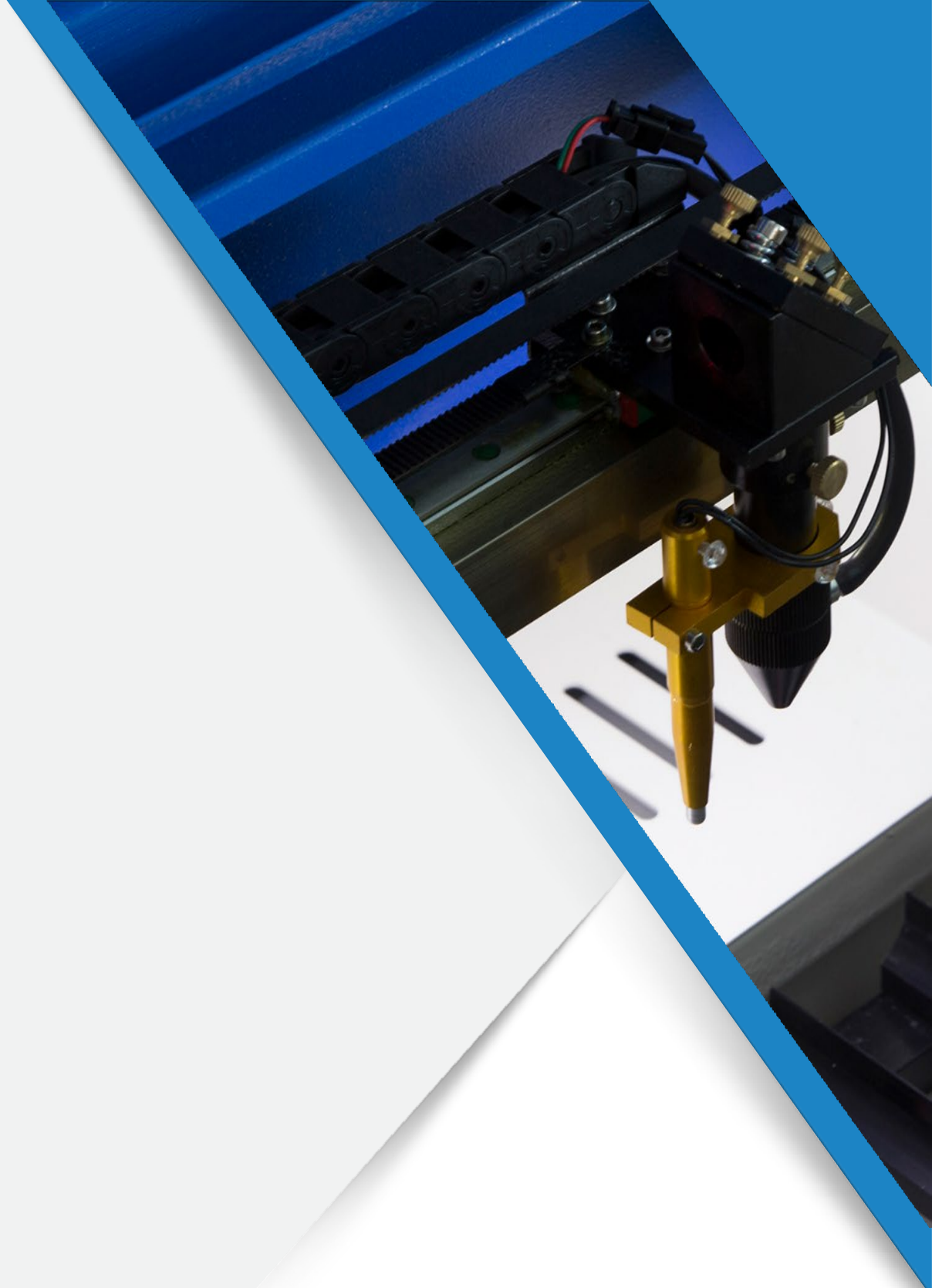


# PRO-SERIES



**Full Spectrum**  

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LASER

Pro-Series Laser System User Manual: PS20 & PS24



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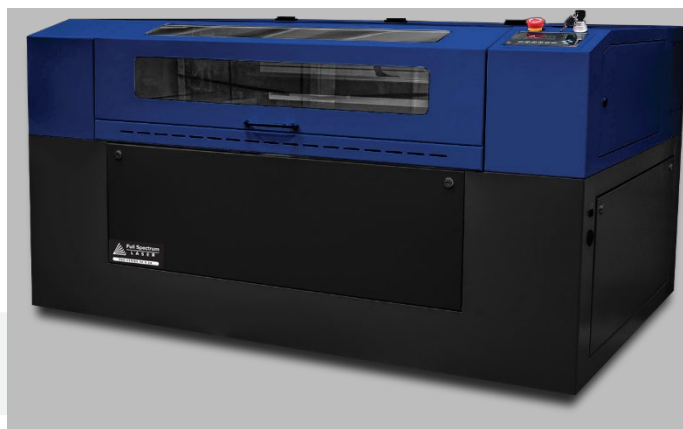
# Pro-Series Laser System User Manual

Congratulations on your purchase of a Full Spectrum Laser Pro-Series Laser System. With proper usage and upkeep, your PS20 or PS24 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.



## PRO-SERIES PS24

## PRO-SERIES PS20



### COMPLIANCE STATEMENT

The Full Spectrum Laser Pro-Series Laser System is a class 3R laser product, as defined in International Standard IEC 60825-1. The Full Spectrum Laser Pro-Series Laser System complies with 21 CFR 1040.10 and 1040.11, the Federal Performance Standards for Light-Emitting 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.

# 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.



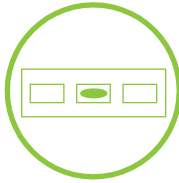
## Fragile Icon:

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.



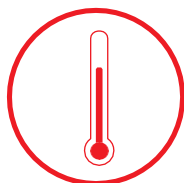
## Fire Icon:

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 uncrate 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 CO<sub>2</sub> 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 buildup 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. 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 guidelines 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 any panel removed.

**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** operate the alignment laser without the focus lens in place. The unfocused beam can be reflected out of the chassis.

**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).



## Laser Safety (cont.)

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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 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.

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# 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.

**ALWAYS** keep a properly maintained and inspected 5lb or larger fire extinguisher on hand. Full Spectrum Laser recommends a Halotron 1 fire extinguisher or a multipurpose dry chemical fire extinguisher. Halotron 1 extinguishers are more expensive than a dry chemical, but offer certain advantages should you ever need to use an extinguisher. The Halotron 1 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.

**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 material, 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

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The power supply is capable of outputting DC 20,000V at up to 30mA—always make sure to give the supply capacitors adequate time to discharge before accessing the electronics area. 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 large red button (e-stop) located on the top of the case in the far right. This is a normally-open twist to release button. To power the laser down, simply press the button down until it locks. To power the laser up, twist the button clockwise according to the indicating arrows on the surface of the button.

**IN CASE OF A BLOWN FUSE** determine the cause of the overload before replacement to protect the machine from damage.

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# SECTION II. UNCRATING

## Pro-Series Toolbox Parts

Your laser ships with a toolbox containing the following parts and accessories:

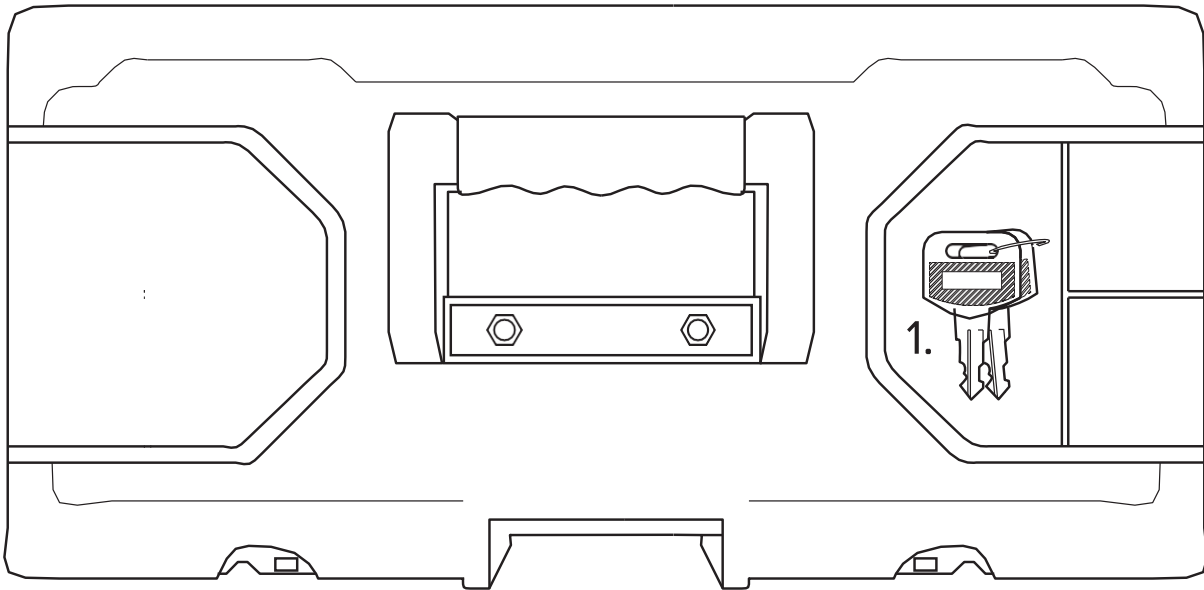


Figure 2.1

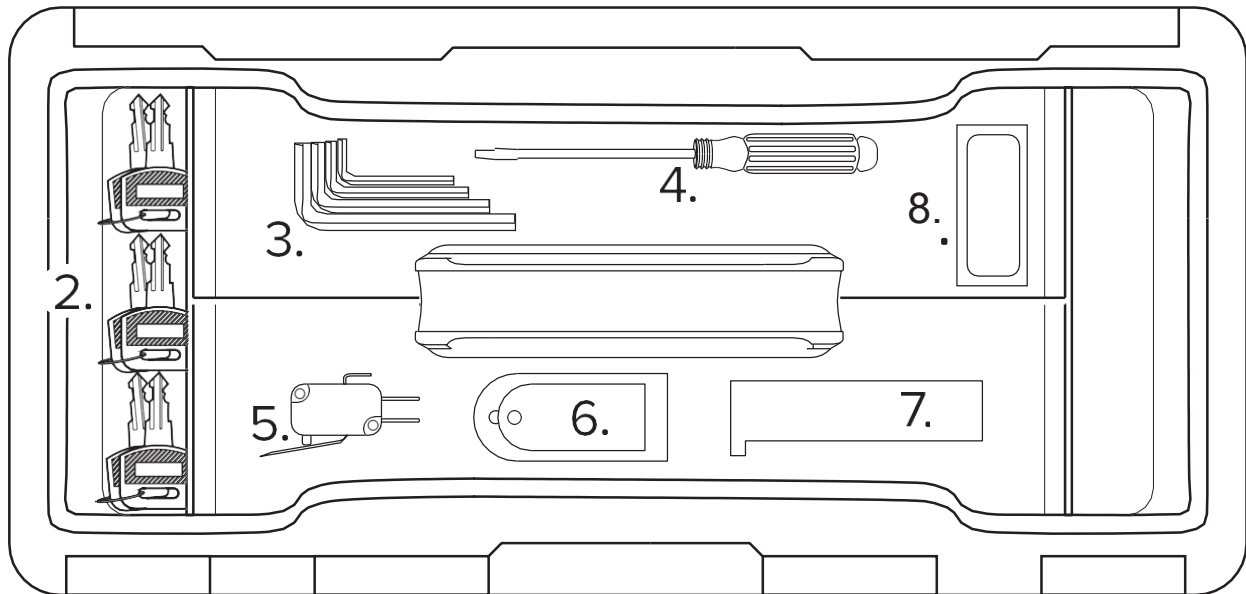


Figure 2.2

**1. Ignition Keys**

**2. Door Panel Keys**

**3. Hex Wrench Set**

**4. Screw Driver**

**5. Spare Limit Switch**

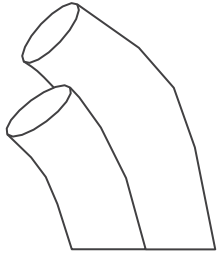
**6. Lens & Mirror Removal Tool**

**7. Focus Ruler**

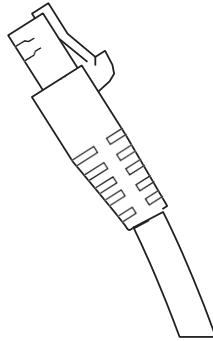
**8. Thermal Paper**

# Pro-Series Parts & Accessories

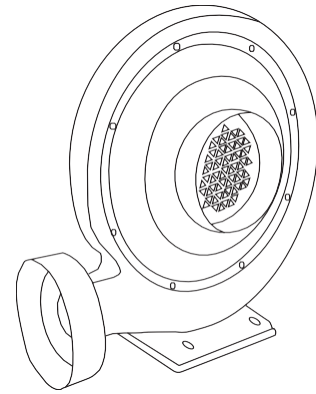
Your laser shipped with the following included parts and accessories:



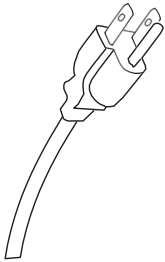
**1. Water Tubes  
(Toolbox)**



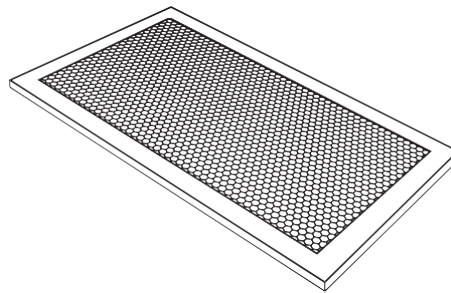
**2. Ethernet Cable**



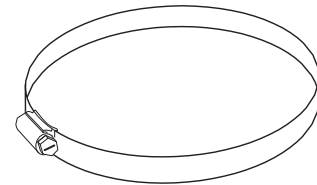
**3. Exhaust Fan**



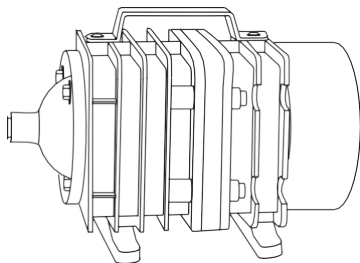
**4. 110v Main Machine  
Power Cord**



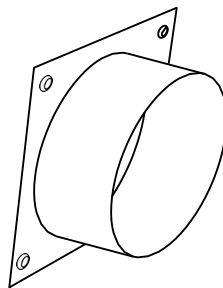
**5. Honeycomb Table**



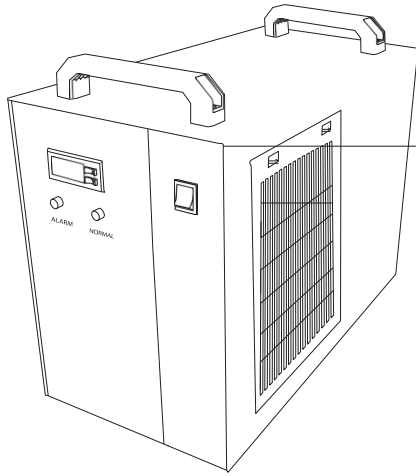
**6. 4" Exhaust Tube Band  
Clamps (3) (Toolbox)**



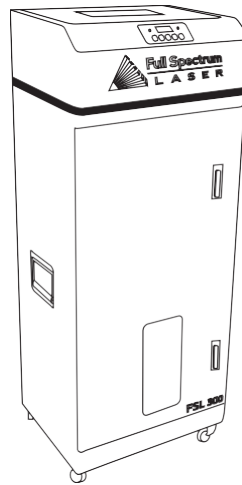
**7. Air Compressor**



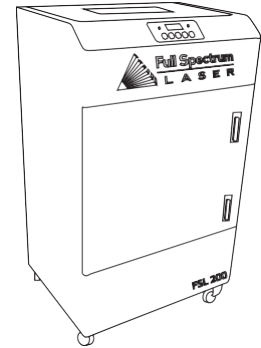
# Optional Upgrades & Recommended Accessories



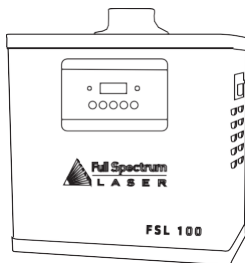
**1. Water Chiller**



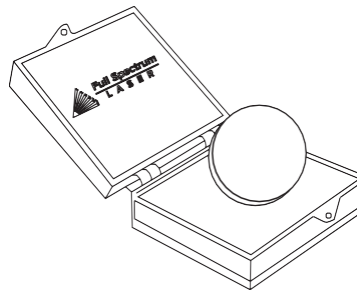
**2. Large Fume Extractor**



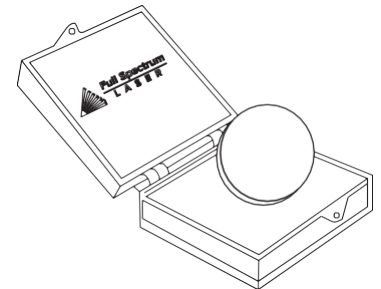
**3. Medium Fume Extractor**



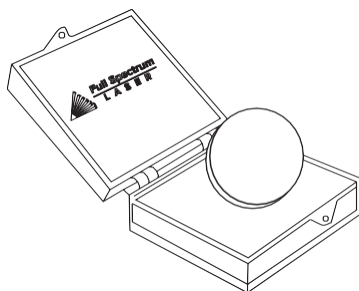
**4. Small Fume Extractor**



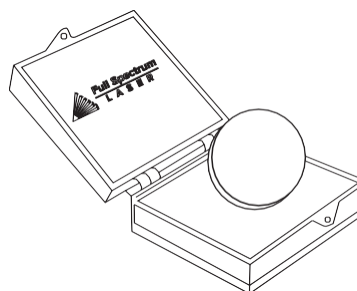
**5. 1.5" Focus Lens**



**6. 2.0" Focus Lens**



**7. 2.5" Focus Lens**



**8. 5" Focus Lens**

# Uncrating Your Pro-Series Laser System

When your Pro-Series PS24 (or PS20) Laser System arrives, it will require careful uncrating and examination of parts. Follow these instructions for best results.



**ATTENTION!** *Be sure to keep the box crate and the packing material used during shipping in case you need to return the machine for warranty service.*

**1. Create a Work Space:** You will need a large, level floor space to place your laser cutter. A clean, open and well-ventilated area is best. Be sure the workspace is free of fire hazards and always have a fire extinguisher handy in case of emergency.

**2. Carefully Open Wooden Crate:** Your machine will arrive packed in a large wooden crate and will require a forklift to move. Set the crate on a flat space near where you will place the machine. Open the crate carefully, starting with the top. If you use tools to open the crate, be careful not to touch the machine or any packed accessories. Always use all tools with caution and only as specified by the manufacturer. Next open the sides of the crate and clear away the wood panels.

**3. Remove the Machine from the Crate:** With the foam packaging intact, carefully lift the machine and place it in your floor space. The Pro-Series PS20 and Pro-Series PS24 will require a forklift to place the machine in your workspace.

**4. Remove Accessories:** Some of the accessories are zip-tied to the front beam attenuator, Cut the zip tie and remove the bags with cords and small accessories. If you ordered a water chiller, it is shipped within the crate in a separate box. The air compressor is shipped in a separate box with the exhaust fan inside the crate as well. Also, inside the machine is a toolbox with more parts and accessories. Inspect these parts to insure they are accounted for and intact.

**5. Remove Honeycomb Table:** Remove honeycomb table from work area and remove the thin foam sheet. Once we have removed the packaged ducting, we will insert it on top of the knife blade table.

**6. Insert the Honeycomb Table:** Place the honeycomb into the laser cutter machine body and lay flat. Be careful not to hit other machine components during this procedure.

**7. Inspect the Machine:** Examine your Pro-Series machine for defects and breakage. In particular, check that there are no cracks or breakage on the glass laser tube. If you find any defects or breakage, contact your sales representative immediately. Have pictures of the damage ready to share. Otherwise, your laser system is now ready to assemble.

# SECTION III. INSTALLATION & ASSEMBLY

With your laser system uncrated and placed in its permanent work space we can now assemble the operating systems. This is a simple process that should take less than an hour to complete. The following stages will be described in detail.

## Assembly Stages:

1. **Remove the Zip Ties**
2. **Connect the Exhaust**
3. **Install Laser Tube**
4. **Connect the Water Chiller**
5. **Assemble the Air Compressor**
6. **Connect Power**
7. **Connect the Ethernet Cable**
8. **Connect to RetinaEngrave v3.0 Software**

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

1. **2 Gallons of Distilled Water**
2. **Internet Connection (to connect to software)**
3. **Flathead Screwdriver**
4. **Clippers**



# Assembly Stage 1: Remove Zip Ties

To secure the machine during shipping, zip ties are used to hold secure the drive belts. These must be removed before operating your laser system for the first time.

**1. Locate Zip Ties:** The motion system is restrained by three (3) zip ties: one on the X-Axis drive belt, and one on each Y-Axis drive.

**2. Cut and Remove Zip Ties:** Using a small pair of clippers (nail cutters work remarkably well), carefully cut and remove all three (3) zip ties listed above. Be careful NOT to damage any part of the machine during this process.

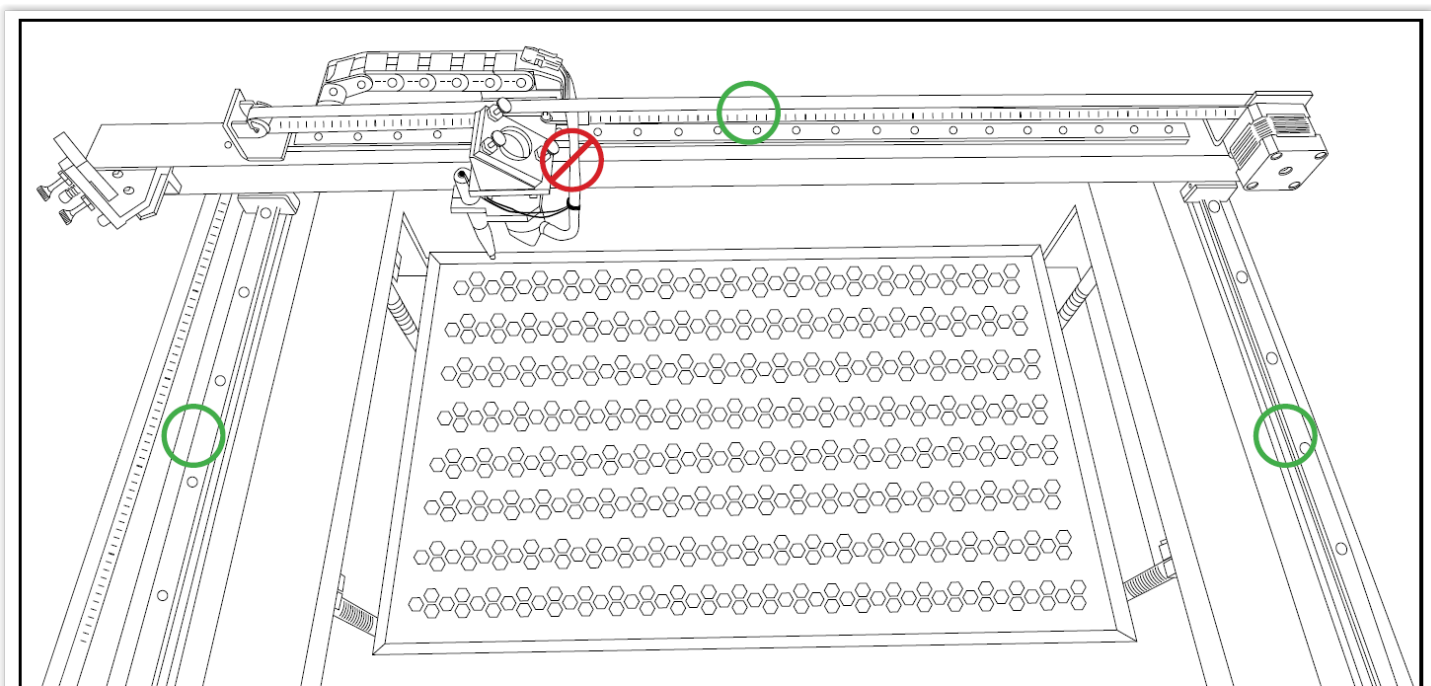


Figure 3.1

○ = Cut    ⊘ = Do Not Cut

# Assembly Stage 2: Connect the Exhaust

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

**1. Attach Exhaust Flange:** Remove the included flange from the toolbox and attach it to the back of your machine using four (4) 3.0 hex screws.

