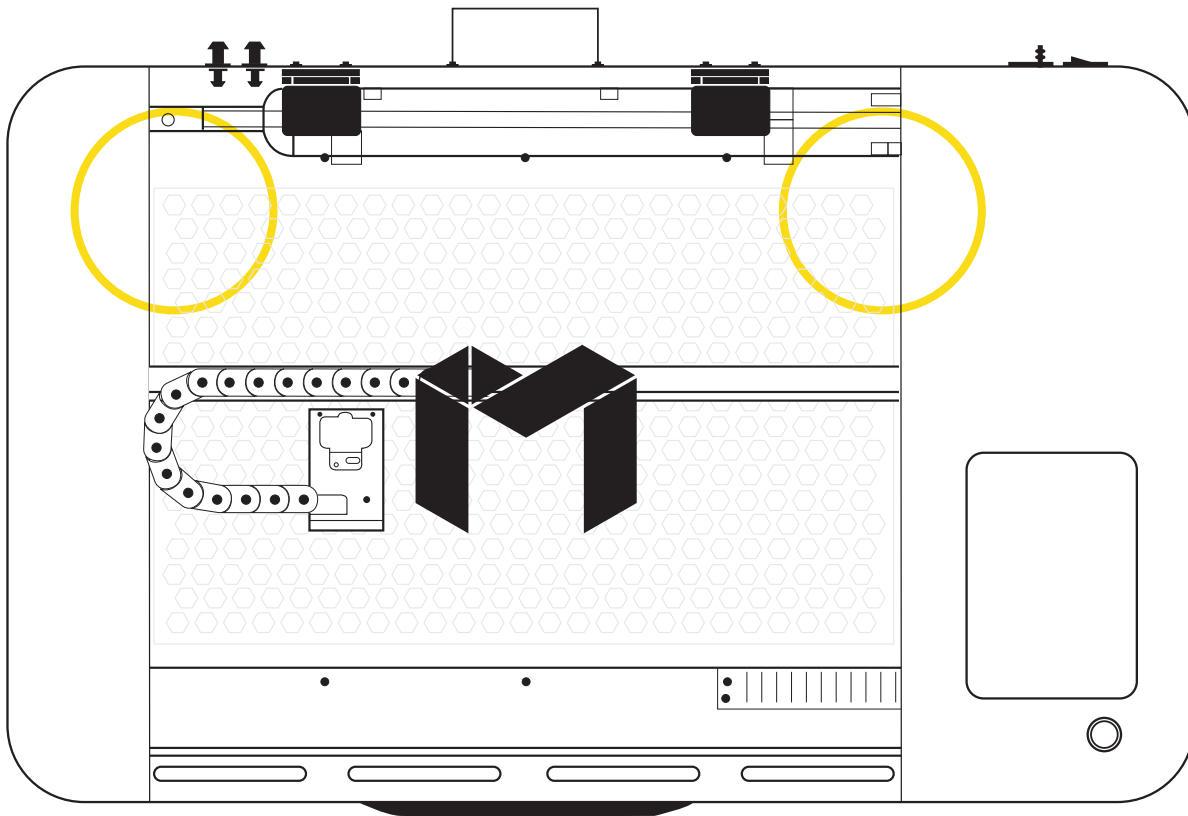


Figure 3.2

- 1. Locate Yellow Zip Ties:** Yellow zip ties secure the laser head and x-gantry during shipping. Open the lid and identify all yellow zip ties.
- 2. Cut and Remove Yellow Zip Ties:** Using a small pair of scissors (nail cutters work remarkably well), carefully cut and remove ALL yellow zip ties. DO NOT cut any other cord or wire. Be aware that the glass laser tube is extremely fragile. Be careful NOT to damage any part of the machine during this process.

Assembly Stage 2: Connect the Exhaust System

It is required that an exhaust fan is connected and operating whenever you run a job on your laser. A properly installed exhaust fan removes smoke and fumes from the case and exhausts them to the outside of the building or a fume extractor.

1. Position Ducting: Place your 4" ducting over the Exhaust Port located at the back of the machine and hold. Secure with 4" ducting clamp.

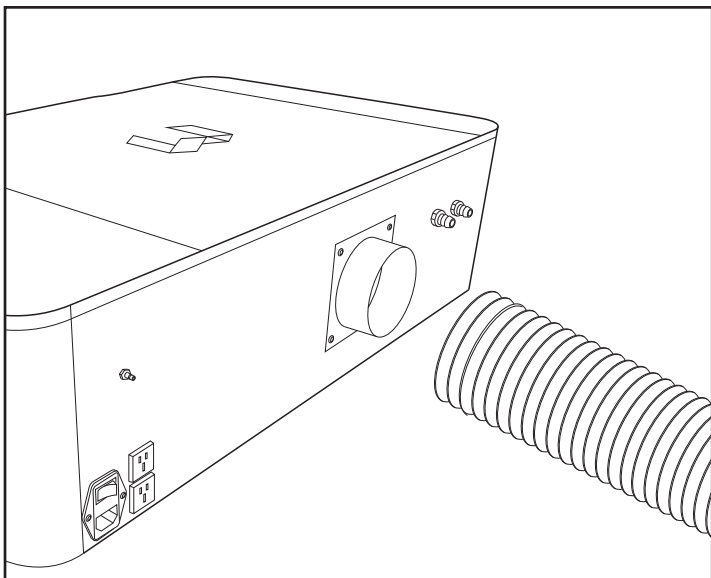


Figure 3.3

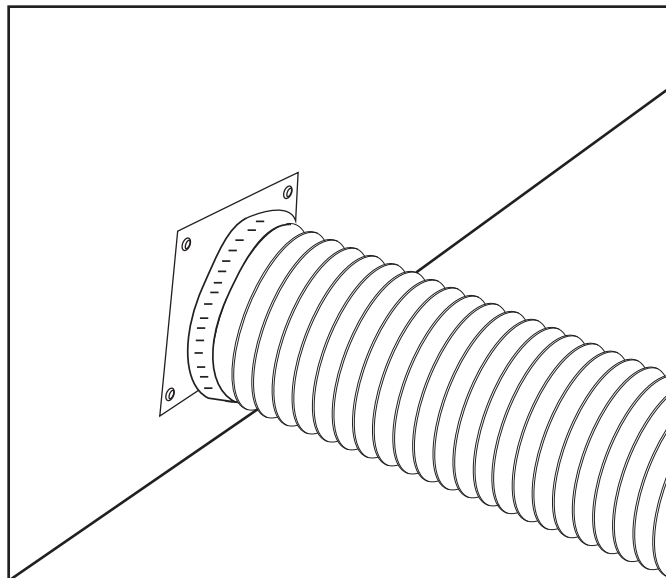


Figure 3.4

2. Attach Exhaust Fan: Secure the other end of the ducting, connected to the machine, to the exhaust fan. Now repeat the ducting and clamping process on the other side of the exhaust fan, creating a sequence of machine to ducting to exhaust fan to second ducting. Now plug in the exhaust fan into the bottom power plug marked "exhaust" on the back of your Muse machine.

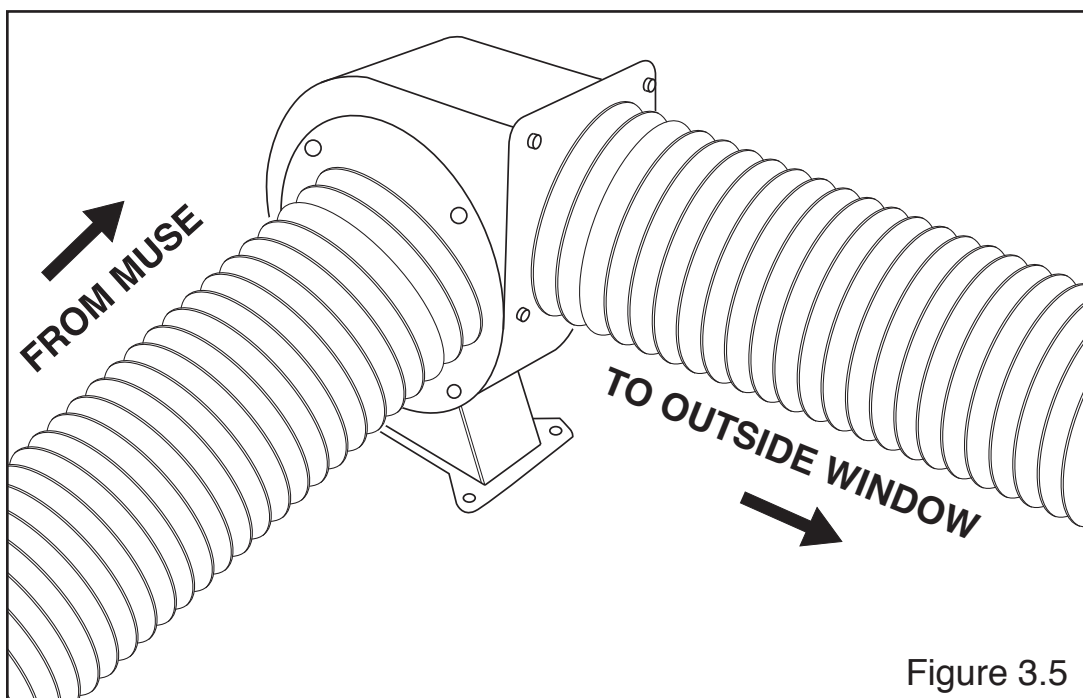
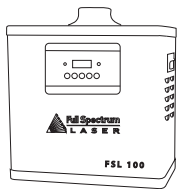


Figure 3.5

3. Ventilate Outside: Set the open end outside of a window or an installed ventilation outlet. Check your system for leaks—most can be remedied with duct tape. Please be aware that the protective housing is not designed to be airtight; the front grill is designed to allow an exhaust system to draw fresh air through the work area.

4. Connect to Power: Plug the exhaust fan power cord into the lower power plug marked “exhaust fan” on the back of your Muse. Note that accessories plugged into the back of your Muse will only turn on when the laser is fired (as intended to save power).

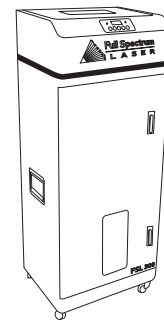
5. Fume Extractor Upgrade (optional): You can also upgrade to a fume extractor. Fume extractors are air purifiers that clean the air through HEPA Filters. Fume extractors do not require outside ventilation. This is a great option for workshops that do not have the option to ventilate outside. Both the extractors and the filters are available on the Full Spectrum Laser website at <https://www.fslaser.com/Products/LaserAccessories>. Ask a customer support representative which fume extractor is right for your needs.



Small Fume Extractor



Medium Fume Extractor



Large Fume Extractor

Fume Extractor filters require routine cleaning and replacement, dependent on use and materials cut. Generally, fume extractor suction will diminish and odors will be detected as filters clog.

NEVER use a fume extractor without all filters in place.

Follow these maintenance guidelines:

Pre-Filters

Clean often. Use a shop vacuum to clean as debris builds. Check weekly, especially if cutting a lot of wood. When accumulated debris remains over 70% after cleaning, replace Pre-Filter.

HEPA Filters

Clean immediately when suction is reduced. Use a shop vacuum to clean accumulated dust. When cleaning does not return optimal suction power, replace HEPA Filter.

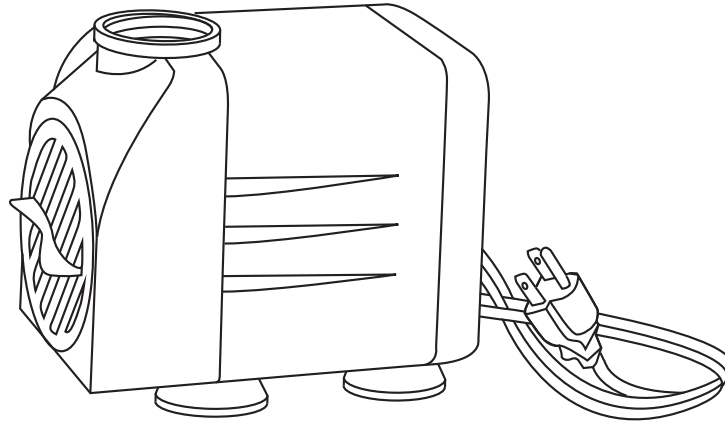
Activated Carbon Filters

Clean when odors are detected or suction is reduced. Gently shake excess dust and debris from carbon filter and follow with a shop vacuum. When cleaning no longer eliminates detectable odors, replace Activated Carbon Filters.

<https://www.fslaser.com/Products/LaserAccessories>.

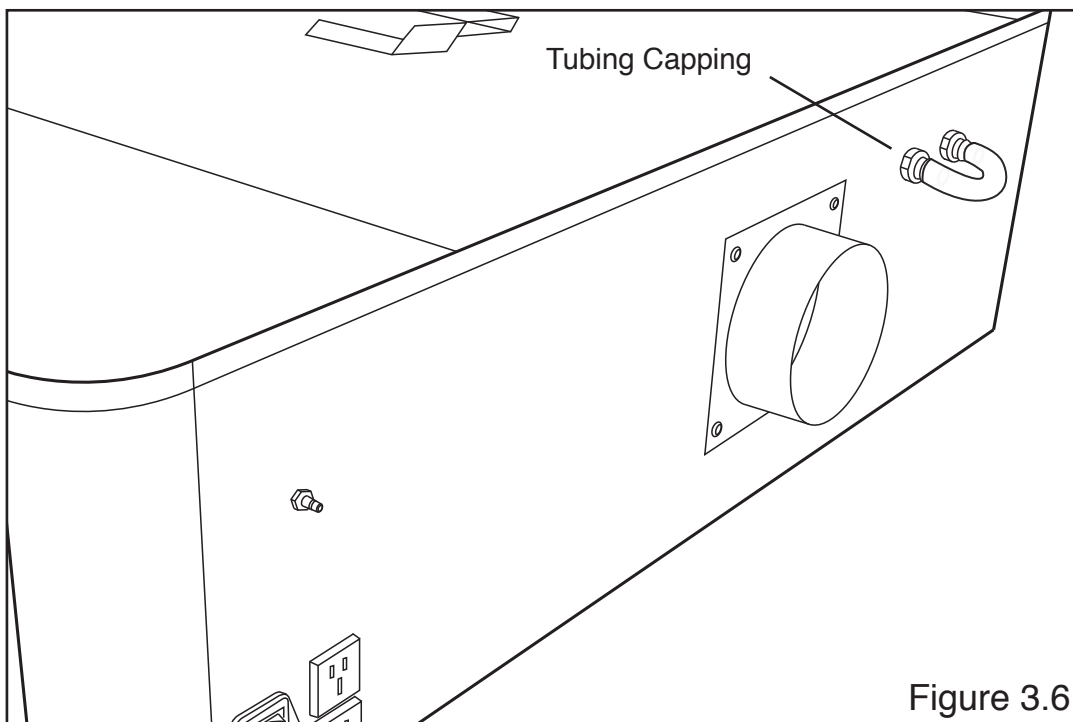
Assembly Stage 3: Assemble the Water System

Muse uses a water-cooled continuous beam CO2 laser tube. The tube requires a flow of room temperature water to regulate the temperature of the laser tube. Your purchase includes a water pump for cooling the laser tube.



Never Fire the Laser: *Without a correctly connected and powered water pump. Firing the laser without turning the pump on or, worse, with no water in the system, will severely degrade or destroy your laser tube and void your warranty.*

1. Remove Capping On Water Inlet/Outlet: Remove the short silicone tubing, capping the water inlet and outlet on the back of the machine.



2. Attach Water Pump Fitting: Remove the water pump from its packaging. Attach the plastic fitting to the water pump by gently screwing it on.

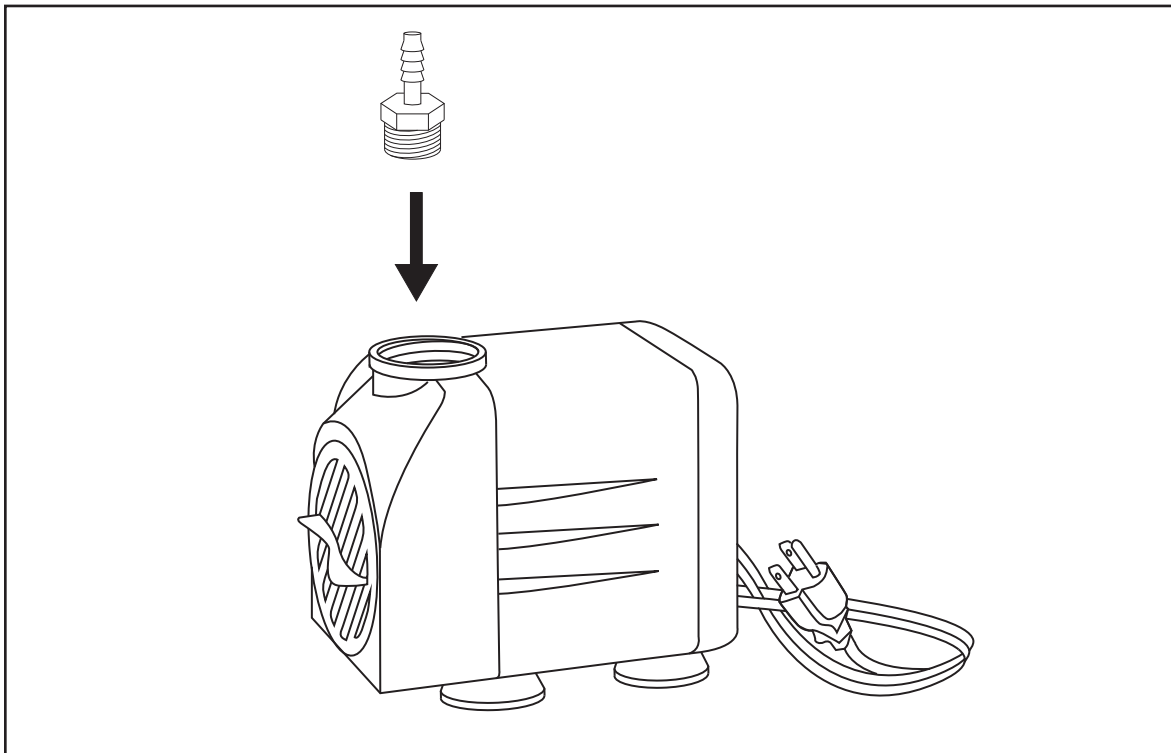


Figure 3.7

3. Prep Water Bucket: Fill a clean 5 gallon bucket (not included) with 3 - 4 gallons of distilled water (not included). ALWAYS use only distilled water and replace often. It is recommended that you choose a bucket with a lid and cut holes to allow the tubes to fit. This will prevent debris falling into your water bucket.

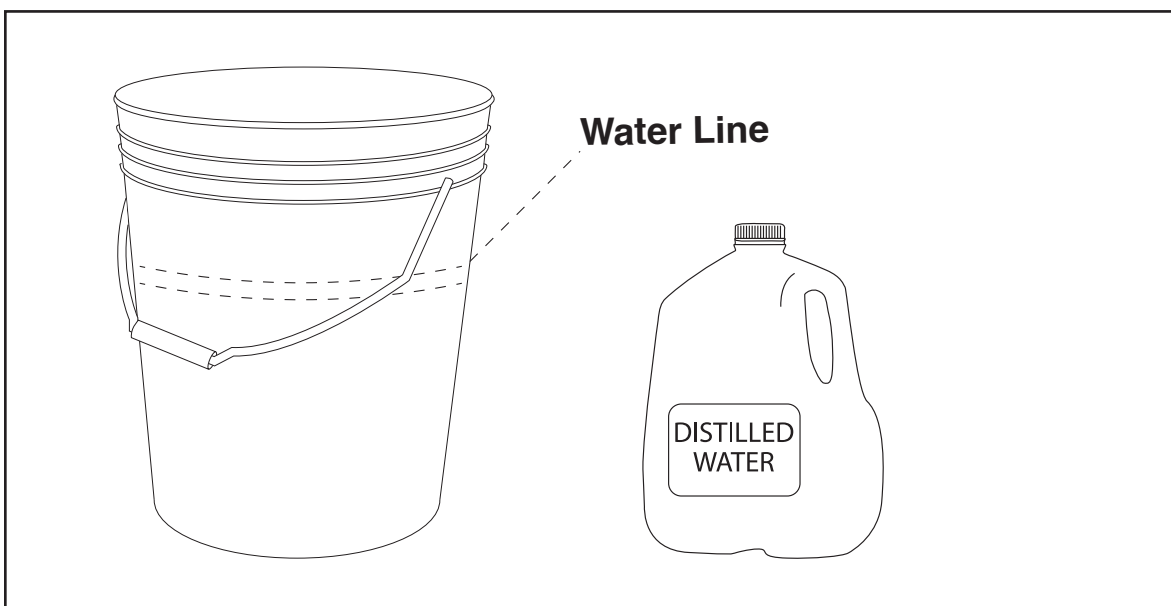


Figure 3.8

4. Attach Inlet Water Tubing: Push one end of one of the two (2) silicone water tubes onto the water pump fitting. Now attach the other end of that tubing to the “water inlet” located at the back of machine. Completely submerge the assembled water pump in the bucket of distilled water.

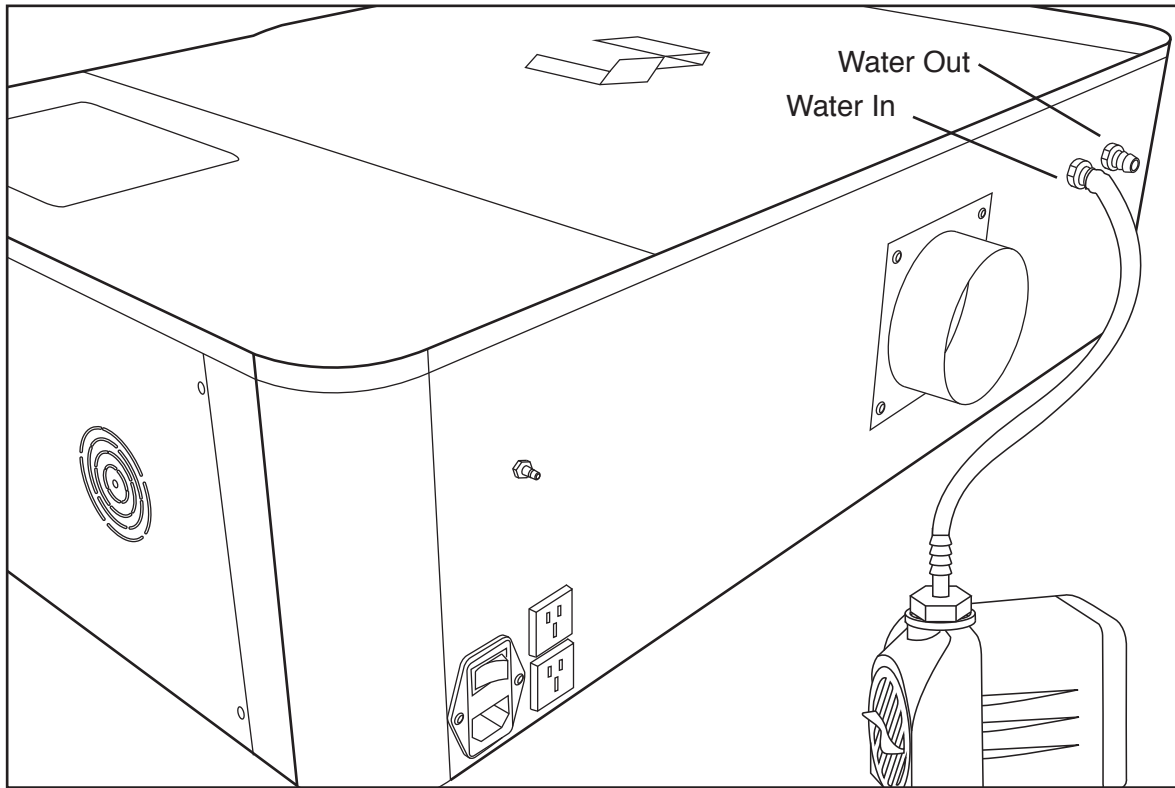


Figure 3.9

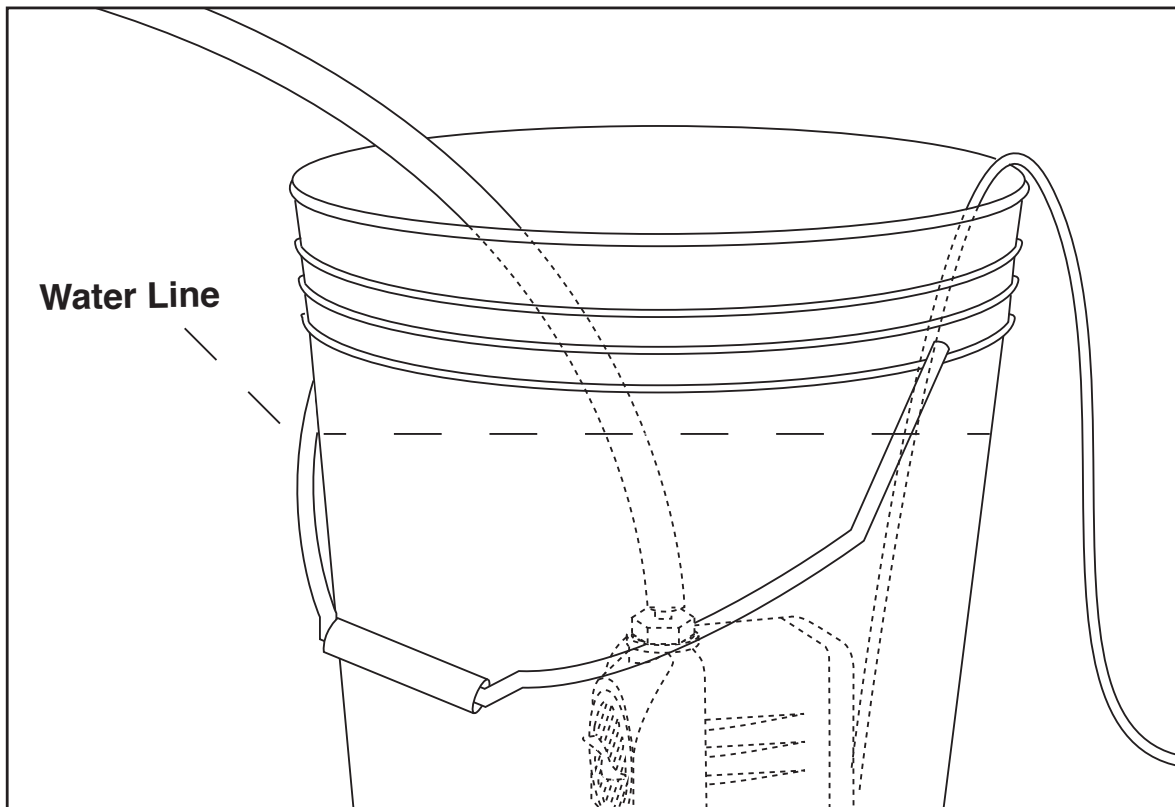


Figure 3.10

5. Attach Outlet Water Tubing: Push one end of the other silicone water tubing onto the “water outlet”. Place the other end of the water tubing into bucket of distilled water.