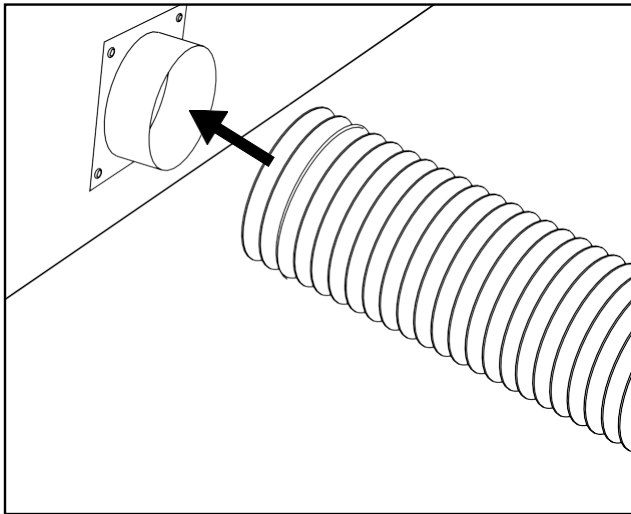


Figure 3.2

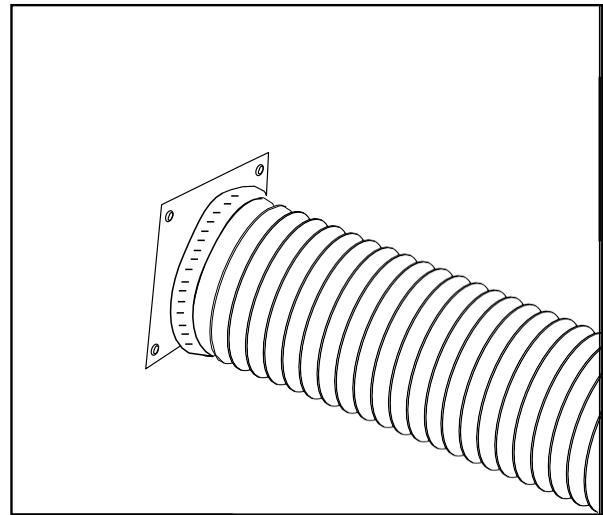


Figure 3.3

**2. Secure with Ducting Clamps:** Place your 4" ducting around the flange. Secure and seal the ducting to the exhaust port using the included 4" ducting clamps.

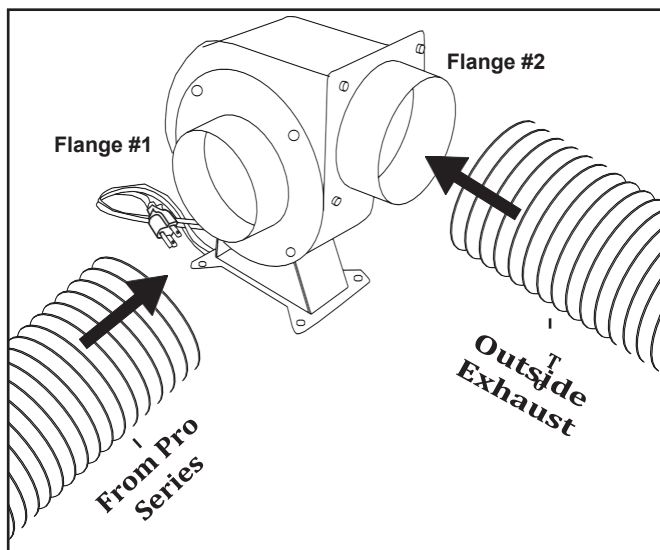


Figure 3.4

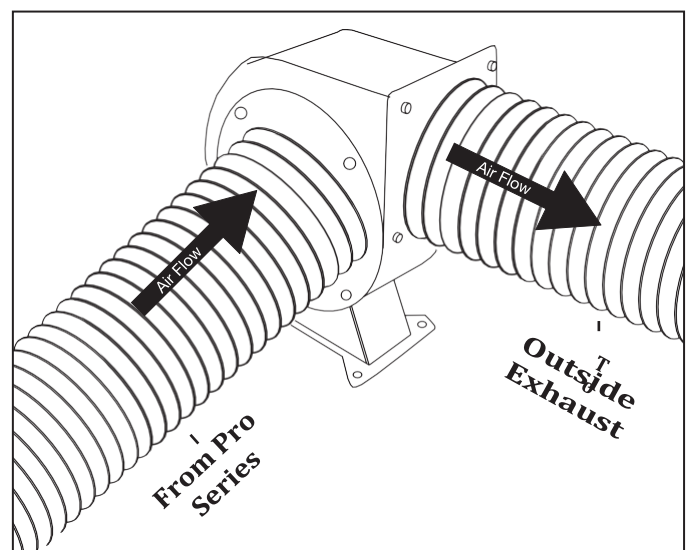


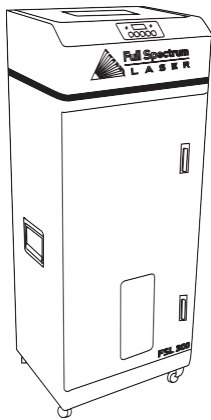
Figure 3.5

**3. Attach Exhaust Fan:** Secure the ducting connected to flange side #1 of the exhaust fan (see figure 3.5). Now repeat the ducting and clamping process on flange side #2, creating a sequence of machine to ducting to exhaust fan to second ducting.

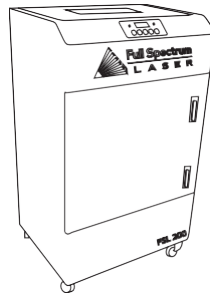
**4. Ventilate Outside:** Attach the open end to an installed ventilation outlet. Check your system for leaks—most can be remedied with duct tape. Please be aware that the protective housing is not designed to be airtight; the front grill is designed to allow an exhaust system to draw fresh air through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

**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 an exhaust fan or 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>. For the PS20 and the PS24 systems we recommend the Large Fume Extractor: <https://www.fslaser.com/Product/LargePurifier>.

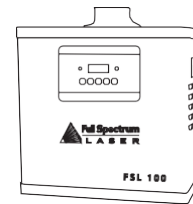
**FSL300 Fume Extractor**



**FSL200 Fume Extractor**



**FSL100 Fume Extractor**



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

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.

# Assembly Stage 3: Install Laser Tube

Please carefully read all instructions before beginning the laser tube installment procedure as there are several critical steps which must be properly followed. Remember to never operate your laser without properly installed air and water systems running. **Note: if you purchased a PS20, the laser tube came pre-installed, and you can skip this procedure.**

**1. Prepare the Laser Tube Mount:** Using a small 2mm hex wrench, unscrew and remove the two (2) M4 screws from the mounting. Keep these screws close by as they will be reinserted after the laser tube is mounted and connected.

## Rear View of Laser Tube

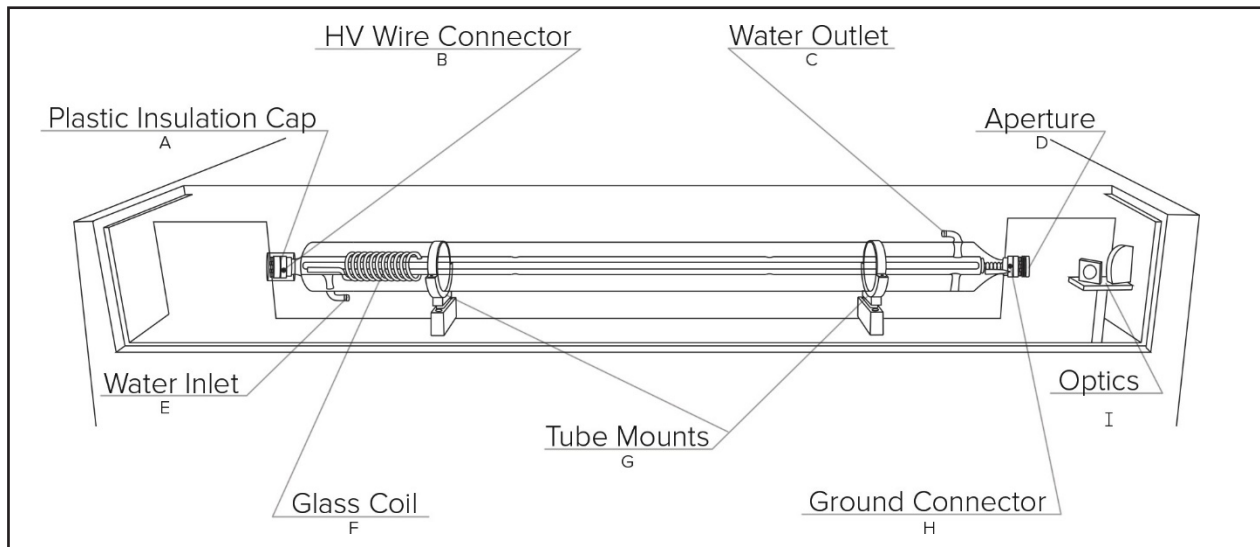


Figure 3.6

## Tube Mounts

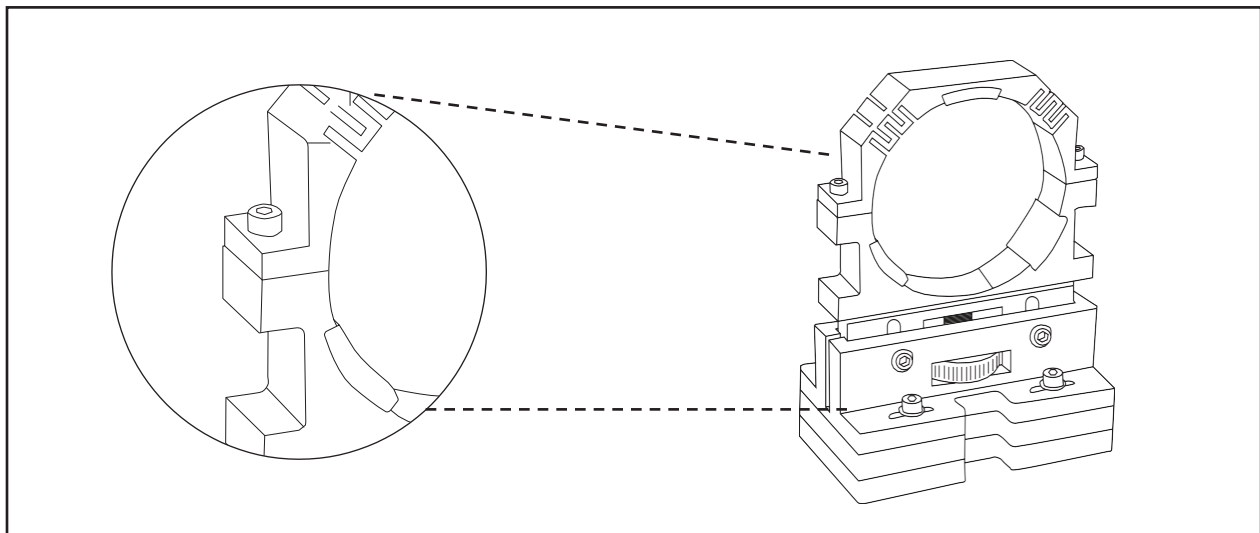


Figure 3.7



**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.

**2. Position the Laser Tube:** Take special care how you position the laser tube in the mounts. Incorrect positioning can cause the laser to misfire and damage your machine or create an extreme shock hazard. Facing the back of your machine, the end of the laser tube with the plastic cap should be pointing to your LEFT (away from the optics). The aperture (D) should be oriented to the RIGHT and pointed toward the optics ( I ).



Figure 3.8

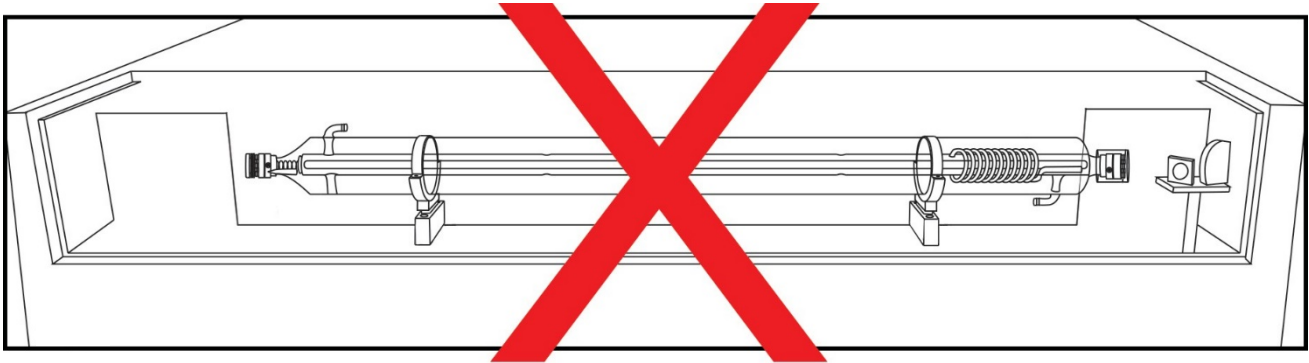


Figure 3.9

Another way to tell if your laser tube orientation is correct is to look at the glass coil (F) on one side of the tube. When properly installed and positioned, the glass coil will always be on the LEFT when viewing the machine from the back.



**ATTENTION!** *Your laser tube may come with labeling that is right side up OR upside down when the tube is properly installed. DO NOT use the label as a guideline to orientating your laser tube.*

**3. Attach the HV Wire.** Carefully remove the plastic insulation end-cap (A) and set it aside where you can find it again. Again, when facing the machine from the back, the end cap should be on the LEFT of the properly positioned laser tube. You will be reinserting it into the same position once the red HV wire is connected. With a small Philips screwdriver, carefully remove the screw and attach the red HV wire as shown below. Ensure that the screw is tightened firmly. Once this is completed, gently reinsert the insulation cap back to its original position. Make sure the cap is pressed on as far as it will go or there is a possibility of electrical arcing when your machine is in use.

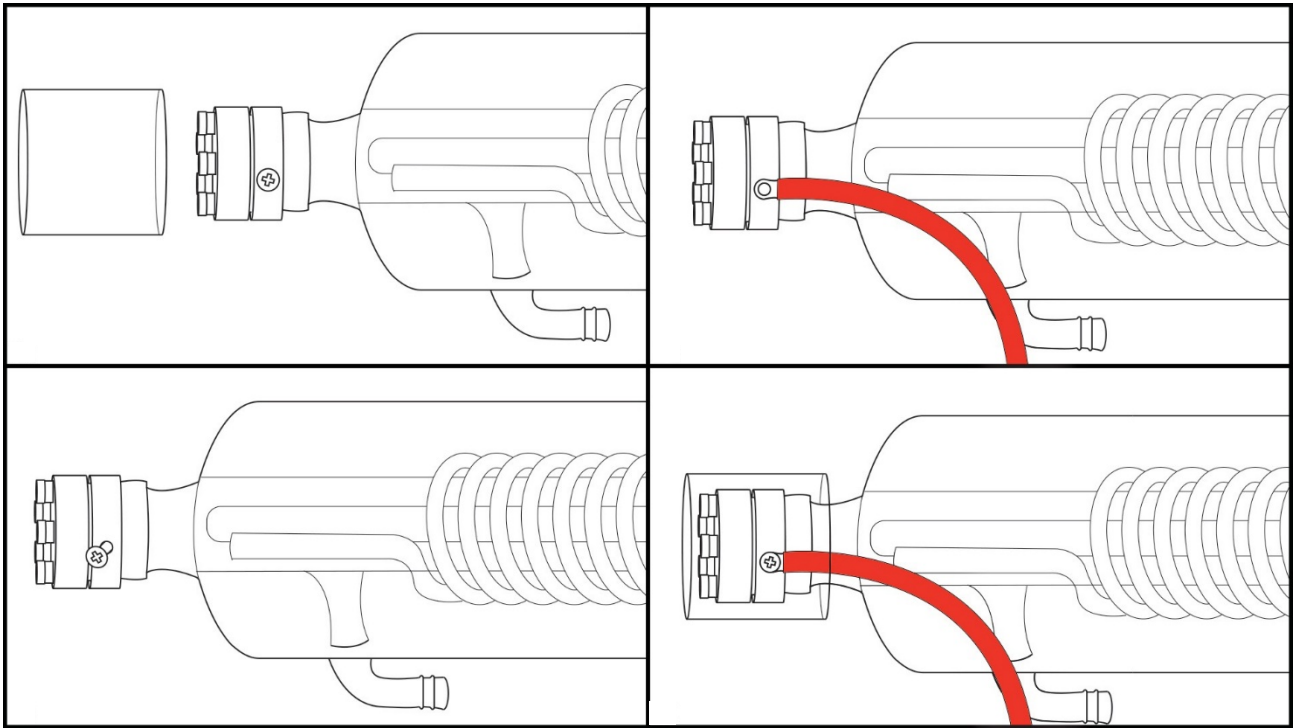


Figure 3.10



**FRAGILE!** *The most fragile part of the laser tube is the “pinch-point” located either next to the HV wire connection or the aperture, depending on the manufacturer. Take extreme care not to hit this point (or any glass surface) with your hands or tools during installation.*



**CO2 GAS!** *Your laser tube is filled with CO2 gas. While carbon dioxide is a class 2.2 gas (non-flammable and non-toxic), release of this gas from the laser tube will render your laser inert.*



**AVOID SHOCK!** When powered, the red HV wire conducts 25,000V and must be installed carefully not to arc. Closely inspect the red wire to ensure there are no kinks in the red laser wire and there are no breaks in the insulation. Avoid sharp bends and never put any loops in the red laser wire. Never touch any exposed metal parts or broken parts of the red laser wire as these will spark out. Use your best judgment to ensure the tube has adequate clearance from the left wall and the optics on the right.

**4. Attach the Water Tubes.** Carefully attach the water tubes as demonstrated below. For best results, moisten the glass receptor slightly (licking your finger works fine) and slowly turn the water tube until it is in a secure position. Do this for both the water inlet and the water outlet. Next, the laser tube so that the water inlet is directly below the laser tube and the water outlet is directly above.

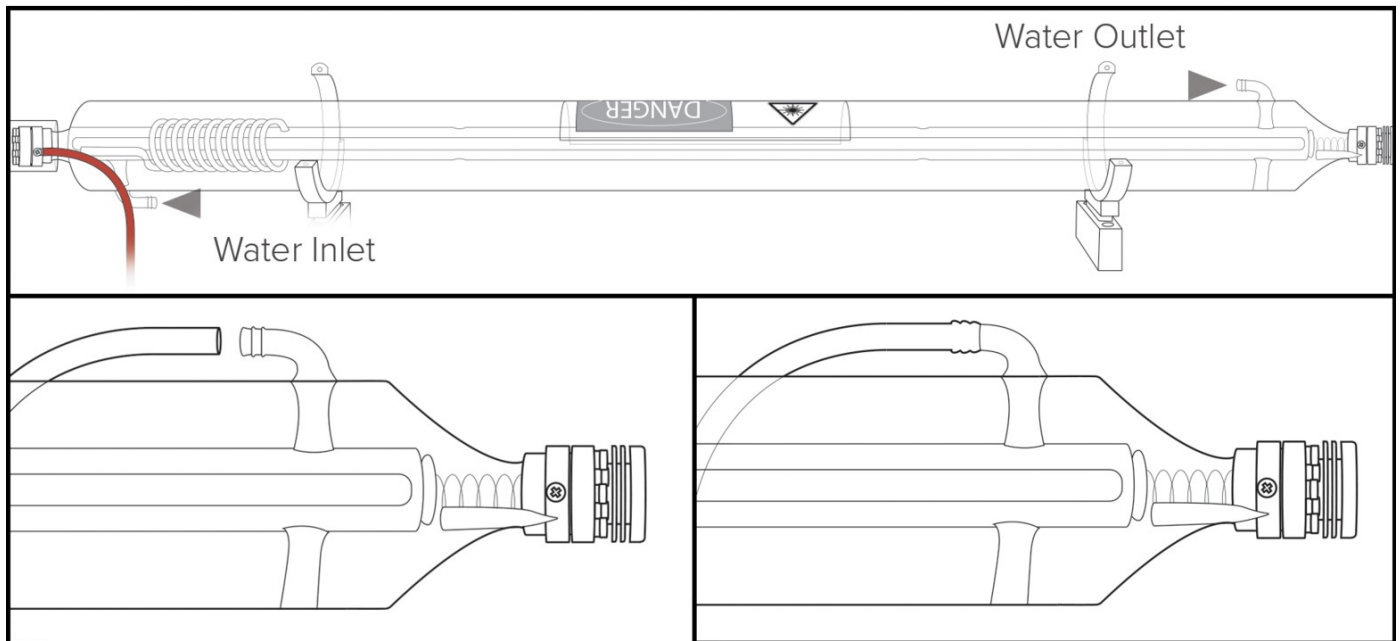


Figure 3.11

**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.



**5. Ground the Connector.** Carefully attach the black ground wire (found on the RIGHT side of machine, when facing it from the back) with a Phillips screwdriver to the aperture (D) as shown below.

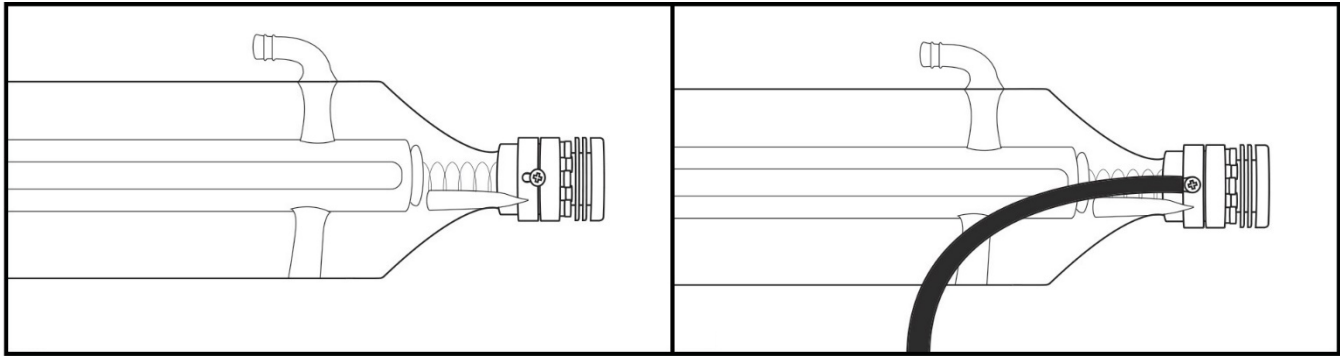


Figure 3.12



**FRAGILE!** *Once again, be aware of the fragile glass “pinch-point” near the black ground wire or the HV wire when using tools during installation.*



**CO2 GAS!** *Your laser tube is filled with CO2 gas. While carbon dioxide is a class 2.2 gas (non-flammable and non-toxic), release of this gas from the laser tube will render your laser inert.*



**AVOID SHOCK!** *Inspect the laser tube carefully and compare it to the diagrams once more to be sure it is properly positioned and that the aperture is orientated to the optics. Now inspect the insulation cap and be sure it is tightly in proper position. Next, examine the water tubes and be sure they are properly attached and rotated.*



**6. Secure the Mounting.** Using the two (2) M4 screws you put somewhere safe (from step one), gently reassemble the mounting and secure the laser tube in place with your 2mm hex wrench. Your laser tube is now ready for test firing.

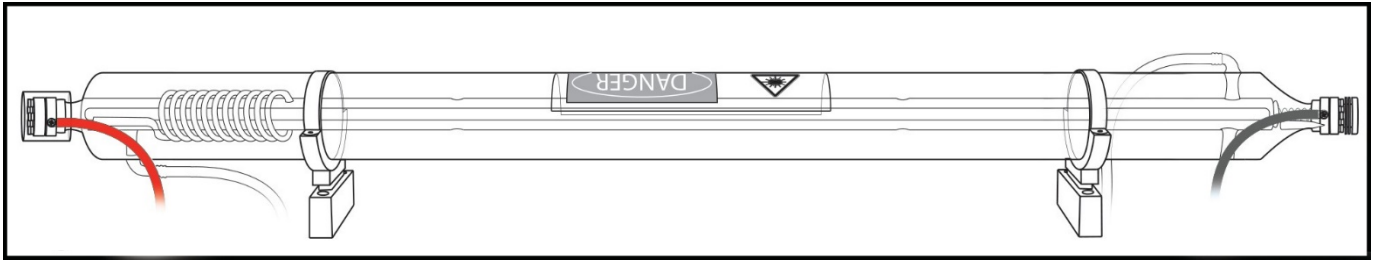


Figure 3.13



**ATTENTION!** Full Spectrum Laser is NOT responsible for damages to your machine or laser tube due to improper user installation (see your warranty for full details). If you have any doubt as to the installation process presented in this document, contact our customer service team at [support@fslaser.com](mailto:support@fslaser.com) to confirm your laser tube installation is correct and safe for use **BEFORE** you operate your laser cutter. Be sure to have pictures ready for the quickest and most thorough review.

# Assembly Stage 4: Connect the Water Chiller

Your laser uses a water-cooled continuous beam CO2 laser tube. The tube requires a flow of room temperature (or cooler) water to regulate the temperature of the resonance chamber. You purchased either the radiator water chiller (which cycles water at room temperature) or the advanced refrigerated water chiller (which cools the water to a constant temperature). Regardless of which system you have, both are easy to install.

**1. Add Water:** Unscrew the cap at the top of the water chiller and fill with water. Always use only distilled water. The radiator water chiller takes approximately 2 gallons of distilled water; the advanced refrigerated water chiller requires 1-2 gallons of distilled water.

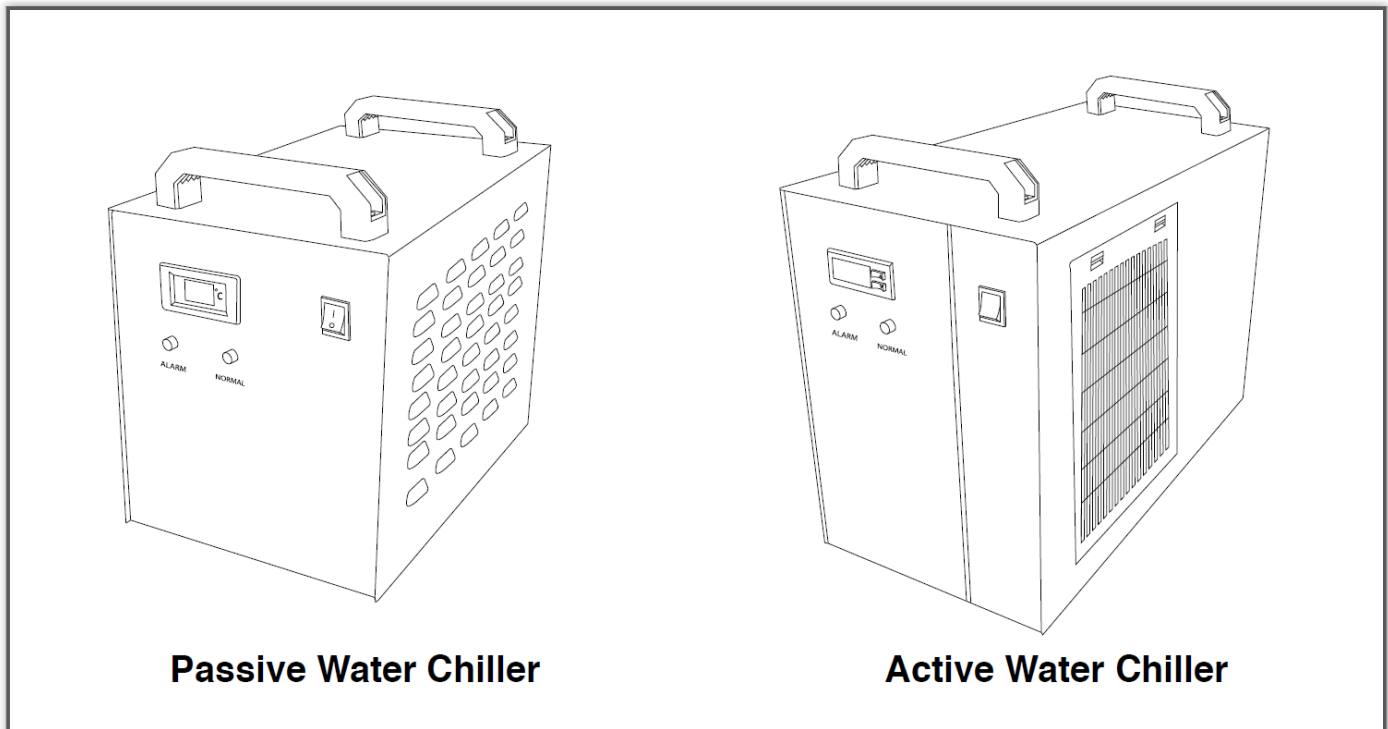


Figure 3.14



**NEVER** fire the laser without a correctly connected and powered water chiller. Firing the laser without turning the pump on or, worse, with no water in the system, could severely degrade or destroy your laser tube and void your warranty. Note that there are interlocks that should prevent firing of the laser without proper water flow.



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

**2. Connect Alarm Signal:** The alarm signal will alert the user if the water chiller is disconnected, malfunctioning, or requires water. Connect the 3-prog end of the signal cord to the water chiller, and the 4-prog end into your Pro-Series.

**3. Connect Inlet Tube:** Connect the water INLET on the water chiller to the water outlet of the laser cutter.

**4. Connect Outlet Tube:** Connect the water OUTLET on the water chiller to the water inlet of the laser cutter.

**5. Connect to Power:** Plug in your water cooler to an appropriate outlet.

**6. Power On:** Turn the water chiller on and the water will begin flowing. For the active water chiller, the other buttons adjust the temperature. The ideal temperature for water is between 55 and 80 degrees Fahrenheit.

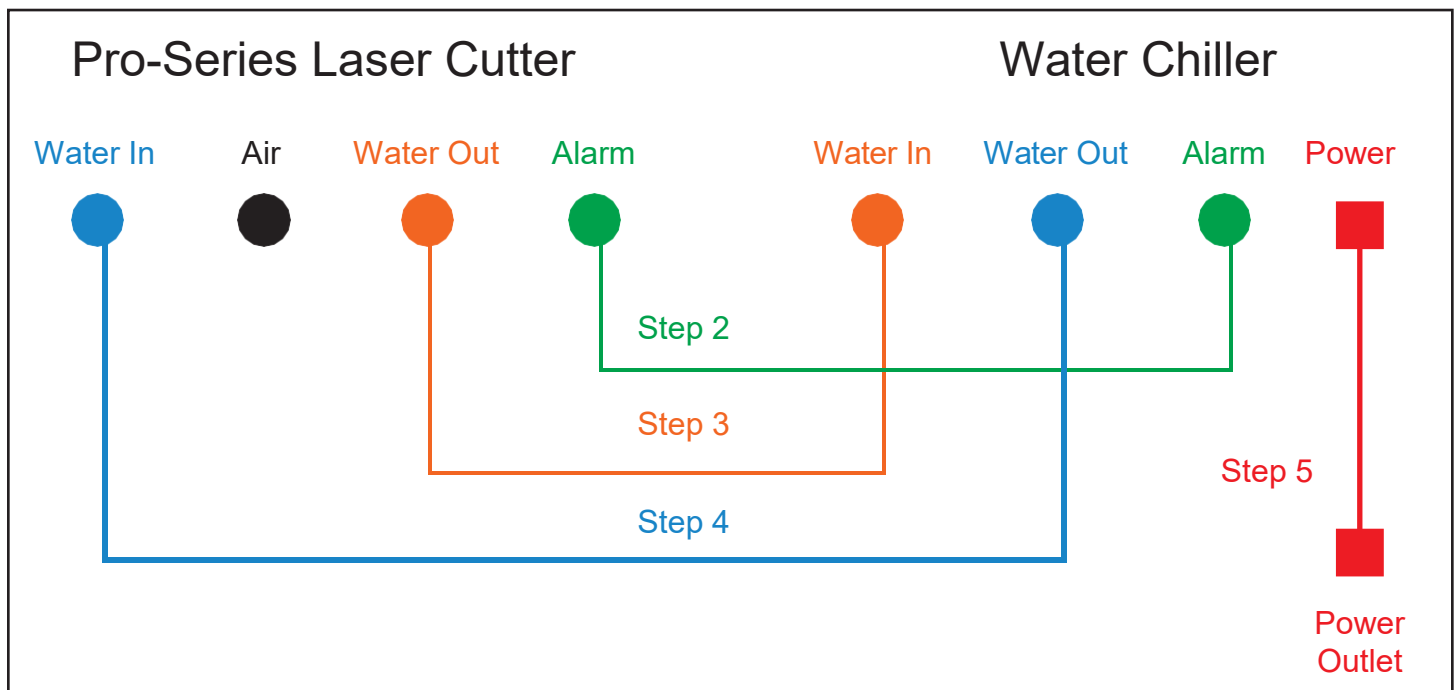


Figure 3.15



**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.

# Assembly Stage 5: 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. Check Air Connections:** The air compressor valve is pre-installed (the gold valve).

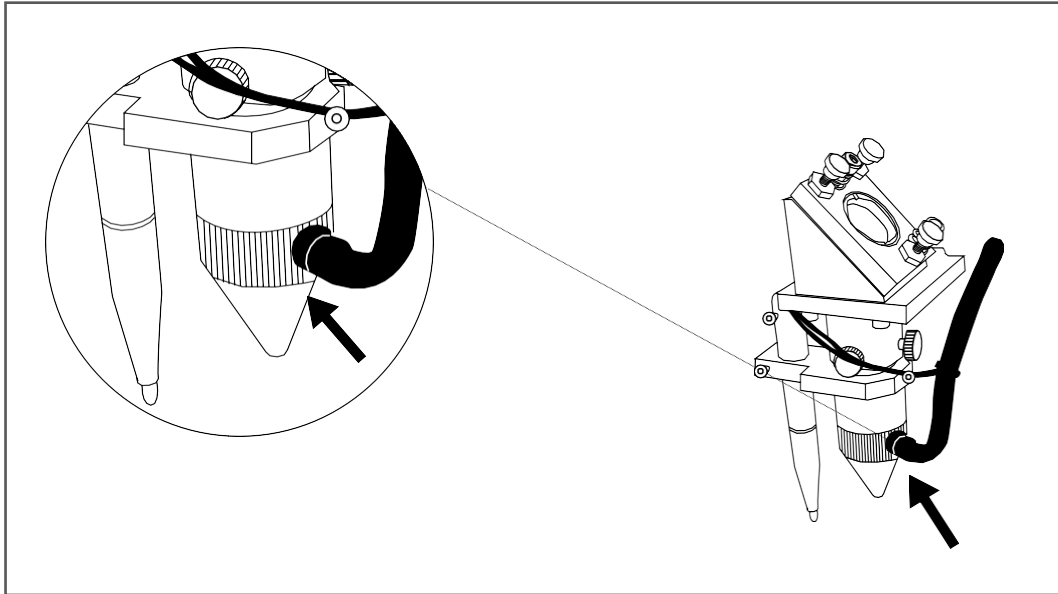


Figure 3.16

**2. Attach Air Hose to Air Compressor:** Attach one end of the silicone air inlet hose onto the air compressor until it is snug.

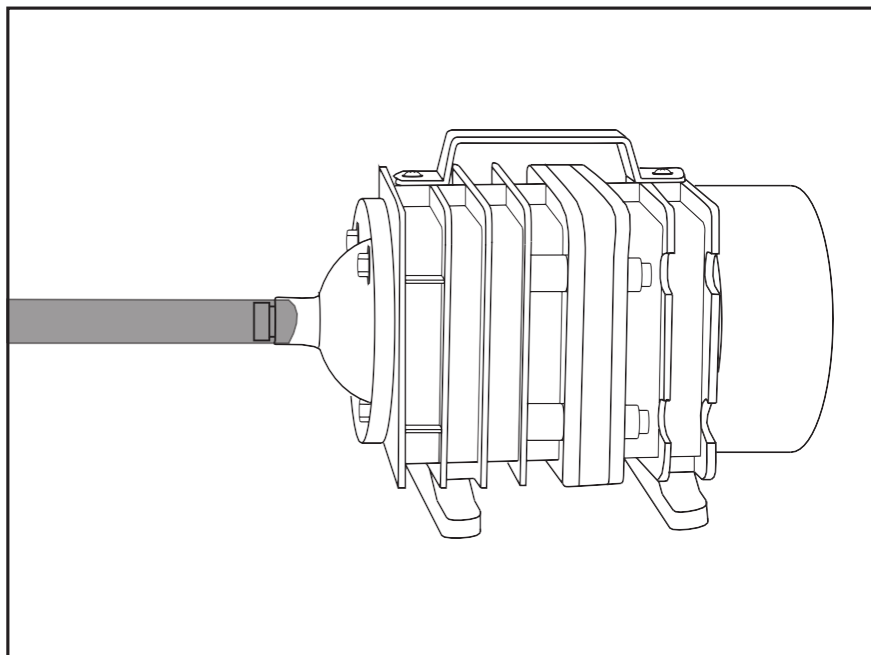


Figure 3.17

**3. Attach Air Hose to Laser Cutter:** Insert other end of the silicone air inlet hose onto the “air inlet” slot in the back of laser cutter.

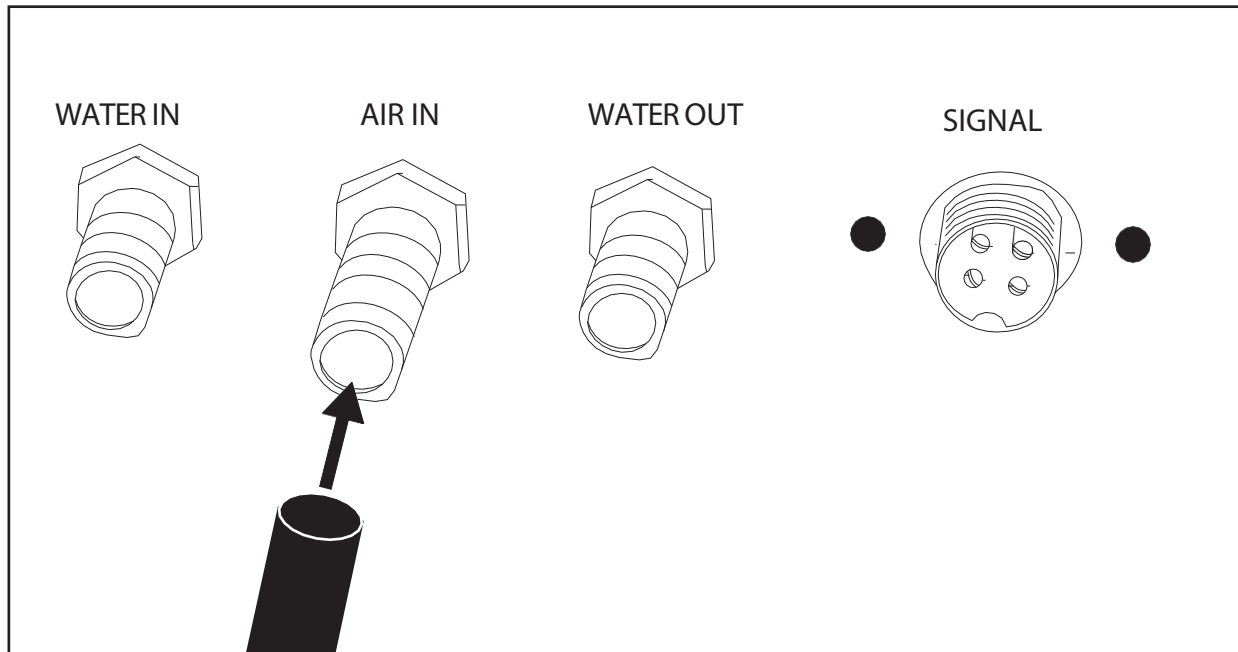


Figure 3.18

# Assembly Stage 6: Connect Electrical Power

The Full Spectrum Laser Pro-Series and available accessories are configured to accept 110VAC at 60Hz by default. 220VAC can be specified and these units connect directly to 220V 50/60 Hz. If you are unsure which voltage was specified, contact support@fslaser.com.

**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.

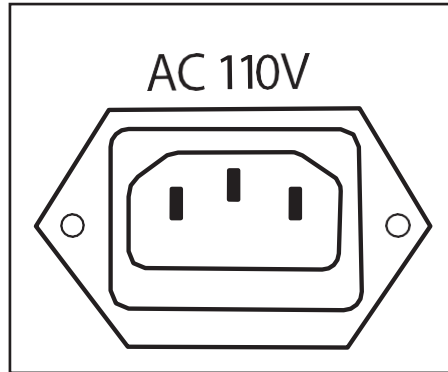


Figure 3.19

**3. Plug in Power Cord to Outlet:** Finally, plug the power cord into any proper outlet socket in your workspace. Note that only the main outlet has power.



**POWER ON/OFF:** *The laser’s power is controlled by the large red button (e-stop) located on the top of the case in the far right. This is an open twist to release button. To power the laser down, simply press the button down until it locks. To power the laser up, twist the button clockwise according to the indicating arrows on the surface of the button.*



**IN CASE OF A BLOWN FUSE:** *Determine the cause of the overload before replacement to protect the machine from damage. The laser system is equipped with a fuse on the power inlet to protect the machine from surges or short circuits. The fuse is user-changeable (machine ships with 10A fuse installed).*



**CAUTION!** *Do not 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.*

# Assembly Stage 7: Connect Ethernet Cable

- 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.
- 3. 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!** *Your laser cutter can connect to your computer via either Ethernet or Wi-Fi connection. Full Spectrum includes an Ethernet cable in the laser accessories.*



**ATTENTION!** *Determine the cause of the overload before replacement to protect the machine from damage. The laser system is equipped with a fuse on the power inlet to protect the machine from surges or short circuits. The fuse is user-changeable (machine ships with 10A fuse installed).*

# Assembly Stage 8: Connect to Software

RetinaEngrave v3.0 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 v3.0. With a local connection (achievable with Wi-Fi or an Ethernet cable) your laser control software will be available for use within your web browser.

1. **Turn On Laser Cutter:** Turning on your laser will automatically boot up the touchscreen interface. Allow 30 seconds or so for the machine and touchscreen to boot up.
2. **Access the Application:** If your network supports “Bonjour” technology (DNS-SD) simply navigate to the following address to access the application: “**fsl.local/**”.  
-OR-
3. **Note the Device Address:** This will be visible on lower left corner of LCD and will vary depending on connection type (ethernet/WIFI).
4. **Type IP Into Browser:** Type this IP number into your favorite browser (Google Chrome is recommended) and press the enter key. This will link you to the RetinaEngrave v3.0 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 to the device while operating the software, either through Wi-Fi or the Ethernet cable.

## Connection Methods

1. **Ethernet (Preferred):** Connect your PS unit to your local router or switch using an ethernet cable. The device IP address may be assigned automatically in most cases as supported by your local network. In cases where no DHCP server exists, you may statically assign an IP address from the LCD or the web application options menu.
2. **WIFI:** Connect you PS to a local wireless network via the LCD or web application.
3. **Hotspot:** Connect your PC, laptop, or tablet directly to the wireless network hosted by the unit.
4. **Direct (Link-Local) Ethernet Connection:** Connect an ethernet cable directly from your PC or laptop to the device.

## RetinaEngrave v3.0 Print Drivers

RE3 users can download the RE3 print drivers from the Full Spectrum Laser website in order to send device-specific print files to the laser cutter directly from most applications. Go to <https://fslaser.com/RetinaEngrave> and choose either the Windows print driver or the MAC/OS print driver.

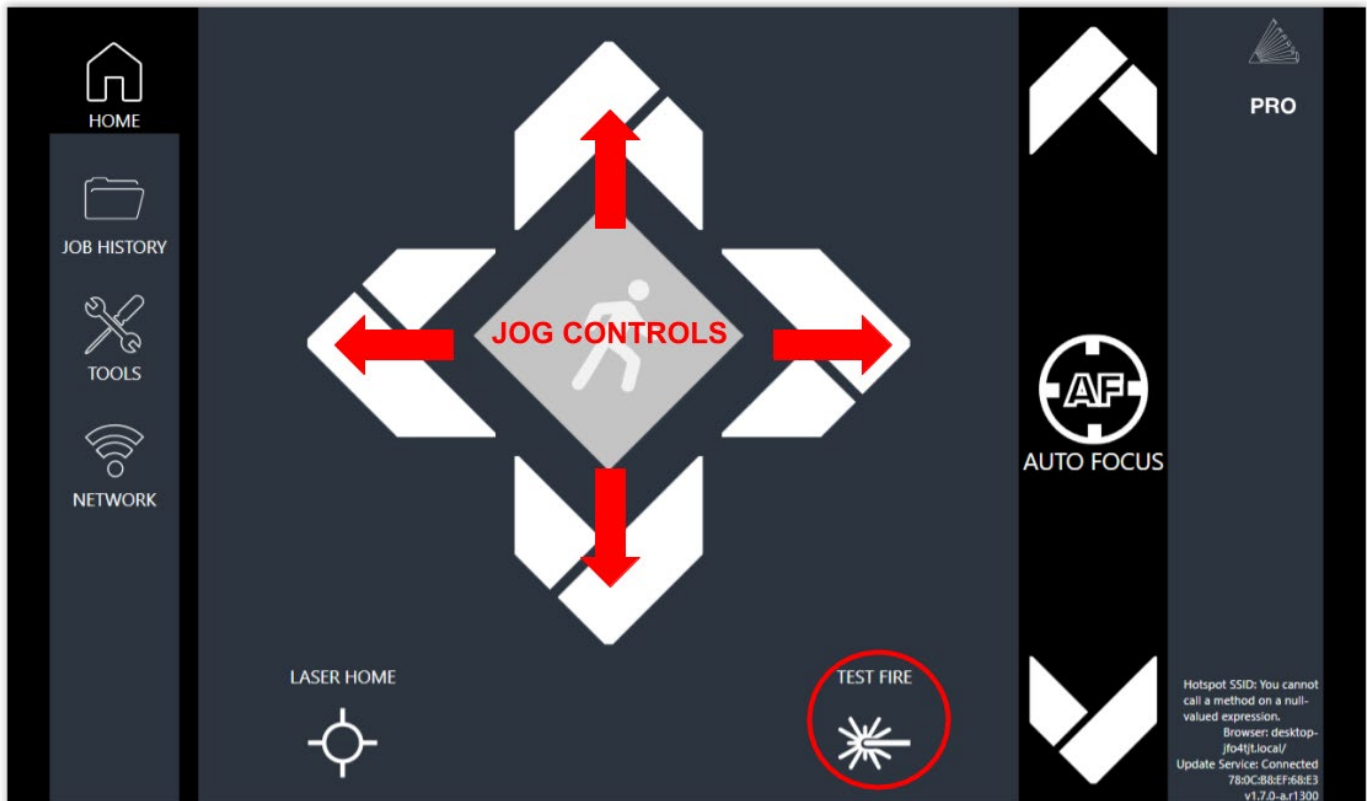


**ATTENTION!** *The laser must be powered on when operating the software or when connecting the laser via the Ethernet cable. You will need uninterrupted Internet access for this process.*



# 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. Be aware of where the test fire button and the jog controls are on your touchscreen, as they will be utilized for some of these procedures.



The following will be on our list of tests and adjustments:

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

# 1. Alignment Test

For this machine, the laser tube 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. For all other Pro-Series machines, the operator will need to follow the laser tube installation process. Once the laser tube is installed, 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 just 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:** Using the jog controls, move the laser head into the upper left corner of the workspace.