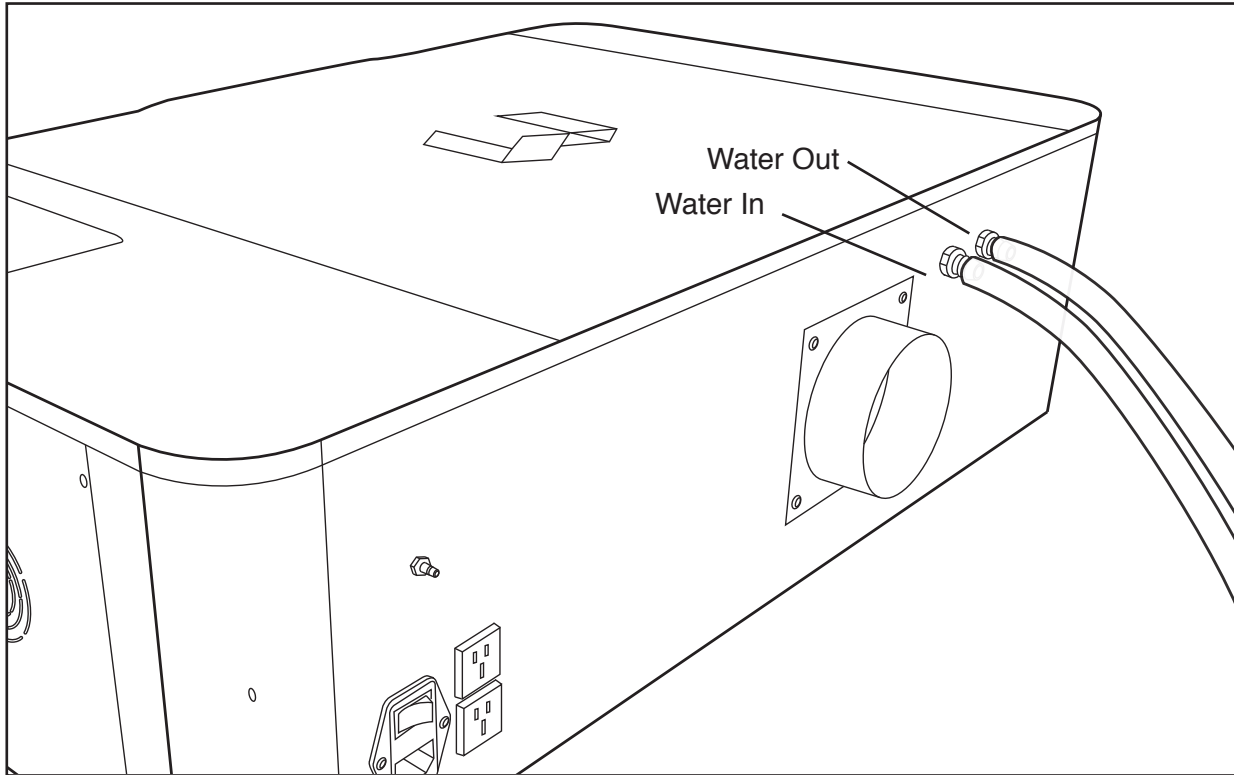


Figure 3.11

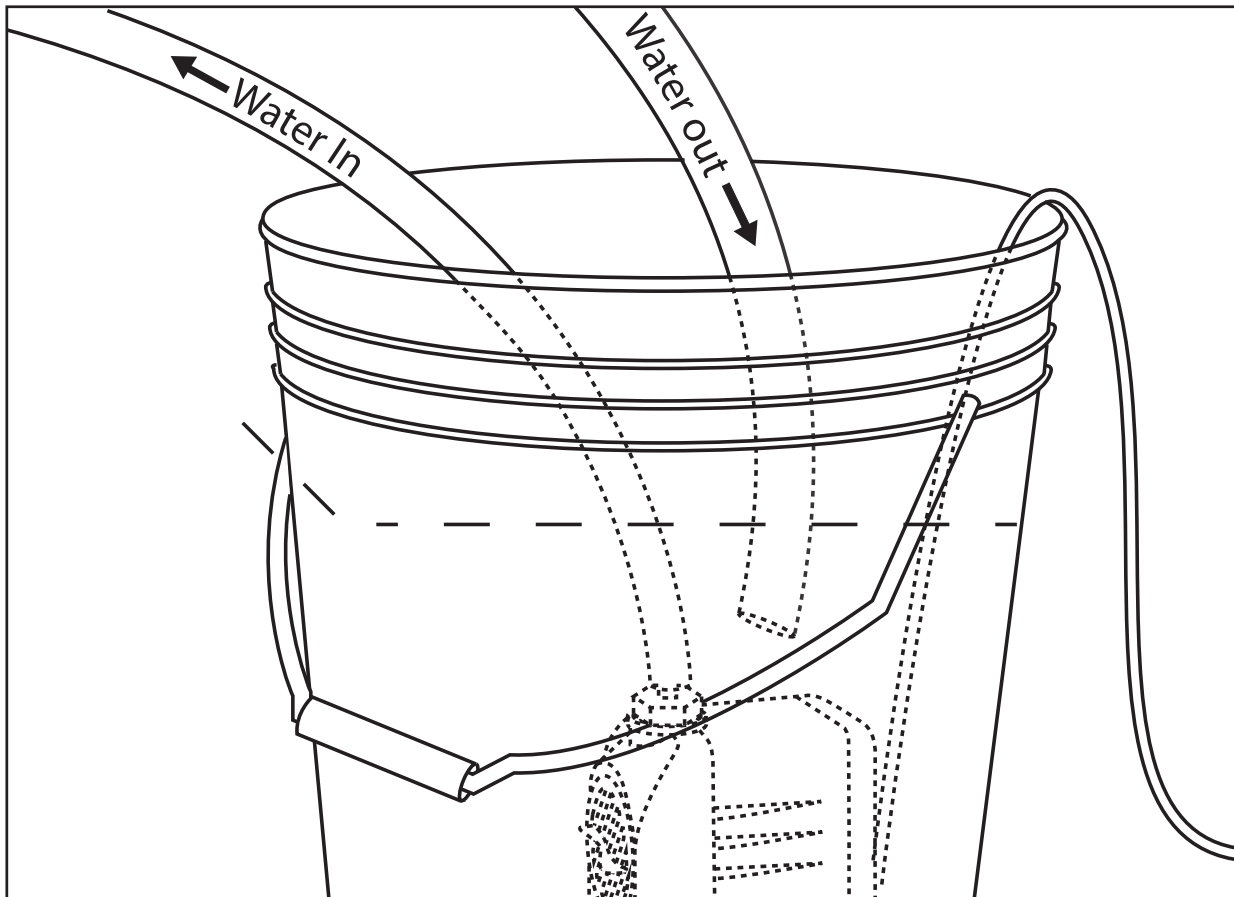


Figure 3.12

Assembly Stage 4: Assemble the Air Compressor

Air is used as a pressurized gas to assist in cutting and engraving operations. This pressurized air is critical to safe and efficient cutting operations as it not only helps cut through material more quickly, but also helps prevent the formation of flames.

1. Attach Push Fitting: Remove the air compressor from its packaging. Gently attach the air hose push fitting to air compressor.

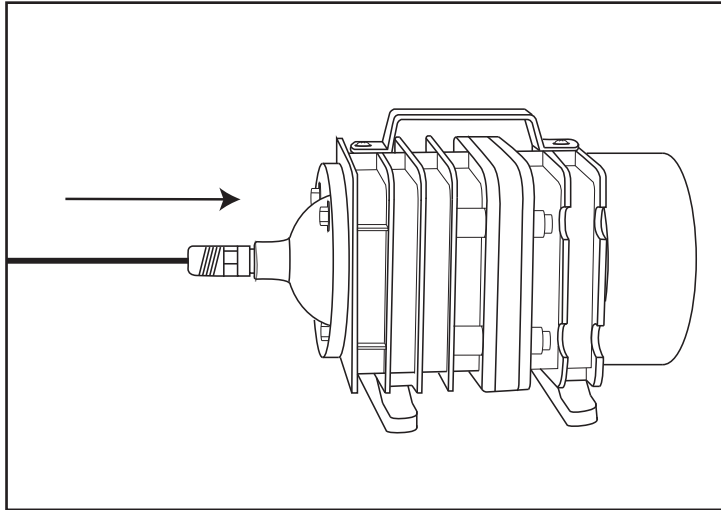


Figure 3.13

2. Attach Air Hose to Air Compressor: Push one end of the black air inlet hose into the air compressor push fitting until it is snug.



PRO TIP! *We recommend that you attach the laser and water pump to a power strip and use that to control the mains power to the unit - this ensures that the water pump is always on when the laser is powered.*



CAUTION! *Make sure that there are no air bubbles inside of the water jacket of the laser tube. Air bubbles can create local hot spots in the lasing chamber and reduce the lifetime of your tube. If present, water bubbles typically migrate to the electrodes on either end of the tube. You should visually inspect the laser tube to make sure that bubbles are not present; slightly tilting the laser while powering on the circulation pump is usually sufficient to remove bubbles.*

3. Attach Air Hose to Laser Cutter: Insert the other end of the black air inlet hose into the “air inlet” nozzle in the back of laser cutter via the barbed air connect fitting.

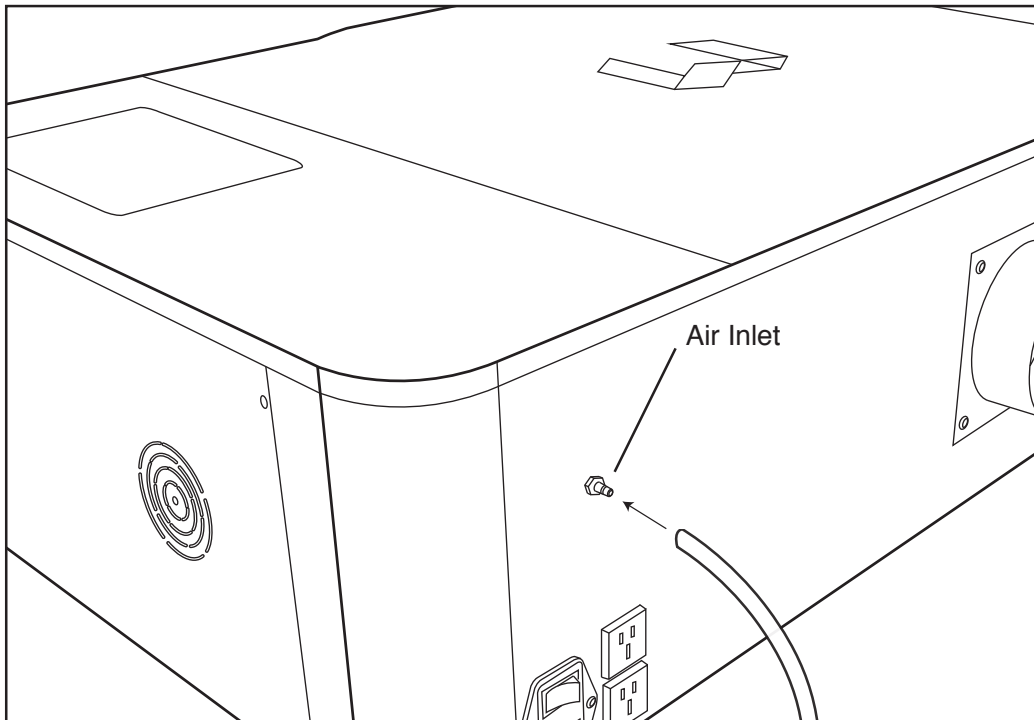


Figure 3.14

4. Connect to Power: Plug the air compressor into the upper power plug marked “air compressor” on the back of your Muse. Note that air compressor will only turn on when the laser is firing.

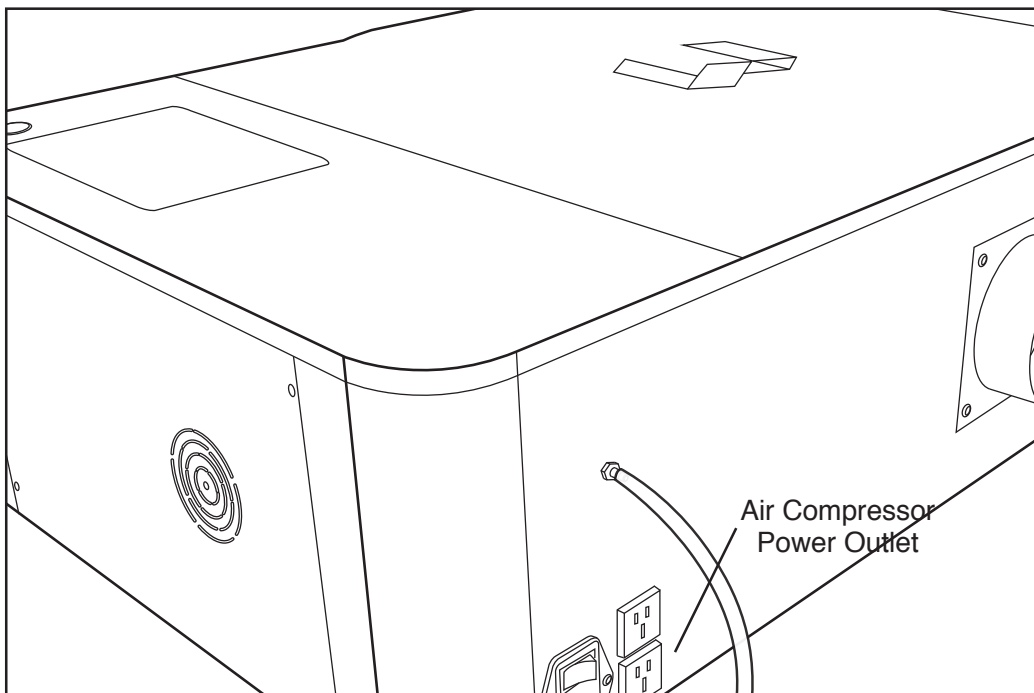


Figure 3.15

Assembly Stage 5: Connect Electrical Power

Muse's Laser System, and available accessories, are configured to accept 110VAC at 60Hz. 220VAC units connect to power through an included converter (single-phase 220VAC).

- 1. Prepare Power Cord:** Remove the electrical cord from its packaging.
- 2. Plug in Power Cord To Laser Cutter:** The power cord plugs into a "C14" power receptacle located on the right side of the machine.
- 3. Plug in Power Cord to Outlet:** Plug the power cord into any proper outlet socket in your workspace.

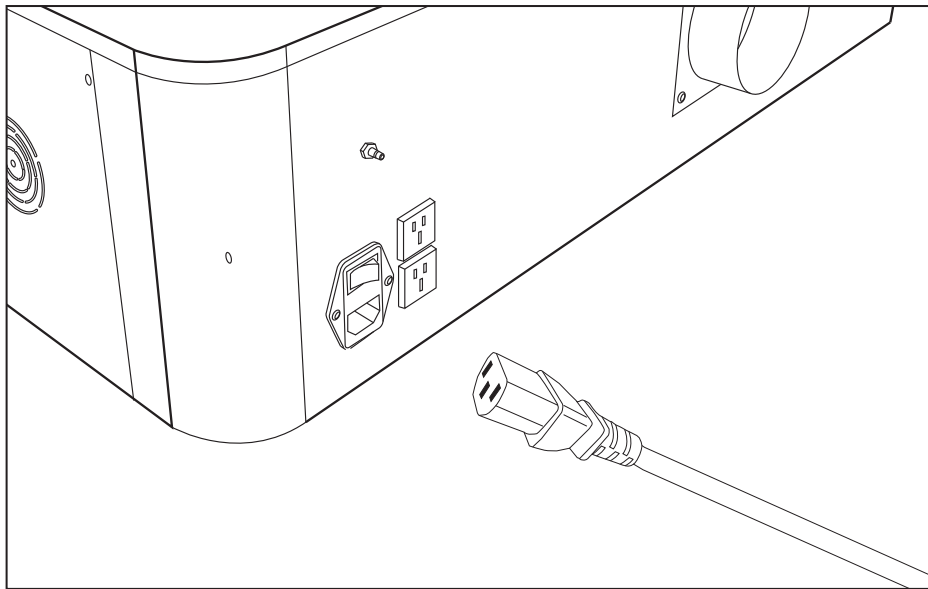


Figure 3.16



PRO TIP! Please be aware that the accessories will increase the circuit load; the most significant power draw usually comes from the blower/exhaust system. Consult the manufacturer's information and manual for the operating parameters of your exhaust system.



IN CASE OF A BLOWN FUSE: The laser system is equipped with a fuse on the power inlet to protect the machine from surges or short circuits. If this fuse ever needs replacement, please contact Full Spectrum Laser technical support.

Assembly Stage 6: Connect the Ethernet Cable

Muse software is browser-based, which means there is nothing to download. With any Mac or PC, you only need an internet browser (such as Google Chrome) to access the latest version of RetinaEngrave 2.0. The easiest method is to connect the Ethernet cable that came with your Muse.

- 1. Identify the Ethernet Cable:** Locate and remove the included Ethernet cable from its packaging.
- 2. Plug Ethernet Cable into Laser Cutter:** Plug in the Ethernet cable into the Ethernet slot on the Muse.
- 3. Plug Ethernet Cable into Computer:** Plug the other end of the Ethernet cable into your computer's Ethernet slot.
- 4. Connect Via Router (Recommended):** Router connectivity is more reliable than directly connecting via Ethernet and should be the primary way of connecting. Direct connect from laser to computer should be a secondary choice, if possible. If direct connecting to router is not available (i.e. due to location of router) then we recommend using an Ethernet to Wi-Fi adapter that is connected to the router. If both of those are not possible then direct connection to computer can be utilized via the Ethernet cable.



PRO TIP! *Muse can connect to your computer via either Ethernet or USB (but not both simultaneously). Full Spectrum includes an Ethernet cable in the laser accessories and recommends the use of Ethernet cables as USB is more prone to electrical interference.*



ATTENTION! *Your laser must be connected to your computer in order to download jobs. The laser can store jobs in its onboard memory while powered, however loss of power will cause stored jobs to be lost. If you purchase and install a USB device, you can download jobs to your laser and run them without a computer attached (however you will not be able to alter the job settings from the laser control panel). Because a USB device is not volatile memory, jobs are stored between power cycles.*



PRO TIP! *If your laser is located more than 6ft from your computer, you will need to use the Ethernet connection. Connecting via Ethernet while the power is on requires you to power cycle your machine in order to obtain an IP address.*



Assembly Stage 7: Connect to Software

RetinaEngrave 2.0 is a combination of a print driver and control software that communicates with, downloads jobs to, and controls the laser system. There is no download required for RetinaEngrave 2.0. With a local connection (achievable with Wi-Fi or the included Ethernet cable) your Muse will link with the software's IP address.

- 1. Turn On Muse:** Turning on your Muse will automatically boot up your Muse Touch Screen interface. Allow 30 seconds or so for the machine and touch screen to boot up.
- 2. Go To Settings:** On the Touch Screen interface, push the gear icon to go to Settings.
- 3. Choose Network:** Push "Network" at the top center of the screen.
- 4. Type IP Into Browser:** On the Network Screen you will see a "Wired IP" number. Using your computer, type this IP number into your favorite browser (Google Chrome is recommended). This will link you to the RetinaEngrave 2.0 interface. You now have full access to the software. There is no need to install or download anything. You must, however, keep a local connection, either through Wi-Fi or the Ethernet cable.



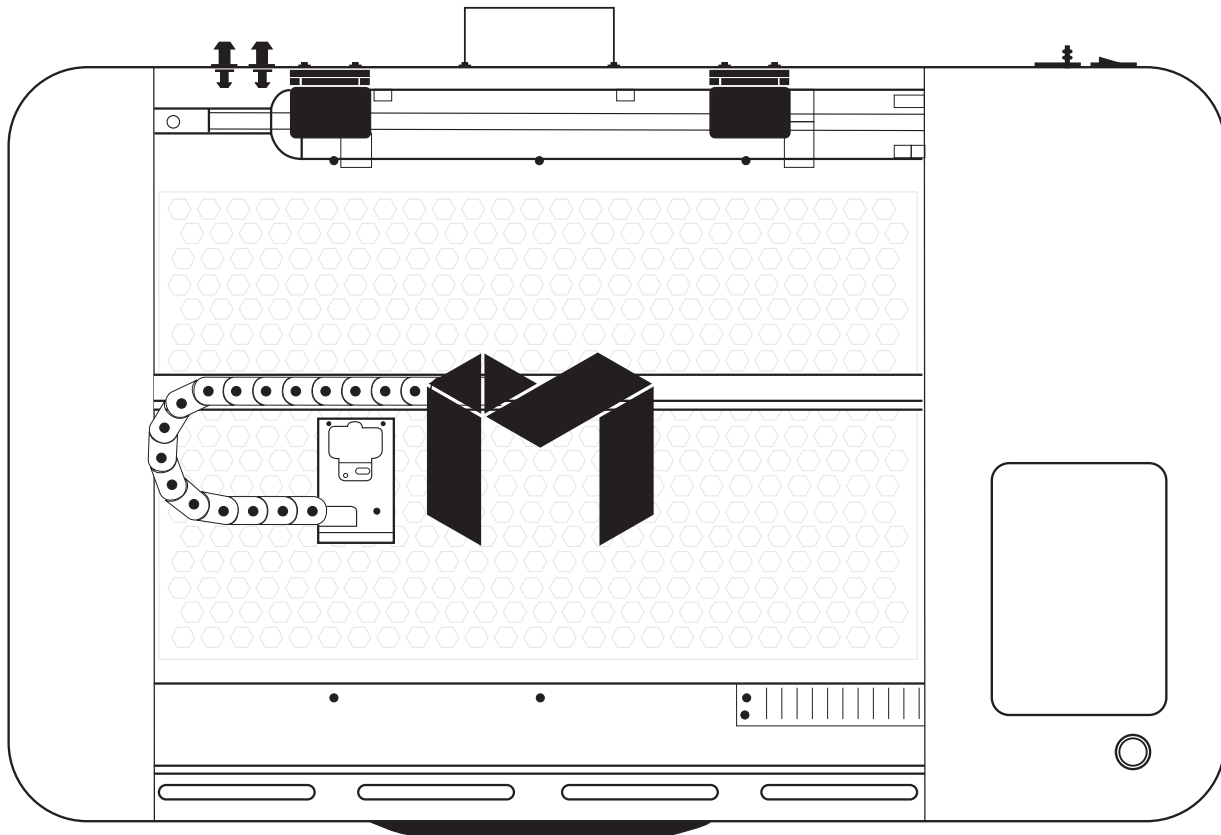
Occasionally, RetinaEngrave 2.0 software will run an update. This is an automatic process that can happen when you first boot up the machine. Typically updates are quick, however, there may be some occasions where updates can take longer. You will know the machine is updating when the interior lights of the Muse turn off. When this happens, DO NOT turn off your machine. Allow the update to complete and the machine lights will turn back on.



ATTENTION! *The laser must be powered on when operating the software or when connecting the laser via the Ethernet cable. You will need uninterrupted Internet access for this process.*

SECTION IV. TESTS & ADJUSTMENTS

It is important that your laser is tested and adjusted (if needed) for proper use before you start your first job. The following will be on our list of tests and adjustments:



- 1. Alignment Test**
- 2. Mirror Alignment Procedure**
- 3. Focusing**

1. Alignment Test

The laser tube that came pre-installed in your Muse was carefully aligned in our facilities in Nevada. When you first turn on your machine, the mirror alignment should be perfect. It is possible, however, that sometimes mirrors may come out alignment during shipping. Before running your first job, you will want to check and make sure the mirrors are properly aligned using this simple test. Once the mirror alignment is confirmed, you are ready to use your laser cutter. If your mirrors are out of alignment, or if you have installed a new laser tube, you must align the laser using the procedure provided. For this alignment test we will test fire the laser once in each corner of the machine to make sure the laser is following the right path to the focus head, and ultimately to the cutting material.

1. Open the Safety Lid: You will need to access the interior of the machine.

2. Place Thermal Paper: Take a small piece of thermal paper (approx. 15 mm should be plenty) and place it over the focus lens under Mirror #3.

3. Position Laser Head: Move the laser head into the upper left corner of the workspace.

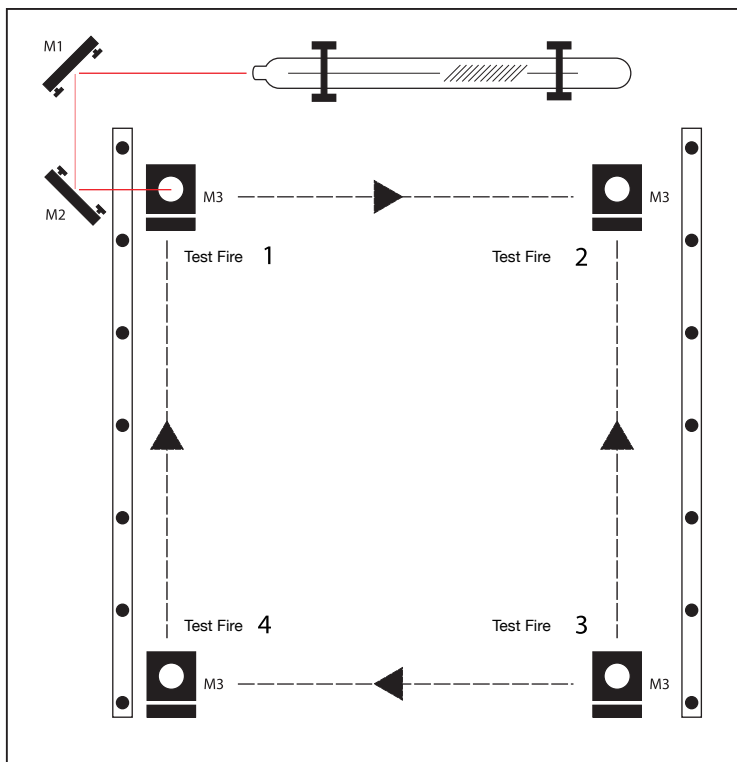


Figure 4.1

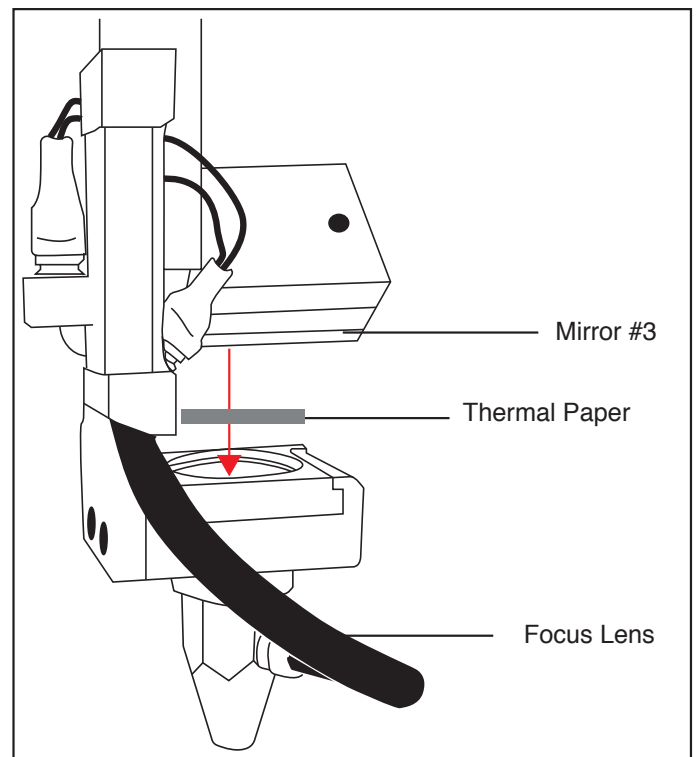


Figure 4.2

4. Close Safety Lid: Safety measures should make it impossible to fire the laser with the safety lid open. Regardless, never attempt to fire the laser with safety lid open.

5. Test Fire the Laser: Press the Fire Laser Icon Button on the touch screen.

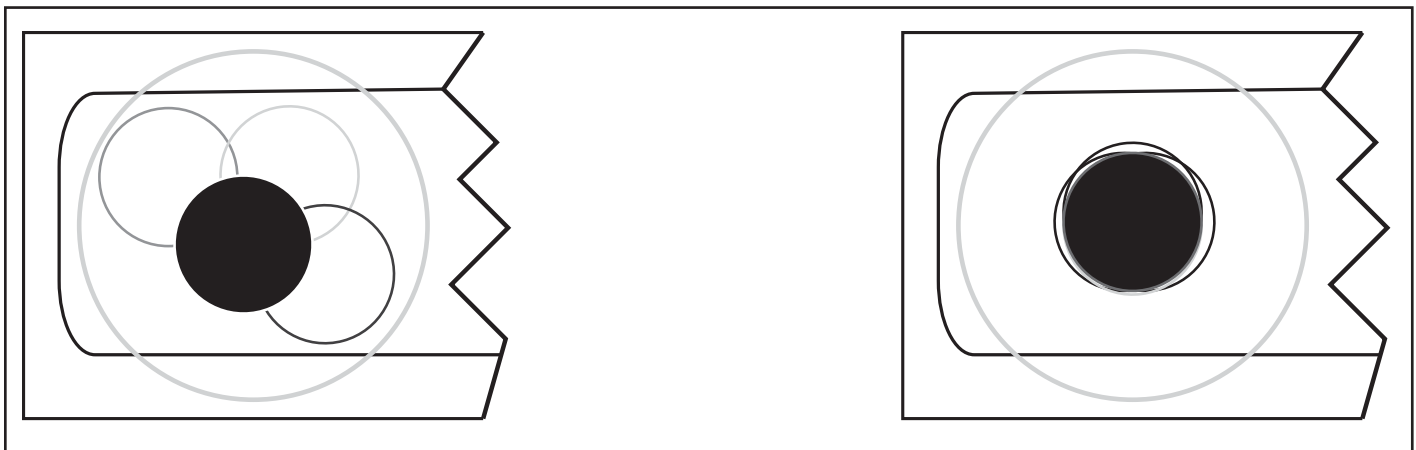


ATTENTION! Find and push this icon on your Muse touch screen to test fire the laser.

6. Repeat Test Fire in Other Three Corners: Without removing the thermal tape, repeat firing the laser once in each of the other corners of the machine (Upper Right, Lower Right, and Lower Left).

7. Check Results: With the fourth corner test fire complete, open the lid and remove the thermal tape. The four burn marks should overlap each other perfectly (see illustration). If they do not overlap perfectly, you will need to align the mirrors.

Figure 4.3



Not Aligned

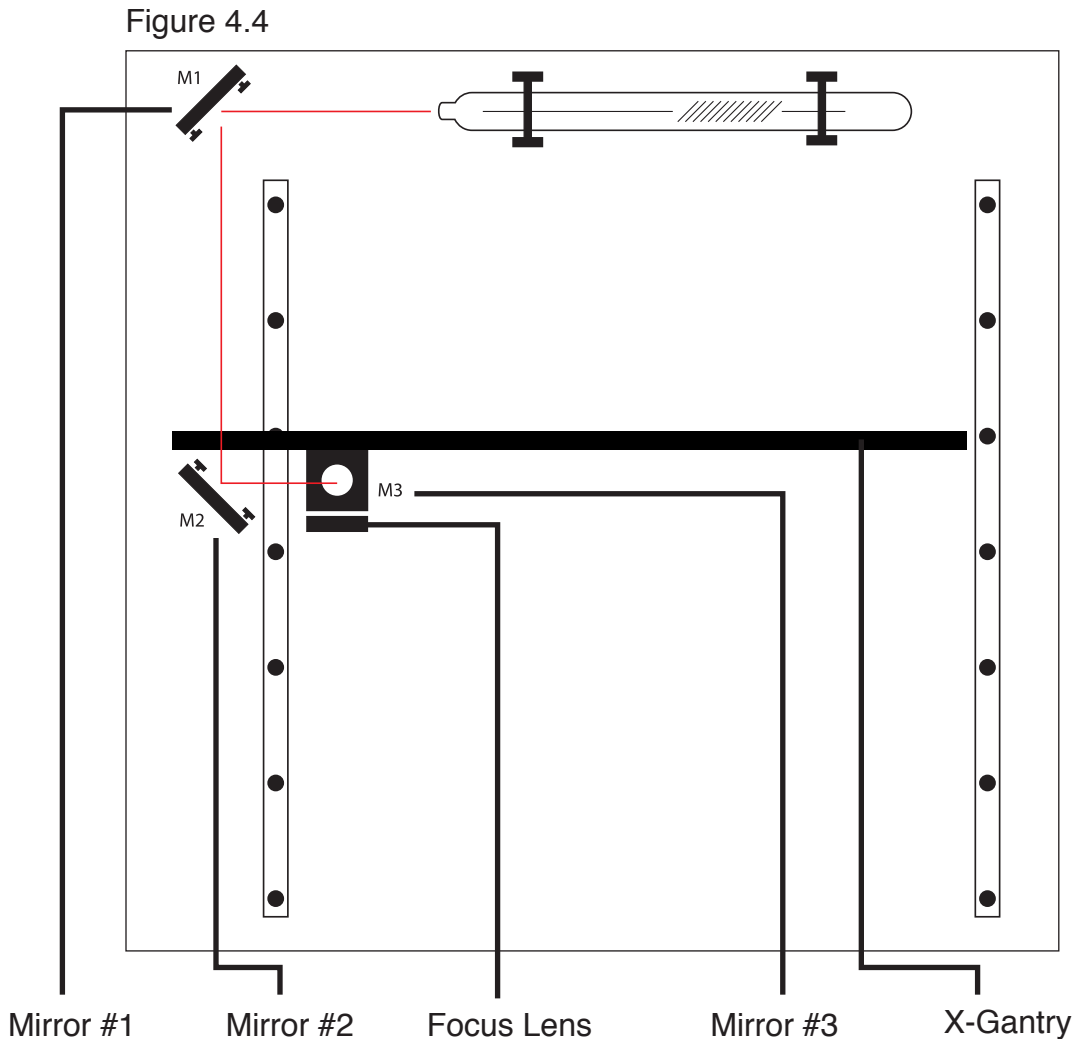
Aligned



PRO TIP! The idea is that when the laser is not aligned, you will have two black dots from the test fires in the top and bottom positions. The red laser pointer is aligned with the invisible laser pointer so gives you immediate feedback on the mirror adjustment. By adjusting it into the middle of the two black dots, you are splitting the error difference. Usually after 1 or 2 iterations, the black dots will be exactly on top and this axis is aligned. The goal is to have the two black dots overlap exactly.

2. Mirror Alignment Procedure

The mirror alignment procedure goal is to first align the visible red beam with the invisible CO2 laser beam then use the red beam as the primary indicator for alignment. The idea is that when the laser is not aligned, you will have two black dots from the test fires in the top and bottom positions. The red laser pointer is aligned with the invisible laser pointer to give you immediate feedback on the mirror, the black dots will be exactly on top and this axis is aligned. The goal is to have the two black dots overlap exactly. It is not necessary that the dots be in the center of the mirror but they should be somewhere on the mirror.



5 Stages:

1. PREP
2. ALIGN LASER OUTPUT TO MIRROR #1
3. ALIGN MIRROR #1 TO MIRROR #2
4. ALIGN MIRROR #2 TO MIRROR #3
5. FOCUS LENS ALIGNMENT

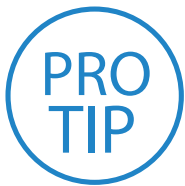
Tools Needed:

- THERMAL PAPER
- 2.5 MM. HEX WRENCH

STAGE 1: PREP

Prepare your tools and workspace.

- 1. Safety First:** Be aware of all safety procedures and precautions before continuing.
- 2. Power On Laser Cutter:** The machine must be powered on to continue this procedure. Turn on the machine by hitting the power switch. Allow the machine time to boot up the touch screen operating system.
- 3. Unlock Driver Motor:** The driver motor needs to be Unlocked to allow manual “jog” control. On the touch screen, press the “Locked” icon to switch to “Unlocked” position. The button will now display the “Unlocked” icon.
- 4. Gather Tools:** A 2.5 mm hex wrench and a supply of thermal paper are required to perform the mirror alignment procedure (if required).



PRO TIP! *DO NOT over-tighten or over-loosen adjustment screws. Tightening or loosening any of the three adjustment screws on the mirrors or the red dot diode will move the position in a particular direction depending on the positioning of the other screws. Some experimenting is required to understand the relationship of each screw and how adjusting one affects the red dot’s positioning. When adjusting the screws, use the absolute minimum turn of the hex wrench to move the red dot or the mirror into position.*

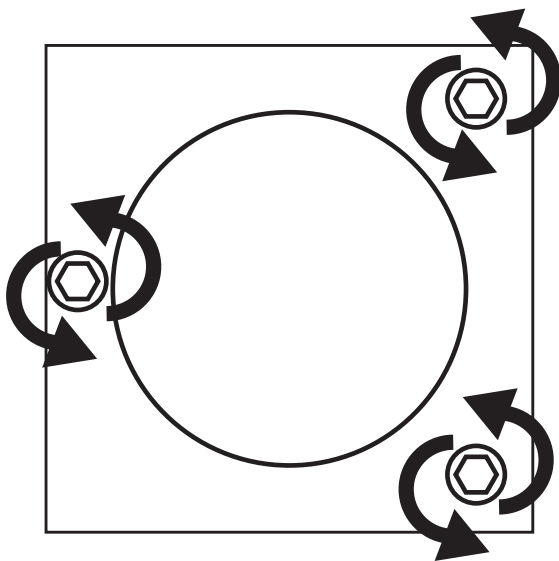


Figure 4.5



STAGE 2: ALIGN LASER OUTPUT TO MIRROR#1

Conceptually, you will be aligning the invisible cutting beam with the visible red beam diode and making sure they hit each mirror precisely. Once again, remember to check your mirror alignment BEFORE starting this procedure as it is likely unnecessary if the laser tube was pre-installed in your Muse.

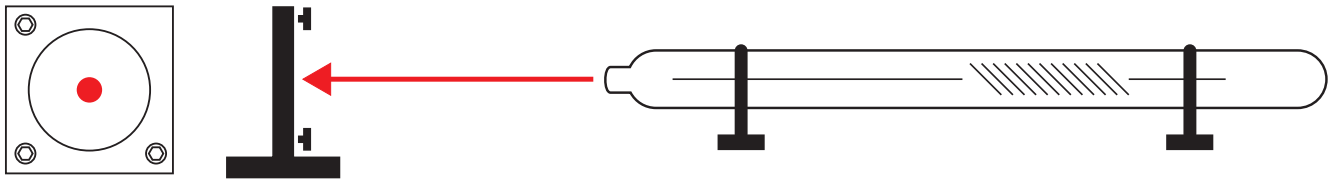


Figure 4.6

- 1. Open the Safety Lid:** You will need to access the interior of the machine.
- 2. Place Thermal Paper:** Take a small piece of thermal paper (approx. 15 mm should be plenty) and place it firmly over Mirror #1.
- 3. Close Safety Lid:** Safety measures should make it impossible to fire the laser with the safety lid open. Regardless, never attempt to fire the laser with safety lid open.
- 4. Test Fire the Laser:** Press the Fire Laser Icon Button on the touch screen. You will see a burn mark on the thermal paper. It should hit the mirror in the middle.
- 5. Adjust Red Beam:** Using your 2.5m hex wrench, make micro adjustments to the three adjustment screws of the red beam diode, and position the red dot exactly over the burn mark.

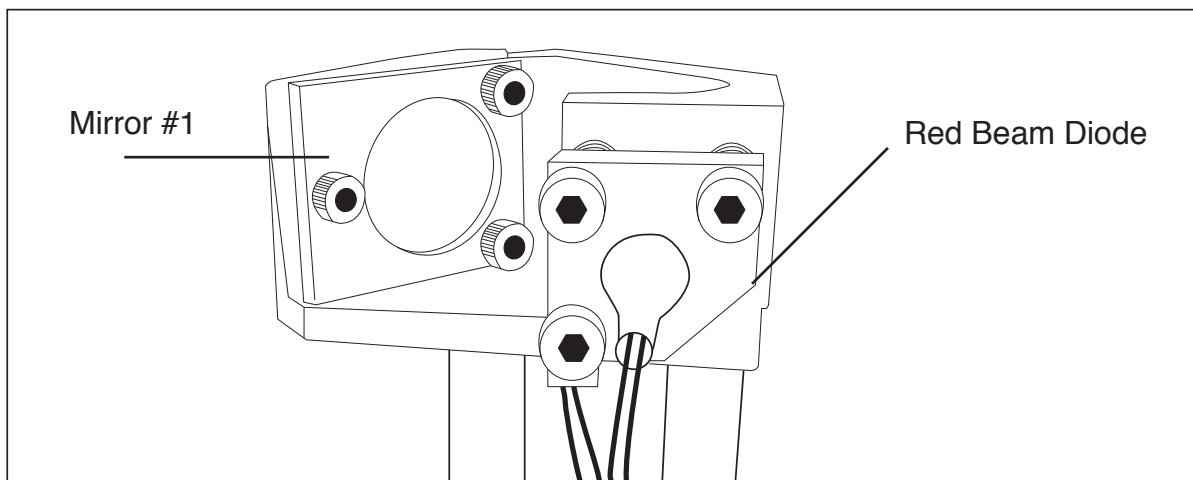


Figure 4.7

STAGE 3: ALIGN MIRROR #1 TO MIRROR #2

Because the 2nd mirror moves along with the X-gantry alignment must be checked between mirrors #1 and #2.

- 1. Open Safety Lid:** You will need to access the interior of the machine.
- 2. Place Thermal Paper:** Take a small piece of thermal paper (approx. 15 mm should be plenty) and place it firmly over Mirror #2.
- 3. Position X-Gantry “Far”:** Jog or manually position the X-Gantry to the lowest position (as shown in Figure 4.7).

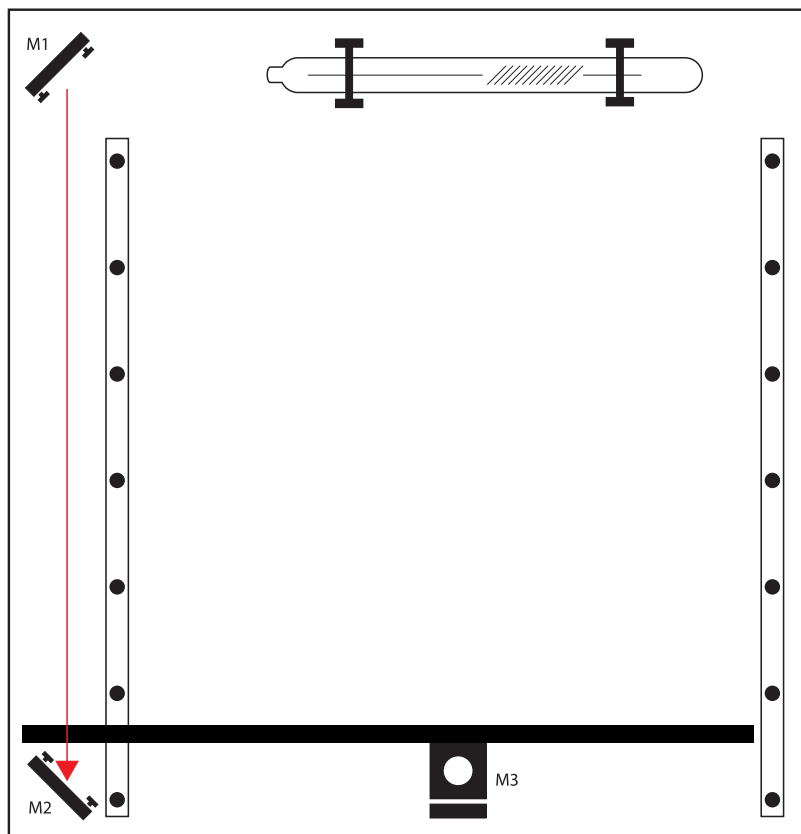


Figure 4.8

- 4. Close Safety Lid:** Safety measures should make it impossible to fire the laser with the safety lid open. Regardless, never attempt to fire the laser with safety lid open.
- 5. Test Fire the Laser:** Press the Fire Laser Icon Button on the touch screen. You will see a burn mark on the thermal paper.
- 6. Adjust Red Beam.** Using your 2.5m hex wrench, make micro adjustments to the three adjustment screws of the red beam diode, and position the red dot exactly over the burn mark. Do not worry if this places the red dot away from the center of the mirror, we will adjust to center in the next step.

7. Reposition the X-Gantry to “Close” Position: Now that we have a burn mark on our thermal paper from a “far” firing of the laser, we want to fire the laser from the closest position. Move the X-Gantry to the upper most position in the machine and test fire again.

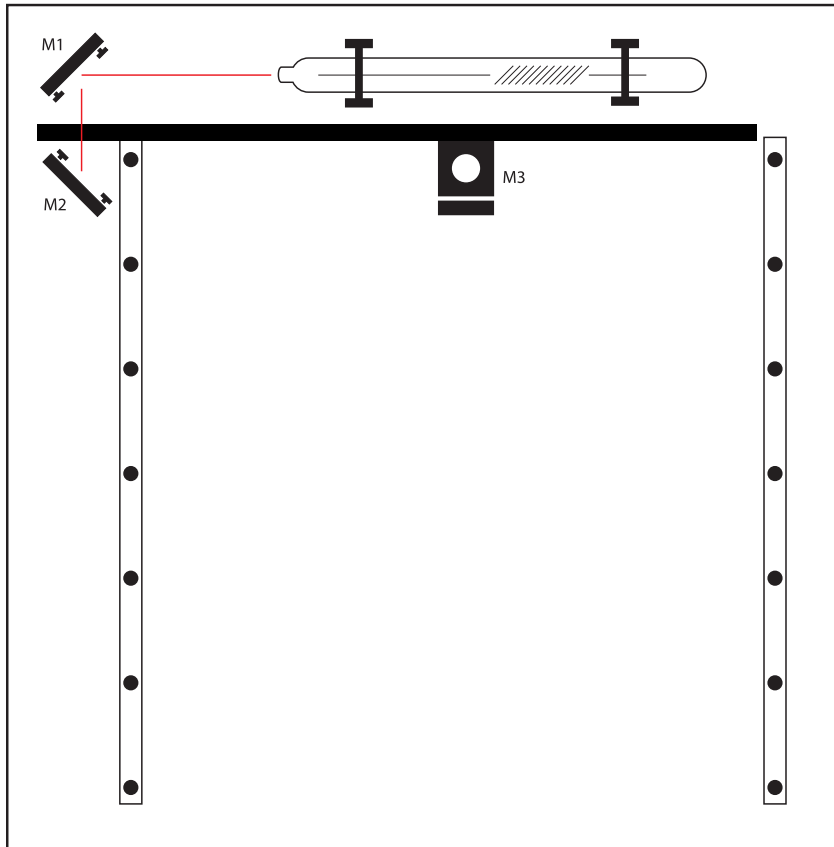


Figure 4.9

8. Re-Position X-Gantry back to “Far”: Jog or manually position the X-Gantry to the far position where you did the first test fire. (as shown in Figure 4.7).

9. Check Results: There should be two observable burn marks on the thermal paper. If they overlap perfectly you can move on to the next mirror. If they are apart, adjust the three 2.5mm hex screws on Mirror #1 (not the red beam diode) to move the second burn mark over the red beam.

10. Repeat Until Aligned: Check your results by repeating this process until the two burn marks are both center and perfectly overlapping each other. Once aligned, you will repeat this procedure on the next mirror.

STAGE 4: ALIGN MIRROR #2 TO MIRROR #3

The 3rd mirror is mounted on the laser head assembly and slides along the X-gantry rail.

1. Open Safety Lid: You will need to access the interior of the machine.

2. Place Thermal Paper: Take a small piece of thermal paper (approx. 15 mm should be plenty) and place it firmly over Mirror #3.

3. Position the Gantry Bar: Place the gantry bar in the center of the work bed, as shown in the diagram below.

4. Position Laser Head “Far”: Jog or manually position the laser head to the far right (as shown in diagram). This is the farthest position of the Mirror #3 from Mirror #2.

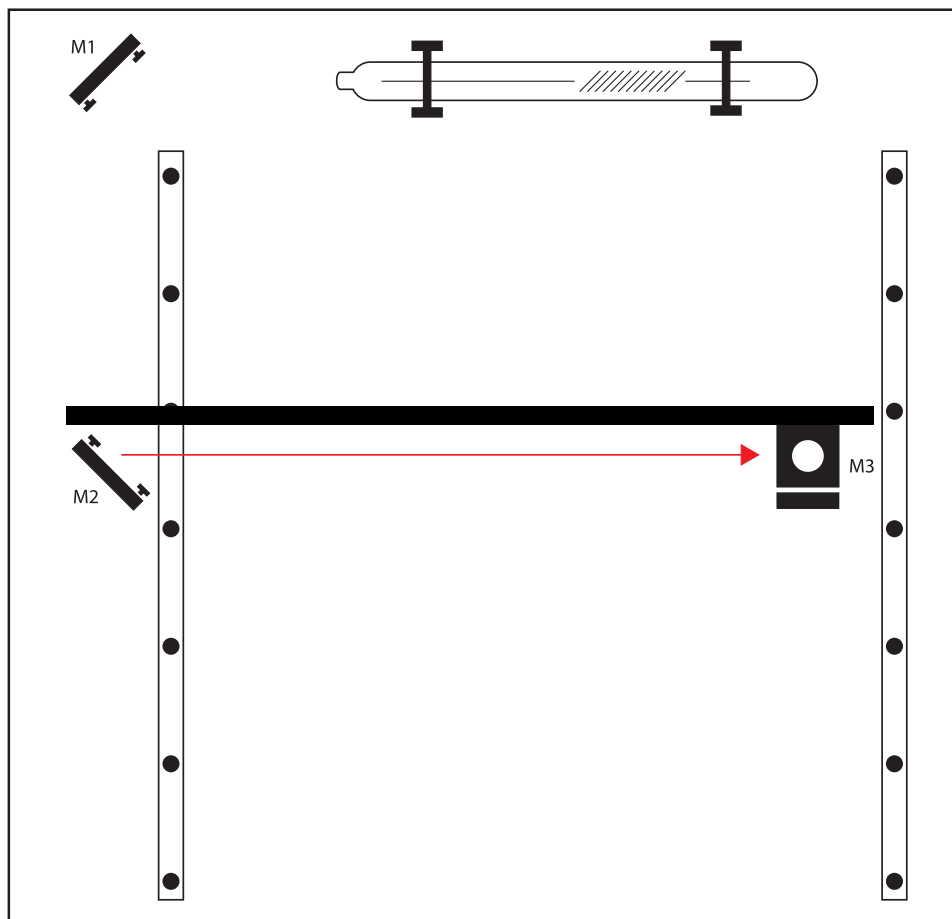


Figure 4.10

5. Close Safety Lid: Safety measures should make it impossible to fire the laser with the safety lid open. Regardless, never attempt to fire the laser with safety lid open.

6. Test Fire the Laser: Press the Fire Laser Icon button on the touch screen. You may need to fire the laser twice to see the burn mark on the thermal paper.

7. Adjust Red Beam: Using your 2.5mm hex wrench, make micro adjustments to the three adjustment screws of the red beam diode, and position the red dot exactly over the burn mark.

8. Reposition the Laser Head to “Close” Position: Now that we have a burn mark on our thermal paper from a “far” firing of the laser, we want to fire the laser from the closest position. Move the laser head to the far left of the machine and test fire again.

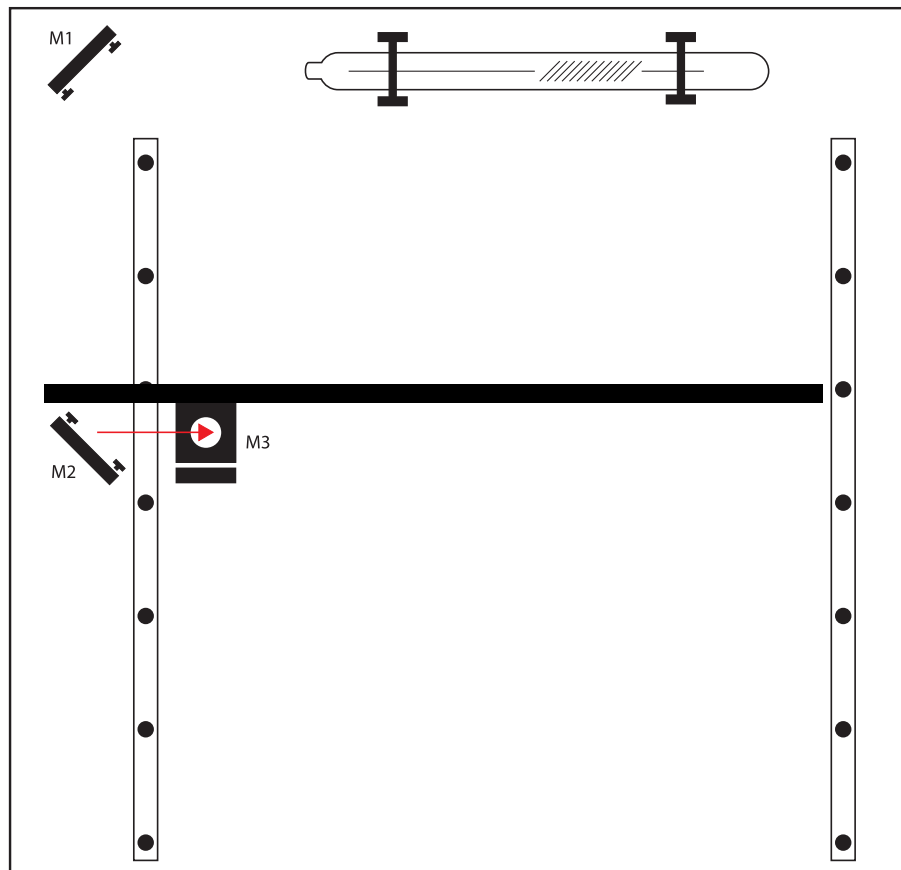


Figure 4.11

9. Re-Position X-Gantry back to “Far”: Jog or manually position the laser head to the far right where you did the first test fire.

10. Check Results: There should be two observable burn marks on the thermal paper. If they overlap perfectly you can move on to the next mirror. If they are apart, adjust the three 2.5mm hex screws on Mirror #2 (not the red beam diode) to move the burn mark over the red beam.

11. Repeat Until Aligned: Check your results by repeating this process until the two burn marks are both center and perfectly overlapping each other.

STAGE 5: FOCUS LENS ALIGNMENT

The focal lens is located at the bottom of the laser head assembly. For proper alignment, the laser beam should always be hitting the center of the focal lens, regardless of the position of the cutting head in the machine.

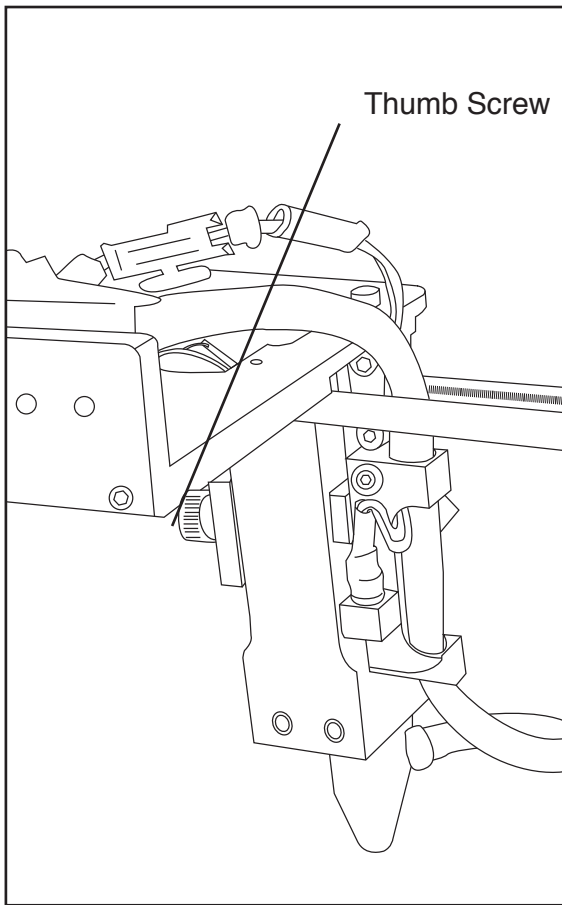


Figure 4.12

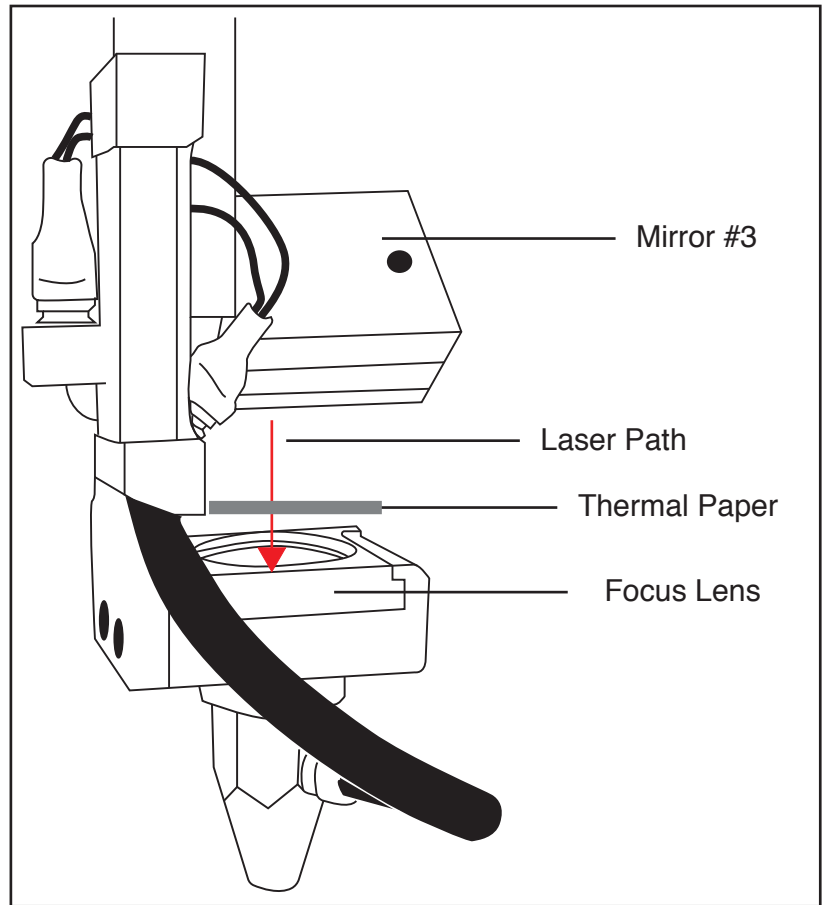


Figure 4.13

- 1. Open Safety Lid:** You will need to access the interior of the machine.
- 2. Place Thermal Paper:** Put a piece of thermal paper on top of the focus lens. It is best to use a slightly smaller piece of thermal tape to fully see the outline of the lens.
- 3. Position Focus Lens “Far”:** Use the thumb screw to loosen and position the focus lens as far down as it will go.