**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.

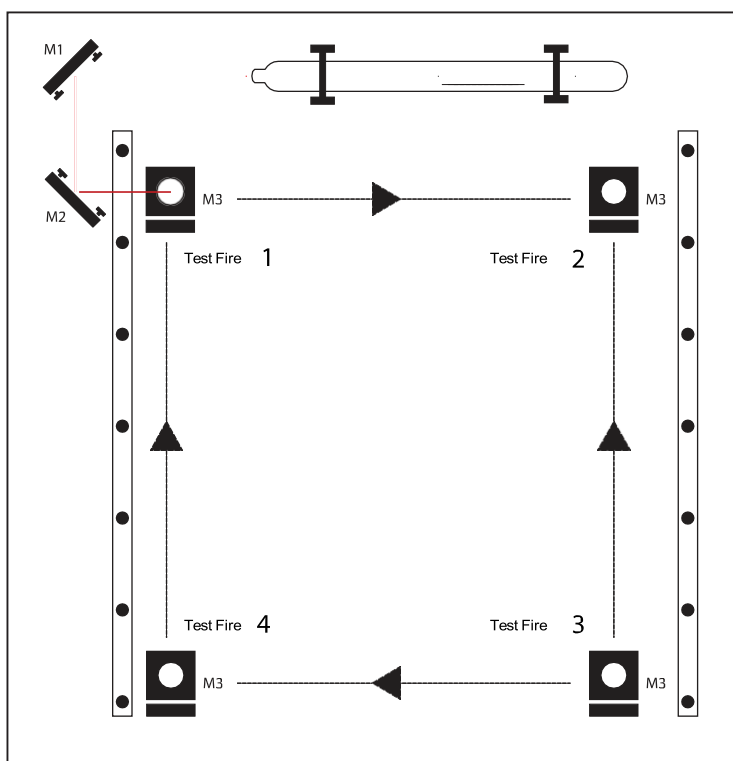


Figure 4.1

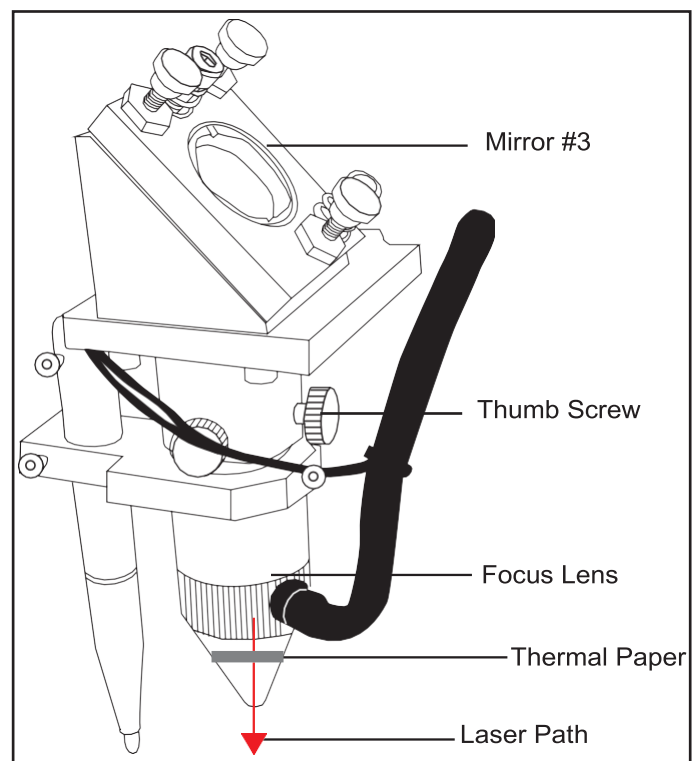


Figure 4.2

**5. Test Fire the Laser:** Press the Test Fire Icon Button on the touchscreen panel.

**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.

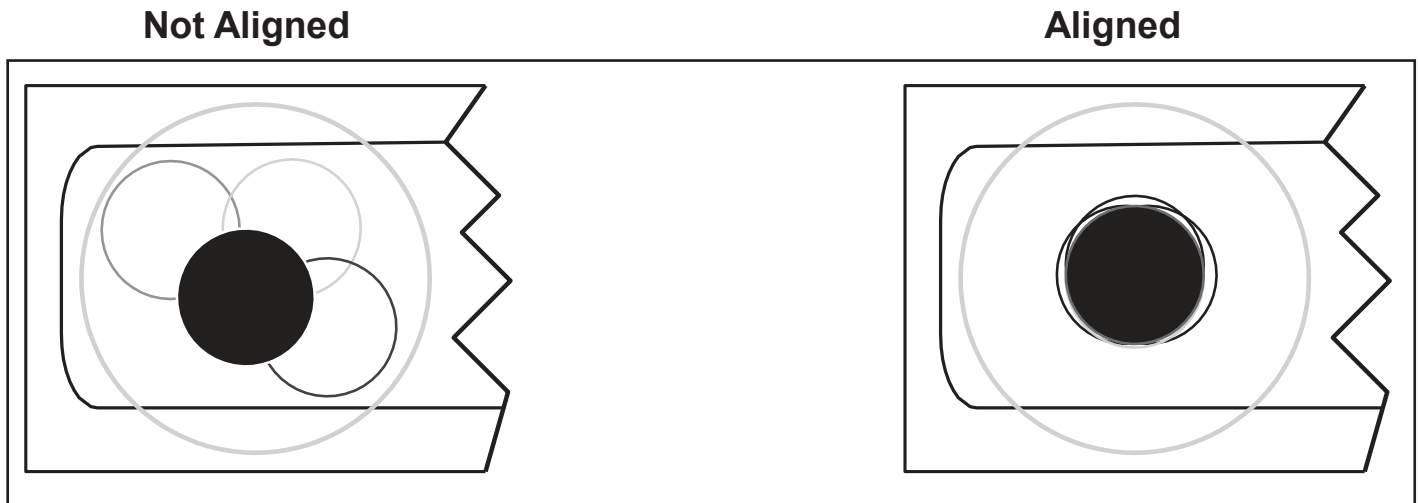
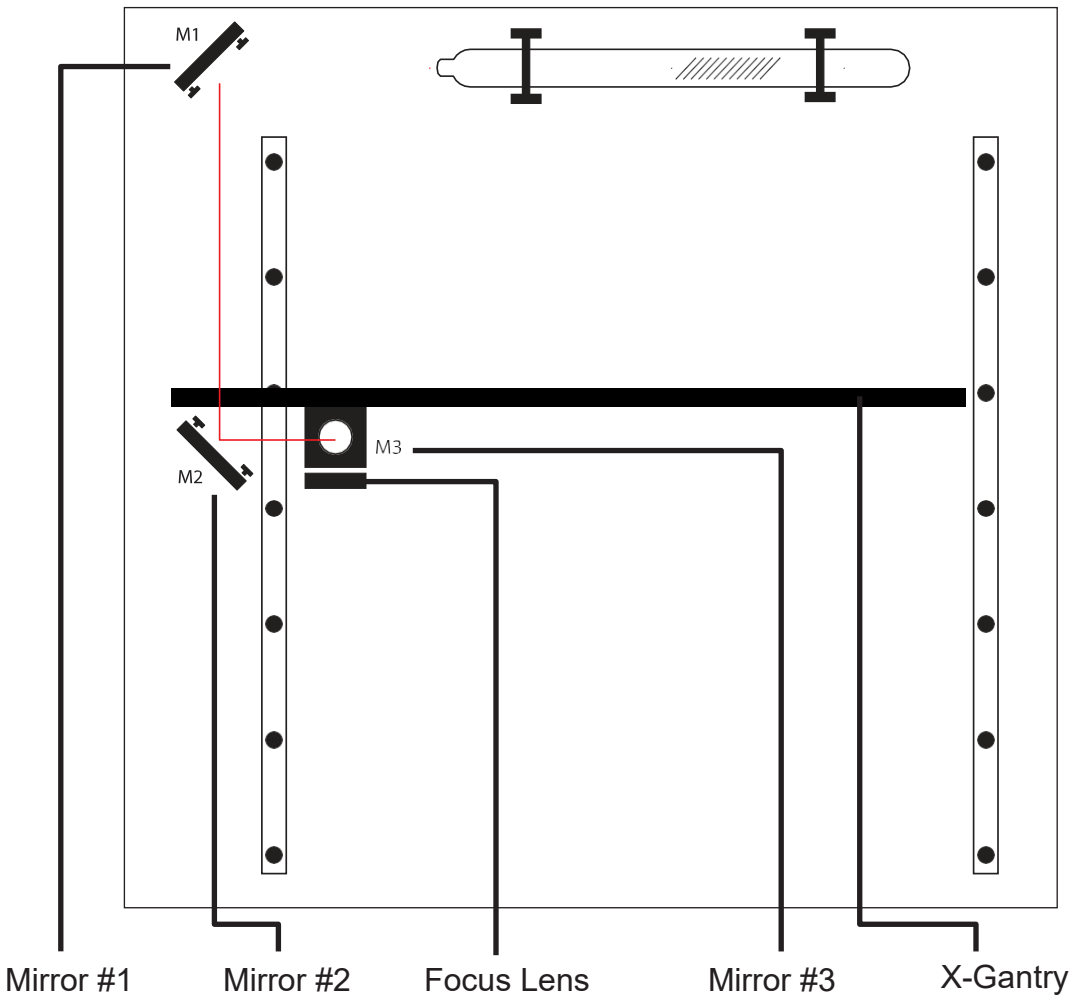


Figure 4.3

## 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.

Figure 4.4



### 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

# TAGE 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 panel operating system.
- 3. Gather Tools:** A 2.5mm hex wrench and a supply of thermal paper are required to perform the mirror alignment procedure (if required).



**PRO TIP!** Note that a 2.5mm hex wrench will perform all of the adjustments a customer may be require to do. If a 2.5mm hex wrench does not fit the screw you want to adjust, it is not meant to be altered by a customer. Call technical support before you adjust or remove any screw not sized for a 2.5mm hex wrench.



**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.

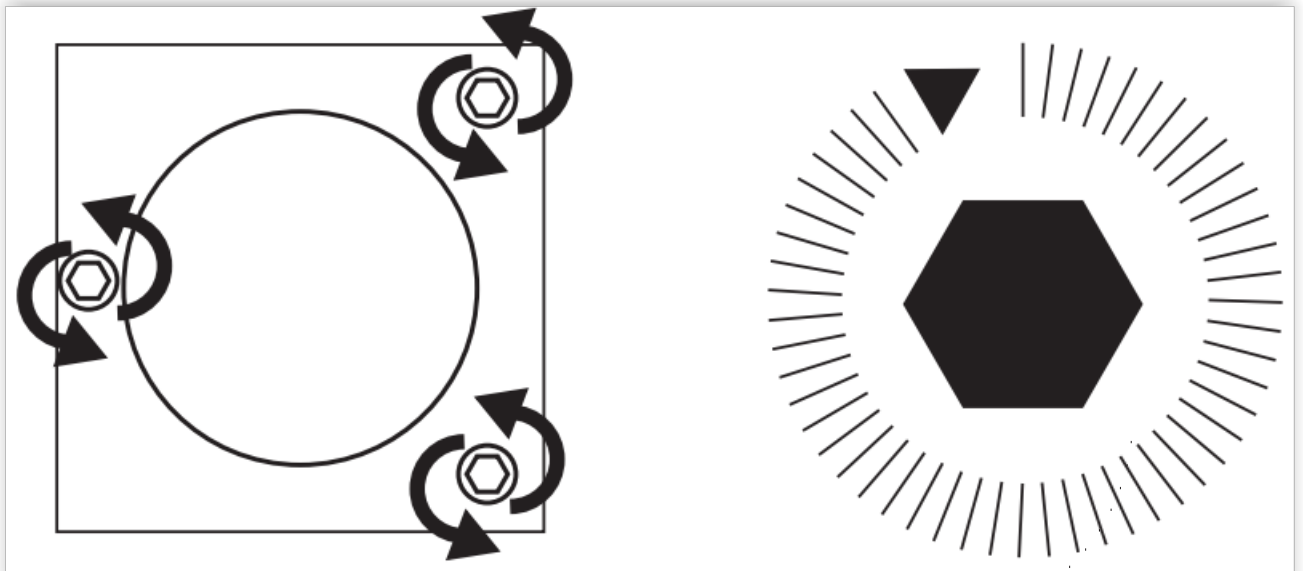


Figure 4.5

# 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 Pro Series.

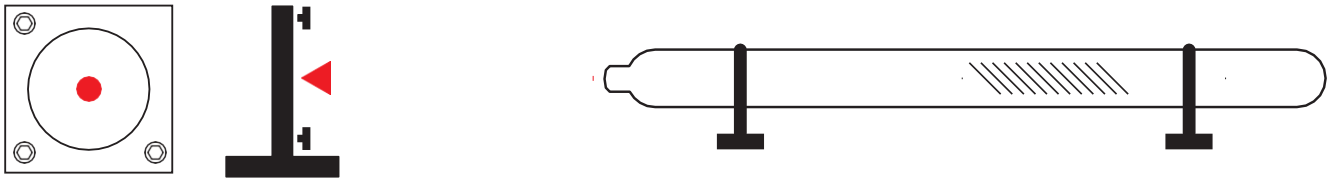


Figure 4.6

- 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 panel. 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.

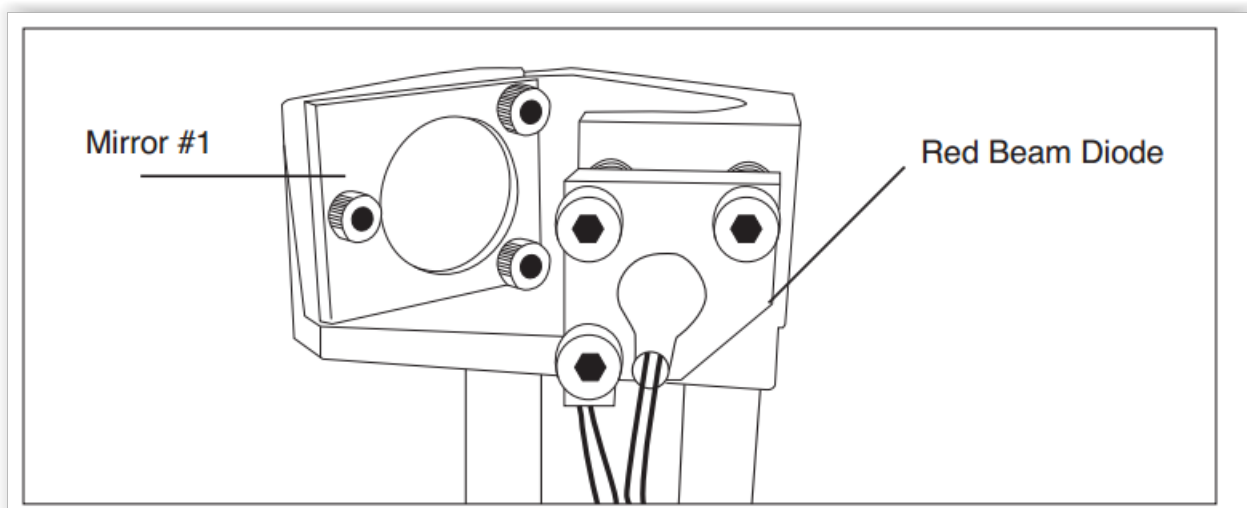


Figure 4.7

- 4. Test Fire the Laser:** Press the Fire Laser Icon Button on the touch panel. 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.

# 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 the x-gantry to the lowest position (as shown in Figure 4.8).

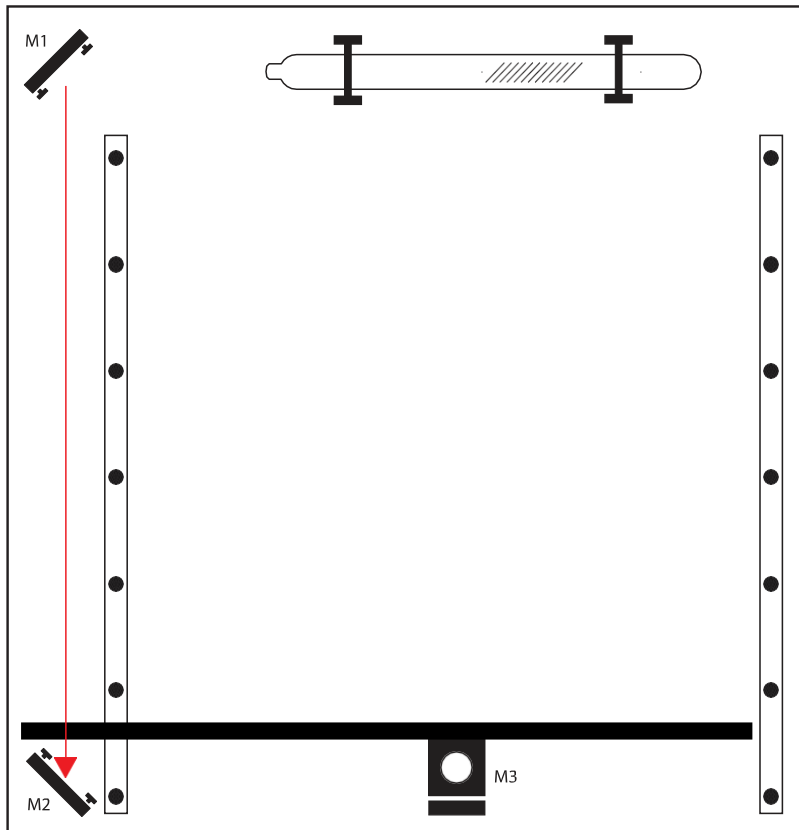


Figure 4.8

- 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 panel. 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.

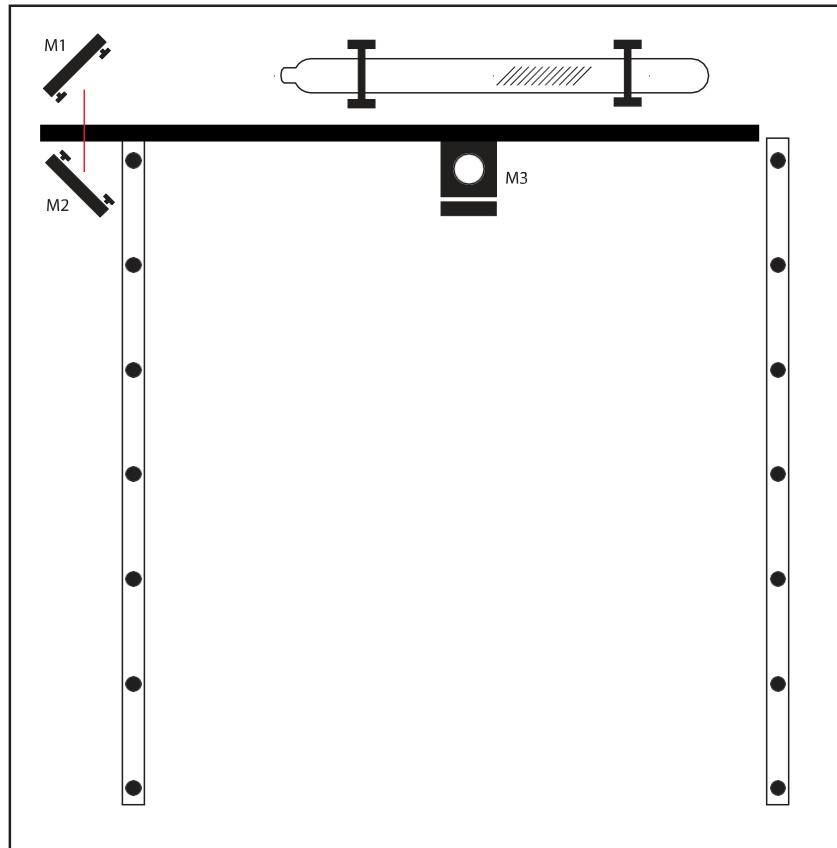


Figure 4.9

**8. Re-Position X-Gantry back to “Far”:** Jog the x-gantry to the far position where you did the first test fire. (as shown in Figure 4.8).

**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. 15mm should be plenty) and place it firmly over Mirror #3.
- 3. Position the Gantry Bar:** Place the gantry bar at the “south” end of the work bed, as shown in the figure below.
- 4. Position Laser Head “Far”:** Jog the laser head to the far right (as shown in Figure). This is the farthest position of the Mirror #3 from Mirror #2.

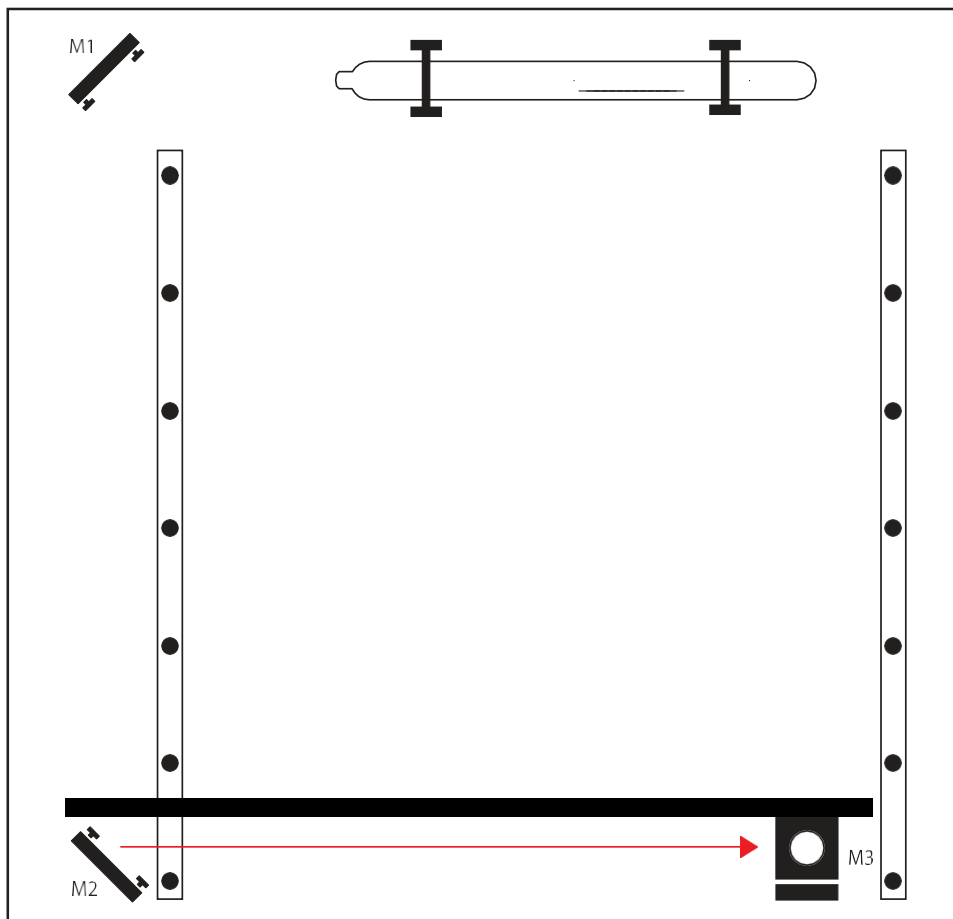


Figure 4.10

- 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 panel. 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.

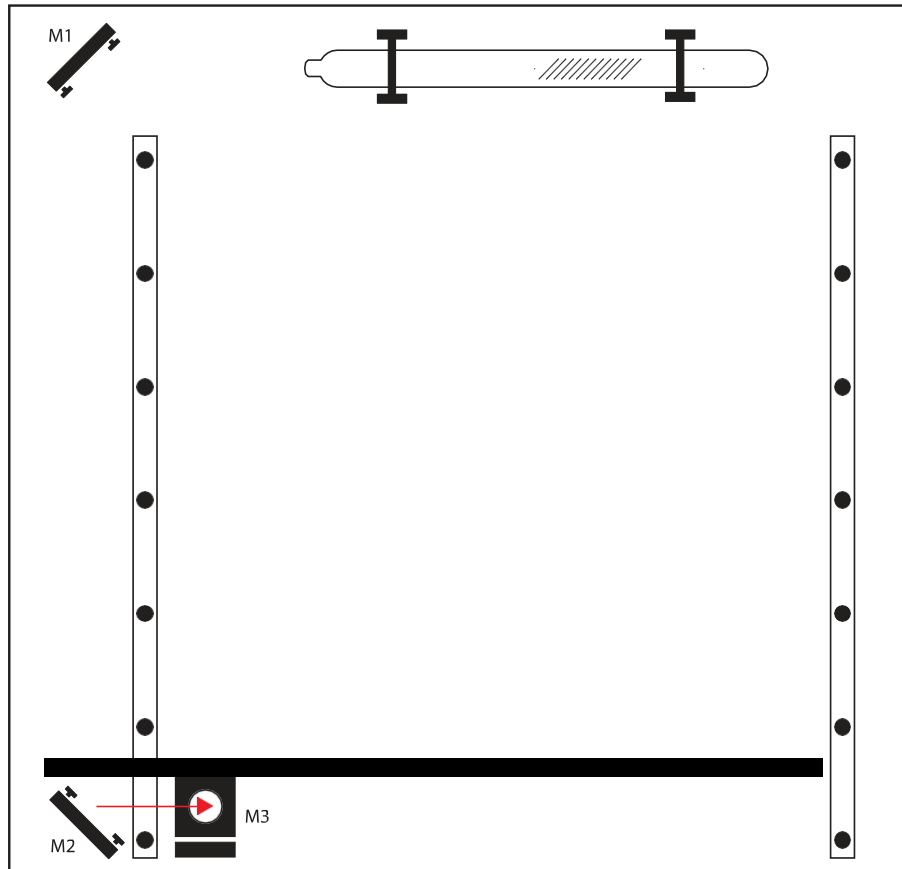


Figure 4.11

**9. Re-Position X-Gantry back to “Far”:** Jog the laser head to the right position where you did the first test fire (see Figure 4.10).