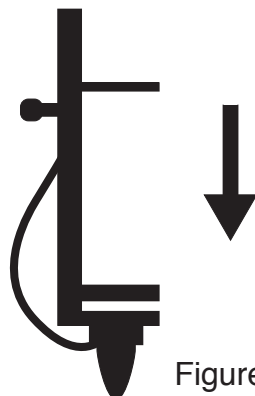


Figure 4.14

4. Close Safety Lid: Safety: measures should make it impossible to fire the laser with the safety lid open. Regardless, never intentionally fire the laser with safety lid open.

5. Test Fire the Laser: Press the Fire Laser Icon button on the touch screen. You will see a burn mark on the thermal paper.

6. Adjust Red Beam: Using your 2.5mm hex wrench, make micro adjustments to the three adjustment screws of the red beam diode, and position the red dot exactly over the burn mark.

7. Reposition the Focus Lens to “Close” Position: Now that we have a burn mark on our thermal paper from a “far” firing of the laser, we want to fire the laser from the closest position. Move the focus lens as far up as it will go. Test fire the laser again, leaving a second burn mark.

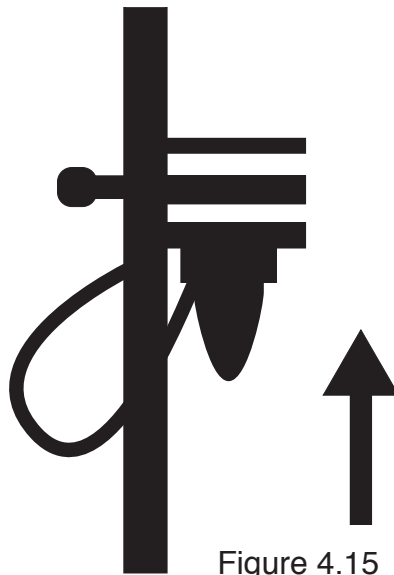


Figure 4.15

8. Re-Position Focus Head back to “Far”: Use the thumb screw to loosen and position the focus lens as far down as it will go.

9. Check Results: There should be two observable burn marks on the thermal paper. If they overlap perfectly you can move on to the next mirror. If they are apart, adjust the three 2.5mm hex screws on Mirror #3 (not the red beam diode) to move the burn mark over the red beam.

10. Repeat Alignment Test: To ensure your laser is aligned, repeat the alignment test by test firing the laser in all four corners and checking that all the burn marks perfectly overlap each other.

3. FOCUSING

Focusing the Muse laser cutter is quick and easy. Your laser included a billet sized for the included 2-inch focal length lens.

1. Place Billet: After inserting your material into the workbed, place the billet on top of the material. Note that if your material isn't flat, you may need to cut the material in stages, focusing each time to each new material level.

2. Release Locking Mechanism: Release the locking mechanism on the focus head until the air assist nozzle rests on top of the billet.

3. Retighten: Retighten the sliding head and remove the billet from the material.

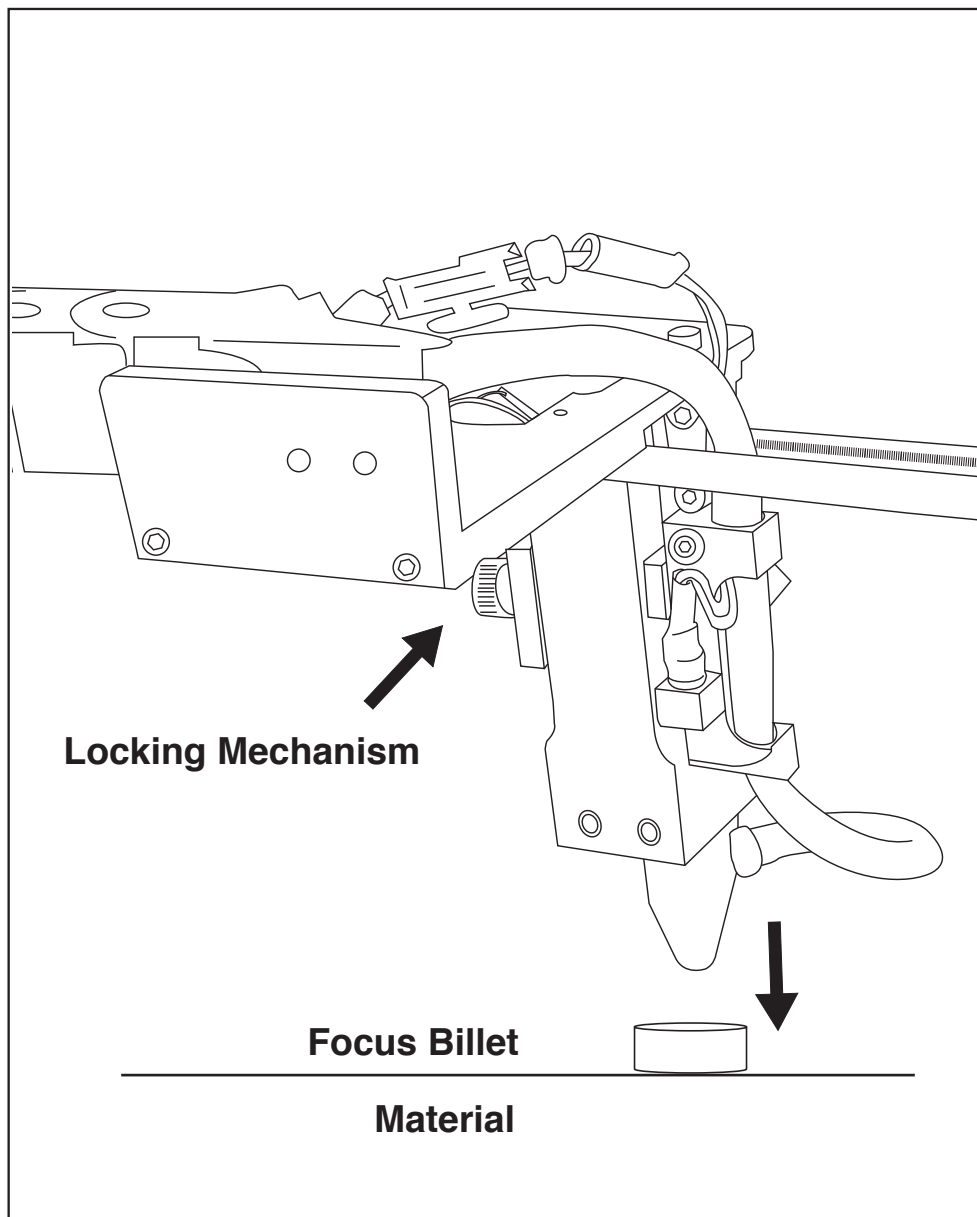


Figure 4.16

SECTION V. TOUCH SCREEN INTERFACE

Muse's touch panel allows you to control the basic functions of your laser without needing to connect to a computer. This is very convenient during alignment and testing procedures. To actually run jobs, you will need to access the RetinaEngrave 2.0 software (see Installations and Assembly Section.)

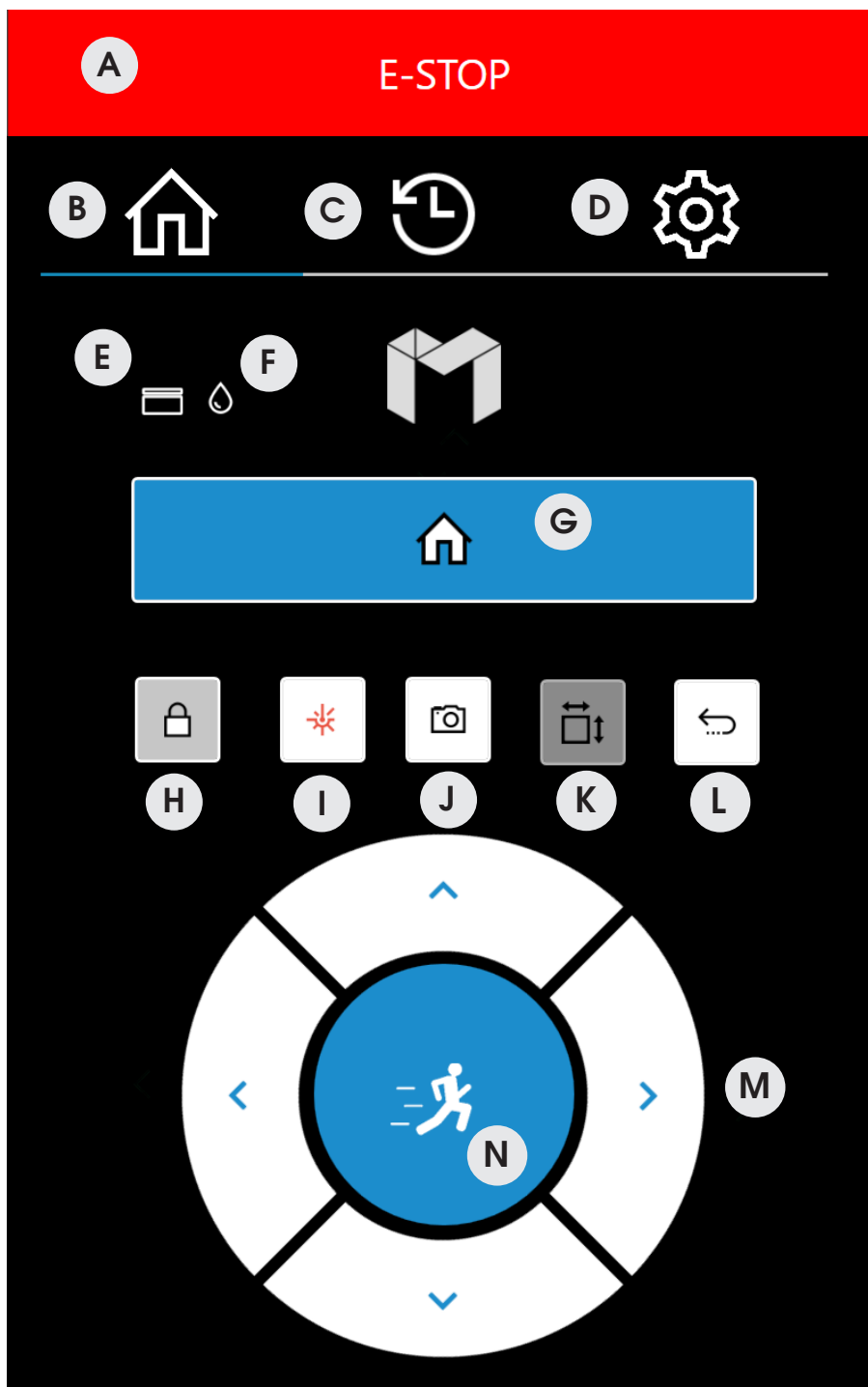


Figure 5.1

- A E-STOP**
Instantly stop any action.
- B HOME MENU**
Returns to the main Home Screen from any sub-screen
- C JOB HISTORY**
Accesses Job History sub-screen.
- D SETTINGS**
Accesses the Settings sub-screens.
- E LID OPEN / CLOSE**
Indicates lid is opened or closed.
- F WATER INDICATOR**
Indicates water system is running properly.
- G HOME LASER**
Instantly homes the laser
- H LOCKED/UNLOCKED**
Lock or unlock the gantry for auto or manual homing
- I TEST FIRE**
Test fire the laser. Used for mirror alignments and testing.
- J CAMERA**
Instructs camera to image workbed
- K JOG PERIMETER**
Laser automatically JOGs the extent of the current project.
- L RETURN TO POSITION**
Return gantry to a custom assigned position
- M JOG CONTROLS**
Jog gantry via control buttons or manually.
- N JOG SPEED**
Switch from slow jog to fast jog

Muse Touch Screen

There are many accessible sub-screens for Muse's touch screen. Each is detailed separately below.

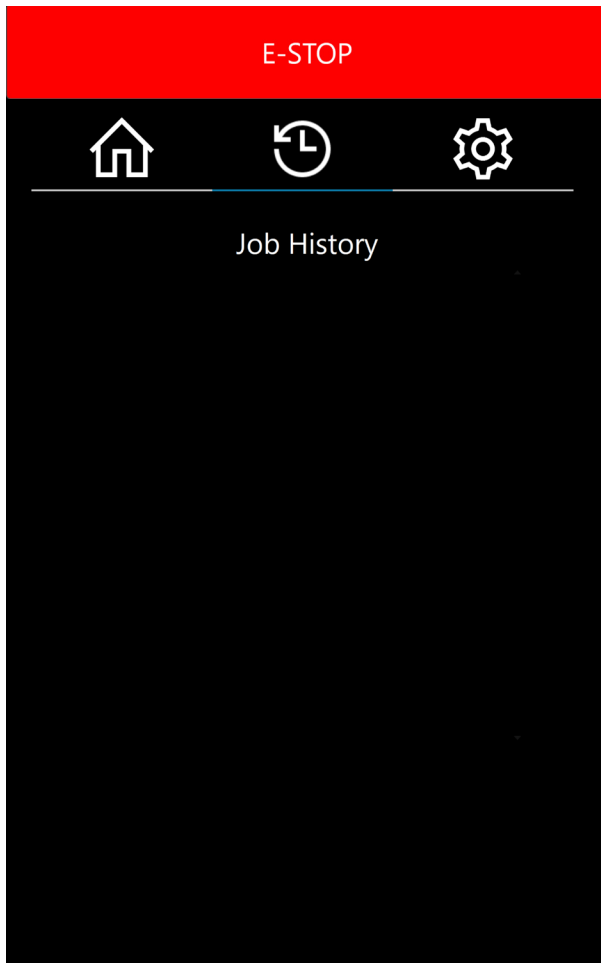


Figure 5.2

HISTORY

No jobs in history. This will change once you start your first project.

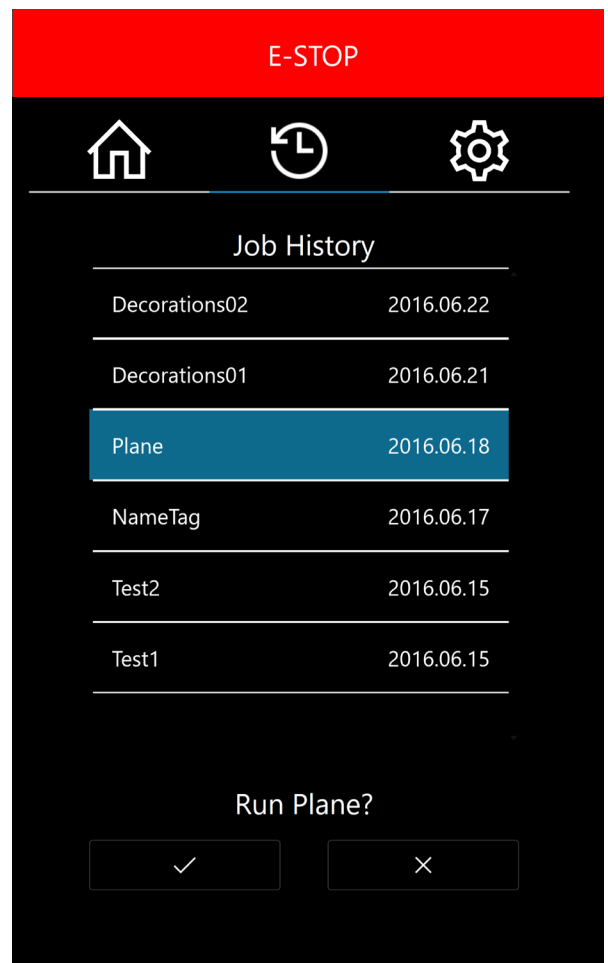


Figure 5.3

HISTORY SELECTION

Scroll through all previous job history. Jobs can be selected and run by highlighting the job and pressing the check.

Network Setting Sub-Screen

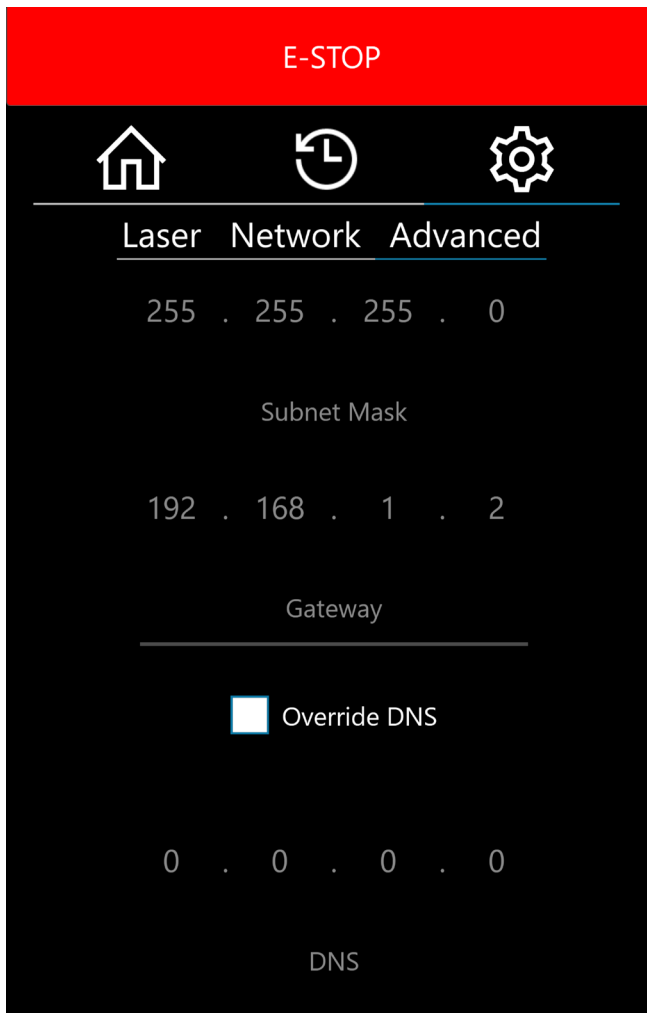


Figure 5.4

DOMAIN NAME SERVER SETTINGS

Automatically scan and connect to local network or input custom settings.

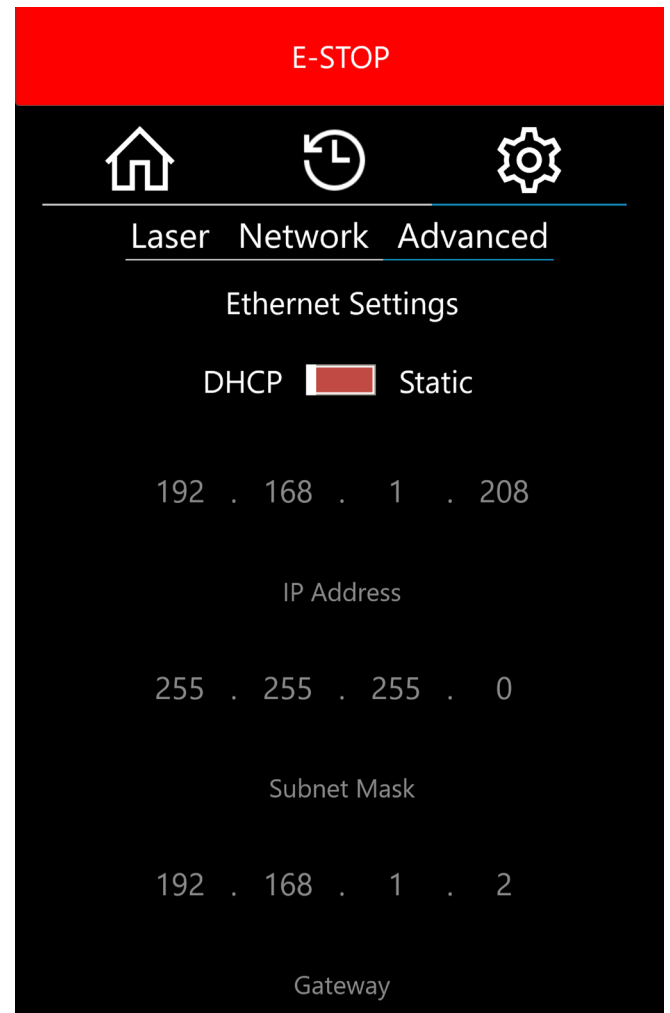


Figure 5.5

ETHERNET SETTINGS

Manually specify network settings or change DHCP.

Network Setting Sub-Screen



Figure 5.6

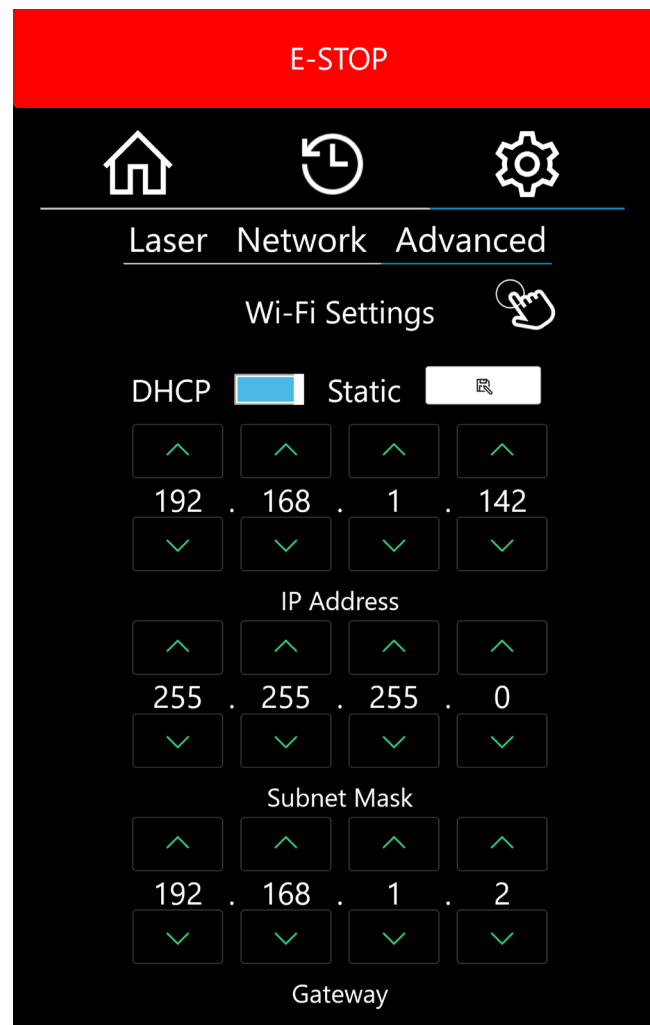


Figure 5.7

Wi-Fi SELECTION

Scan and connect to a Wi-Fi network. If the network is password protected, you will need to enter that password.

Wi-Fi AUTO/STATIC

Change the configuration of Wi-Fi settings or choose DHCP settings.

Other Screens

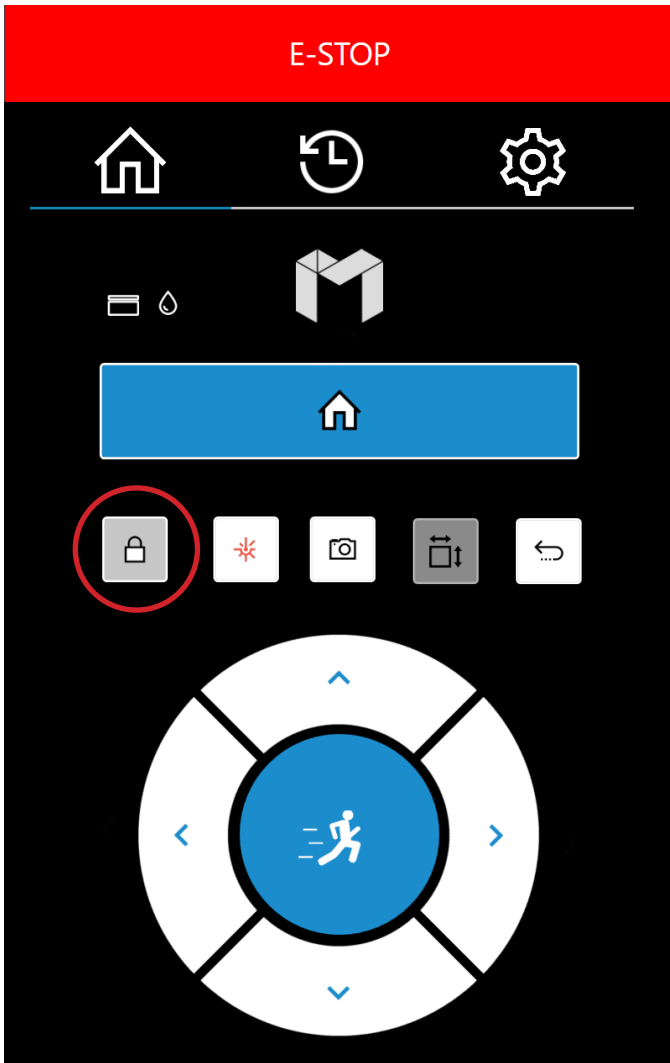


Figure 5.8

LOCKED SCREEN

Indicates the gantry is locked. When locked, user may not manually move the gantry.

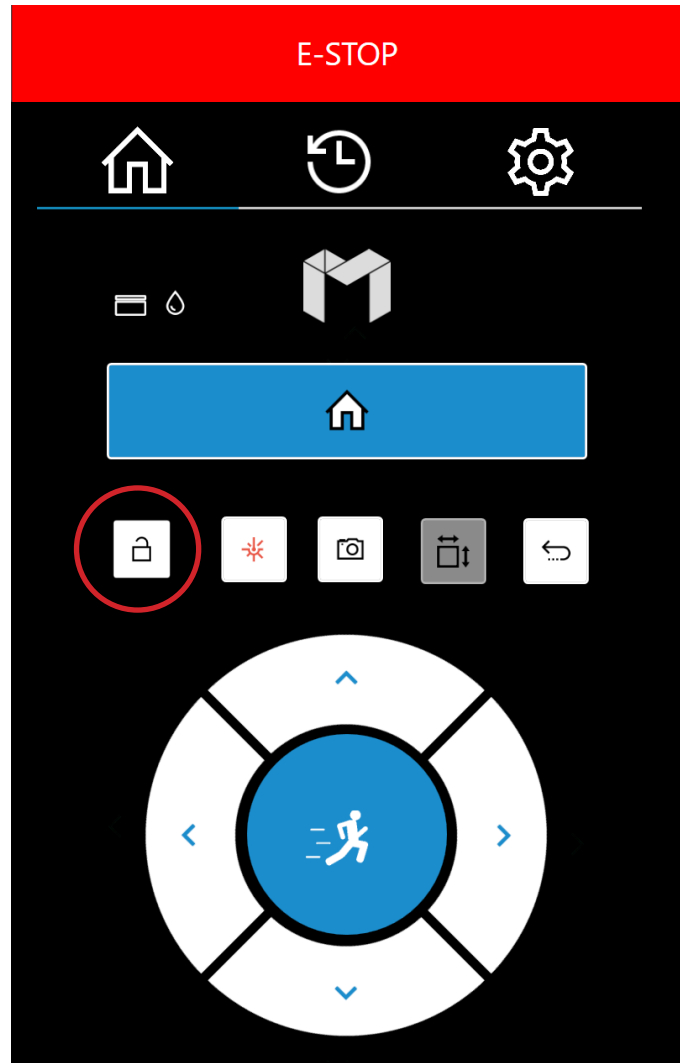


Figure 5.9

UNLOCKED SCREEN

Indicates the gantry is unlocked. When unlocked, user may manually move the gantry.

Other Screens

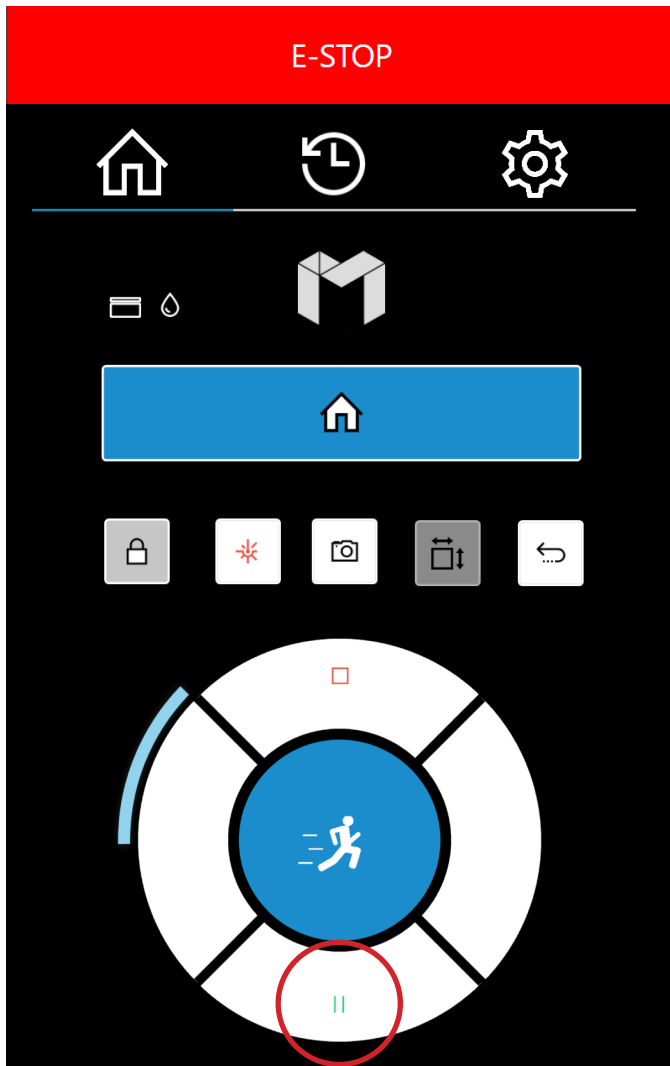


Figure 5.10

JOB IN PROGRESS (PAUSE)

Indicates a job is in progress. Pause by pressing the play / pause button.

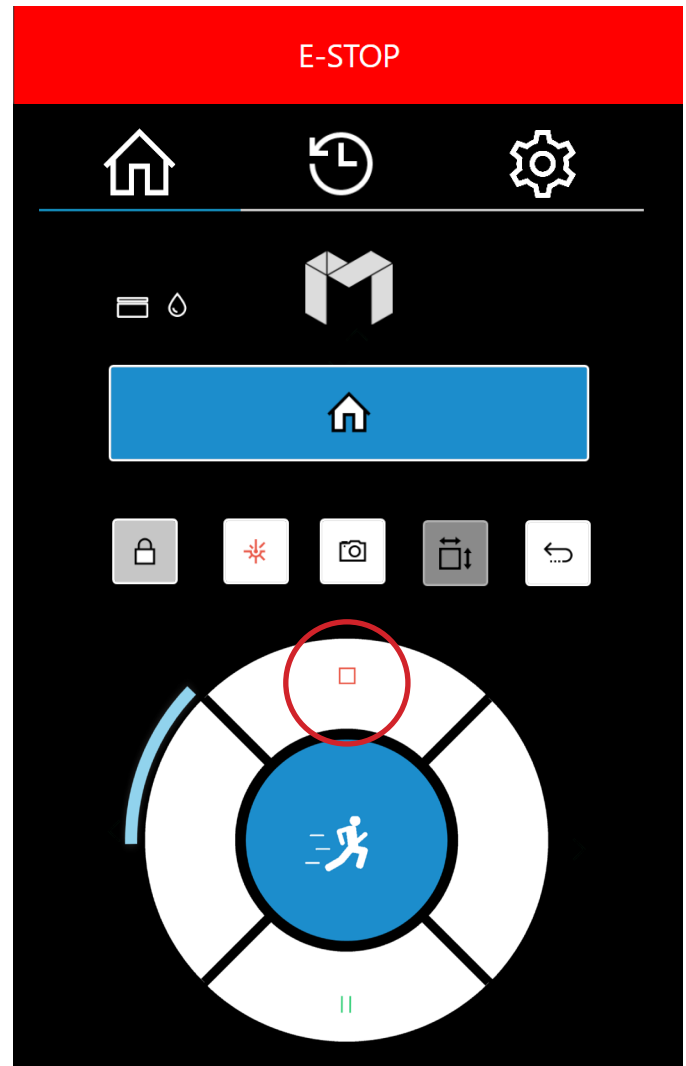


Figure 5.11

JOB IN PROGRESS (STOP)

Touch the red stop button to stop a job in progress.

SECTION VI. SOFTWARE

Using RetinaEngrave 2.0 Software

In this section you will be introduced to the major interface features of RetinaEngrave 2.0.



Workspace Window

The workspace window shows a preview of your current job and its position in the laser bed.

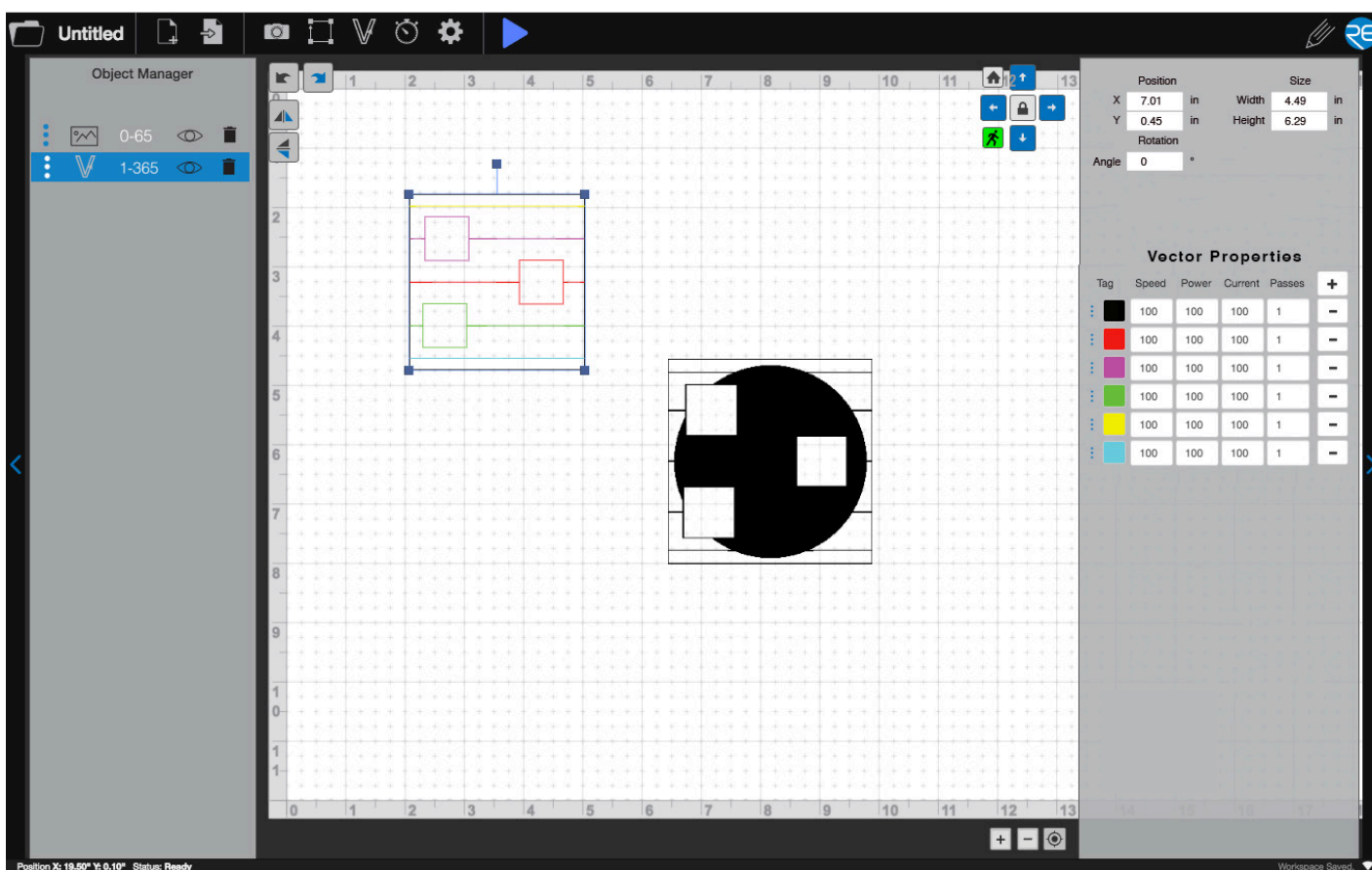
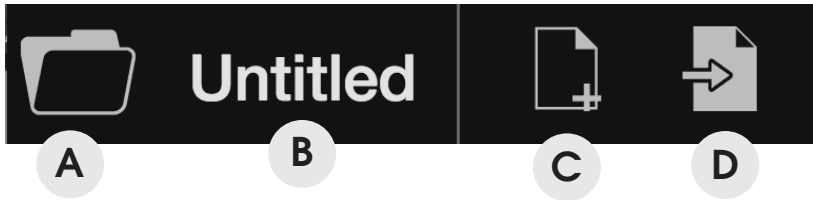


Figure 6.1

Top Line Menus



A. PROJECTS LIST

Lists past project files for easy access. Simply “drag ‘n drop” into the workspace.

B. TITLE PROJECT

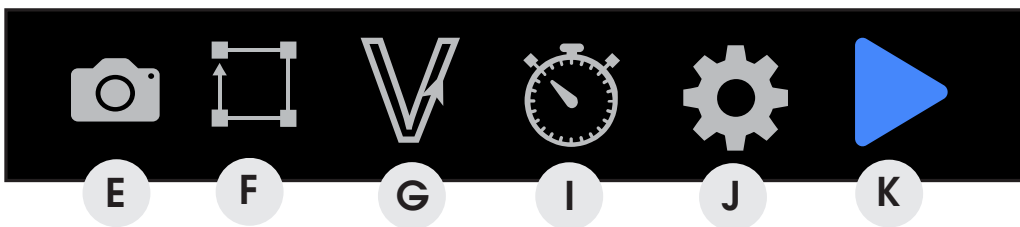
Click window to rename project.

C. NEW PROJECT

Start a new project.

D. OPEN FILE

Open an existing project.



E. CAMERA

Initiates camera operation (see camera features).

F. JOG PERIMETER

Laser continuously outlines the border of current project until stopped.

G. VECTORIZE

Used with camera to apply vectors to selected area of image.

H. ESTIMATE TIME

Click for estimation of time to complete current job.

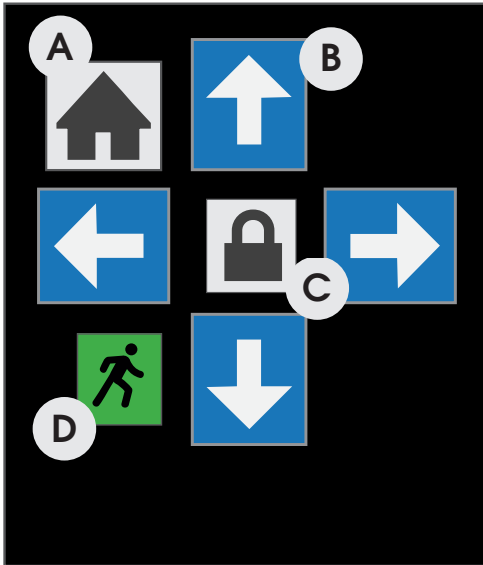
I. GLOBAL SETTINGS

Should only be used after reading user manual, control all object properties in properties manager.

J. START JOB

Run your project. When job is running, “play” button is replaced with “pause” and “stop” buttons.

Jog Menu



A. HOME

Homes laser to 0, 0 (X, Y), then returns to previous position.

B. JOG (DIRECTION)

The four arrows will jog the gantry UP, DOWN, LEFT and RIGHT.

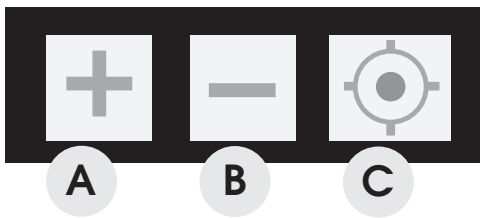
C. LOCK/UNLOCK MANUAL CONTROL

Locks the gantry for JOG button control or Unlocks the gantry for manual control.

D. JOG

Button has three states: FAST (Green figure), SLOW (White Figure) and STOP (Red figure).

Zoom In Zoom Out Work Area



A. ZOOM IN

Enlarges workspace screen detail.

B. ZOOM OUT

Reduces workspace screen detail.

C. FIT TO WINDOW

Auto size to fit window.

Workspace Controls



A. UNDO LAST OPERATION

Removes the last operation.

B. REDO LAST OPERATION

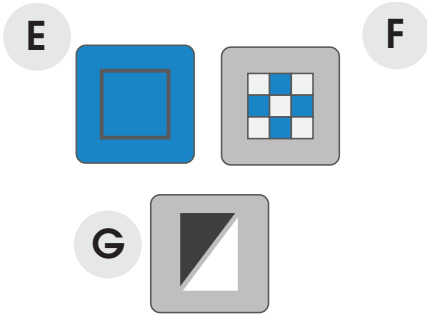
Returns to last operation.

C. FLIP OBJECT ALONG X-AXIS

Reverse image along the X-Axis.

D. FLIP OBJECT ALONG Y-AXIS

Reverse image along the Y-Axis.



E. NO DITHER

Turn dither off.

F. DITHER

Create gradients for photo engraving.

G. THRESHOLD

Adjusts range of color that adjust to either black or white.

Settings Menu

The settings menus give operators access to various information and features.

Info: Clicking “Info” brings up a screen with information on your machine, including serial number, version number and status indicators.

Device: The “Device” button brings up options to switch to rotary mode, display jog options on the software, laser positioning and laser trajectory settings.

Image: The “Image” button displays the image dithering defaults with slide bars to customize.

Engrave: Clicking “Engrave” displays engraving default settings, which can also be customized.

Properties Tab

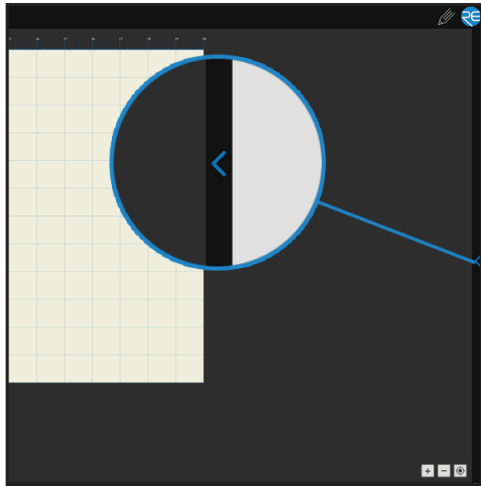


Figure 6.2

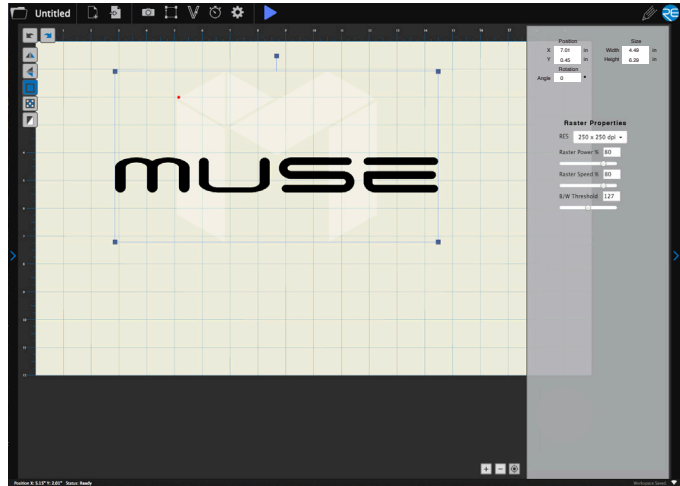


Figure 6.3

Properties Tab

Once an image file is imported, it appears in the workspace window as an “object”. By clicking on an object, the Properties options tab opens (you can also click the RIGHT ARROW TAB to open and close the Properties interface).

The Properties interface includes Object Properties, which allows for custom object positioning options. Depending on the file type (Vector or Raster), this tab will also display either Vector Properties or Raster Properties options.

Object Properties

The Object Properties window allows you to create custom object properties. The following properties are available to customize:

A. Position:

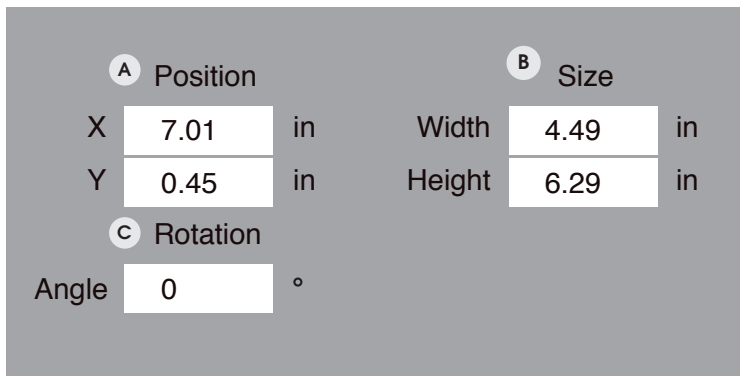
Set a custom x-axis and/or y--axis by inputting a number into the window. You can also adjust the axis with your mouse.

B. Size:

Adjust the size of the object by entering a measurement. You can also adjust size with your mouse.

C. Rotation:

Set a custom angle to increase or decrease the angle in increments of one. You can also adjust angle with your mouse.



Raster Properties

A. RESOLUTION(RES)

Resolution is controlled by the DPI (Dots Per Inch) settings. DPI options include 250 (default), 500 and 1000. The more dots per inch, the higher precision and quality of your images, while a lower DPI will process and engrave faster.

B. RASTER POWER %

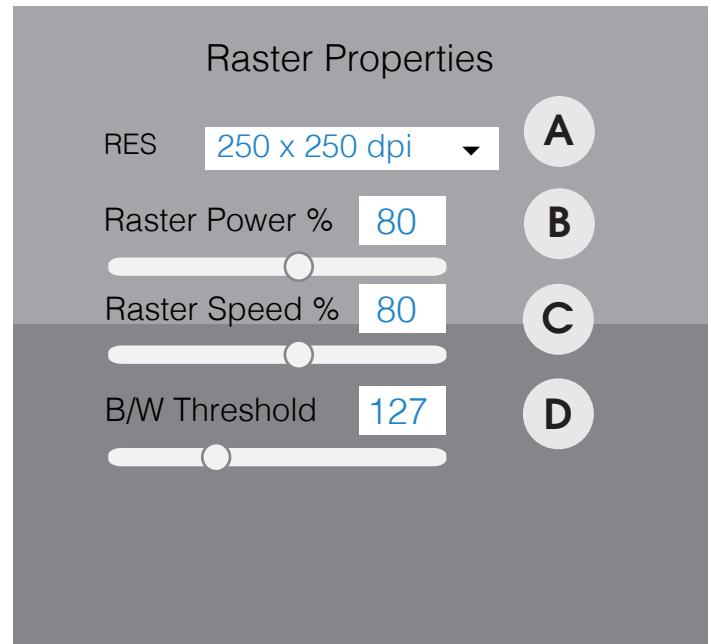
When engraving, adjust the amount of power applied to the material.

C. RASTER SPEED %

Adjust the speed the laser head passes over the material when engraving.

D. B/W THRESHOLD

Used independent of dithering, this adjust which range of colors will be engraved as “black”.



Vector Properties

A. REORDER LAYERS

Click and drag up or down to change order of vector layers.

B. TAG

Identifies different vector colors in each object, allowing to adjust setting independently.

C. SPEED

Adjust the speed the laser head passes along vector lines when marking or cutting.

D. POWER

Adjust the amount of power received by the laser tube.

E. CURRENT

Adjust the amount of current received by the laser tube.

F. PASSES

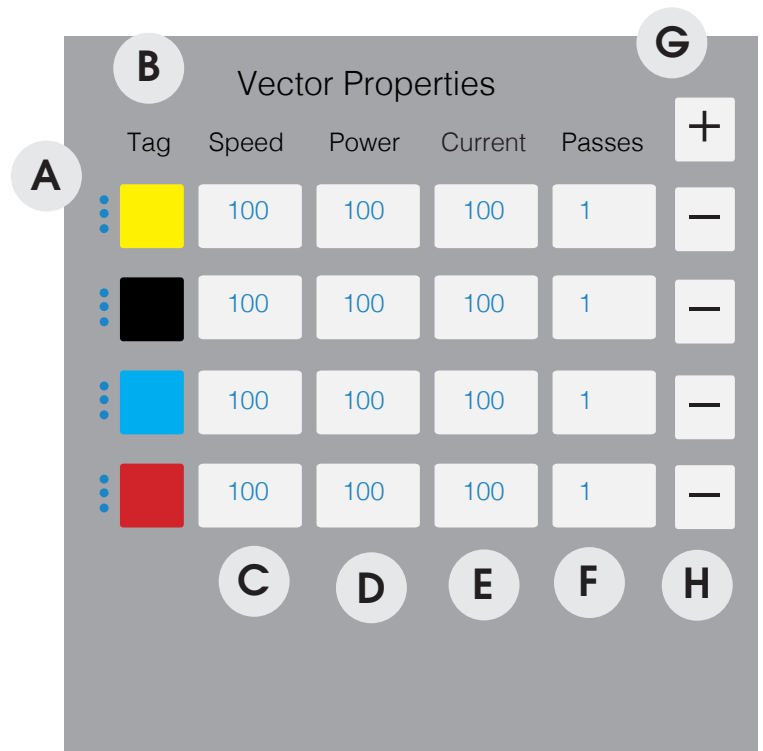
Apply multiple passes of same color vector line. Set pass to 0 before deleting a vector layer.

G. PLUS (+)

Add a vector layer.

H. MINUS (-)

Remove a vector layer.



Object Manager

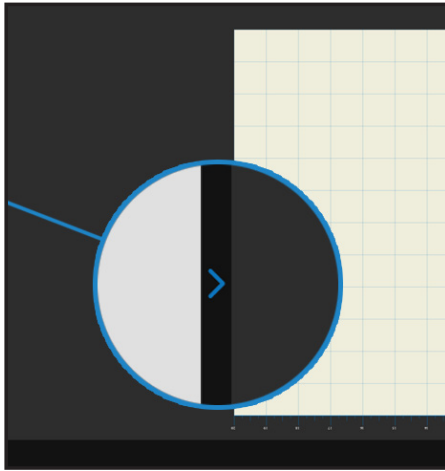


Figure 6.4

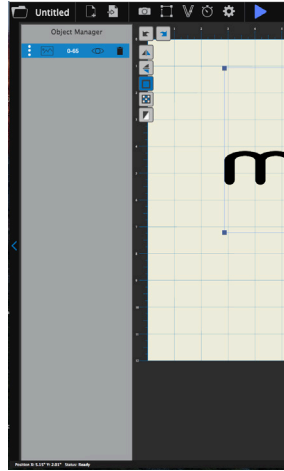


Figure 6.5

OBJECT MANAGER TAB

Clicking an image in the workspace will allow you to access the Object Manager Tab located on the right side of the main screen. Clicking this tab will open the Object Manager options.

A. OBJECT MANAGER

The Object Manager feature allows users to layer their cuts and rasters to create more complex designs. Muse will start with the top and move down sequentially. You can drag n' drop each object in any order you wish.

B. REORDER OBJECTS

Click and drag up or down to change order of operation.

C. OBJECT TYPE

This icon tells you what type of operation the object layer is. The “V” icon indicates a vector file, while the “photo” icon represents a raster.

D. ID CODE

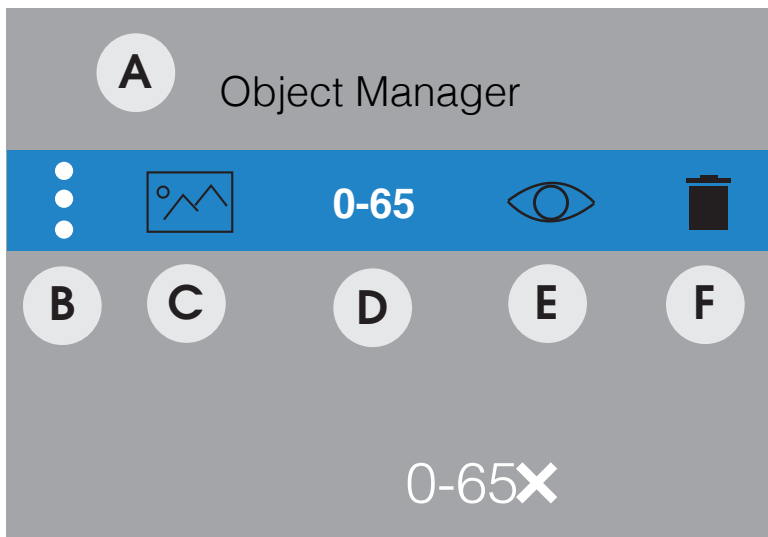
This is a random designation to your object layer. You can custom name your object layers as well.

E. HIDE/UNHIDE OBJECT

Clicking the “eye” icon either hides or makes the object visible. Hidden objects will be skipped in the cutting process.

F. DELETE

Click the X to remove an object layer. object layer.



VECTOR



RASTER

Design View Screen



ACCESS DESIGN VIEW SCREENS AND MENUS

RetinaEngrave 2.0 comes with a drawing tool to allow for custom designs within the software itself. This is called the “Design View” screen.

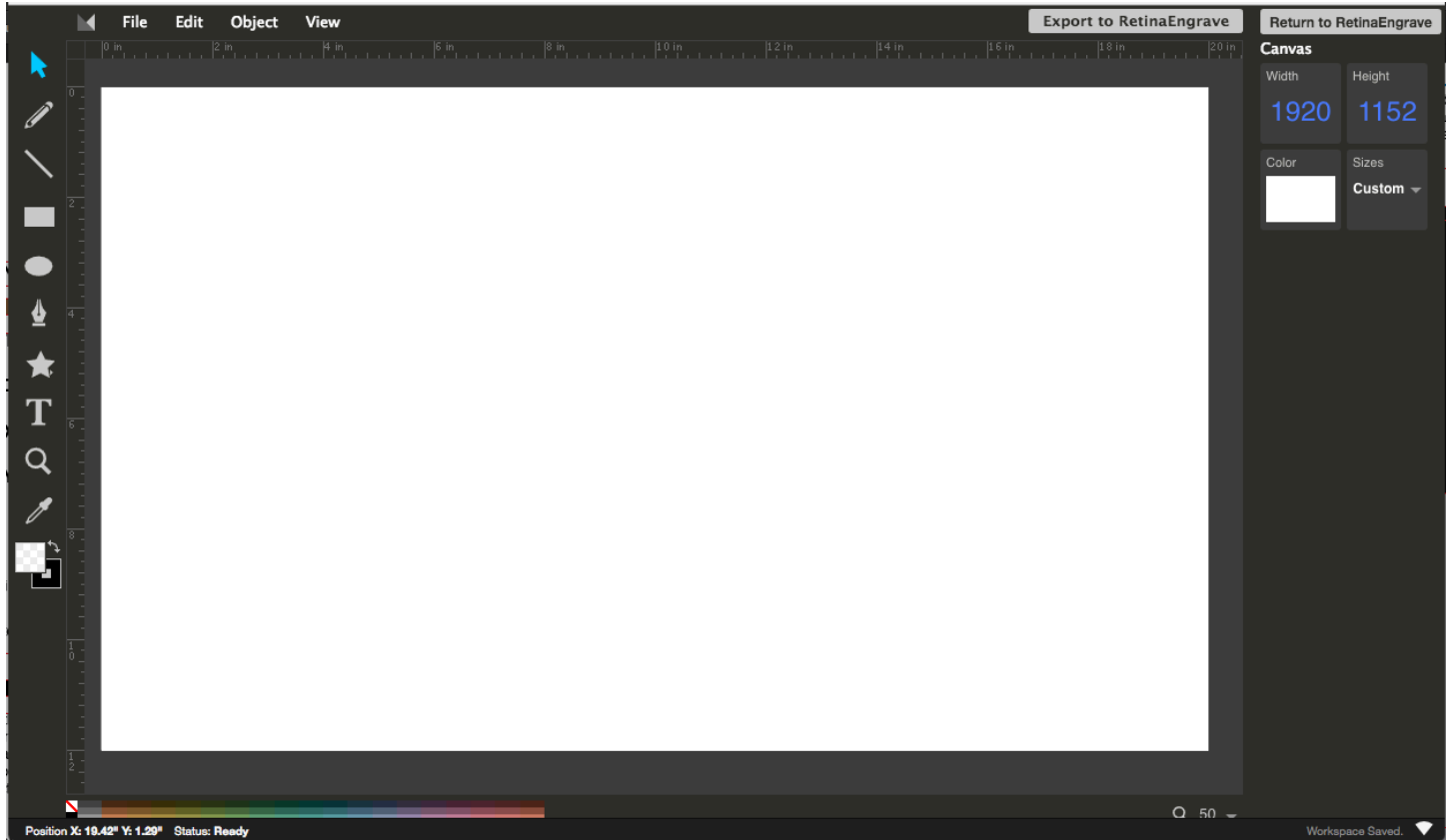


Figure 6.6

Design View Top Buttons



A. ABOUT

Offers information about the Editor and allows the user to add keyboard shortcuts.