**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. Once aligned, you will repeat this procedure on the next mirror.

# 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.

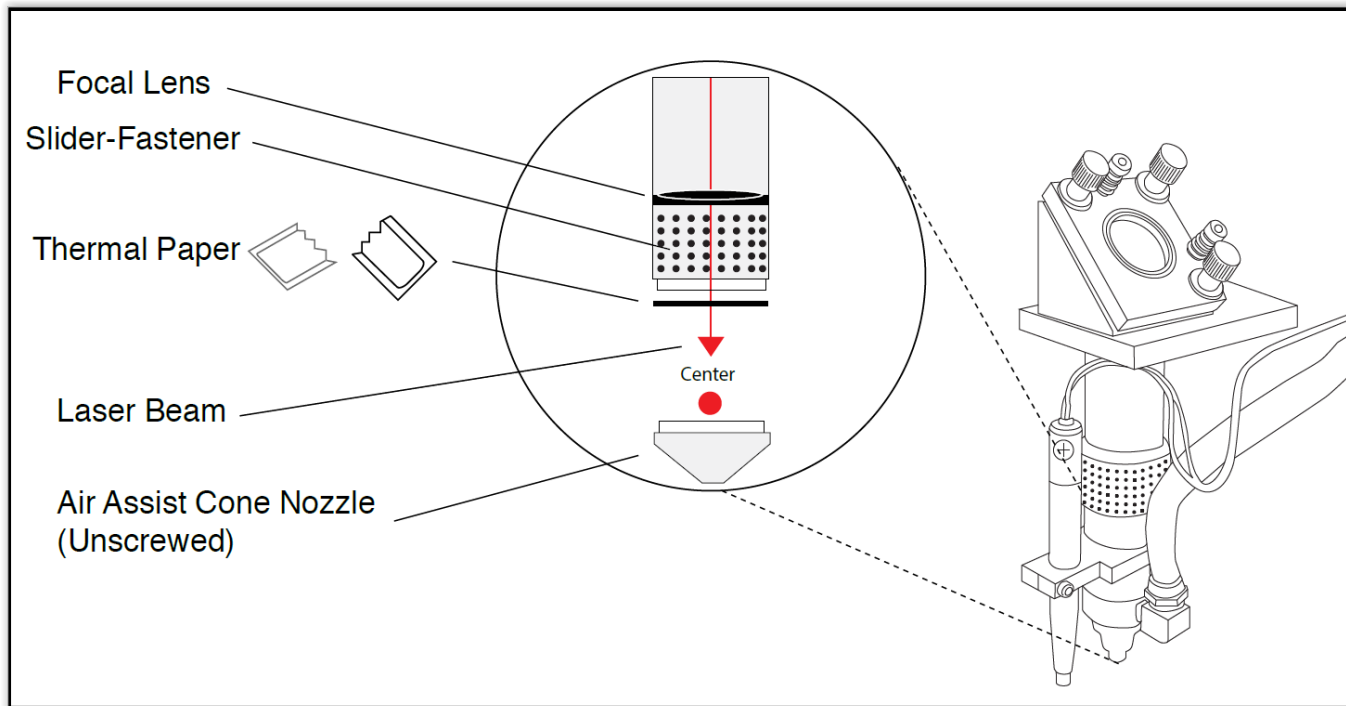


Figure 4.12

- 1. Open Safety Lid:** You will need to access the interior of the machine.
- 2. Place Thermal Paper:** Unscrew the air assist cone. Put a piece of thermal paper on the bottom of the slider/fastener.
- 3. Position Focus Lens “Far”:** Use the thumb screw to loosen and position the focus lens as far down as it will go. Retighten thumbscrew.

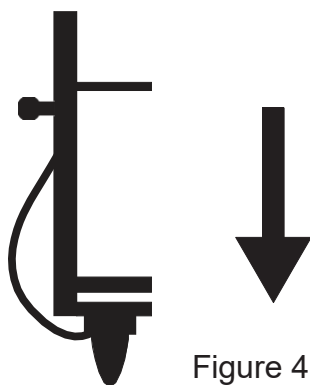


Figure 4.13

**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 panel. 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.

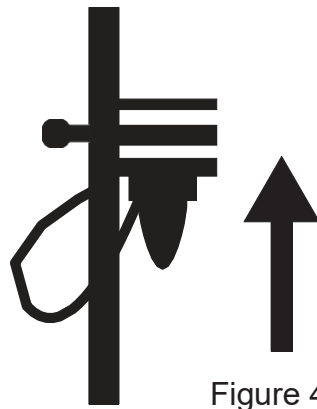


Figure 4.14

**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 Pro-Series Laser System is quick and easy. Your laser included an acrylic ruler sized for the included 2.5" focal lens.

- 1. Place Ruler:** Place the included acrylic ruler on the top of gold bracket as shown in the diagram.
- 2. Focus:** Place notch of ruler on top of gold AF bracket and raise or lower Z table/material until notch of ruler rests on gold bracket and bottom of ruler contacts surface of material.
- 3. Retighten:** Retighten the sliding head and remove the ruler from the workpiece.

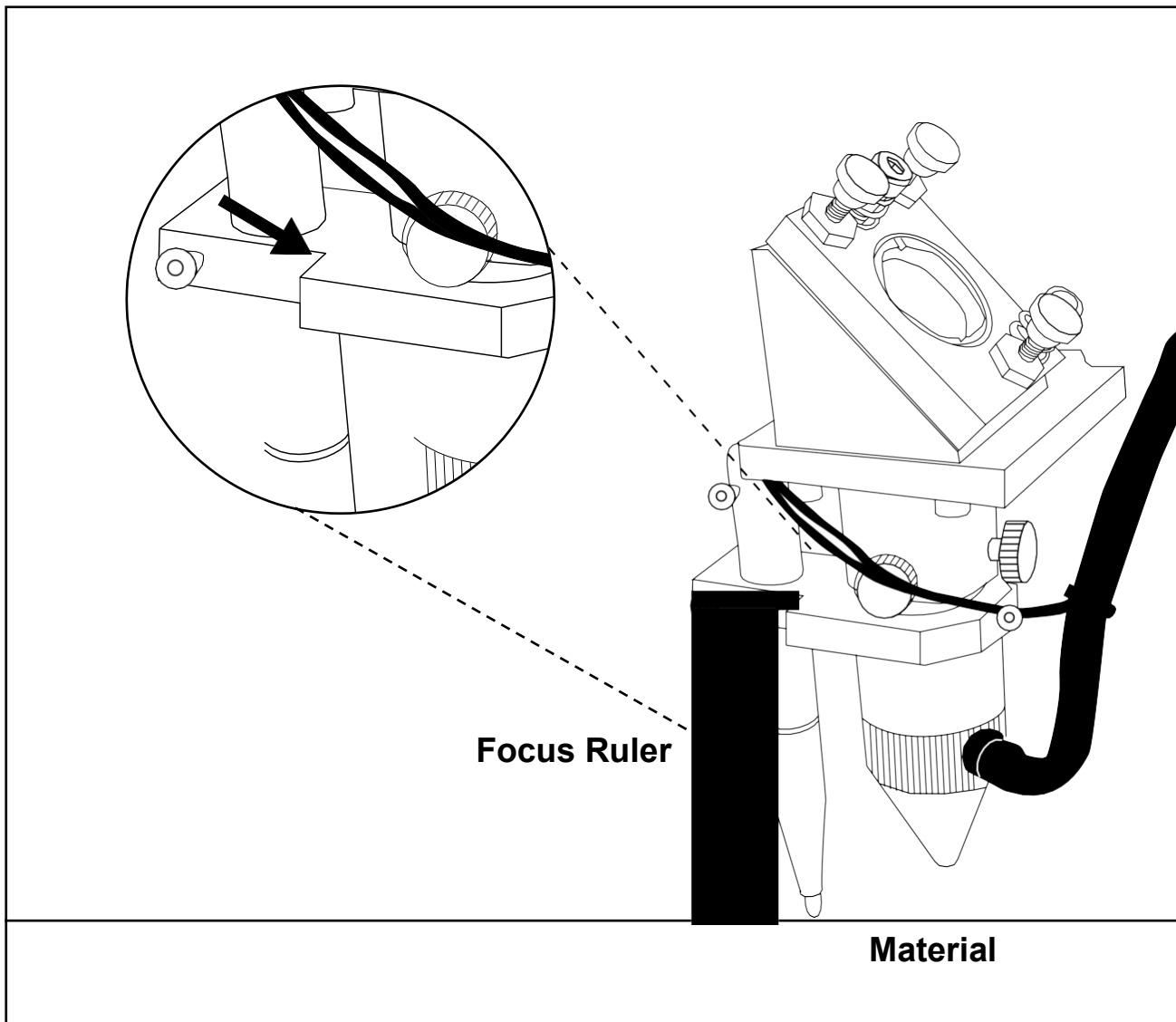


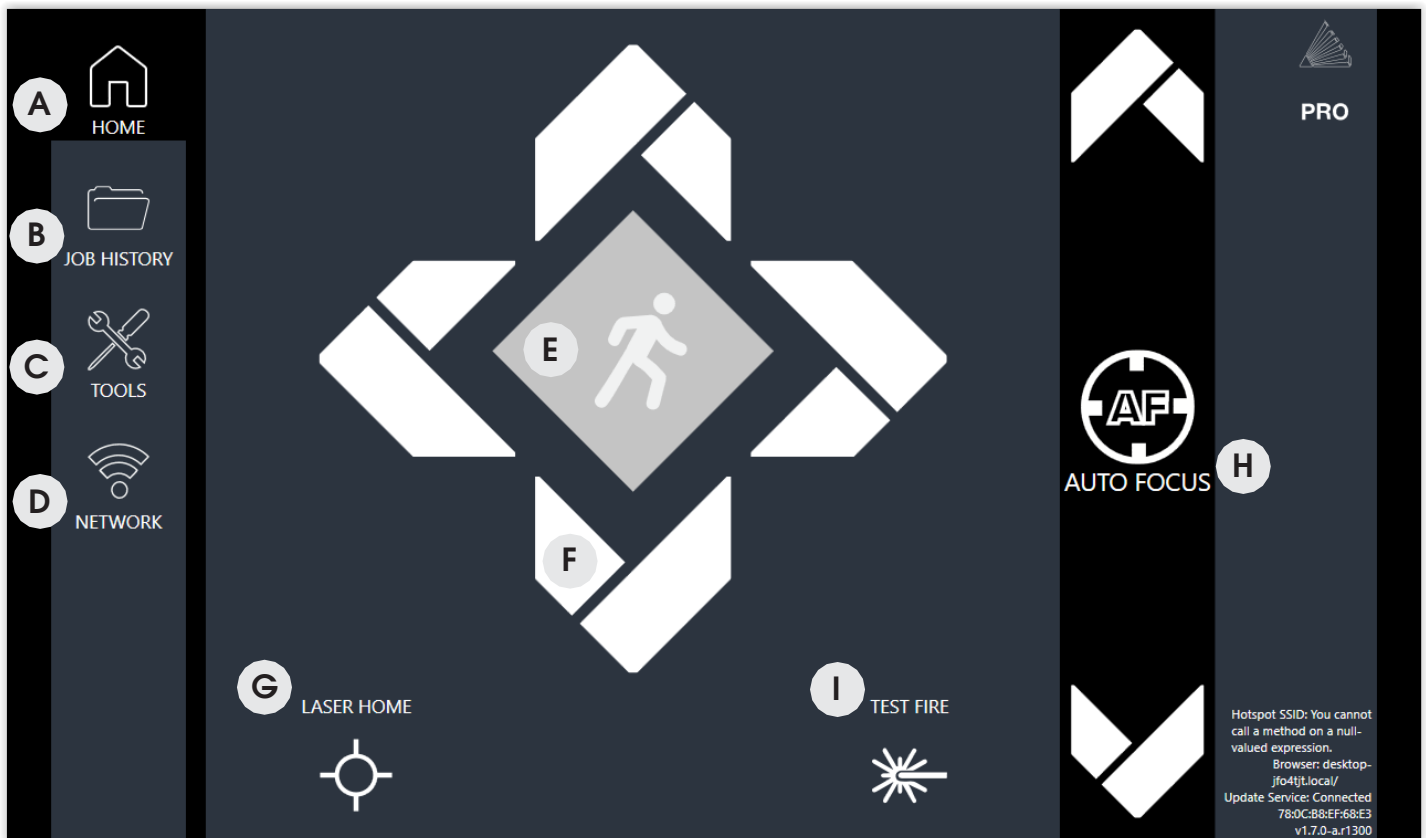
Figure 4.15

# SECTION V. TOUCHSCREEN INTERFACE

## Pro-Series Laser System Touchscreen Interface

Your 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.

### HOME SCREEN



**A HOME MENU**

Returns to the main Home Screen from any sub-screen.

**B JOB HISTORY**

Accesses Job History sub-screen.

**C TOOLS MENU**

Accesses Tools sub-screen.

**D NETWORK MENU**

Accesses Network sub-screen.

**E JOG SPEED**

Switch from slow jog fast jog.

**F JOG CONTROLS**

Jog gantry via control buttons.

**G HOME LASER**

Instantly homes the laser.

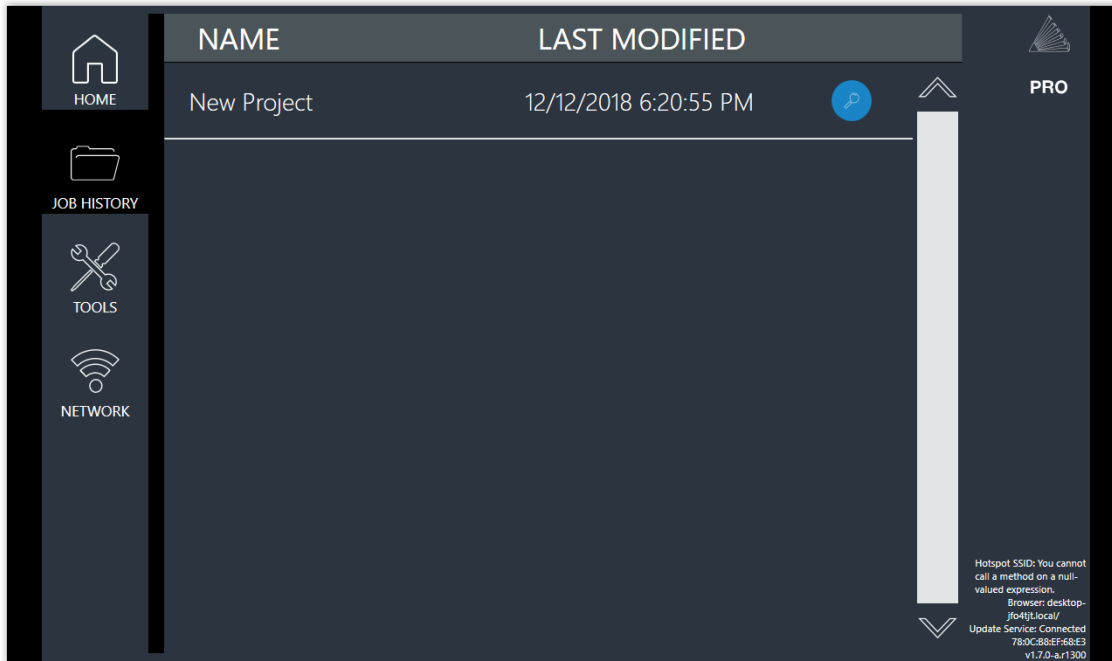
**H AUTO FOCUS**

Auto focuses to material

**I TEST FIRE**

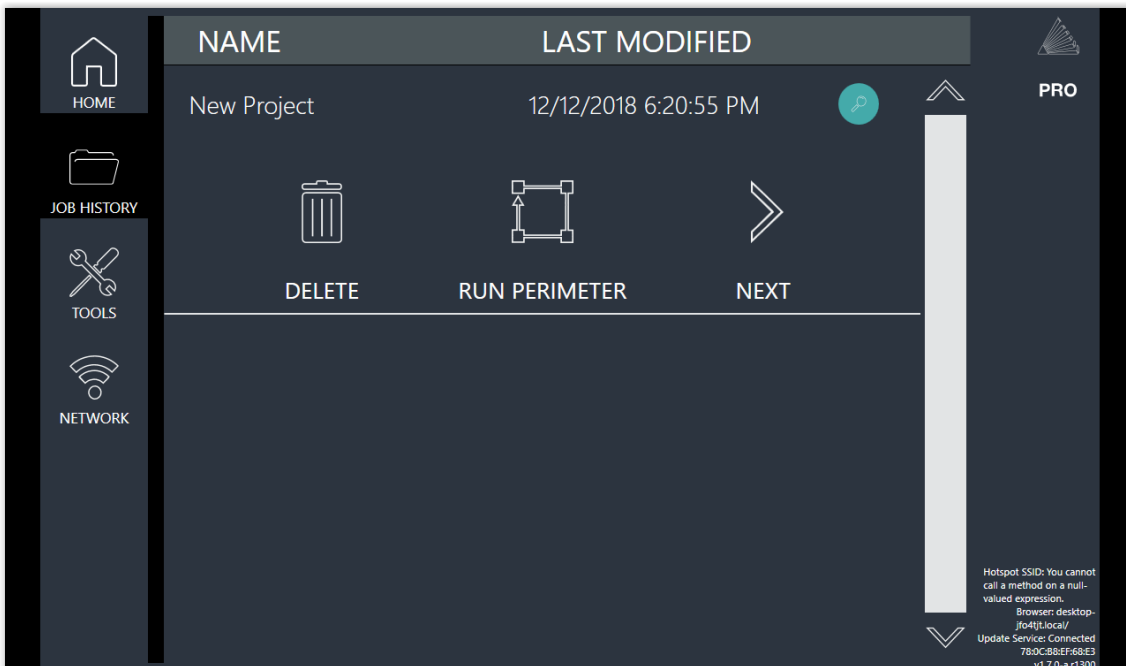
Test fires the laser  
Used for mirror alignment and testing.

## JOB HISTORY SCREEN (MAIN)



Screen shows no jobs in history. This will change once you start your first project. Then, user can scroll through all previous job history. Jobs can be selected and run by highlighting the job and pressing the check. Click the “search” icon to open job history options menu.

## JOB HISTORY SCREEN (OPTIONS)

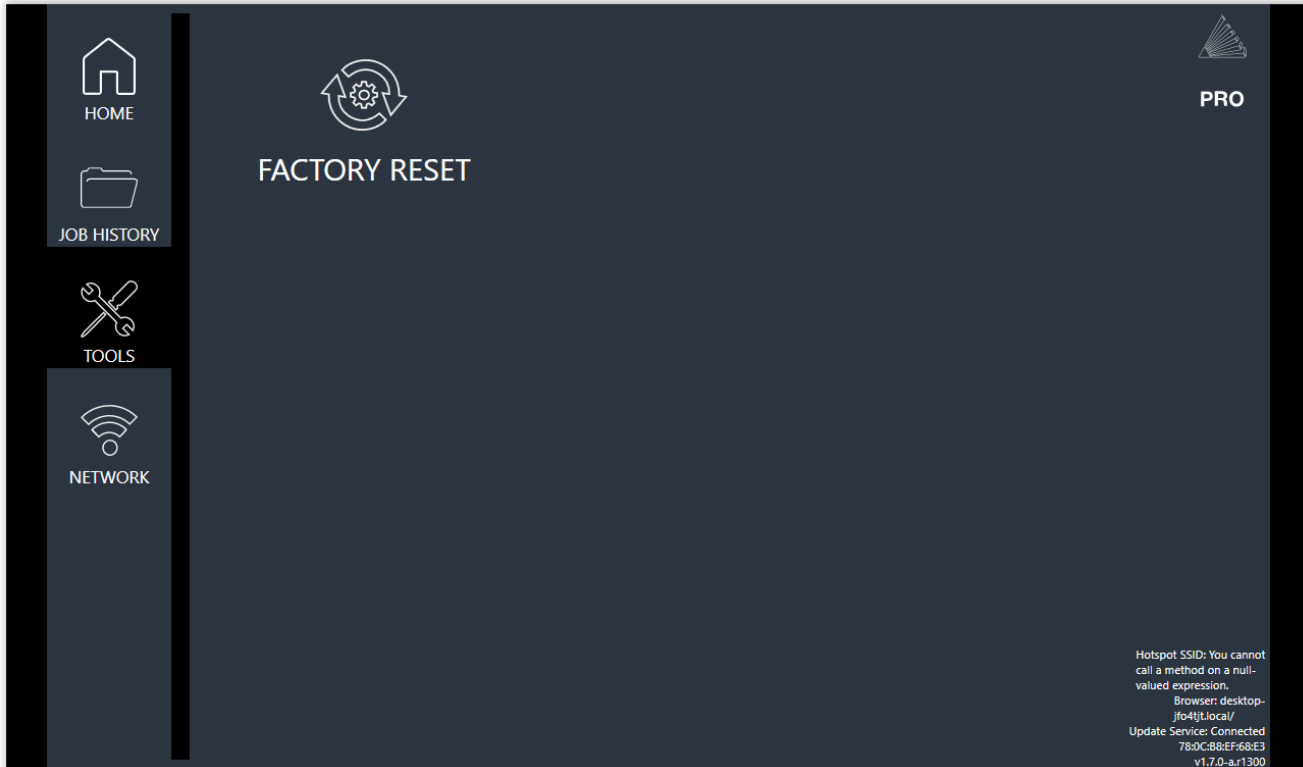


**Delete:** Delete project from history.

**Run Perimeter:** Laser automatically JOGS the extent of the current project’s border.

**Next:** Go to next project in history.

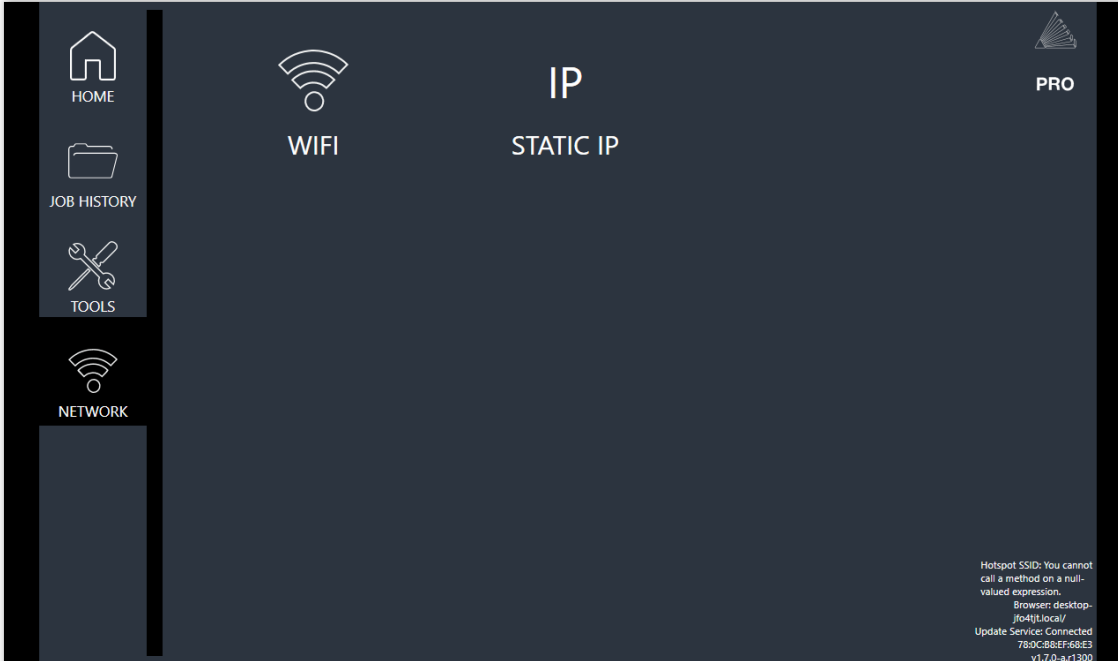
## TOOLS SCREEN (OPTIONS)



**Factory Reset:** Restore all settings to original factory settings.

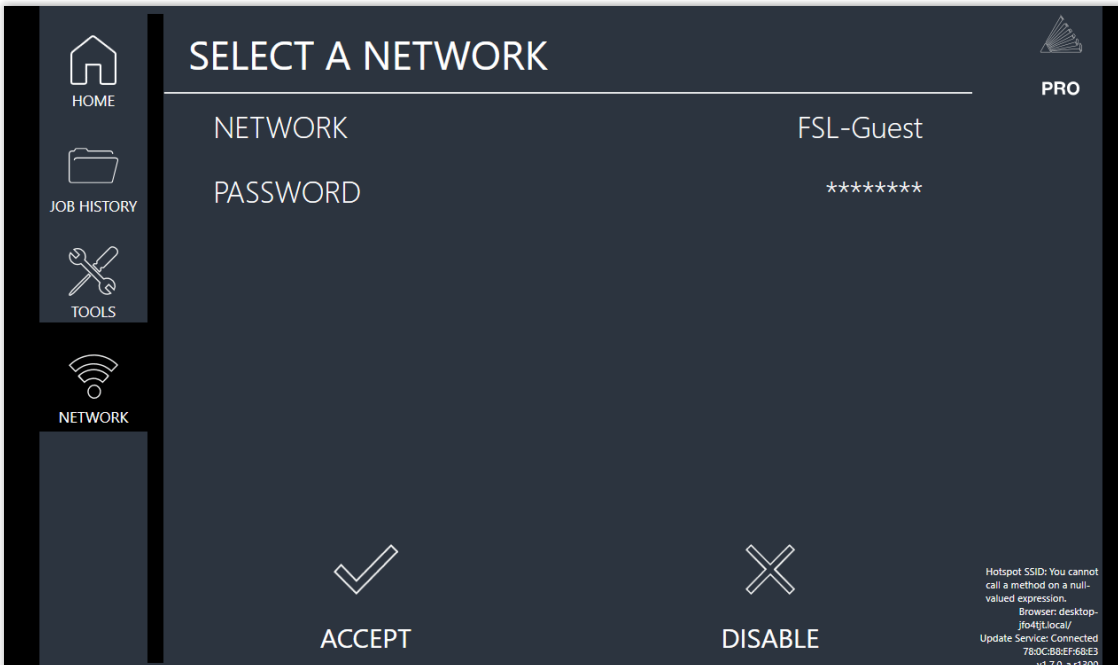


## NETWORK SCREEN (MAIN)



**WIFI:** Choose a WIFI connection. If it is password protected, you will need to enter the password.  
**STATIC IP:** Choose wireless IP or wired IP option.