B. FILE

New Doc - Start a new document

Open SVC - Open File Explorer menu

Import Image - Bring an image from an outside source

Save Image - Save your created image

Export to RetinaEngrave 2.0 - Export image to RetinaEngrave 2.0 workspace

C. EDIT

Undo - Reverse your last step

Redo - Reverse your last Undo

Cut - Cut some portion of the drawing

Copy - Copy some portion of the drawing

Paste - Paste a copied portion of the drawing

Duplicate - Make a copy of an entire image

Delete - Delete an image

D. OBJECT

Bring to Front - Bring an element to the front of the image

Bring Forward - Bring an element one layer forward

Send Backward - Send an element one layer backward

Send to Back - Send an element to the back of an image

Group Elements - Group multiple elements as one asset

Ungroup Elements - Separate a group of elements

Convert to Path - Create points and connect them to create custom shapes

E. VIEW

View Rulers - Toggle on or off the workspace rulers

View Wire frame - Toggle on or off the workspace wire frame

View Grid - Toggle on or off the workspace grid

Toolbar



A. Select Tool - Choose a tool to use.

B. Pencil Tool - Draw directly to the image space.

C. Line Tool - Create perfect lines.

D. Square Tool - Create and scale squares and rectangles.

E. Circle Tool - create perfect circles and oval shapes.

F. Path Tool - Create custom shapes.

G. Shape Library - Select from a variety of shapes and silhouettes.

H. Text Tool - Add text to your drawing.

I. Zoom Tool - Zoom in and out.

J. Eye Drop - Sample a color from an image.

K. Select Color - Adjust foreground and/or stroke color .

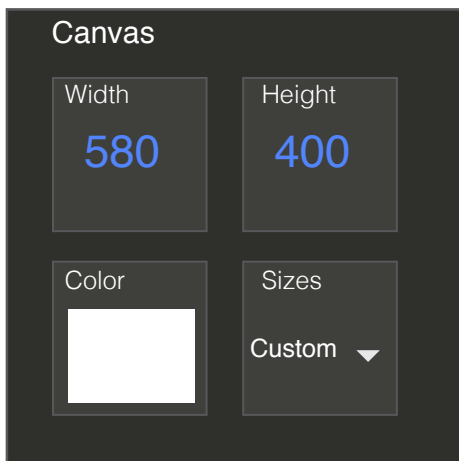
COLOR BAR

Highlight an element and change its color by clicking a color box.



Figure 6.7

Side Expansion Menu Tabs

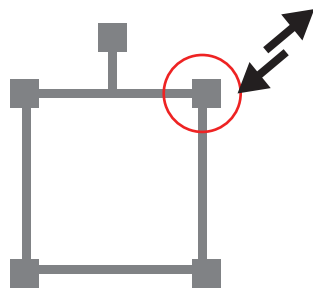


CUSTOM CANVAS

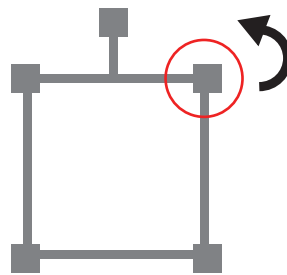
Adjust the width, height, area, and background color of your drawing canvas

Figure 6.8

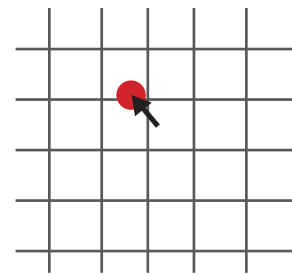
Mouse Controls



Resize



Rotate



Home to Location

A. Drag ‘n Drop

Click and hold a design file and then drag it into the workspace. You will be invited to “Drop anywhere!”. Once uploaded, click and hold the left mouse button and drag the mouse to move the object in the workspace.

B. Resize/Rotate

Clicking on the object with your mouse will highlight the square adjusters for size and orientation. Use mouse to manipulate the object’s size by expanding or constricting the square adjusters or turning the rotation node to rotate object.

C. Alt + Left Click to Rotate

Hold the Alt button on your keyboard, then left click and hold your mouse over the rotation node. By moving the mouse, you can resize the object from center rather than the corner.

D. Alt + Left Click to Resize

Hold the Alt button on your keyboard, then left click and hold your mouse over one of the four corner “resizing” nodes. By moving the mouse, you can to rotate the object from the opposing node.

E. Home to Location

Instantly home the laser to any location in the work bed by simultaneously holding the Ctrl key and left-clicking the mouse. This allows you to choose where the laser starts the job.

SECTION VII. OPERATIONS

This section will guide you through using your Muse laser cutter. To get started, it is important to understand the meanings of “Vector Cutting” and “Raster Engraving” and their associated file types.

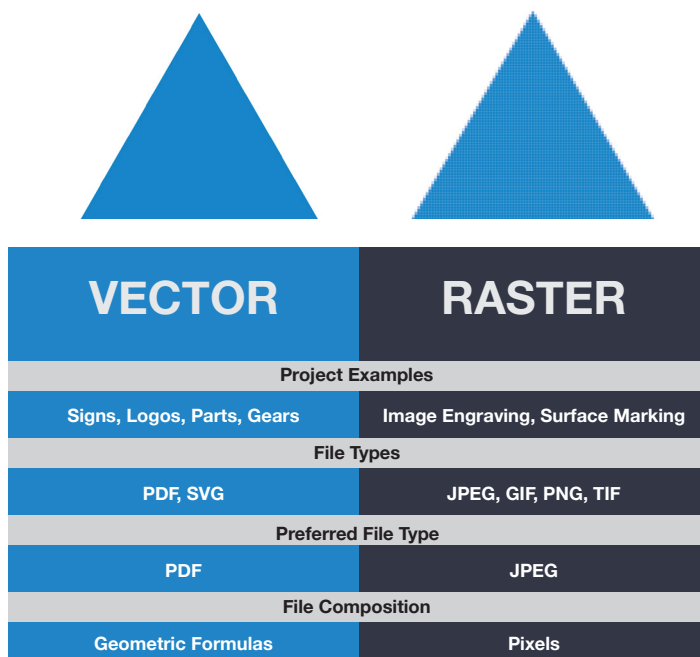


Figure 7.1

General Functions

Vector Cutting

Vector cutting is the most common feature of a laser cutter. Vector cutting with a laser means “to cut a line or shape”. When vector cutting, the laser follows the “vector lines” embedding in the vector image to cut out the design. The laser starts at a designated location and follows the vector lines until the shape is cut out. This process is highly accurate and requires no resolution adjustments because of the properties of a vector image.

Vector Images

In Vector Cut mode, the software receives information from the print stream and interprets it as a series of paths for the laser head to follow. For the print stream to have vector information, the file being printed must be a vector image. Vector images are more flexible than raster images. These images are created using mathematical equations rather than pixel blocks. PDF’s work great as vector files and are easy to resize without losing resolution. Company logos and branded graphics are usually vector images.

Raster Engraving

Raster engraving is the process by which complex designs are etched into a work piece. Engraving can range from a simple surface mark all the way through deep material removal. Engraving is

differentiated from cutting in that cutting is the process of burning a closed contour completely through a workpiece. The most common type of engraving is known as “Raster Engraving” or “Rastering”.

For raster engraving, a laser has two states: on and off. Every black pixel or “laser dot” is the result of the laser turning on and firing once at a location. This location is controlled by the input image, which can be thought of as a “map” of on and off pixels. The laser fires individual pulses corresponding to pixels in an image. When the laser is operating in raster mode the head moves rapidly from left to right and slowly from top to bottom, engraving your image pixel by pixel and line by line.

Raster Images

Raster images use multiple colored pixels to form an image. JPEGs, GIFs and PNGs are common raster image types. Most of the photos found on the Internet and photo prints are raster images. Raster images are created using a fixed number of colored pixels, so they can't be dramatically resized without distorting their resolution. When sized to fit a space they weren't designed to, the pixels become visibly grainy and the image becomes distorted. When this happens, altered photos may appear pixilated or low resolution compared to the original source. Because of this, it is important that you save raster files at precisely the dimensions needed to eliminate possible resolution issues.

PDF Files

Engraving works with both vector and pixel-based source files, allowing you to engrave anything from a simple block logo all the way to high-resolution photographs. A PDF file type is generally treated as vector file, however, RetinaEngrave 2.0 can read PDF files as either a vector or a raster file when you import the image. This allows operator great freedom in converting any image file to a PDF.

Direct Printing PDF Files

The easiest way to import any file type to RetinaEngrave 2.0 is to “drag ‘n drop” it directly into the workspace window. If there are ever any problems importing files in this manner, direct printing a converted PDF file is the next method to try. Most design software have a simple method for converting files to PDF and then directly printing them to the RetinaEngrave 2.0 software.

Design Software

To get the most from your Muse, you will create designs using design software and transfer the files to Muse for cutting. Full Spectrum Laser carries out unit testing using CorelDraw X7 and recommends that Muse owners use this program. If you use different design software and run into a problem with the print interface, we recommend printing to the XPS Document Image Writer or saving as a PDF. PDF files save vector information and are the best way to carry artwork from a non-compatible operating system (Mac or Linux) onto your Windows PC.

Limited testing has been carried out with CorelDraw X6 and it appears to be a good choice, as well. Other popular packages include Adobe Illustrator, Inkscape and Google's free online vector drawing application. Additionally, most CAD packages are able to output drawings in a vector format for printing; Autodesk 123D is particularly interesting for its cost (free) and built-in 3D slicing capabilities

Using your Muse

Positioning the Laser Head (Jog)

Operators will want to become accustomed to moving the laser head, in order to position the laser. This can be done in one of two methods: manual and jog control. Manually moving the laser head requires that the laser head be in the “Unlocked” position. To unlock the laser head, push the “Lock” icon, on the touch screen, so that the icon has an open lock icon. The laser head can now be freely moved to any position in the workspace by hand.

Jogging is when the operator uses the touch screen “jog” buttons, or the software jog buttons, to move the laser head. To use the jog feature, the laser head must be in the “Locked” position. To lock the laser head, push the “Lock” icon so that the icon has a closed lock icon. Now you can use the directional arrows to move the laser head to any position in the workspace.

Project Workflow

The RetinaEngrave 2.0 software works with your Muse to create a simple and intuitive set of operations that is easy to learn and use. With experience, you will find your Muse achieving amazing results following this procedure. Use this Project Workflow List for the “best practice” sequence for any project and follow the step-by-step instructions from start to finish.



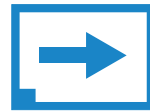
1. Create Design:

Create your design in the program of your choice. **Note:** Files should be created with laser cutting considered.



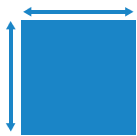
2. Connect to Software:

Link your Muse to the software by typing the IP address found on the Touch Screen (Settings>Network>Copy IP) into your browser (Google Chrome Suggested).



3. Import Design:

Using direct print from your design program, or by drag-n-dropping the file into the RetinaEngrave 2.0 workspace, import your design to the software.



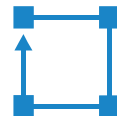
4. Place Material:

Place your material into the laser bed workspace.



5. Focus:

Using the included focus billet, focus the laser to the material (consult your user manual).



6. Align Laser to Material:

Using either the perimeter tool, or camera function (see camera features), align your design on the appropriate area of your material.



7. Adjust Object Properties:

Using the Properties Manager Window, adjust your Vector or Raster settings for your cut, mark or engraving.



8. Run Job:

Double check your safety precautions and accessories, and press the “play” button to start the job.



Safety First

Before starting any project, be sure you are aware of all safety issues. Be sure you read and understand all safety warnings presented in Section I: Safety First and that all safety requirements are being upheld. This is a good time to check your machine's power connections and that the accessories are properly attached and are operating normally.



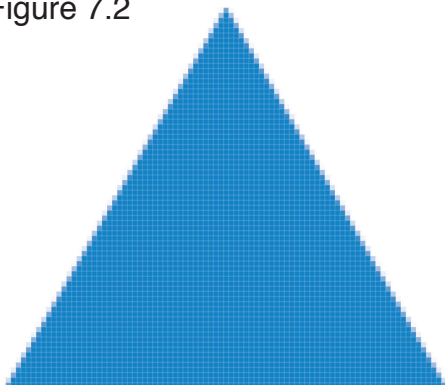
1. Create Design

Typically, projects are created in design software and then imported to RetinaEngrave 2.0. Generally, a PDF file is optimal for most vector cuts, as PDF files are easy to convert to and most design software has "convert to PDF" as a standard feature. For rastering (engraving), a JPEG file is best as these are bitmap files perfect for pixel based images.

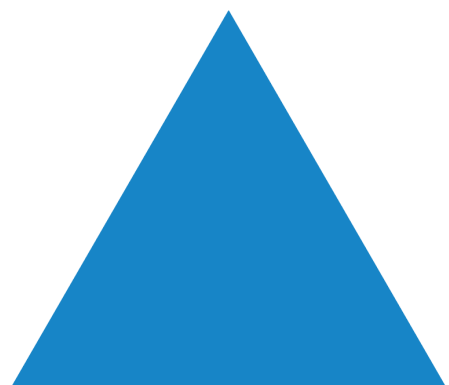
It is important to know, at this stage, if you intend to do a vector cut or a raster and choose the most appropriate file type (PDF or JPEG). This will greatly aid the software to run the job smoothly and quickly.

Just about any design software will work (You can choose the software you are most comfortable with, as long as you can convert files to PDF (which most can). You can also "direct print" to the software. Each operating system does this in a slightly different way, so check the instructions for your particular computer.

Figure 7.2



Raster Image (bitmap)
Pixel based image.
Example: JPEG

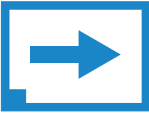


Vector File
Geometric based
image. Example: PDF



2. Connect to Software

Follow the instructions presented in Section III: Installation & Assembly. Briefly, you will turn on your computer and your Muse laser cutter and wait for both to finish their boot cycle. Then, using the Muse touch screen, touch the “Settings” button and then touch “Network”. Copy the IP address on the touch screen into your computer’s browser and the program will appear, ready to use. For best results, we recommend using Google Chrome as this is the most compatible with RetinaEngrave 2.0 technology.



3. Import Design

Import your designs by selecting the “Open File” icon, or by dragging and dropping your file into the workspace. This software detects a wide variety of file types, however, for vector cuts PDF files work best and are simple to convert on most design software. For raster engraving, the JPEG file format is widely used and can easily be taken from a cell phone photo or an image found online.

It is important to know what files work best with vector or raster images. A raster image is a pixel based image (bitmap) and works well as a JPEG file. When you import a JPEG file, the software will automatically detect it as a raster file and will set up the project accordingly by presented raster options in the properties tab menu. When you import a PDF file, you will be given the following options in a drop-down menu:

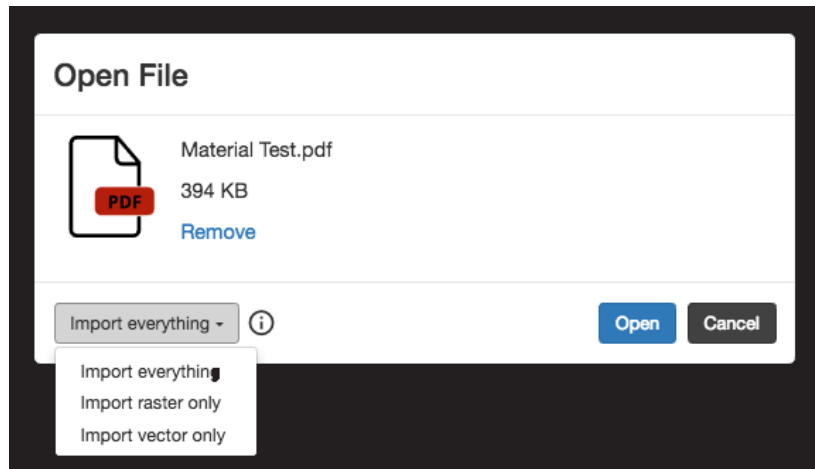
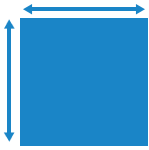


Figure 7.3

Import Everything: Create both a raster file image & a vector file image in the workspace. Click each one individually to set raster and vector properties using the Properties Tab.

Import Raster Only: Creates a raster file image in the workspace. Click the image and then the Properties Tab to access raster properties.

Import Vector Only: Creates a vector file image in the workplace. Click the image and then the Properties Tab to access vector properties.



4. Place Material

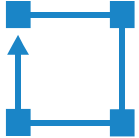
At this stage you will place your material into the laser bed workspace. The material can be placed anywhere within the workbed, however, we recommend placing material close to center of the workbed. Once the material is placed, close the lid.

Your material is what you will be cutting or engraving. Typical materials include wood, acrylic, cardboard, fabric, etc. Note that it is the user's responsibility to know the components of any material used and the limitations of utilizing that material (thickness, chemical residues, etc.) with a 45W laser tube. Always check with the material manufacturer if there are any questions to its usage. We recommend using a Materials Log to keep track of the different materials you use.



5. Focus

Follow the Focusing instructions given in Section IV: Tests & Adjustments. Just to recap, you will place focusing billet on top of the material you wish to cut. Then align the laser head to the focus billet and release the focus lens locking mechanism and allow the laser head to rest lightly on top of the focus billet. Finally, retighten the focus head and remove the focus billet from the workspace.



6. Align Laser to Material

Alignment of the material ensures the design to be cut is contained within the material in the workspace. This process also makes sure the design is aligned to the material so the cut is positioned straight. Typically this can be done with a simple vision check while "jogging the perimeter". Follow these instructions:

By using the directional arrows on the touchscreen or in the software (see manual jogging), move the laser dot to the top left corner of your material. When placing a raster image, leave at least 1/2" inch of space on the left and right side. When creating raster engravings, you must compensate for the left and right overshooting of the laser head. This will prevent the head from crashing and prevent damage to your machine.

Once the material looks aligned, click the "Jog Perimeter" button. The laser head will automatically outline the material with the red beam diode. You can then adjust the material as needed. Note the laser head will continue to outline the material until stopped manually by clicking the "Run Perimeter" button a second time. See Positioning below for more options.



7. Adjust Object Properties

It is again important to know if you intend to raster, vector cut or both. Once the file is imported, and the image is clicked with your mouse, you will have access to the Properties Tab. Click this tab and select the parameters for your cuts and/or engravings. For details on setting these parameters, see below.



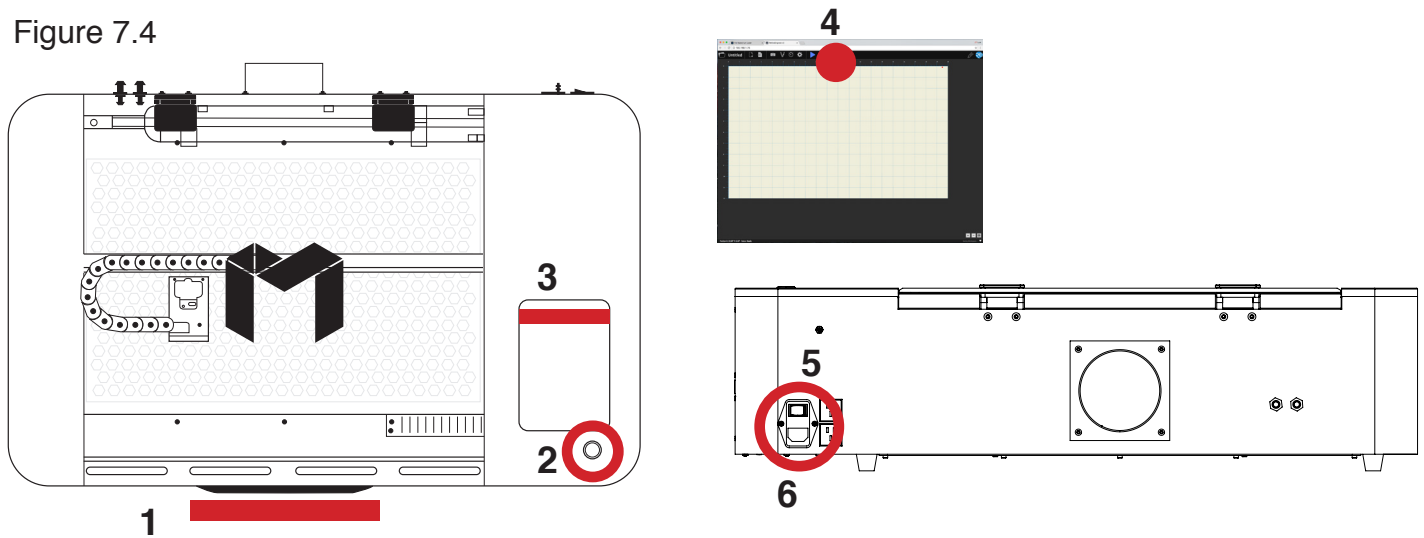
8. Run Job

Clicking the "Start Job/Play" button begins the laser cutting process. Before doing so, double check your safety protocol and that your system accessories are connected properly. Be sure to monitor the job while the laser is firing. If there is a problem, stop the laser using one of the methods mentioned below.

Stopping the Laser

Once a project has begun, the laser will continue until the project is complete. If for any reason an operator needs to stop the laser immediately, choose one of these options:

Figure 7.4



1. Open the Lid. The large workbed access lid is installed with a device that automatically (and instantly) cuts off the laser if it is opened even slightly. This should be your first method of stopping the laser during an emergency. This is a safety feature of Muse and under no circumstances should this safe lid auto-shutoff device be tampered with or removed. Doing so will void your machine's warranty. If the machine ever fails to shut off the laser when the safety lid is open, immediately unplug the machine and contact customer service.

2. Touch Screen Pause Button. Top of Machine Pause Button. On the top of Muse machines there is a button that can pause or stop the laser. Press once to pause the job. Press and hold to stop the job. Once a job is stopped, starting again will start the project from the beginning.

3. E-Stop. On the touch screen, the top red bar is an "Emergency" stop button (E-Stop). Pushing this bar will instantly cut power to the laser. Be aware this is still part of the touch screen and is fragile. Do not slam this button.

4. Software Pause Button. In the software, on your computer, you can click the Pause Button (converted Play button when laser is running a job) to halt the laser. This may take a second to process, so it is not recommended as a method of stopping the laser in an emergency.

5. Power Switch. At the back of the machine is the power on/off switch. Flipping this switch to the off position instantly cuts power from the laser head (and the entire machine). Using this option will completely cut power from the laser, the touch screen and all other Muse systems.

6. Unplug Power. You can also simply unplug the power cord of the main Muse unit. This should be a last resort method for emergencies as the other methods are quicker to access and prevent pulling on cords and connections.

Setting Object Properties

As mentioned, clicking an object (design image) in the workspace will allow you to access the object properties tab. You can click your mouse directly into any window and then enter the number with your keyboard. You can also adjust these specifications using your mouse (see Mouse Controls).

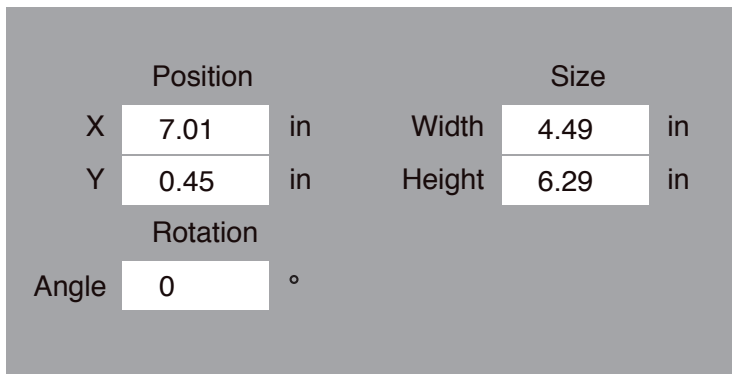


Figure 7.5

Setting Raster Object Properties

Setting Resolution

Select the image and open the right hand menu by clicking the arrow located in the middle of the browser (IMG 4). Select your resolution (IMG 5).

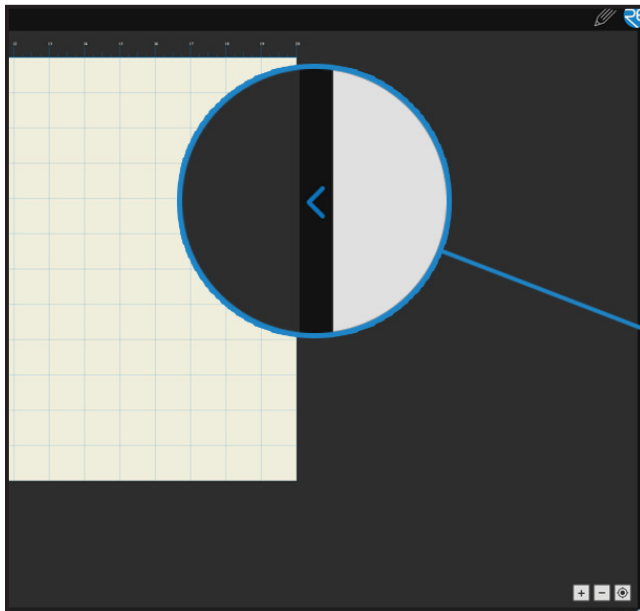


Figure 7.6

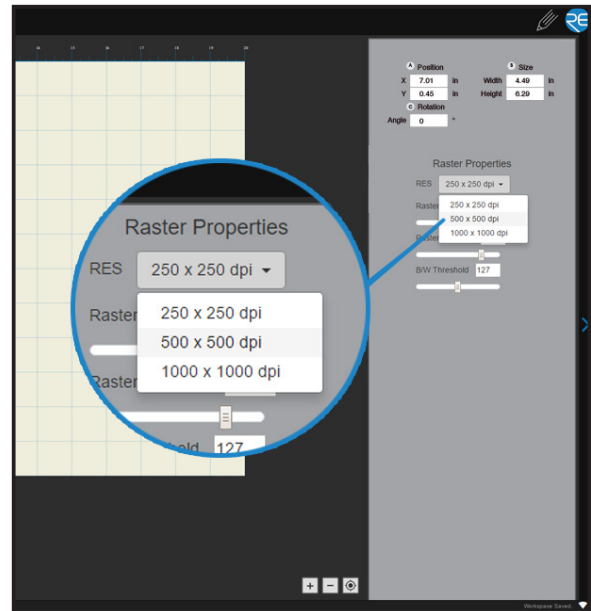


Figure 7.7

The resolution of your engravings can be controlled by the DPI (Dots Per Inch). DPI options include 250, 500, and 1000. The more dots per inch, the higher precision and quality of your images, while a lower DPI will process and engrave faster.

Remember that with a higher DPI (1000), the laser is in contact with the material for a longer period of time and may result in deeper engravings than with a lower DPI (250). Speed and power should be compensated for different DPI settings. The software's default resolution is set to 250 DPI.

Setting Raster Power

The power settings determine the output of the laser tube. A 100% power setting will create a deeper engraving while lower settings will create more surface level engravings.

Setting Raster Speed

Speed settings determine how quickly the laser head will move. For faster engravings, 100% is ideal. Lowering the speed will allow you to create deeper engravings as it allows the laser beam to be in contact with the material for a longer period of time.

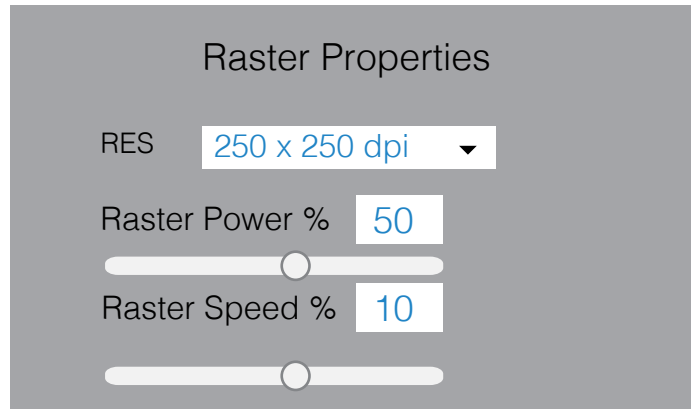


Figure 7.8



PRO TIP! Speed and power settings will vary depending on the density of the material. It's recommended to run a test on an inconspicuous part of the material before creating your final piece. Ideally, operators will keep a materials log and keep track of settings for each project.

Setting B/W Threshold

At this moment, the image is still displayed in black and white. The black and white raster feature is great for tracing logos, text, or simple high contrast images that only appear in a single color. You can adjust the threshold of what's considered black, and what's considered white by selecting your image and using the "B/W Threshold" slider (IMG 6).

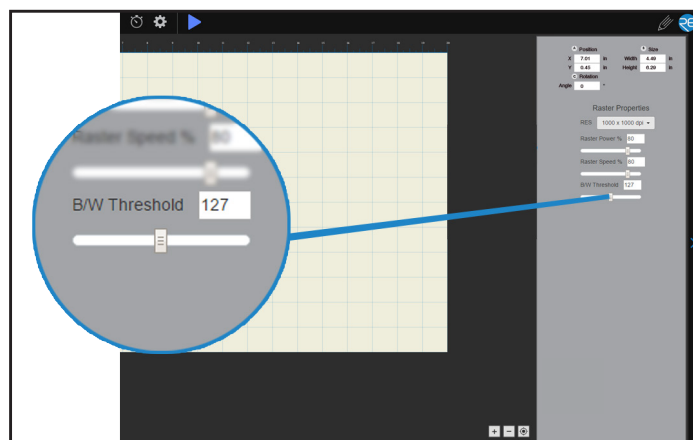


Figure 7.9

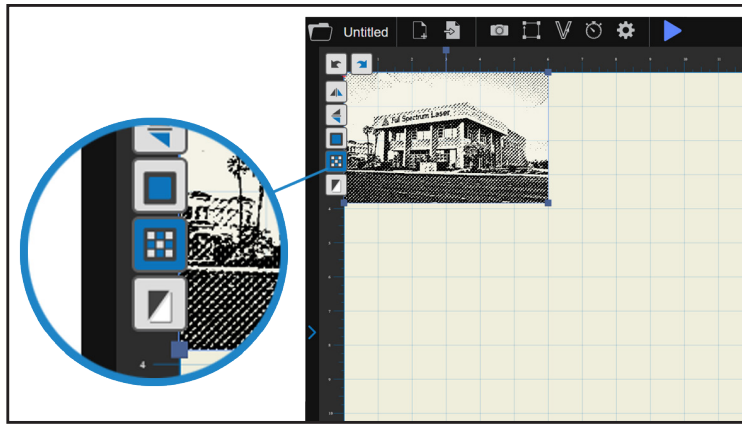
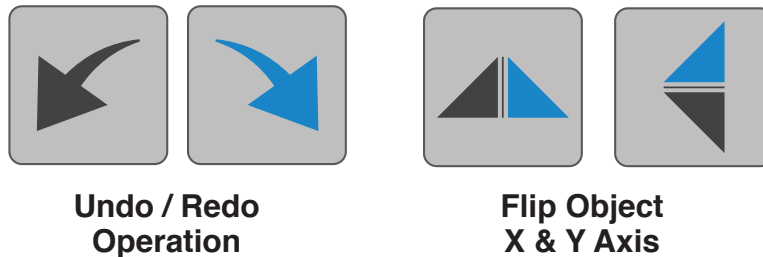


Figure 7.10

Dithering Option

For images that have shadows and depth, it's ideal to use dithering. Dithering creates a series of dots similar to newsprint. This effectively creates a grayscale that is ideal for photo realistic engravings. To dither an object, select the image, and click the dithering button in the menu that appears (IMG 7). Remember that the on screen resolution is intentionally lowered for faster processing.



Undo/Redo Operation

Clicking the “Undo Operation” icon will negate the last command you gave to the software and return to the last command given. For example, if you clicked the “Dither” icon and then clicked “Undo Operation” the dithering would be removed. Clicking the “Redo” icon has the opposite effect, and will return to the command prior to clicking “Undo”.

Flip Object

There are two options when utilizing the “Flip Object” buttons: x-axis flip, or y-axis flip. Clicking the x-axis “flip” reverses the image “left to right”, creating an opposite facing image. Clicking the y-axis “flip” reverses the image from “top to bottom”, creating an upside-down image of the original. Clicking either button twice reverses the image again.

Setting Vector Object Properties



Figure 7.11

Setting Tags

Tags allow you to create separate vector layers and keep track of them with a unique color. Each color will match an object in the workscreen. You can set the order of operations by clicking on the “three dots” and then dragging the layer up or down. Objects are then processed from top to bottom.

Setting Vector Speed

The optimal speed setting varies, depending on the power of the laser tube and properties of the material itself. Like raster engraving, speed will determine how quickly the laser head moves. You will need to experiment with material testing to find the right speed for your vector cuts.

Setting Vector Power

Power will determine how much power the laser tube delivers. As with speed, power will vary depending on the wattage of the laser tube and the material itself. You will need to experiment with material testing to find the right speed for your vector cuts.

Setting Vector Current

Vector current is a control unique to vector files. Vector current controls the pulse of the laser. 100% will create constant power for smooth cutting, while lower percentages will add increasingly more off time between pulses. As always, settings will vary with your tube wattage and type of material. It's best to test on an inconspicuous part of your material before creating your final piece. Once optimal results are discovered for speed, power and current, through material testing, record the settings for each in a materials log.

Passes

This allows the operator to assign how many times the laser will complete a full cycle. Adding passes creates deeper cuts. Note that if you delete a vector line (by clicking “-“), set passes to “0” first.

Plus (+) & Minus (-)

Clicking plus (+) will add a vector layer and minus (-) will delete a vector layer. When deleting a vector layer, reduce the number of passes to 0 prior to deletion.

Object Manager

The Object Manager Tab helps operators keep track of the various objects in the main work-screen. This is especially helpful when combining vector and raster elements. Notice that in this menu, both files are listed in different layers.

The “V” icon indicates a vector file, while the “photo” icon represents a raster. By clicking and dragging these layers, we can rearrange the cut order of the project. Objects on the top will cut first while the objects underneath will follow. Ideally, you want to engrave the image first, then cut the pieces. By cutting in this order, we prevent pieces falling or shifting out of focus before being engraved.



Figure 7.12

When dealing with multiple layers, clicking on the image will only select the topmost layer, and can increase the chance of accidentally misaligning a section by dragging. To prevent this, select the layer from the Object Manager menu. When you open the Object Manager Tab menu, you’ll notice that the properties of that object are listed.

You can remove any object by clicking the “X” at the end of that object’s row.

Other Settings and Adjustment Options

Resizing (Mouse)

To resize an object, select the object to highlight the adjustment nodes (IMG 2). Clicking and dragging these nodes will resize the image, while the top node (IMG 3) will rotate the object.

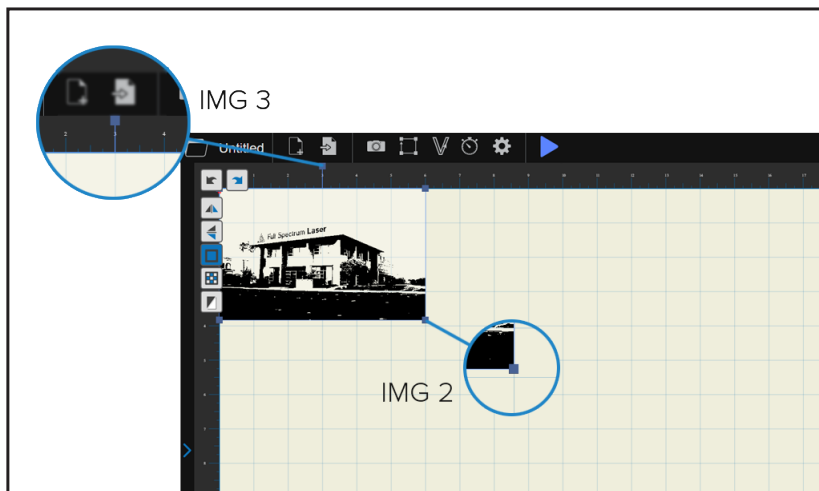


Figure 7.13

Home to Any Location (Ctrl + Left Mouse Click)

You can instantly home the laser to any location in the work bed with the Ctrl + Left Click function. Place your mouse cursor at the desired location in the workspace window in the RetinaEngrave 2.0 software. Then simultaneously hold the Ctrl key and click the left mouse button. This will place a red dot in the workspace window and the laser head will then “home” to that exact location in the work bed. In this way, you can choose where the laser starts the job.

Positioning

There are two positioning modes available to use. You can switch between these by selecting settings (IMG 9) then selecting the mode in the drop down menu that appears (IMG 10).

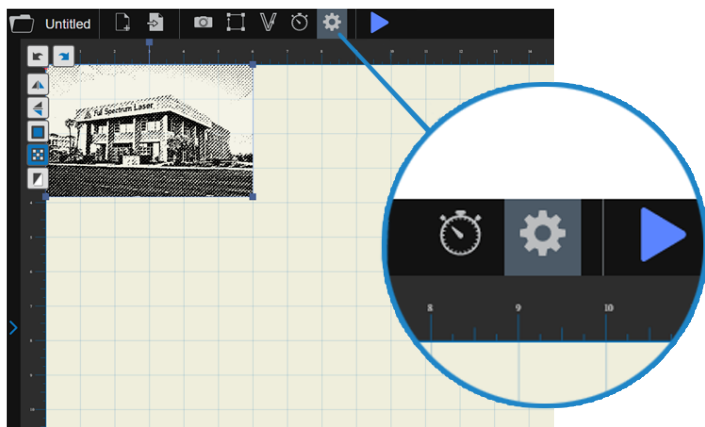


Figure 7.14

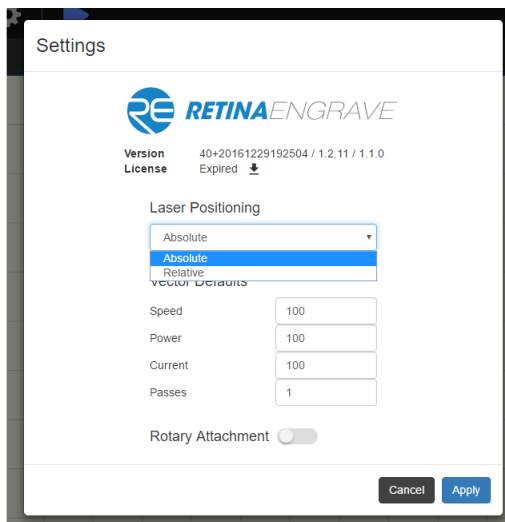


Figure 7.15

Relative positioning is relative to the laser head. The red dot from the laser will be considered the top left corner of an image. This makes positioning easier without the use of the Muse camera system.

Absolute positioning is the default mode and will directly translate the object's location on the computer workspace to the respective location on the laser bed. Absolute positioning is ideal when using the camera system.

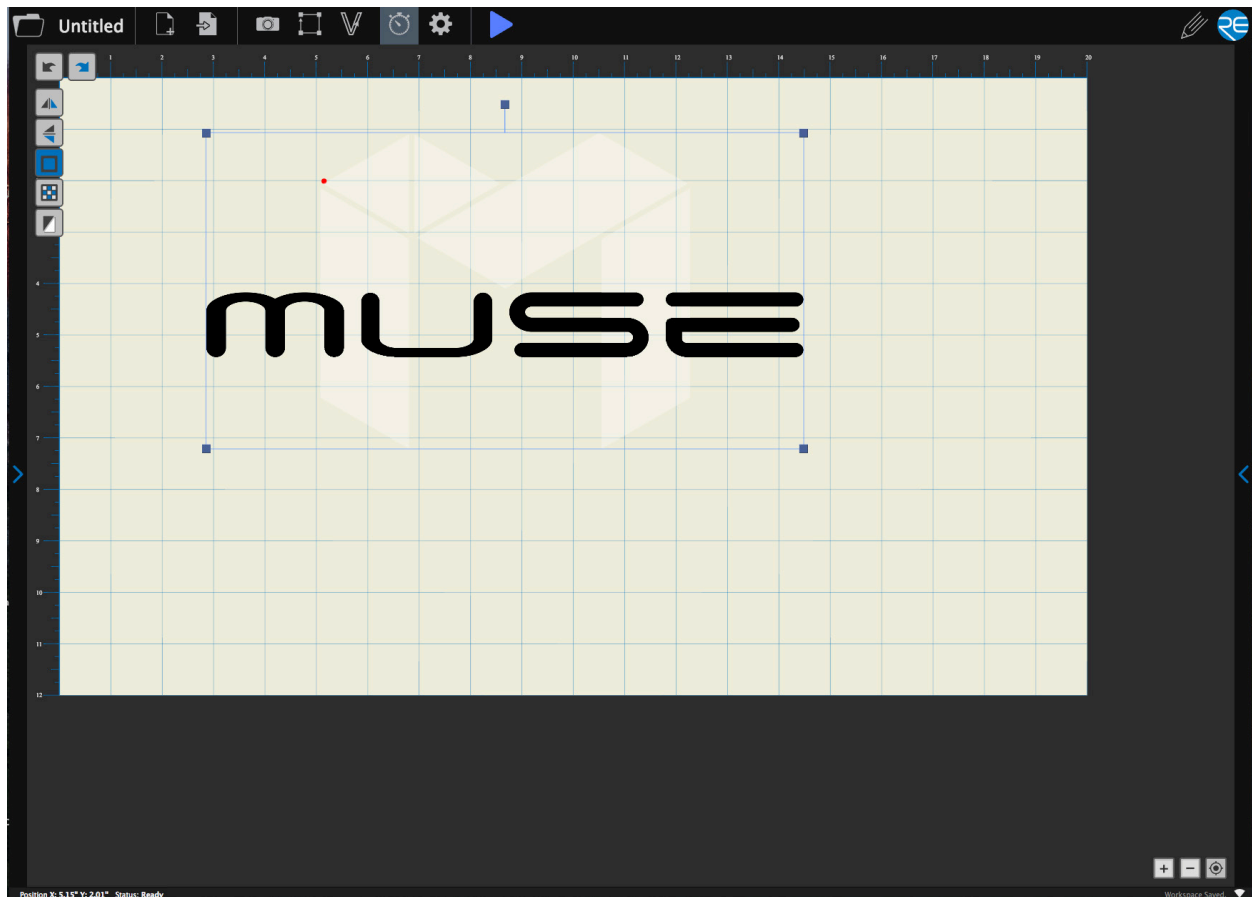


Figure 7.16

By using the directional arrows on the touchscreen or in the software, move the laser dot to the top left corner of your material. When placing a raster image, leave at least $\frac{1}{2}$ " inch of space on the left and right side. When creating raster engravings, you must compensate for the left and right overshooting of the laser head. This will prevent the head from crashing and prevent damage to your machine.

Design View

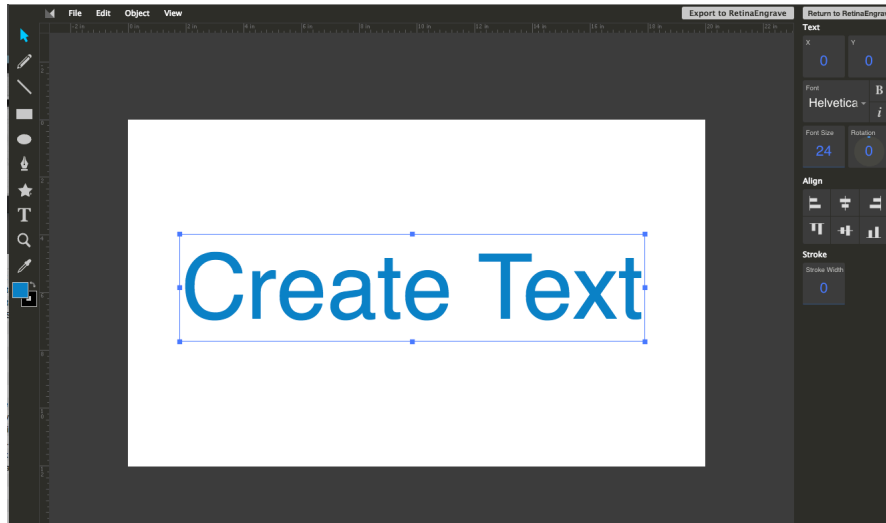


Figure 7.17

Using Design View

The Design View screen is a drawing tool to allow for custom designs within the software itself. Here you can design objects without accessing third-party design software. To open the design view menu, select the pencil icon in the top right corner of the screen.

Adding Text in Design View

Click the “T” icon and then click anywhere in the design view window. You can now write your text. You can resize your text just like resizing an object.

Creating Objects in Design View

The easiest way to create an object is to select a shape from the tools menu. For example, you want to make a circle. Select the circle tool, then click and drag to create a circular shape. By holding shift while dragging, you can constrain the proportions so that the circle is perfectly round. Design view has hundreds of shapes that can be selected and manipulated to endless choices. Click the “Star” icon to access shape library.

Export to RetinaEngrave 2.0 Workspace

Once your shape or text is ready, you will need to export it back to the workspace of RetinaEngrave 2.0 by clicking “Export to RetinaEngrave”. When the object imports, notice that it’s in its own layer. You can now treat it as any other object. Click and use the mouse to move this layer and use the nodes to position and resize it, as needed.

Export to RetinaEngrave



Camera: Capture Workspace

Use the onboard camera to capture your workspace to align your design.

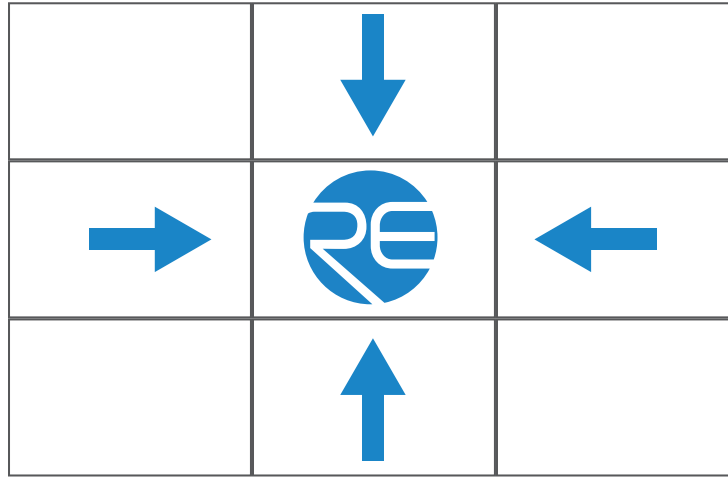


Figure 7.18

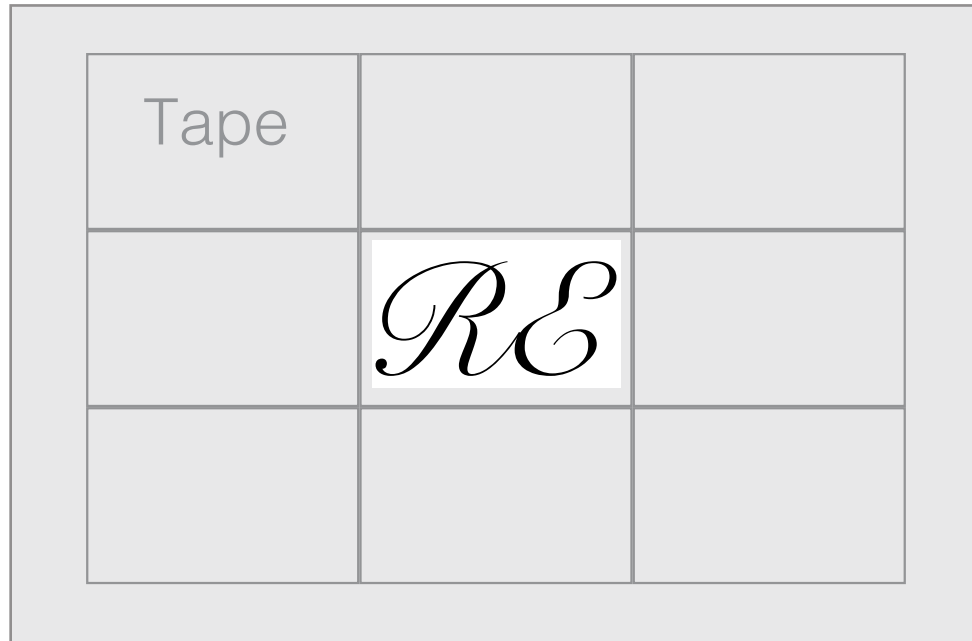
1. Place material in center of laser bed.
2. Position the laser head above the material and use the focus billet to focus the cone above the material surface. Ensure your material does not impede the movement of the laser head.
3. Initiate Camera Sequence - Press the Camera Icon on your RE2 software, or on the LCD touch screen (for touch screen controls, see user manual) - Note that you 1) use the camera button, 2) position the head, and 3) press the camera button again (this initiates sequence with no indication on software). Follow the steps on the screen. Click “New Height Measurement”. The laser head will shift back and measure the height of your material using the secondary red beam laser. You can repeat this step several times for more accurate results. If results don’t improve, it may be that your material is an uneven surface. Click Continue when focused.
4. After 9 photos are taken and stitched, your workspace should now represent your laser bed. Position your design as needed (for help importing, see the Work-Flow Section), and adjust setting.
5. You are now ready to run your job! To double check a position on your workspace, CTRL-Click anywhere on the work space to position the laser head there.



Camera:Vector Trace

Use the onboard camera to capture your workspace to align your design.

Figure 7.19



MASKING TAPE OVER WORK AREA

1. Choose your material, and prep. Flat objects work best, and we suggest you place masking tape (paper tape) on the surface before marking with a pen (sharpie). Don't allow the masking to tape to overlay on the material when applying more than one strip.
2. Using a thick black marker or pen, draw on your material. Thick solid lines will be read the best. If coloring in a space, ensure completely filled in.
3. Capture the workspace as shown in steps 3 & 4 in the "Capture Workspace" instructions.
4. Click on the "Vectorize" icon in the top menu bar (show with label). This will bring up a sub-menu. Using your mouse, select the section you want to vectorize and press ok. You can repeat this step as many times as you like. Place a white piece of paper behind your self-drawn design to help aid if having trouble capturing the area you want to vectorize.
5. You now have Bitmap and Vector data for your object available. They should appear in the Object Manager box. Delete data not needed. If just engraving, delete vector data, if just cutting or marking, delete bitmap data.
6. You are now ready to run your job!

Maintaining Your Camera

Follow these simple tips to keep your camera clean and functioning at peak performance:

Just like with mirrors, you will need to clean the camera lens periodically. Use lens wipes to gently clean the camera lens as needed.

Your camera system comes with a lens cap. When using the camera, remove this lens and keep in a safe place. It is recommended that this cap be placed on the camera lens when the camera is not in use.

Just like with mirror alignment, it may occasionally be necessary to correct the camera offset if the camera is bumped or jostled. Follow the “Correcting Offset Camera Calibration” instructions below.

Camera: Height Calibration

Muse can detect the height of the material using the camera features. It is possible, however, that the height calibration can be jarred out of alignment. To check height calibration, follow these instructions:

Height Calibration Test

1. Remove all objects from the interior workspace, including the honeycomb tray.
2. On the Touch Screen, click the camera icon. A popup screen will appear.
3. Click “New Height Measurement”. You will see a range of numbers appear. If the numbers are all within 5/-5, the height calibration is acceptable. If the numbers are not within 5/-5, you will need to adjust Height Calibration.

Height Calibration Procedure

1. On the Touch Screen, click the settings icon. Then click “Advanced”. Scroll to the bottom of the page.
2. Click “Calibrate Height”. You will receive the following warning:
“Changing Height Calibration may invalidate custom Position Calibration data on the device. It’s recommended to run this before calibrating camera position. If you already have position calibration, this will be incorrect and must be recalibrated if height calibration is changed.”

3. Click “Confirm”. The following instructions will appear:

“This page lets you calibrate the height measurement laser for the camera. It’s recommended to use a stack of 18 US Quarters and opaque tape to reduce the reflectivity. However, if you don’t have this, you can enter a custom calibration material thickness. All objects you use for height calibration must be of identical height. Start with nothing in the laser bed for an initial measurement. Then place three quarters, or your custom material, under the red laser. Click measure, then repeat with more height each time until enough data has been collected.”

Again, it is required that the interior workspace be free of all objects, including the honeycomb tray.

4. Click “Measure”. The laser head will move to a fixed position in the workspace. Place your three stacked quarters under the red beam dot. Click Measure and repeat until 5 measurements are taken. Note that the editable height default is 5.25 millimeters, the height of 3 US quarters. This number can be adjusted for other coins or measuring blocks. After the 5 measurements, the Total Height Measurement should be equal to or greater than 30 millimeters.

It is important to note that when a new height calibration is performed, the position calibration will have to be re-calibrated, as well. This is not the case in reverse, however, and height calibration is not necessary after position calibration

Camera: Position Calibration

This tool allows you to set image offsets at multiple points around the camera snapshot. Whenever the snapshot function is used on materials of similar height, this calibration will be used to fine tune the camera result. You may need to add additional calibration for materials of different heights.

1. On the Touch Screen, click the settings icon and then click “Advanced”. Scroll to the bottom of the page and click “Calibrate Position”. Click “Confirm” and follow the on-screen instructions. They will begin by telling you, “Height calibration and stitching need to be performed prior to proceeding.”

2. Click “Activate”. This will cause the laser head to move to a fixed position in the workspace.

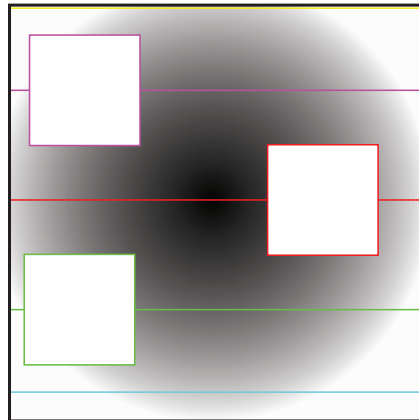
3. Place a sheet of thin material (a sheet of lined paper works well) under the red beam dot. It will be helpful to mark the page with a “+” symbol to create an identifiable target to align with. Remember, your machine’s interior should be empty, including removing the honeycomb tray. Click “Done”.

4. Click “Measure”. The laser head will move to a fixed position in the workspace. Note, that when you select “Measure” for the first time, and the laser head moves to that fixed location, it will set a base height. You will also need to click “Done” between measurements. Place your three stacked quarters under the red beam dot. Click Measure and repeat until 5 measurements are taken. Note that the editable height default is 5.25 millimeters, the height of 3 US quarters. This number can be adjusted for other coins or measuring blocks. After the 5 measurements, the Total Height Measurement should be equal to or greater than 30 millimeters.
5. Click “View”. You will see the camera snapshot of the interior workbed. Click “Done”.
6. Click “Calibrate” and then click “Confirm”.
7. You will be taken to a new screen on the touch panel. At the top of the touch screen, the image you took is displayed. You can zoom and move the crosshairs with your fingers. Pick a spot, preferably your marked crosshairs, and manually maneuver the crosshairs over the mark you put on the paper. Click “Set Calibration Point”. The red dot will move into position over that spot.
8. Next, look at the position of the red dot in the interior of the machine. If it is not directly over your target, use the slow jog buttons to bring the red dot exactly aligned with the mark.
9. When you are satisfied they are aligned, click “Set Offset Point”.
10. You can back up or repeat the process, if desired. Click “Finish”.
11. Click “Confirm”.

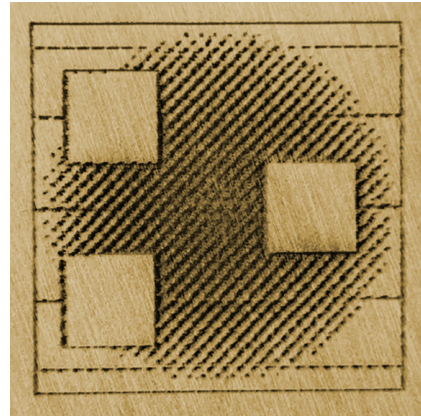
Materials Testing

Muse is capable of cutting a wide range of materials. Common materials include wood, cardboard, paper, fabric, acrylic, leather, and many more. Muse can also engrave on tile, stone, glass, and other hard surfaces. Muse is not designed to cut metal of any type. If you have any questions whether a material is suitable for a CO2 laser, contact the material manufacturer before use.

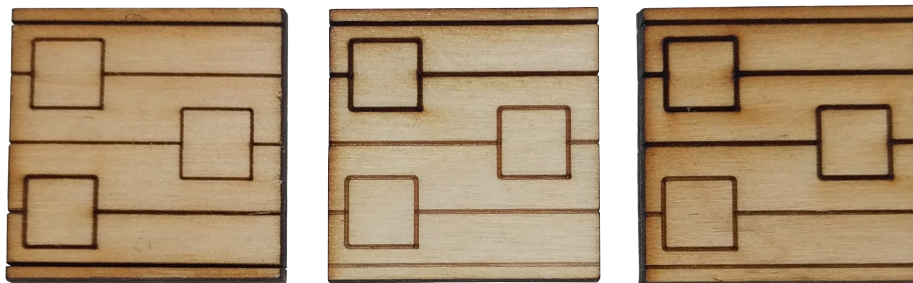
Figure 7.20



Sample File



Dithered Example



Vector Examples from Dark to Light

Using suitable materials will still have wide variance in power, current and speed settings depending on the properties of that material, such as density and thickness. For example, wood can be soft (pine) or hard (oak), depending on the source. Settings will also be determined by vector or raster choices, depth of the cut and overall desired outcomes. This makes it difficult to provide operators with exact settings for each type of material. Instead of giving inaccurate data, operators should become accustomed to material testing.