## NETWORK SCREEN (SELECT NETWORK)

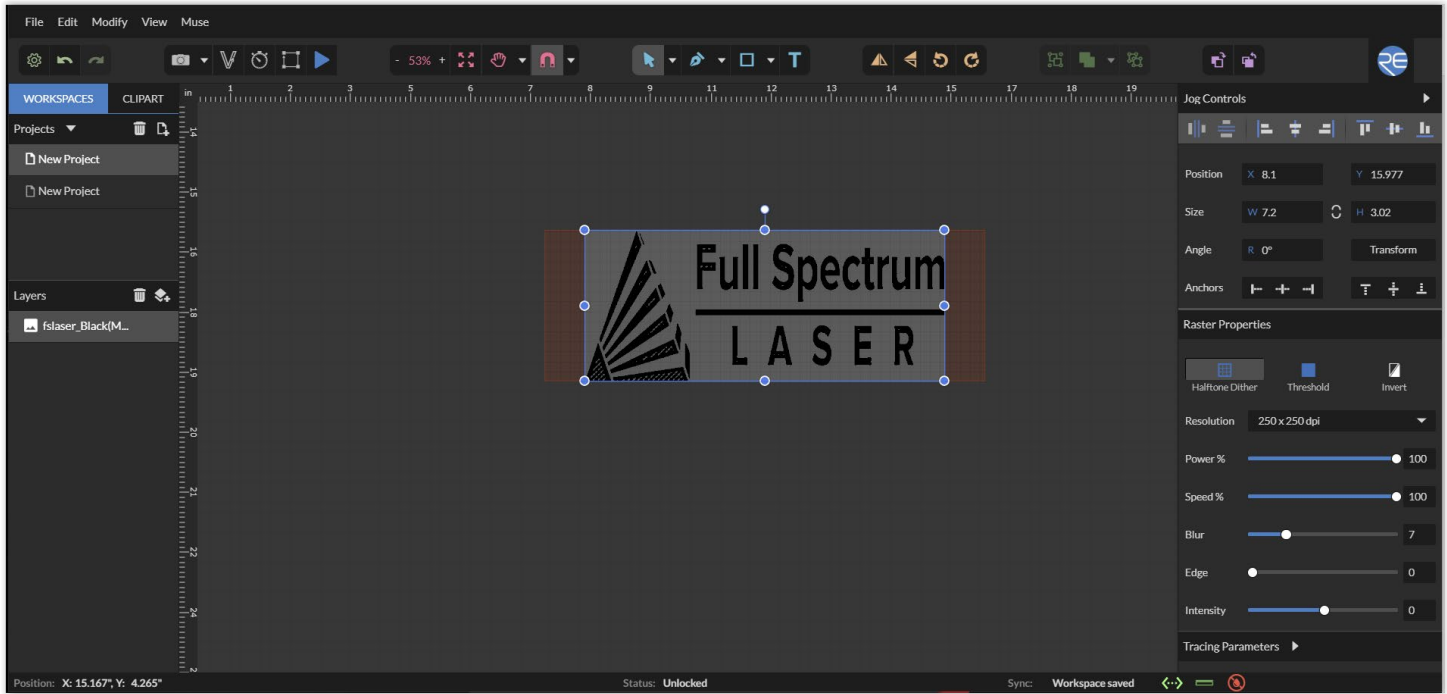


**Select a Network:** Choose a network and enter the password, if required.

# SECTION VI. SOFTWARE

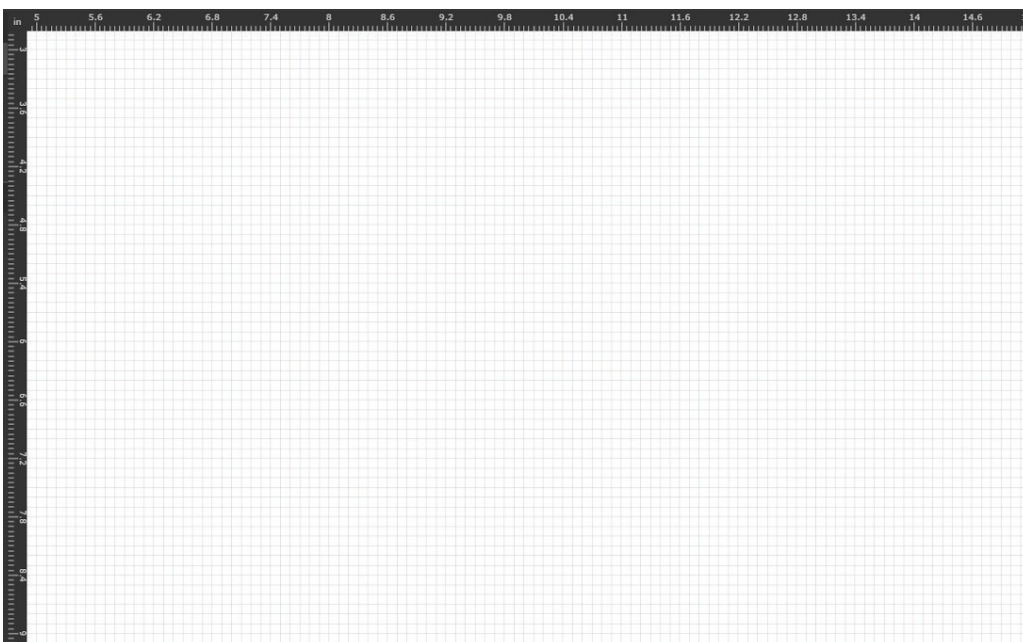
Your Pro-Series PS Systems operate with RetinaEngrave v3.0 software. This software can import design files, adjust settings, and a host of other functions. You will need to access the software using the instructions in Section III: Installation & Assembly.

## RETINAENGRAVE v3.0 INTERFACE



### Workspace Window

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



# Top Menu

File Edit Modify View Muse

## File Menu

**New Project (Alt+N):** Start a new project.

**New From Clipboard (Shift+Ctrl+Alt+N):** Start a new project from the clipboard.

**Load Project from File (Ctrl+O):** Load a project from a saved file.

**Place/Import:** Import and place a file.

**Import fonts:** Add fonts from outside source.

**Export Project to File (Shift+Ctrl+E):** Export to a file.

**Submit Support Ticket:** Auto send a support request ticket.

## Edit Menu

**Undo Delete Layer or Item (Ctrl+Z):** Reverse previous project command.

**Redo (Shift+Ctrl+Z):** Reverse your last undo.

**Cut (Ctrl+X):** Selected object or item is removed.

**Copy (Ctrl+C):** Copy some portion of an object or item.

**Paste (Ctrl+V):** Paste a copied or cut portion of an object or item.

**Delete (Del):** Delete selected object or item.

**Paste In Place (Shift+Ctrl+V):** Paste a copied object or item in same location.

**Paste Inside Selection:** Paste a copied object or item inside selected area.

**Paste Style (F4):** Paste and match style.

**Duplicate (Ctrl+D):** Create a copy of a selected object.

**Clone (Shift+Ctrl+D):** Create an exact copy or 'clone' of an object.

**Select All (Ctrl+A):** Select all items in work screen.

**Deselect All (Shift+Ctrl+D):** All items in work screen are deselected.

**Invert Selection (Ctrl+I):** Items previously selected are now unselected and items unselected are selected.

**Select by Font Type:** Select item by font type.

**Settings:** Displays settings menu.

# Modify Menu

## Arrange

**Send to Front (Shift+Ctrl+Up):** Send an object to the front layer.

**Bring Forward (Ctrl+Up):** Send an object one layer forward.

**Send Backward (Ctrl+Down):** Send an object one layer backwards.

**Send to Back (Shift+Ctrl+Down):** Send an object to the back layer.

## Align

**Align Left:** Align object to the left.

**Align Center:** Align object to center.

**Align Right:** Align object to right.

**Align Top:** Align object to top.

**Align Middle:** Align object to middle.

**Align Bottom:** Align object to bottom.

**Same Width:** All selected objects convert to same width.

**Same Height:** All selected objects convert to the same height.

**Distribute Horizontally:** Evenly arrange selected objects horizontally.

**Distribute Vertically:** Evenly arrange selected objects vertically.

**Snap to Full Units:** Snap to grid as full units.

**Snap to Half Units:** Snap to grid as half units.

## Transform

**Rotate 45° Left:** Rotate selected object left 45°.

**Rotate 90° Left:** Rotate selected object left 90°.

**Rotate 180° Left:** Rotate selected object left 180°.

**Rotate 45° Right:** Rotate selected object right 45°.

**Rotate 90° Right:** Rotate selected object right 90°.

**Rotate 180° Right:** Rotate selected object right 180°.

**Flip Vertical:** Reverse selected object's orientation along vertical axis.

**Flip Horizontal:** Reverse selected object's orientation along horizontal axis.

**Group Selection (Ctrl+G):** Select a group of objects.

**Merge Selection (Ctrl+M):** Merge a selected group of objects.

**Split Selection (Shift+Ctrl+M):** Split up a compound shape or object.

## Create Compound Shape

**Union:** Combine layers into a single compound layer.

**Intersection:** Combine overlapping layers into a single compound layer.

**Subtract:** Remove and combine non-overlapping layers into a single compound layer.

**Difference:** Combine non-overlapping layers into a single compound layer.

**Create Nested Compound:** Combine compound shapes into a single compound shape.

## Path

**Join Paths (Ctrl+J):** Combine 2 or more selected paths into one compound path.

**Split Paths (Shift+Ctrl+J):** Split a compound path into its original separate paths.

**Convert to Path (Shift+Ctrl+P):** Convert a non-path to a layer path.

**Convert to Raw Path:** Convert a path or non-path layer to a new path.

**Convert to Outline:** Create an outline path of a specified size around an object.

**Expand/Shrink:** Scale an object up or down by a specified amount.

**Vectorize Border:** Create a vector path of the border of an object.

**Rasterize** - Convert object to raster

**Vectorize Image:** Create vector paths of each separate element in an image.

**Attach Text to Path:** Attach and conform text to a path.

**Detach Text from Path:** Detach text that is attached to a path.

**Simplify Path (Ctrl+Alt+S):** Simplify (and smooth) a path to varying degrees of tolerance.

**Connect Path Lines:** Connect together the ends of 2 or more paths.

**Break Curve:** Break apart a path at a specified node.

**Reverse Order:** Reverse the order of nodes in a path.

## View Menu

**Original View (Ctrl+0):** Return the workspace back to the original view state prior to zooming or panning.

**Fit Selection:** Fit the current selection to the viewable page area.

**Fit Layer:** Fit the currently selected layer to the viewable page area.

**Fit All (Alt+Ctrl+0):** Fit all layers, whether or not selected, to the viewable page area.

## Magnification

**+6% - +25600% Magnification:** Increase or decrease magnification.

**Zoom In (Ctrl++):** Enlarges workspace screen detail and size.

**Zoom Out (Ctrl+-):** Reduces workspace screen detail and size.

## View Mode

**Full View:** Set to full view mode.

**Fast View:** Set to fast view mode.

**Outline View:** Set to outline view mode.

**Show Rulers (Ctrl+Alt+R):** Toggle rulers on and off.

**Show Guide Lines (Ctrl+,):** Toggle guide lines on and off.

**Show Grid (Ctrl+Alt+G):** Toggle grid on and off.

**Show Tooltips (Ctrl+J):** Toggle tooltips on and off.

**Show Effects (Ctrl+E):** Toggle effects on and off.

## Snap To

**Use Snapping (Shift+F10):** Enable or disable the snapping feature.

**Use Snap Zones:** Enable or disable the snap zone feature.

**Snap to Grid:** Enable or disable the Snap to Grid feature.

**Snap to Guide Lines:** Enable or disable the Snap to Guide Lines feature.

**Snap to Full Pixels:** Enable or disable the Snap to Full Pixels feature.

**Snap to Anchor Points:** Enable or disable the Snap to Anchor Points feature.

**Snap to Shapes:** Enable or disable the Snap to Shapes feature.

**Snap to Pages:** Enable or disable the Snap to Pages feature.

**Show Inspector Panel:** Toggle inspector panel on and off.

**Show Outline Panel:** Toggle outline panel on and off.

**Toggle Fullscreen (F):** Toggle full screen view on and off.

## Laser Menu

**Capture Workspace:** Currently unavailable for PS.

**Clear Last Visual:** Currently unavailable for PS.

**Trace Background:** Currently unavailable for PS.

**Estimate Job Time:** Give approximate time for job to complete.

**Run Perimeter:** Laser continuously outlines the border of the current project. Press again to stop running perimeter.

**Run Job:** Run your project. When running, "Play" button is replaced with "Pause" and "Cancel".

**Pause Job:** Pause the laser from continuing with current project.

**Cancel Job:** Stop the laser and cancel current operation.

# Setting Options



## Info

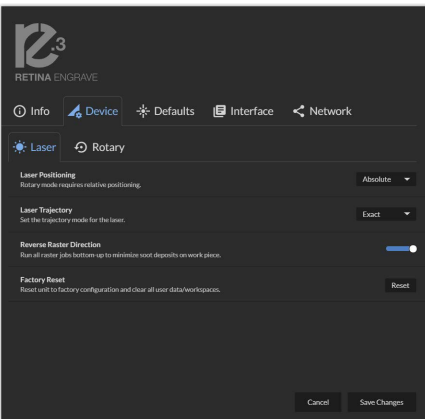
Displays information regarding your machine.

**Version:** Version information.

**WIFI MAC Address:** As reported by device.

**Raster Statistics:** Total time in raster mode and raster lines completed.

**Vector Statistics:** Total time firing while in vector mode.



## Device

Displays information regarding device options.

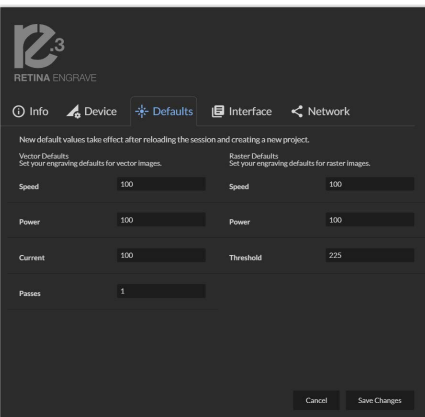
**Laser Positioning:** Toggles between “Absolute” and “Relative” positioning.

**Laser Trajectory:** Toggle trajectory (Exact, Fast and Mixed).

**Reverse Raster Direction:** Run raster jobs "Bottom-Up".

**Factory Reset:** Reset to factory configuration and clear all user data.

**Rotary Mode:** Informs machine a rotary device is being used.



## Defaults

Set you engraving defaults for vector and raster images.

**Speed:** Set speed default from 1 to 100.

**Power:** Set power default from 1 to 100.

**Current:** Set current default from 1 to 100.

**Passes:** Set the number of passes default.

**Threshold:** Set threshold default value from 0 to 255.



## Interface

Show or hide tooltips and other modes.

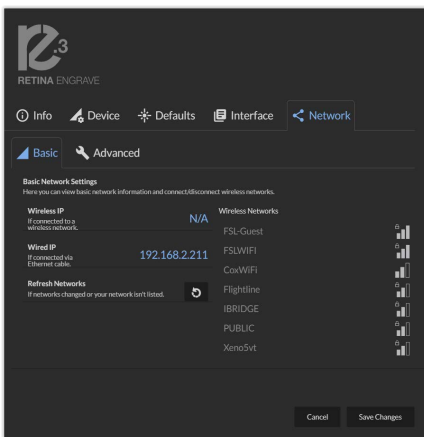
**Highlight On Hover:** Highlight shapes when hovering with mouse.  
**Show Coordinates Tooltip:** Show current coordinates tooltip when creating or moving shapes.

**Show Size Tooltip:** Show current size tooltip when creating or resizing shapes.

**Show Angle Tooltip:** Show current rotation angle tooltip when rotating shapes.

**Invert Selection Mode:** Toggle inverted selection mode on and off.

**Auto Expand Layers:** When set, auto expands the layer tree for the current selection.



## Network

View network information and connect / disconnect wireless network.

**Basic Settings:** View basic network information and connect/disconnect wireless network.

**Wireless IP:** Wireless IP information displayed.

**Wired IP:** Ethernet connection information displayed.

**Refresh Network:** Click button to refresh network.

**Advanced Settings:** Set static IPs and change DNS settings.



## Setting Controls

Access settings options and undo / redo actions.



**Settings:** Click to open setting options.

**Undo:** Reverse your last action.

**Redo:** Reverse your last undo.

## Laser Controls



**Capture Workspace:** Currently unavailable for PS Laser Systems.

**Clear Last Visual:** Currently unavailable for PS Laser Systems.

**Vectorize:** Currently unavailable for PS Laser Systems.

**Estimate Job Time:** Give approximate time for job to complete.

**Run Perimeter:** Laser continuously outlines the border of the current project. Press again to stop running perimeter.

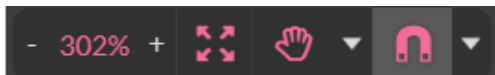
**Run Job:** Run your project. When running, “Play” button is replaced with “Pause” and “Cancel”.

**Pause Job:** Pause the laser from continuing with current project.

**Cancel Job:** Stop the laser and cancel current operation.

## View / Snap Controls

View options or position items on workspace grid.



**Zoom (-/+):** Enlarges/Reduces workspace screen detail and size.

**Fit All**

**View**

**Pan (H):** Manually pan project window using mouse.

**Zoom (Z):** Zoom project window using mouse.

**Snap**

**Use Snapping (Shift+F10):** Enable or disable the snapping feature.

**Use Snap Zones:** Enable or disable the snap zone feature.

**Snap to Grid:** Enable or disable the Snap to Grid feature.

**Snap to Guide Lines:** Enable or disable the Snap to Guide Lines feature.

**Snap to Full Pixels:** Enable or disable the Snap to Full Pixels feature.

**Snap to Anchor Points:** Enable or disable the Snap to Anchor Points feature.

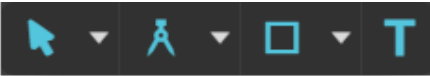
**Snap to Shapes:** Enable or disable the Snap to Shapes feature.

**Snap to Pages:** Enable or disable the Snap to Pages feature.

**Show Grid:** Toggle grid on and off.

**Show Guidelines:** Toggle guidelines on and off.

## Draw Controls



**Select (Pointer):** Instantly initiate mouse pointer.

### Subselect

**Pointer (V):** Initiates mouse pointer.

**Subselect (D):** Initiates “subselect” mouse pointer.

**Lasso (O):** Initiates “lasso” mouse pointer.

**Layer (M):** Initiates “layer” mouse pointer.

### Path

**Pen (P):** Initiates “pen” mouse pointer for creating custom paths.

**Bezigon (B):** Initiates “bezigon” mouse pointer for creating custom path points.

**Freehand:** Initiates “freehand” mouse pointer for creating freehand paths.

**Magic Hand:** Initiates “magic” mouse pointer for creating paths.

### Shape

**Line (L):** Create a line with the drawing tool.

**Rectangle:** Create a rectangle with the drawing tool.

**Ellipse (E):** Create an ellipse with the drawing tool.

**Polygon:** Create a polygon with the drawing tool.

**Triangle:** Create a triangle with the drawing tool.

**Star:** Create a star with the drawing tool.

**Text:** Create an object made of text.

## Position Menu



**Flip Horizontally:** Flip object along horizontal axis.

**Flip Vertically:** Flip object along vertical axis.

**Rotate 90° Left:** Rotate object 90° left.

**Rotate 90° Right:** Rotate object 90° right.

## Group Menu



**Group:** Group objects

### Merge

**Union:** Combine layers into a single compound layer.

**Difference:** Combine non-overlapping layers into a single compound layer.

**Intersection:** Combine overlapping layers into a single compound layer.

**Subtract:** Remove and combine non-overlapping layers into a single compound layer.

**Split:** Split up a compound shape or object.

## Arrange Menu

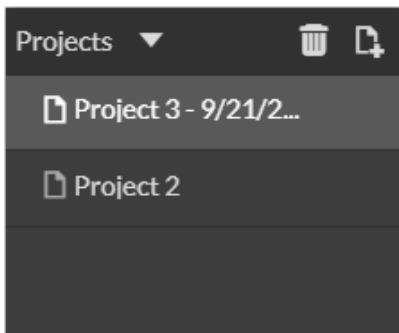


**Bring Forward:** Send an object one layer forward.

**Send Backward:** Send an object one layer backward.

## Projects Menu

Displays information about projects.



**Reduce Window:** Reduce or expand projects window.

**Delete:** Delete selected project.

**Create New Project:** Begin a new project.

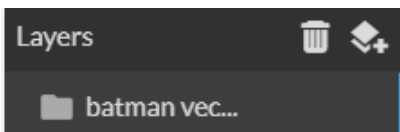
**Project Name:** Displays project's name.

**Toggle Lock:** Lock or unlock project in current order.

**Toggle Visibility:** Turn visibility of project on or off.

## Layers Menu

Displays information on layers.



**Delete:** Delete selected layer.

**New Layer:** Add a new layer.

**Layer Name:** Displays name of project.

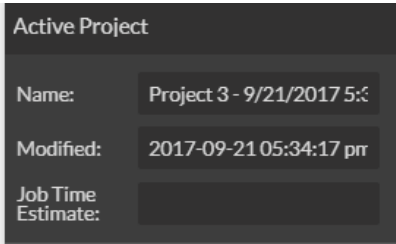
**Toggle Lock:** Lock or unlock layer in current order.

**Toggle Visibility:** Turn visibility of layer on or off.

**Toggle Outline:** Turn displayed outline of layer on or off.

## Active Window Info

This window displays information regarding the active project.

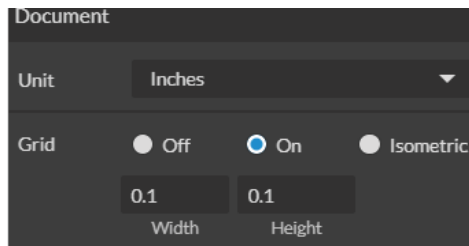


**Active Project Name:** Displays name of active project.

**Modified:** Displays last date project was modified.

**Job Time Estimate:** Displays estimated time until job is complete.

## Document Window



**Unit:** Choose unit of measurement from the following -

**Pixels:** Sets unit of measurement to pixels.

**Centimeters:** Sets unit of measurement to centimeters.

**Millimeters:** Sets unit of measurement to millimeters.

**Inches:** Sets unit of measurement to inches.

**Picas:** Sets unit of measurement to picas.

**Points:** Sets unit of measurement to points.

**Grid:** Toggles grid on/off/isometric.

**On:** When "on" grid displays in workspace.

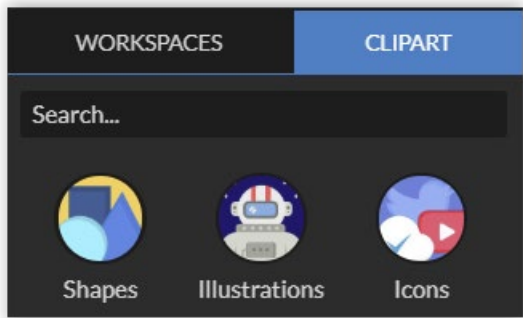
**Off:** When off, grid does not display in workspace.

**Isometric:** Toggles grid from squares to isometric grid.

**Width:** Displays width of item according to chosen unit of measurement.

**Height:** Displays height of item according to chosen unit of measurement.

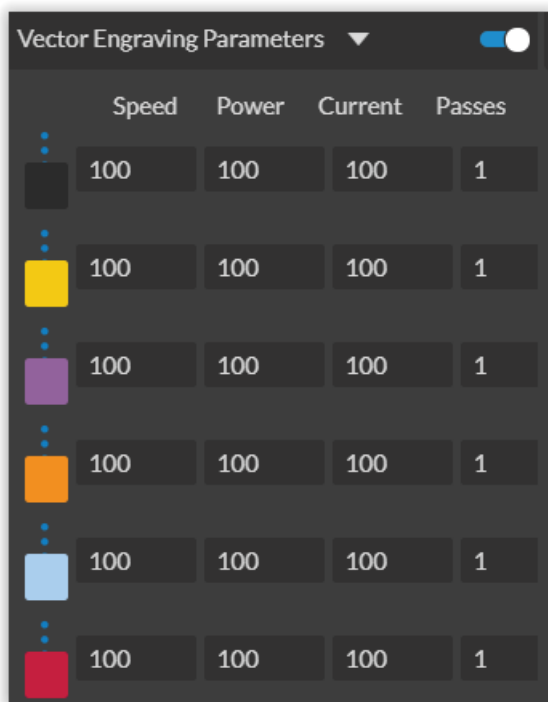
## Clip Art Window



Access pre-made clip art samples of shapes, illustrations and icons.

## Vector Engraving Parameters Window

Window appears when vector file is detected and is used to input vector settings.



**Hide Window:** Click to hide vector engraving parameters window.

**Show All Parameters:** Toggle to show or hide all parameters.

**Change Position:** Drag with mouse to reorder any color.

**Color Indicator:** Separates vector cuts with color indicators.

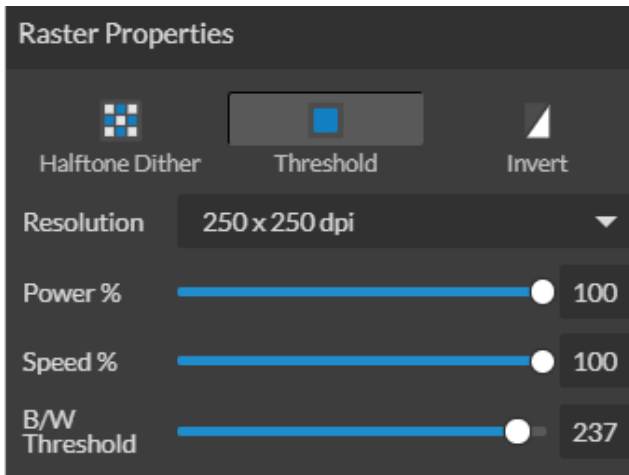
**Speed:** Input speed settings.

**Power:** Input power settings.

**Current:** Input current settings.

**Passes:** Input the number of passes for the laser.

# Raster Properties Window



**Halftone Dither:** Apply Halftone Dither.

**Threshold:** Apply Threshold.

**Blur:** Adjust blur filter radius from 0 to 30.

**Edge:** Adjust edge enhancement threshold from 0 to 30.

**Intensity:** Adjust intensity from -255 to 255.

**Invert:** Reverse Black and White elements.

**Resolution:** Set resolution (250, 500, 1000 dpi).

**Power %:** Select power percentage from 1 to 100.

**Speed%:** Select speed percentage from 1 to 100.

**B/W Threshold:** Select black and white threshold from 0 to 255.

## Indicators (Bottom Row)

**Position Indicator:** Displays current position of the laser on the grid.

Position: X: 6.890", Y: 3.937"

**Time Remaining Indicator:** Displays the time remaining to complete the current job.

Remaining: 3 Min, 36 Sec 41%

**Status Indicator:** Displays whether laser is ready to initiate a job or is currently executing a job.

Status: Ready

Status: Executing job

**Sync Indicator:**

Sync: Workspace saved

**Machine Indicators:** Displays information on connected devices.



**Device Connection Available:**

**Lid Indicator:** Tells operator if lid is open or closed. The laser will not fire if lid is open.


**Water Flow Indicator:** Tells operator if water is flowing through the laser tube or not. The laser will not fire if water is not running through the laser tube.

**Air Assist Indicator:** Tells operator if air assist is on or off. Air assist should always be on when running a job.

**Exhaust Indicator:** Tells operator if exhaust is on or off. Exhaust should always be on when running a job.

# SECTION VII. OPERATIONS

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



VECTOR	RASTER
Project Examples	
Signs, Logos, Parts, Gears	Image Engraving, Surface Marking
File Types	
PDF, SVG	JPEG, GIF, PNG, TIF
Preferred File Type	
PDF	JPEG
File Composition	
Geometric Formulas	Pixels

## What is 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.

## What is Engraving?

Engraving is the process by which complex designs are etched into a workpiece. 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. Engraving is also known as “Raster Engraving” or “Rastering”. For 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 at that 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.

## Images and Engraving

Engravable images use multiple colored pixels to form an image. JPEGs and PNGs are common engraving 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 pixelated 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 v3.0 can read PDF files as either a vector or an engraving 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 v3.0 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 has a simple method for converting files to PDF and then directly printing them to the RetinaEngrave v3.0 software.

## Design Tools

RetinaEngrave v3.0 includes a robust set of design tools, allowing users to design in the software without needing outside design software. Third party design software, however, is still an option for RetinaEngrave v3.0 users. 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 program.

If you use third party 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.

Compatible design packages include: CorelDraw, 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 LASER CUTTER

## Project Workflow

The RetinaEngrave v3.0 software works with your Pro-Series PS Laser System to create a simple and intuitive set of operations that is easy to learn and use. With experience, you will find your machine 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.

## Project Workflow Checklist

### 0. 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.

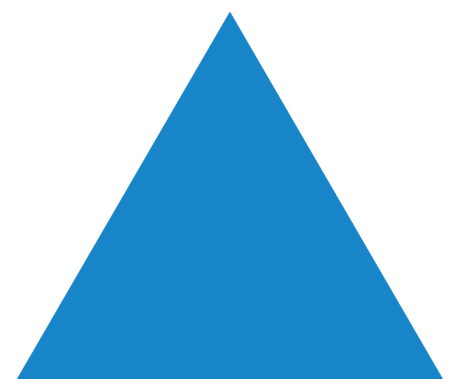
### 1. Create Design



Typically, projects are created in design software and then imported to RetinaEngrave v3.0. 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 an engraving and choose the most appropriate file type (PDF or JPEG). This will greatly aid the software to run the job smoothly and quickly. RetinaEngrave v3.0 includes a robust set of design tools, allowing users to design in the software without needing outside design software. Third party design software, however, is still an option for RetinaEngrave v3.0 users. 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.



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

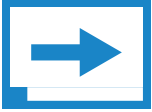


**Vector File**  
**Geometric based**  
**image. Example: PDF**



## 2. Connect to RetinaEngrave v3.0

Follow the instructions presented in Section III: Installation & Assembly. As a recap, you will turn on your computer and your laser cutter and wait for both to finish their boot cycle. Then, observe the connected network address on the lower left corner of the LCD. Copy this IP address into your computer's browser navigation bar and the program will appear, ready to use. For best results, we recommend using Google Chrome as this is the most compatible with RetinaEngrave v3.0 technology. Note that your PC and your laser unit must be connected to the same network at all times during normal operation.



## 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 setup the project accordingly by presented raster options in the properties tab menu.



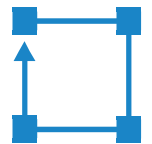
## 4. Place Material

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. 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 is the user's responsibility to know the components of any material used and the limitations of utilizing that material (thickness, chemical residues, etc.). Always check with the material manufacturer, or MSDSONline.com, 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 your machine's user manual. Note that if your machine has an auto-focus feature, focusing will be done automatically when the job is run.



## 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". By using the directional arrows on the touchscreen or the arrow keys on your computer, move the laser dot to the top left corner of your material. When placing an engraving image, leave at least 1/2" inch of space on the left and right side. When creating engravings, you must compensate for the left and right overshooting of the laser head. 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

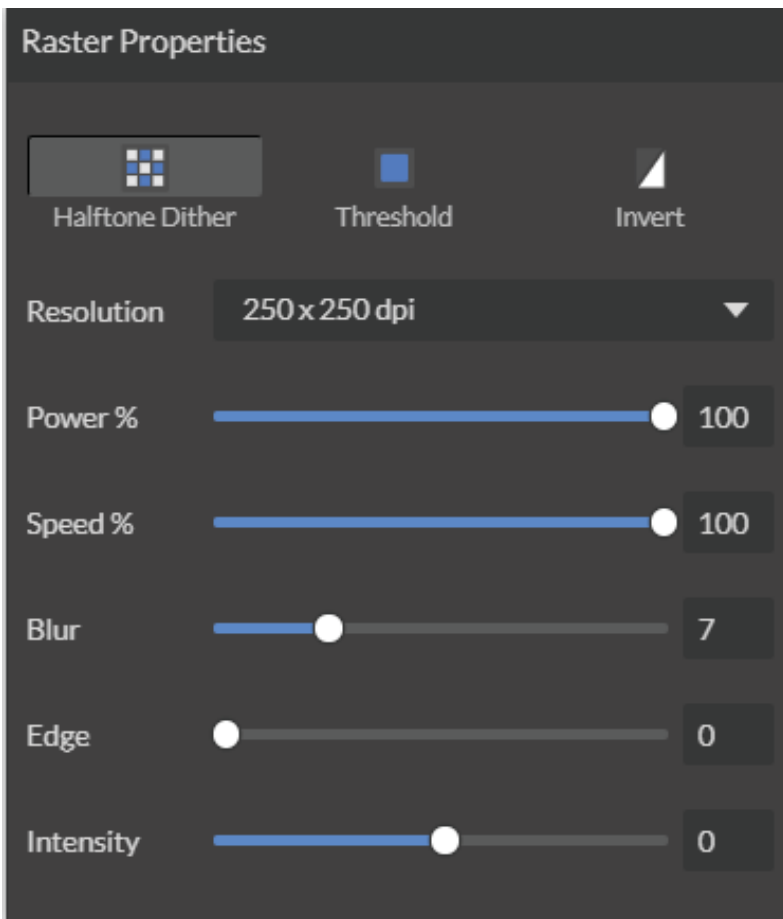
Clicking the “Start Job/Play” button begins the laser cutting process. Before doing so, double check your safety protocol and that your system accessories are connected properly. Be sure to monitor the job while the laser is firing.

## Engraving

Engraving, also called Rastering, is the process of creating a surface image on material without cutting through the material entirely.

### Setting Engraving Properties

Clicking an object (design image) in the workspace will allow you to access that object properties tab. The software will identify if the object is a vector or an engravable object and present the appropriate properties window. To show the properties of an engravable object, click the object.



### Setting Resolution

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.

## Applying 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 clicking "Threshold". This will bring up a B/W Threshold slide bar, from which you can adjust B/W threshold to your liking.

## 3D Engraving Options

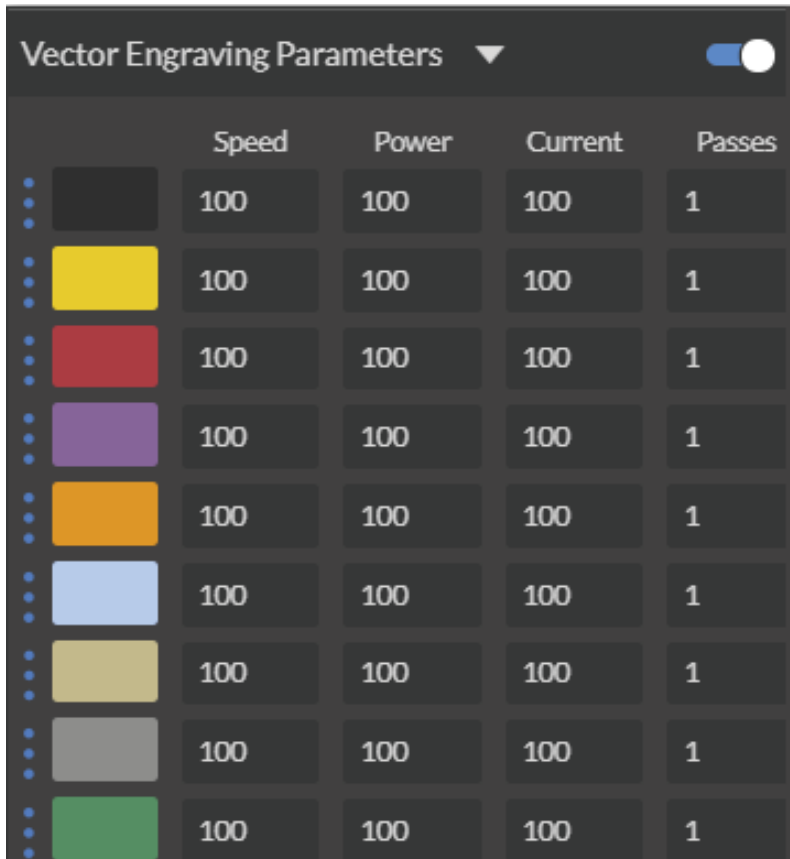
For images that have shadows and depth, it's ideal to use 3D engraving "also called dithering". Dithering creates a series of dots similar to newsprint. This effectively creates a grayscale that is ideal for photorealistic engravings. To dither an object, click the dithering button. You can then adjust the dither with the Blur, Edge and Intensity slide bars.



# Vector Cutting

## Setting Vector Properties

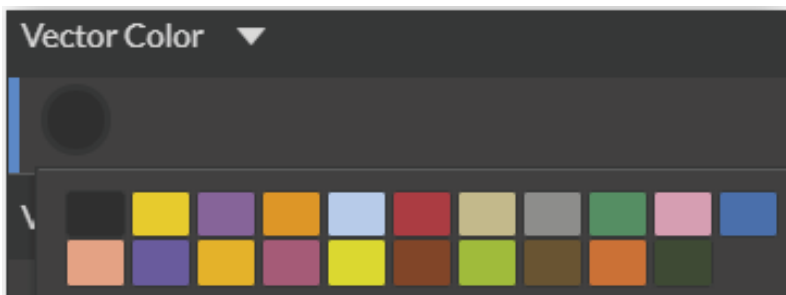
When a PDF file is imported into RetinaEngrave v3.0, the program automatically detects it as both a vector file and a raster file.



	Speed	Power	Current	Passes
Black	100	100	100	1
Yellow	100	100	100	1
Red	100	100	100	1
Purple	100	100	100	1
Orange	100	100	100	1
Light Blue	100	100	100	1
Gold	100	100	100	1
Grey	100	100	100	1
Green	100	100	100	1

## Vector Color

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 work screen. 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.



## Vector Engraving Parameters Window

Window appears when vector file is detected and is used to input vector settings.



**Hide Window:** Click to hide vector engraving parameters window.

**Show All Parameters:** Toggle to show or hide all parameters.

**Change Position:** Drag with mouse to reorder any color.

**Color Indicator:** Separates vector cuts with color indicators.

**Speed:** Input speed settings.

**Power:** Input power settings.

**Current:** Input current settings.

**Passes:** Input the number of passes for the laser.

## 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. In general, the slower the speed, the more the laser will contact the material, allowing for deeper cuts and engravings.

## 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.

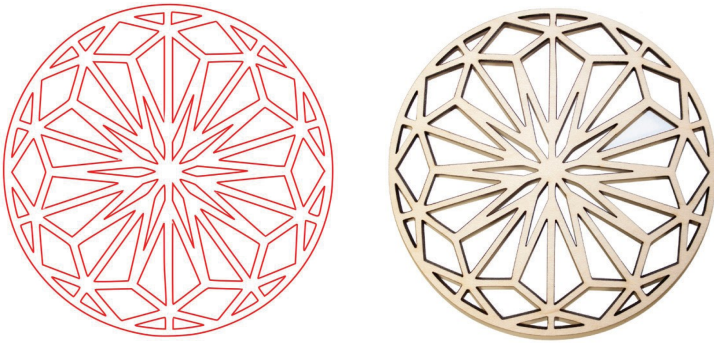
## Show All Parameters

This toggle switch displays or hides all possible vector tag as a series of color options. Often when performing both vector cuts and raster engraving, it is a good idea to change the color of the vector cut to something other than black. This will avoid the laser detecting the vector cut as part of the raster.



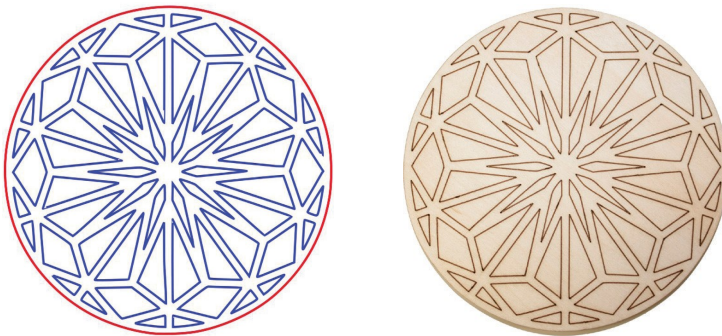
## Basic Vector Cutting Example

In the software, the red lines tell the laser what to cut. All red lines will be cut through the material creating the empty space in the final project.



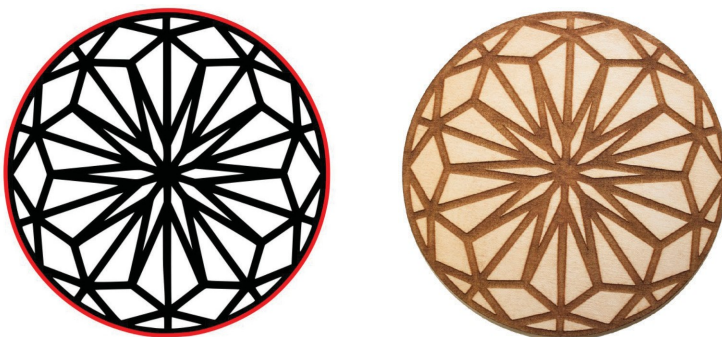
## Vector Cutting Example

We can outline (as opposed to fill) parts of the pattern for a second design option. Again, we will instruct the laser using our vector properties. In this design, the blue lines will not be cut through on our material, but instead will be marked, as the red outline is still cut through.



## Combining Vector and Raster

Engravings can be combined with vector cuts to create a variety of outcomes. A simple example is to engrave an image, and then cut the image out with a vector outline. In this case the laser will raster in the black fill and cut the red line.



# DESIGNING WITH RETINAENGRAVE v3.0

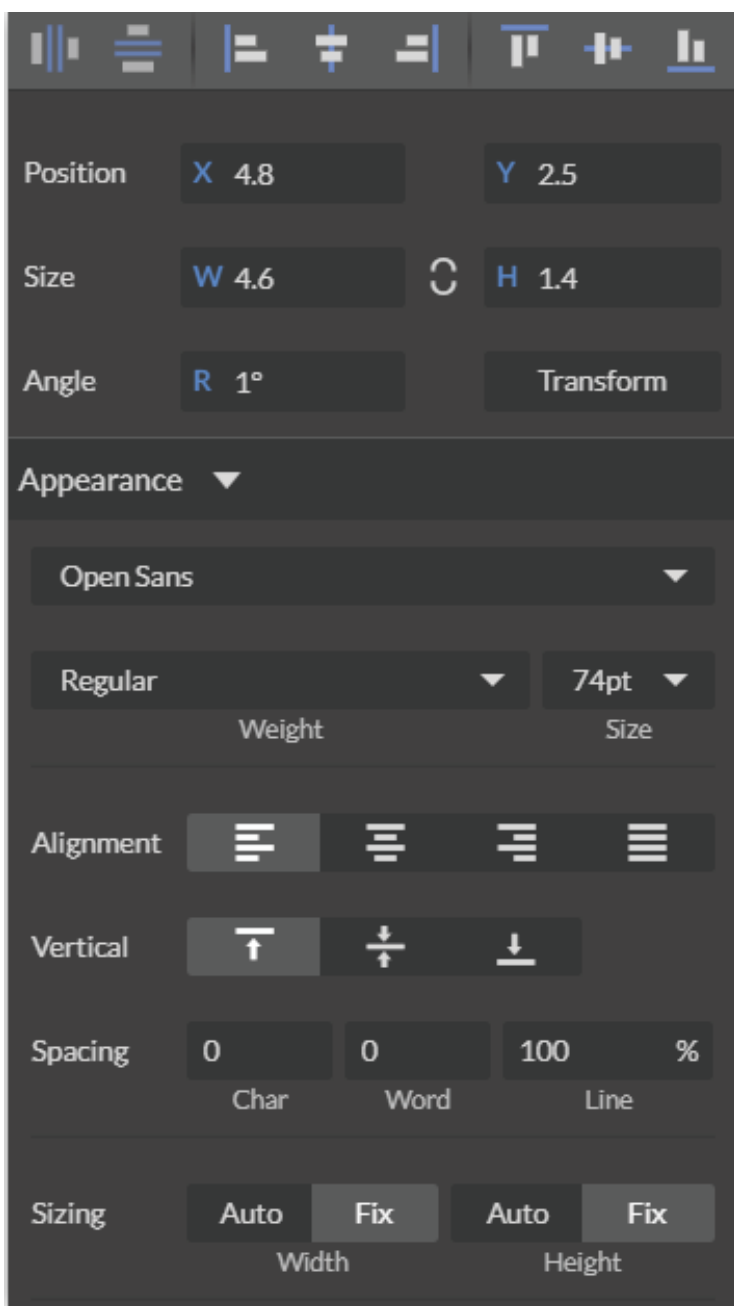
RetinaEngrave v3.0 contains design tools to allow for custom designs within the software itself. Here you can design and create objects and text without the need for third-party design software.

## Adding Text



Click the “T” icon and then click anywhere in the view window. You can now write your text. To customize your text, click on the text object you created and a new window will appear with options to adjust the positioning, size and font of your text.

### Full Text Options Window



## Text Positioning

Text position can be quickly adjusted by clicking on one of the following options.