Full Spectrum Laser provides a free materials test template with suggested starting points in power and speed settings. From there, you can experiment with your own materials testing. Once the perfect settings are determined, we recommend recording those results in a Materials Log.

To access the material test templates, complete material testing instructions and a free materials log, go to <http://laser101.fslaser.com/materialtest>.

SECTION VIII. HARDWARE & MAINTENANCE

With a little care and maintenance, your Muse Laser Cutter will remain clean and continue to run at top efficiency for years to come. Be aware of all safety and maintenance issues with your machine by following all the safety instructions in this manual.

Replacing the Laser Tube

This section provides procedures and a walkthrough to replace the laser tube on your Muse. Although it should last for hundreds of projects, the laser tube is considered a consumable and will eventually need to be replaced. Please carefully read all instructions before beginning the replacement procedure as there are several critical steps which must be properly followed to avoid breaking the laser tube. The included pictures show how to properly connect wires to the tube's electrodes and secure the connections.

REQUIRED PARTS AND TOOLS:

- **45W REPLACEMENT TUBE**
- **2.5 MM HEX WRENCH**



FRAGILE GLASS! *Pulling on the tube wires will break your laser tube at the neck. The water connections are very fragile, DO NOT pull or force the connection tubes— gently work the tubes off of the connectors.*



SHOCK WARNING! *The capacitors in the power supply retain power even after turning the laser off. To ensure your safety, turn off the laser, remove the power cord and wait at least 1 hour before accessing the power supply.*

Replacing Laser Tube Steps

- 1. Power Off Machine:** Power off and unplug your unit. Wait at least 1 hour for capacitors to discharge.
- 2. Disconnect Water:** Detach the water tubes from their connectors on the laser tube and drain the water into a bucket.
- 3. Remove Water Tubes (Step One):** Remove the two (2) water tubes from the bulkheads on the back of the machine and carefully drain any water into a bucket. Use the small piece of tubing that shipped with your laser to shunt the two water bulkheads in the back of the machine together.
- 4. Remove Water Tubes (Step Two):** GENTLY remove the water tubes from the laser glass bulkhead. Be careful not to let any excess water in the tubes spill onto the machine's components.
- 5. Remove Tube Retainer Straps:** Using a 2.5mm hex wrench (included with your purchase), remove the four (4) M5 hex nuts from the two (2) tube retainer straps that hold the laser tube in the rubber restraints.
- 6. Remove Old Laser Tube:** Remove the tube from the rubber holders and carefully set it on top of the machine. Be aware the laser tube is still connected to the machine's wiring. DO NOT pull on the wiring.
- 7. Remove Universal Laser Pin Connector:** Carefully unscrew the universal laser pin connector off the aperture end of the laser tube. Next unclip the connector on the other side of the laser tube. You can now place the old laser tube aside for later disposal.

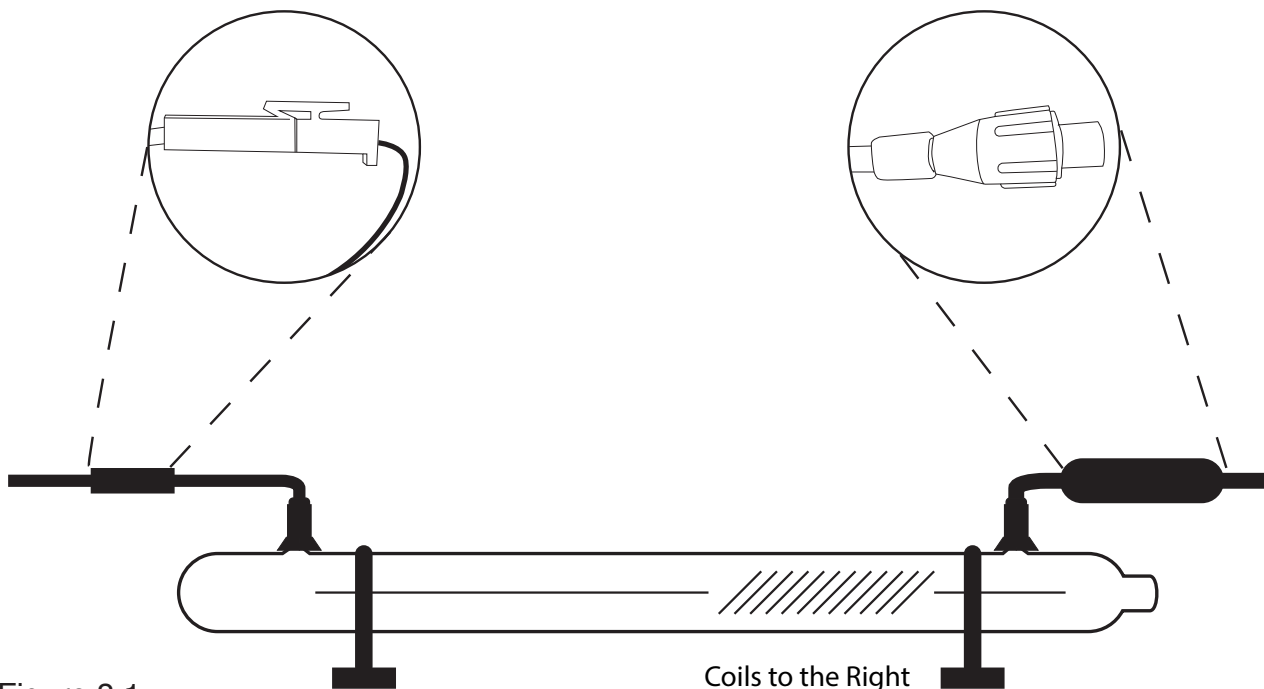


Figure 8.1

8. Reattach Universal Laser Pin Connector: Reverse step 8. Screw the universal laser pin connector onto the aperture end of new laser tube and clip the connector back to the other end of the laser tube.

9. Place New Laser Tube: Place the new tube into the rubber holders in the same orientation as the old tube was in when it was removed (with the glass coils oriented to the RIGHT when facing the machine).

10. Re-Attach Tube Retainer Straps. Gentle place the tube restraining straps back into position over the rubber holders and secure the new laser tube in place.

11. Re-Thread Hex Nuts. CAREFULLY re-thread the M5 hex nuts onto the U-bolt posts and make snug (but not yet tight) with the rear panel.

12. Re-Attach Water Tubes. Carefully re-attach the water tubes to the proper laser connection bulkheads. Make sure that the water tube routing and locations match the original configuration.

We have now switched the old laser tube for the new laser tube.

You will need to retest the mirror alignment and possibly go through the mirror alignment procedure again.

Belt Installation

The belts on your laser system are a consumable item and will eventually stretch beyond a usable length or break. You can contact Full Spectrum Laser support for replacements.



SHOCK WARNING! *The capacitors in the power supply retain power even after turning the laser off. To ensure your safety, turn off the laser, remove the power cord and wait at least 1 hour before accessing the power supply.*



WATER WARNING! *You will be disconnecting the water system and working with the laser upside down. Be sure the machine is dry before proceeding with this process.*

REQUIRED PARTS AND TOOLS:

2.5mm Hex key (included with accessories)

1. BELT INSTALLATION STEPS:

Power Off Machine. Power off and unplug your unit. Wait at least 1 hour for capacitors to discharge.

2. Disconnect Water: Detach the tubes from the rear connectors. Use the small piece of tubing that shipped with your laser to shunt the two water bulkheads together.

3. Loosen Retaining Screws: Loosen or remove the M3 retaining screws and washers so that the old belt can be removed and discarded.

4. Mount Belt: Run each end of the new belt through the mounting slot with the teeth on the inside of the closed loop. The ends of the belt should protrude by approximately 3 teeth (6mm) through the slot. Make sure that the belt forms a flat, closed loop.

5. Tighten Retaining Screws: Tighten the M3 retaining screws to secure and retain the belt. Starting the thread with your fingers can speed the process up.

6. Loosen the idler pulley mount: Once the belt has been installed on the riser, loop over the drive and idler pulleys.

7. Tension the belt: Pull on the Y idler pulley mount with your hand. Moderate to strong force is recommended. If the motors do not jog, verify that the motors are connected to the control card.

Focus Lens Replacement Instructions

Parts: Air Assist Cone (A) – Fitting O-Ring (B) – Air Assist Fitting (C) – Focus Billet (D)
– Focus Lens w/ case (E)

Instructions:

1. Loosen the focus head thumbscrew, slide the focus head to the uppermost position and tighten thumbscrew.
2. Disconnect air hose by gently pulling it.
3. Using a 1.5 hex wrench (not included), loosen the “set” screw, but do not remove.
4. Remove the current air assist cone.
5. Place the fitting O-ring on the air assist fitting and attach to new air assist cone.
6. Place new air assist cone under focus lens and into slot. Tighten “set” screw with a 1.5 hex wrench. Reattach air hose.
7. Slide the current focus lens out of the slot. This does not require tools.
8. Slide new lens into slot.

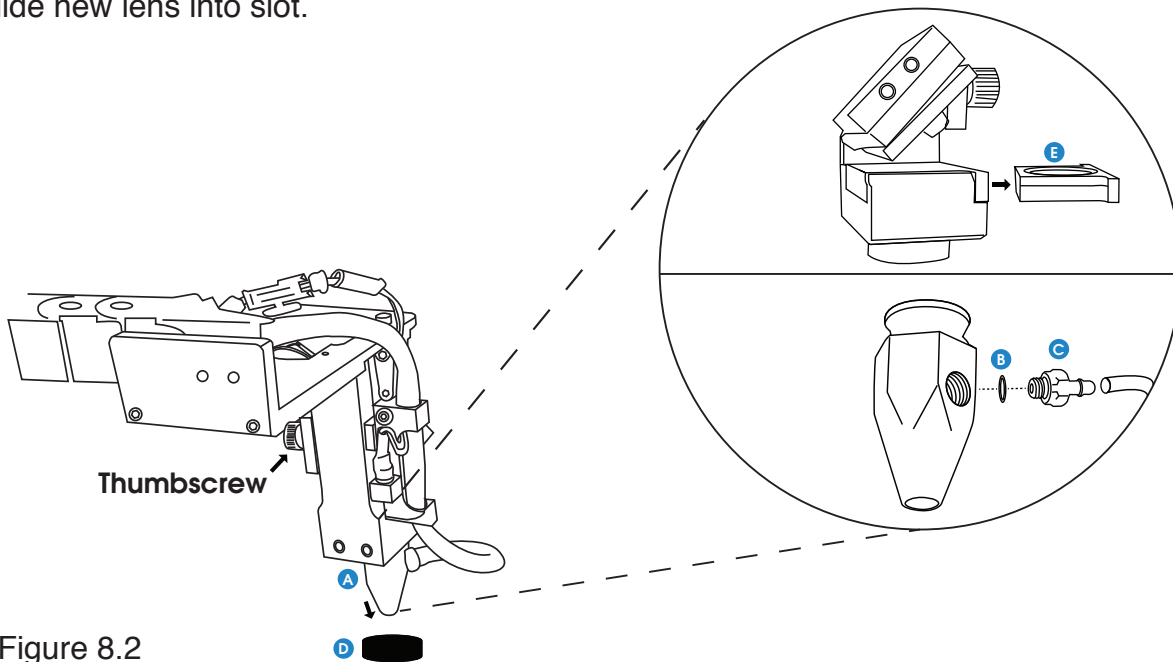


Figure 8.2

Maintenance: The Focus Lens will need, at minimum, weekly cleaning, depending on usage and types of materials used. Only use optical grade lens wipes and gently wipe the surface of the lens clean. Save the case the lens came for storage when switching to a different lens. With any lens, always use the correct focus billet and air assist cone.

Lens Descriptions:

1.5” lens is appropriate for extra fine engravings such as fonts below 6pts.

2.0” lens* has a good combination of fine engraving and thin cutting for fonts between 6pts and 8pts.

2.5” lens is appropriate for cutting up to ¼” of material and engraving detail to around 8pts.

5.0” lens is for cutting thick foam. it is also a good lens for engraving into deep bowls, when more room is needed.

*This is the included lens for Muse

General Maintenance

Before Every Job:

- Always be sure your water, air, exhaust, and power systems are properly assembled and operating normally.
- Be sure that the machine and workspace are clutter-free.
- Be aware of any material warnings and that you are working in a well-ventilated workspace.
- Check that your fire extinguisher is up to regulation and is easily accessible.
- Always follow all safety protocol.

Weekly

- Wipe down the walls the machine with a clean rag.
- Use optical grade lens wipes to clean both sides of the beam combiner, all mirror surfaces, the focus lens, and the tube aperture. Optic surfaces may need to be cleaned more often if cutting materials produce excessive residue (possibly daily).
- Clean fallen debris from the catch tray of the machine. Less excess material will reduce fire risk, and provide for better exhausting.
- Always keep rails, motors and moving parts free from excess material as it can obscure movement and cause damage.

Monthly

- Check rail lubrication. When the laser arrives, you should be able to visibly see the lubricant on the X and Y rails. These rails will not need to be re-lubricated often, but check monthly to be sure that the rails are properly lubricated and aren't grinding or catching.
- Check your fume extractor filters. Depending on your output and the materials being cut, your fume extractor filters may need to be replaced as often as every month (or sooner).

Quarterly

- Change water in cooling system. This will keep your tube safe from unwanted debris, mold or evaporation.
- A chiller system is enclosed and will stay relatively clean and undisturbed, but it is good practice to check and change the water as needed.
- Check for wear on belts. Well lubricated belts should last, however, eventually they may wear and crack and need replacement.

Appendix A: Troubleshooting

As with any machinery, individual user results may vary. In this section we will discuss the most common issues users report and the simple solutions to fix them and get back to work. If you cannot find the solution to your problem in this section, please don't hesitate to contact customer support for personalized discussion of your issue.

PROBLEM: LASER DOES NOT FIRE.

POSSIBLE CAUSE

1. Laser cover is open or magnet wires are disconnected.
2. Water is flowing in the wrong direction or water sensor is not working.

SOLUTIONS

1. Make sure that the cover of your laser is closed during jobs or test fires. Check that the magnet wires are connected to the terminals on the power supply.
 2. Be sure that water is flowing from right to left through the laser tube. If confirmed and issue persists contact support.
-

PROBLEM: ENGRAVED LINES ARE DIFFUSE; CUTTING FAILS EVEN AT HIGH POWER.

POSSIBLE CAUSE

1. Laser is not in focus.

SOLUTIONS

1. Check that your laser is in focus. Rest the included focus billet on top of your work piece. Loosen the lens slide so the output nozzle rests on the focus billet. Retighten the slide.
-

Appendix B: Rotary Attachment Installation

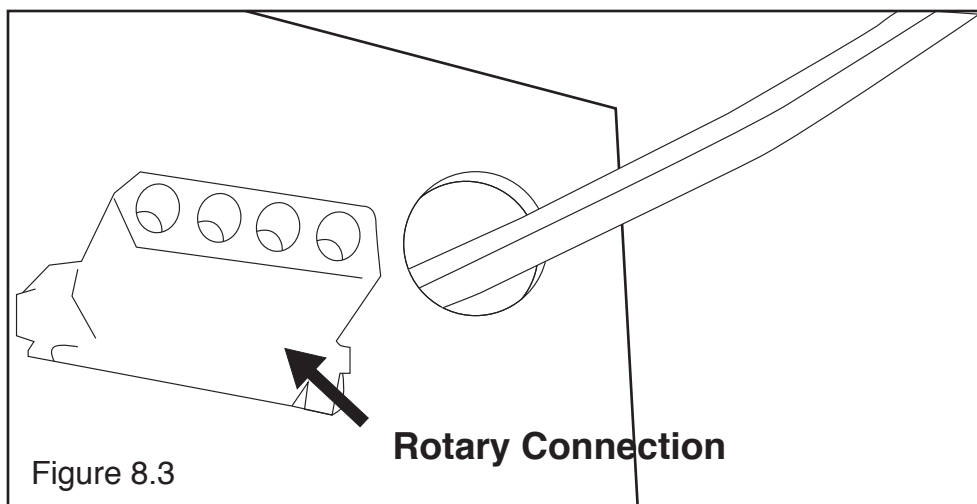
The Full Spectrum Laser Hobby Advanced Rotary Attachment is an accessory to the Muse Laser System and is not included with the base purchase. You can order the rotary attachment from the Full Spectrum Laser website at <http://fslaser.com/Products/LaserAccessories>. The rotary attachment is capable of engraving on objects from 0.25in diameter. This Appendix explains the typical install method of the rotary attachment into a Muse Laser System. Once you have unpacked your rotary attachment, you will need to connect it to your laser's RetinaEngrave 2.0 controller before running any jobs.

ROTARY ATTACHMENT INSTALLATION

The rotary attachment is a friction-wheel type—objects rest on two driven and two idling wheels and are turned to engrave an image onto the surface of a cylindrical object. The rotary attachment works by translating Y motion along a cylindrical surface.

INSTALLATION STEPS

- 1. Power Off Machine:** Power off and unplug your unit. Wait at least 1 hour for capacitors to discharge.
- 2. Position Rotary:** Place the rotary attachment into your laser's work area.
- 3. Connect Rotary:** Find the rotary connector inside the machine under the LCD display. Connect the rotary attachment motor keeping the same orientation as in the diagram below.



PRO TIP! *Once you have connected your rotary attachment, you can activate your laser and move the rotary attachment and laser head into a position to engrave on your workpiece. The red dot should be in the same vertical (X-Z) plane as the center axis of the workpiece.*

Appendix C: Using the Rotary Attachment

The rotary attachment is designed to be used within the laser case, however its maximum engraving diameter can be increased by modifying your laser system's bottom panel. Please be aware that any system modifications must be performed by an authorized technician and in accordance with all applicable state and federal laws.

ALIGNING YOUR ROTARY ATTACHMENT

The best way to align your rotary attachment with the laser head is to build a jig that uses the frame as a reference. This is a very quick process.

- 1. Starting Position:** Focus the laser head onto the rear frame of the rotary attachment on the far left when facing the machine from the front.
- 2. Slide:** With the red dot visible, slowly slide the laser head to the right.
- 3. Align:** Adjust the positioning of the rotary until the red dot tracks back and forth evenly down the center. Note that the rotary is not assembled to the body of the machine but is freestanding. You may need to re-align your rotary each time you use it.

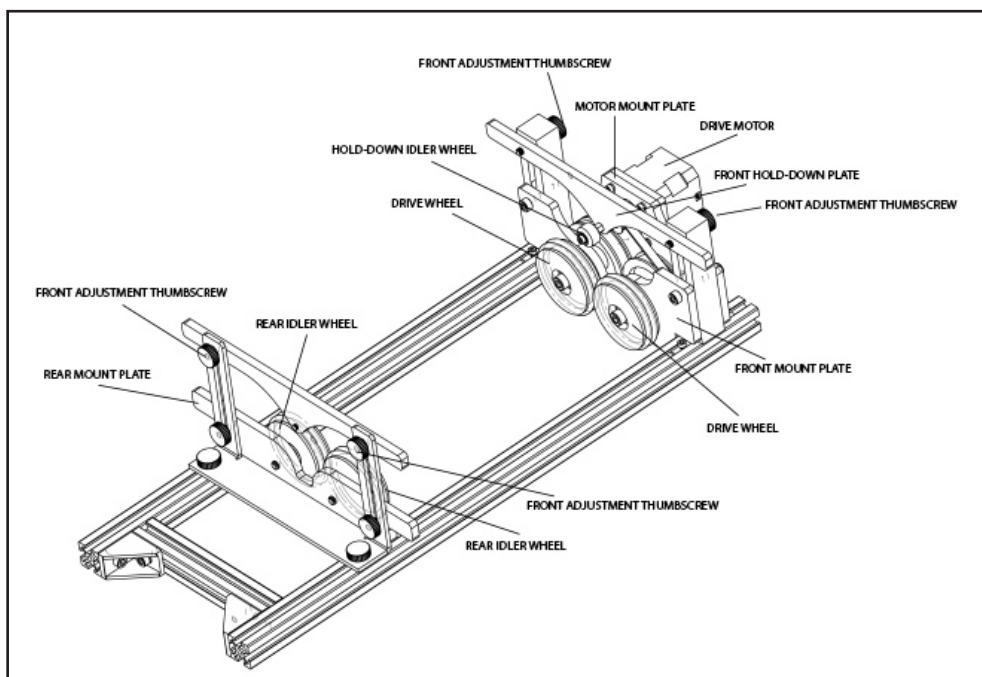


Figure 8.4



PRO TIP! Rotary engraving is best performed along the topmost area of the project. **It is crucial that the rotary be level. Use a small carpenter's level to be sure your rotary is flat within the interior of the laser cutter.**

Appendix D: Warranty Information

Within the first 30 days, Full Spectrum Laser will replace or repair any defective parts free of charge and pay for ground shipping of parts. Overnight shipping is available at extra charge.

Outside the first 30 days, Full Spectrum Laser will replace or repair any defective part within the warranty period free of charge but shipping charges are the responsibility of the customer. The warranty includes parts and labor only. Shipping of defective and replacement components is excluded by the warranty. The customer may arrange their own shipping or drop parts off to exchange parts at our warehouse free of charge. Typically Full Spectrum Laser has most replacement parts on hand for immediate shipment of under warranty parts.

All defective parts must be returned to Full Spectrum Laser postage paid for evaluation before replacements are issued unless otherwise authorized. The warranty is valid for normal use only and excludes Acts of God, user error and use outside of normal parameters. Parts damaged by fires are considered user error if the machine is left unattended. Just like operating a household gas stove, always stand next to the machine with a fire extinguisher and be ready to turn it off in case of a fire and never operate the machine unattended.

Prior to 8/7/2012, the extended warranty was charged separately and the Hobby Lasers had a 60 day base warranty on all items excluding shipping unless an extended warranty was purchased.

After 8/7/2012, the Hobby lasers have a 60 day warranty on all items and a free extended limited 1 year warranty which excludes consumable items/shipping included in their price. The limited warranty excludes shipping and consumables and other normal wear and tear items. All electronic items (control cards, power supplies, motors) and most mechanical items are covered under the extended warranty unless damaged by abuse/fires. Consumables not covered include, but are not limited to, rubber parts such as tubing, belts, plastic wheels, lenses, mirrors, other optics, and laser tubes.

Within the first 30 days the original purchaser may transfer the balance of your warranty to anyone else free of charge provided you notify us in writing. Outside of the first 30 days, we will only provide warranty and tech support services to the original purchaser unless a warranty transfer fee is paid as there is a cost involved with initial tech support of new users and accounting fees. If you sell your machine, the warranty remains valid but the buyer must arrange with the original purchaser to request RMAs and send in the machine for repairs unless a warranty transfer fee is paid.

Please Note: Full Spectrum Laser DOES NOT offer warranties or customer support for 3rd Party replacement parts, including replacement laser tubes. Use of such parts may not be compatible with Full Spectrum Laser machines and can cause damage to your laser system.

Go to <http://fslaser.com/service-and-support> for most current warranty postings.

Appendix E: Customer Support

Full Spectrum Laser provides the best customer support in the industry. Contact us if you have any questions or issues with your Muse Laser Cutter. We can also offer convenient purchasing of accessory upgrades and replacement of consumable items. Refer to this sheet for all your customer support and reordering needs.

PLEASE CONTACT OUR TEAM:



SUPPORT

M-F 8am to 5pm (PMT)
support@fslaser.com
702.802.3103



MANUALS

For a PDF of the user manual, warranty & video tutorials:
fslaser.com/support



SALES

M-F 8am to 5pm (PMT)
sales@fslaser.com
702.802.3101



SOFTWARE

Access RetinaEngrave 2.0 by typing IP address displayed on the touch screen into your browser

ORDER ACCESSORIES & UPGRADES

LASER TUBES

45W Laser Tube

FOCUS LENSES

1.5" Lens, 2" Lens, 2.5" Lens, 5" Lens

EXTRACTORS & FILTERS

Large Fume Extractor

Large Filter Replacements

Medium Fume Extractor

Medium Filter Replacements

Small Fume Extractor

Small Filter Replacements

AIR ASSIST

Air Compressor, Exhaust Fan, Large Exhaust Fan

ROTARY ATTACHMENTS

Friction Rotary

WATER ASSIST

Water Chiller, Advanced Water Chiller

Appendix F: Workflow Checklist

Project Workflow

The RetinaEngrave 2.0 software works with your Muse to create a simple and intuitive set of operations that is easy to learn and use. With experience, you will find your Muse achieving amazing results following this procedure. Use this Project Workflow List for the “best practice” sequence for any project and follow the step-by-step instructions from start to finish.



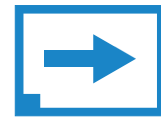
1. Create Design:

Create your design in the program of your choice. **Note:** Files should be created with laser cutting considered.



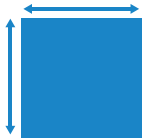
2. Connect to Software:

Link your Muse to the software by typing the IP address found on the Touch Screen (Settings>Network>Copy IP) into your browser (Google Chrome Suggested).



3. Import Design:

Using direct print from your design program, or by drag-n-dropping the file into the RetinaEngrave 2.0 workspace, import your design to the software.



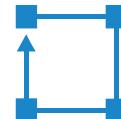
4. Place Material:

Place your material into the laser bed workspace.



5. Focus:

Using the included focus billet, focus the laser to the material (consult your user manual).



6. Align Laser to Material:

Using either the perimeter tool, or camera function (see camera features), align your design on the appropriate area of your material.



7. Adjust Object Properties:

Using the Properties Manager Window, adjust your Vector or Raster settings for your cut, mark or engraving.



8. Run Job:

Double check your safety precautions and accessories, and press the “play” button to start the job.

Appendix G: Focus Lenses

There are a variety of lenses available for your Pro-Series machine, each specializing in a different cutting thickness or level of engraving detail. The lenses are listed by “inches” which is not an indication of the lenses’ physical size, but rather the focus distance from the material. All Pro-Series machines come standard with a 2.5” lens. See below for the recommended lens for different needs. You can order new or replacement lenses at <http://fslaser.com/Products/LaserAccessories>.

2.5” Focus Lens

Full Spectrum Laser’s Pro-Series comes standard with a 2.5” lens which is good for cutting up to ¼” of material and engraving detail to around 8pt fonts with a 90w tube. Other lenses are also available that offer different levels of precision, depending on the goals of the project. If you need to ever replace your 2.5” you can order a new one at <http://fslaser.com/Product/FocusLens2-5in>.

2” Focus Lens

If you are requiring finer engraving and thinner cutting, such as fonts below 8pts, we recommend the 2” lens. The 2” lens has a good combination of fine engraving and thin cutting. A short focus lens has a smaller minimum spot size but spreads out more quickly after reaching the focus making them better for fine detail but not good for thick cutting. A long focus lens keeps the focus longer allowing for straighter edges but does not focus down to as small a minimum spot. To order a 2” lens go to <http://fslaser.com/Product/FocusLens2in>.

1.5” Focus Lens

If you are requiring extra fine engraving such as fonts below 6pts, we recommend the 1.5” lens. This is a short focus lens has a smaller minimum spot size but spreads out more quickly after reaching the focus making them better for fine detail but not good for thick cutting. To order a 1.5” lens go to <http://fslaser.com/Product/FocusLens1-5in>.

5” Focus Lens

This optic is appropriate for cutting thick foam. The 5” lens has a large spot size, when focused, which prevents it from being ideal for cutting wood and acrylic. It is also a good lens for engraving into deep bowls, where you need more working space. To order a 5” lens go to <http://fslaser.com/Product/FocusLens5in>.

Join the Full Spectrum Laser Community

Full Spectrum Laser invites you to join our community of hobby makers and professional manufacturers through our social media channels (Facebook, Twitter, Tumblr, etc.). We always have something positive to say about hobby maker culture or the industry we work in. You can follow us as we cross the country going to conventions and maker events or just check out all the awesome stuff we make. Best of all, we offer all those designs for all those projects we make with our laser cutters and 3D printers for FREE. Join our community and see what all the excitement is about.



www.facebook.com/fslaser

www.twitter.com/fullspeclaser

www.instagram.com/fullspectrum

www.tumblr.com/blog/fslblog

www.youtube.com/user/FullSpectrumLasers



Full Spectrum
LASER

Ready to go Professional?

Have you gotten the most out of your hobby laser? Have you hit the limits of your output quotas and want to see how the professionals do it? Step up to Professional Grade with Pro-Series by Full Spectrum Laser.

Our Pro-Series C02 and Fiber Laser Cutters take your production to the next level. Industrial grade components give you faster movement, better precision and increased laser power. All Pro-Series lasers come with our RetinaEngrave 2.0 software, motorized z-stage, autofocus, knife edge and honeycomb trays and all necessary accessories included standard.



Full Spectrum

LASER