**Distribute Horizontally:** Evenly arrange selected Text horizontally.

**Distribute Vertically:** Evenly arrange selected text vertically.

**Align Left:** Align text to the left.

**Align Center:** Align text to center.

**Align Right:** Align text to right.

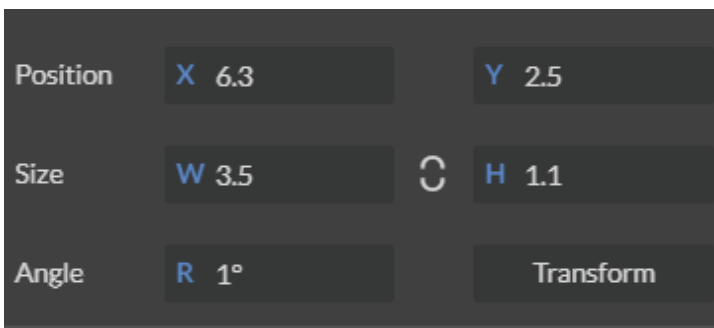
**Align Top:** Align text to top.

**Align Middle:** Align text to middle.

**Align Bottom:** Align text to bottom

## Text Positioning Coordinates

This window displays the coordinates and other specs of the selected text. Coordinates can be changed manually by entering the desired specifics directly into the software.



**Position:** Displays position of text in X/Y coordinates in the workspace. Click box to directly input X/Y coordinates.

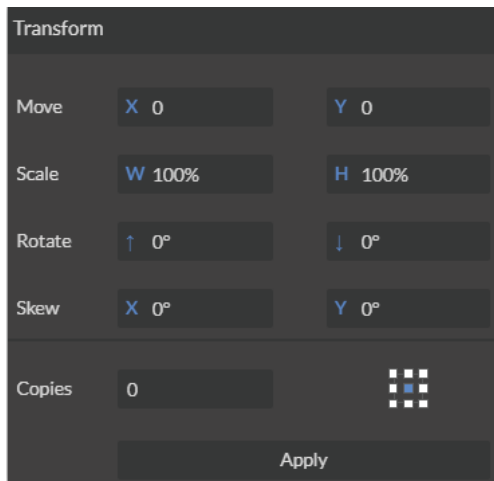
**Size:** Displays size of text according to width and height. Click box to directly input desired width and height of text.

**Angle:** Displays angle of text as a degree. Click box to directly input angle degree of text.

**Transform:** Clicking the transform button brings up the Transform Window options.

## Text Transform Options

Transform options allow the operator to alter the shape and skew of text.



**Move:** Set X/Y coordinates.

**Scale:** Manipulate the scale of text, separately, in width and height.

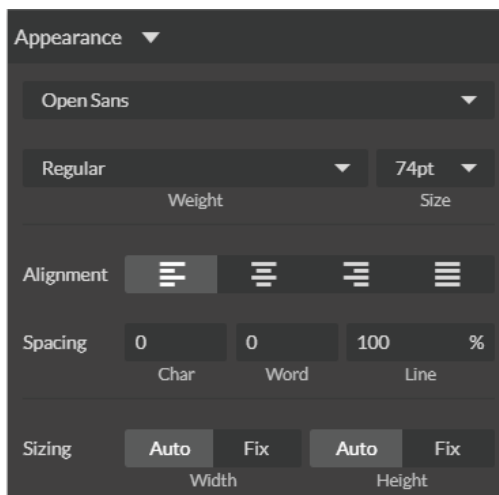
**Rotate:** Rotate text a set number of degrees, up or down.

**Skew:** Skew the angle of text by a set number of degrees on the X and Y axis.

**Copies:** Create duplicates of the selected text.

**Apply:** Click to apply all transform changes.

## Text Appearance



**Select Font:** Choose or change selected text font.

**Weight:** Choose bold and italic options for selected text.

**Font Size:** Choose font size for selected text.

**Alignment:** Align or justify selected text left, right or center.

**Spacing:** Set pacing or characters, word blocks and line spacing.

**Sizing:** Lock all sizing options (Fixed) or allow custom alterations (Auto).

When set to auto, click on text and use mouse to manipulate corner nodes to change size.

## Text Path Options

### Attach Text to Path

This function allows the user to attach text to a shape and contour the text to that shape. As an example, user creates an ellipse design and a text element separately. With the mouse, drag a square over both. By clicking Attach Text to Path, the text is merged with the ellipse and the text conforms to the contour of the shape. The user can then drag the text element to the desired position, using the mouse.

### Detach Text from Path

This function reverses the Attach Text to Path option. Select the object and text with the mouse by dragging a square to highlight both. Then, click Detach Text from Path. The shape and the text will now be separated.

### Convert to Path (Shift+Ctrl+P)

Convert a non-path to a layer path. If a layer is composed of elements that are treated like paths, internally, or the layer is a Text object, the existing paths that make up the object are simply extracted from the object as they are already defined. The result is a compound path containing all of the separate paths. Any transform information from the original layer is not retained in the individual paths. For all other types of layers, a new path is created, preserving any transforms. The user creates a text layer then converts to a path. Because the text was comprised of more than one distinct element a compound path is created. The compound path can then be split into separate paths for each distinct element in the text.

### Convert to Raw Path

Convert a path or non-path layer to a new path. This is similar to Convert to Path with some important differences. With Convert to Raw Path new path objects are always created regardless of the type of the original layer and transforms are preserved. The user creates a text layer then attaches it to an ellipse path so that it follows the curvature of the ellipse, then converts the text to a raw path. The text retains its curvature because the transforms of the separate text paths are preserved.

# Creating Objects in RetinaEngrave v3.0

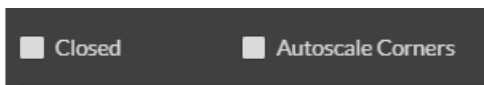
The easiest way to create an object is to select a shape from the tools menu. For example, you want to make a circle. Select the circle tool, then click and drag to create a circular shape. By holding shift while dragging, you can constrain the proportions so that the circle is perfectly round. Design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

## Creating Shapes



Click the Square Icon and then click and hold anywhere in the view window. By moving the mouse, you can expand and manipulate the square you want to create. By clicking the drop-down arrow next to the Square Icon, you can choose other base shapes and expand them just like with a square. The basic shape library includes **line**, **rectangle**, **ellipse**, **polygon**, **triangle** and **star**. You can modify any shape by clicking on it and then adjusting the interface data appearing on the right side of the screen. Each shape will have slightly different options as follows:

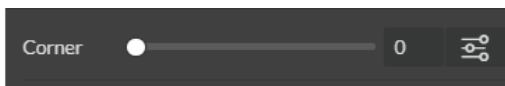
### Line (L)



Closed:

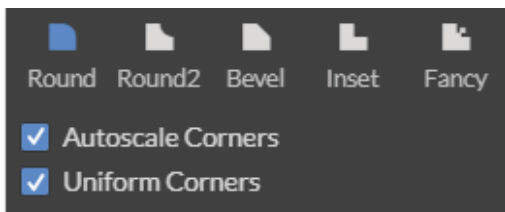
Autoscale Corners:

### Rectangle (R)



**Corner:** Slide bar contorts and manipulates corner styles.

**Advanced Settings:** Open a window for additional corner options.



**Round:** Create rounded corners.

**Round2:** Create inverted rounded corners.

**Bevel:** Create beveled corners.

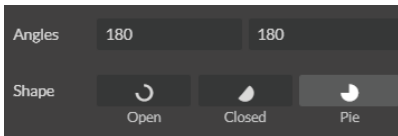
**Inset:** Create inset corners.

**Fancy:** Create fancy corners.

**Autoscale Corners:** Toggle autoscale corners on and off.

**Uniform Corners:** Click to ensure all corners have the same parameters.

## Ellipse (E)



**Angles:** Input custom angles.

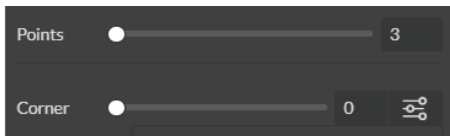
**Shape:**

**Open:** Click for open ellipse.

**Closed:** Click for closed ellipse.

**Pie:** Click for pie shaped ellipse.

## Triangle, Polygon & Star

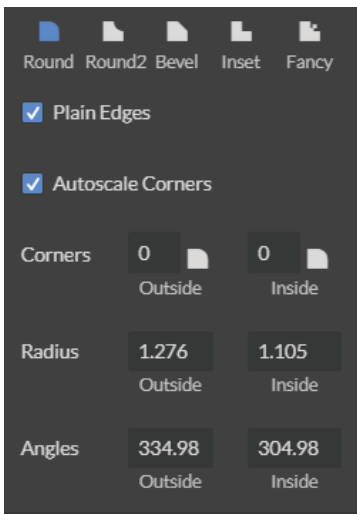


**Points:** Slide bar to create polygons with multipoints (3 to 25).

**Corner:** Slide bar to curve corners.

**Advanced Settings:** Clicking the icon opens a new popup window.

## Advanced Settings



**Round:** Create rounded corners.

**Round2:** Create inverted rounded corners.

**Bevel:** Create beveled corners.

**Inset:** Create inset corners.

**Fancy:** Create fancy corners.

**Autoscale Corners:** Toggle autoscale corners on and off.

**Uniform Corners:** Click to ensure all corners have the same parameters.

**Plain Edges:** Toggle plain edges on and off.

**Corners:** Input outside and inside corner curvature.

**Radius:** Input outside and inside corner radius.

**Angles:** Input outside and inside corner angles.

# Creating and Manipulating Compound Shapes & Objects

Operators can combine and modify shapes and objects to create unique compound shapes and objects with these functions (see also Modify):

## Split Selection (Shift+Ctrl+G)

Split up a previously created compound shape or object that has been “Unioned” with other shapes. Select the compound shape and choose Split Selection. The different objects are split back up into individual layers that can be moved independently.

## Create Compound Shape>Union

Combine multiple layers into a single compound layer. Union will create a compound shape containing all of the selected layers, retaining their relative positions. Union together several different object and create a compound shape so they can all be moved and manipulated as one. To reverse, select the compound shape and choose Split Selection. The different objects are split back up into individual layers so you can move one of them independently.

## Create Compound Shape>Intersection

Combine overlapping layers into a single compound layer. Intersection will create a compound shape containing the areas where the selected layers overlap. Intersect together part of an ellipse and part of a rectangle to create a new compound shape with curved and straight lines.

## Create Compound Shape>Subtract

Remove and combine non-overlapping layers into a single compound layer. Subtract will create a compound shape containing only the areas of the last selected layer where the other selected layers do not overlap. For example, users can create an ellipse and subtract a rectangular area so the ellipse can be placed over another layer and not obstruct part of it. Or use to make a design that is made up of standard shapes by subtracting certain areas.

## Create Compound Shape>Difference

Combine non-overlapping layers into a single compound layer. Difference is the opposite of Intersection. It will create a compound shape containing only the areas where the layers do not overlap. For example, the user can create a large circle ellipse, then create a smaller circle ellipse. Place the smaller circle ellipse over the large circle ellipse and center it. Select both layers and choose Difference. A hole is created in the large circle ellipse and a donut design is formed.

## Create Nested Compound

Combine compound shapes into a single compound shape. All of the selected compound shapes will be nested within the compound shape that was selected last. For example, if user has created compound shapes and created the layout with the desired spacing but would like to move them all while retaining the existing layout, creating a nested compound shape that includes them all works best.

## Convert to Outline

Create an outline path of a specified size around an object. If the original object is not continuous, such as a line, an outline is created around the line and the original line is replaced. If the original object is continuous, such as a rectangle, an outline is created around the rectangle and the original rectangle is preserved, resulting in a compound path with two rectangles. The user creates a curved line then converts it to an outline of size 10. The result is a continuous curved polygon that looks like a wet noodle.



## **Expand/Shrink**

Scale an object up or down by a specified amount. The user creates an object and wants to grow it a few pixels but trying to scale it with a selection box is too difficult. He can expand the object by specifying the exact amount.

## **Creating & Converting Vector Paths**

A vector path indicates the line the laser moves along while cutting. For a simple line, the path is a clear route from Point A to Point B. More complicated paths, and shapes, can be created using the following options in the Modify drop-down window:

### **Vectorize Border**

Use to create a vector path of the border of an object. For example, the user creates an object, such as a rectangle, and wants to have a vector path of just the border of the triangle.

### **Vectorize Image**

Use to create vector paths of each separate element in an image. For example, the user first imports an image. User then wants certain parts of the image to be vectors so they can be cut. User vectorizes the image and then moves some of the resulting vectors out of the image object. The vectors can then be edited.

### **Join Paths (Ctrl+J)**

Combine 2 or more selected paths into one compound path. The result is a single layer titled 'Compound Path'. It does not connect them into one continuous path but rather a single object with breaks between the individual paths that were joined. The user joins together multiple path objects so that they can be transformed more easily and change their properties as a single object.

### **Split Paths (Shift+Ctrl+J)**

Split a compound path into its original separate paths. The result is a path layer for each separate path in the Compound path.

### **Simplify Path (Ctrl+Alt+S)**

Simplify (and smooth) a path to varying degrees of tolerance. The user creates a freehand line or compound curve but the resulting curve has some sharp turns and jagged edges. Next, select the path and simplify it with a tolerance. The resulting path has fewer vertices and smoother turns.

### **Connect Path Lines**

Connect together the ends of 2 or more paths. The user vectorizes an image containing text. Due to the low quality of the image some, of the text characters have breaks in their paths, so the user selects the lonely paths and uses the "Connect Paths Lines" feature to connect the paths.

### **Break Curve**

Break apart a path at a specified node. The user creates a path but would like to separate it and add space at certain vertices to add another artistic element in between. Or maybe to specify different engraving parameters for different parts of the path. To do so, the user selects a node and chooses "Break Curve". The path is separated into two separate paths.

### **Reverse Order**

Reverse the order of nodes in a path. When the user creates several paths and uses the "Connect Paths Lines" feature, they are connected but not at the desired ends. This is because the paths are connected from the last node of one path to the first node of the next. Undo the previous action and chooses "Reverse Order" on one of the paths. Then connects the paths and they are connected perfectly.

## OTHER OPERATIONS

### 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 Ctrl + Left Mouse Button within the web application workspace, 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.

### Positioning Material

**Relative positioning** is relative to the laser head. The red dot from the laser will be considered the top left corner of an image.

**Absolute positioning** is currently unavailable for PS laser systems.



#### POSITIONING WHEN RASTER ENGRAVING

When rastering an image, the laser head accelerates to the desired speed over some at the default job origin—if you are using a changed origin, such as a center origin, the laser head will still move to the upper left corner before beginning the job. Because of the acceleration and deceleration distances, some jobs will require a one (1) inch buffer on the left and right sides to avoid crashing the laser head.

# Mouse Controls

## 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 the 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

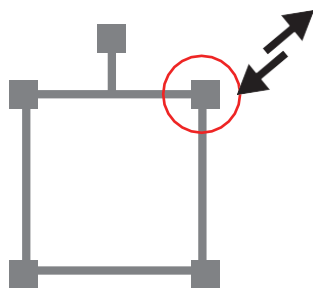
Hold the Alt button on your keyboard, then left click and hold your mouse over the rotation node. By moving the mouse, you can resize the object from center rather than the corner.

## D. Alt + Left Click to Resize

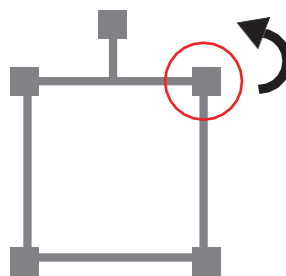
Hold the Alt button on your keyboard, then left click and hold your mouse over one of the four corner “resizing” nodes. By moving the mouse, you can to rotate the object from the opposing node.

## E. Home to Location

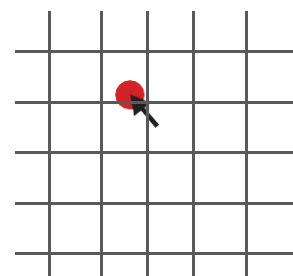
Instantly home the laser to any location in the work bed by simultaneously holding the Ctrl key and left-clicking the mouse. This allows you to choose where the laser starts the job.



Resize



Rotate



Home to Location

## SECTION VIII. MAINTENANCE & TROUBLESHOOTING

With care and maintenance, your Pro-Series Laser System 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.

### Belt Installation

The belts on your laser system are a consumable item and will eventually stretch beyond a usable length or break. Contact Full Spectrum Laser support to order replacement belts, as needed.

#### REQUIRED TOOLS:

2.5mm hex key (included with accessories)

**1. 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.

# 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

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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

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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

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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.

# 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:** Front Panel does not turn on.

## POSSIBLE CAUSE

1. USB Disconnected.
2. Control card is not receiving power.
3. Laser is not ON.
4. Loose connections.

## SOLUTIONS

1. Check that the internal USB connection between the Control Card and the Control Panel is in place.
2. If the USB cable is connected, check that the Control Card is receiving power. The green LED on the Ethernet port will be lit as well as the blue controller light and the Ethernet port lights.
3. If the Ethernet LED is not lit, verify that the laser is plugged in and the power is ON (E-stop is unlocked). If the laser is plugged in and power switch (E-stop) is ON, check that the power supply is receiving power.
4. If power supply LED is receiving power, check connections between laser and power supply. If connections are good (no loose connectors or wires) and foregoing tests passed, please contact support.

**PROBLEM:** Laser does not fire.

## POSSIBLE CAUSE

1. Laser cover is open or magnet wires are disconnected.
2. Signal port not working or chiller is not pumping water through the laser tube.

## 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 by confirming they run to the black connector and are sealed properly.
2. Be sure that water is flowing from left to right through the laser tube and that the water chiller is ON. If confirmed and issue persists, contact support.

**PROBLEM:** Laser head crashes during a job.

**POSSIBLE CAUSE**

1. This issue is only apparent on jobs that take up the full work area or are run close to the edge.

**SOLUTIONS**

1. In either Raster or Vector mode, the laser must first be Homed for the soft limits to work properly.

2. In Raster mode, the laser requires an acceleration and deceleration distance that varies with the Speed %; lower speeds require a shorter acceleration/deceleration distance. As a general rule of thumb, at 100% Raster speed, jobs need 1" clearance on the left and right.

**PROBLEM:** Engraved lines are diffused; cutting fails even at high power.

**POSSIBLE CAUSE**

1. Laser is not in focus.

**SOLUTIONS**

1. Check that your laser is in focus.

**PROBLEM:** Red diode laser OFF.

**POSSIBLE CAUSE**

1. Loose power cords.

**SOLUTIONS**

1. Check that the plugs on the power supply are connected, as it is possible they came loose during shipping.

**PROBLEM:** Motors to not jog.

**POSSIBLE CAUSE**

1. Motors are not connected.

**SOLUTIONS**

1. Verify that the motors are connected to the control card.

**PROBLEM:** PC does not connect to Laser.

### **POSSIBLE CAUSE**

1. Internet connection is not properly configured.
2. Third-party anti-virus or firewalls blocking RE from establishing connection.

### **SOLUTIONS**

1. Verify that your internet connection is properly configured for DHCP. You must reset the laser after connecting the Ethernet cable. On some PCs it is not possible to browse the internet over Wi-Fi and connect to the laser via Ethernet at the same time.
2. Temporarily disable windows firewall and third party antivirus software to allow connection. Engraved lines are diffuse; cutting fails even at high power.

**PROBLEM:** Vector cut lines are not straight.

### **POSSIBLE CAUSE**

1. This problem is usually caused by a mis-adjusted laser head.

### **SOLUTIONS**

1. Return to the instructions for Laser Head Adjustment



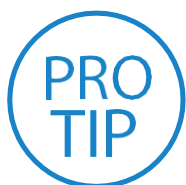
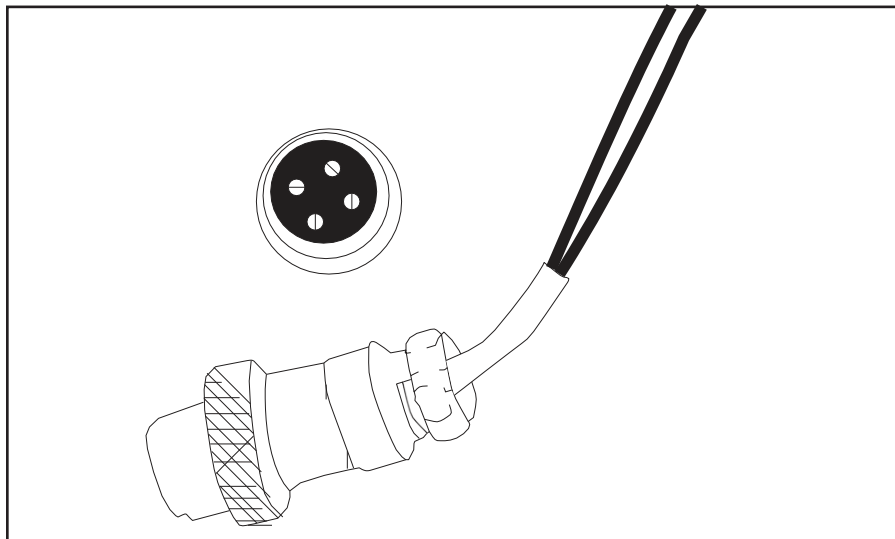
# Appendix A: Rotary Attachment Installation

The rotary attachment requires disconnection of the Y-Axis motor from the motor driver. The attachment effectively replaces the Y-Axis by rotating the object as the laser fires.

## 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.

- 1. Insert Rotary:** Place the rotary attachment in the machine. Align it parallel with the X-Axis by dragging the red dot over a straight object like a label or piece of tape on the bottom.
- 2. Align Rotary:** Raise the jack until the work piece is level. Use a level to check the surface.
- 3. Power Off Machine:** In the next step we will be connecting cables within the machine. Be sure to turn the laser off and unplug it from its power source.
- 4. Connect Rotary:** Your rotary attachment ships with a round 4-pin connector that is designed to mate with the Y-Axis plug on the right side of the work area. With the power off, unscrew the ring securing the connectors together and disconnect the motor driver cable. Connect the rotary attachment cable in the same fashion. To reconfigure the laser for normal operation, switch the 4-pin rotary connector with the 4-pin Y-Axis motor connector you removed to plug the rotary in.



**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.*

# Using the Rotary Attachment

The rotary attachment is designed to be used within the laser case. Please be aware that any system modifications must be performed by an authorized technician and in accordance with all applicable state and federal laws.

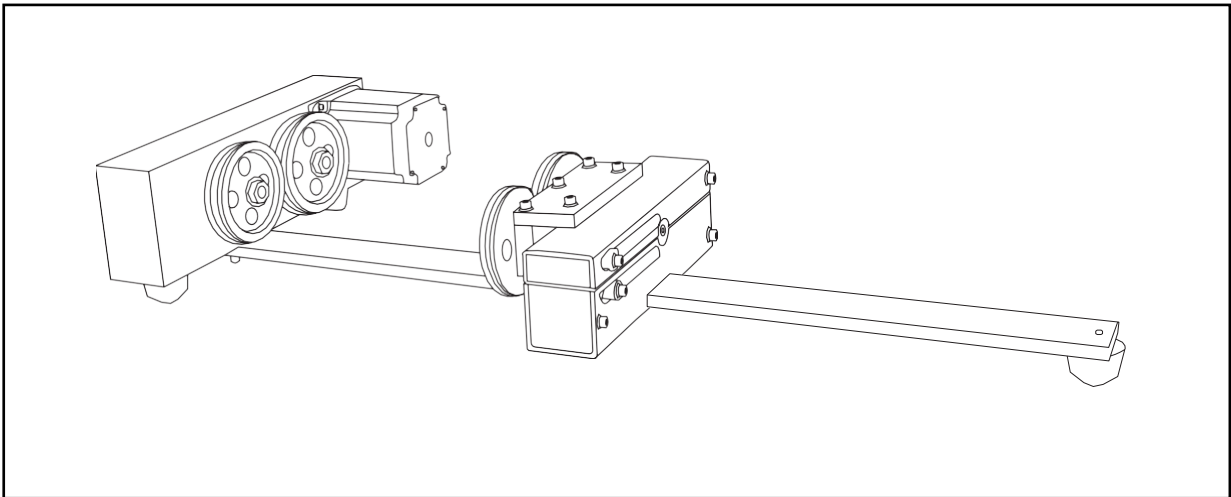
## ALIGNING YOUR ROTARY ATTACHMENT

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.



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

# Appendix B: Customer Support

Full Spectrum Laser provides the best customer support in the industry. Contact us if you have any questions or issues with your Pro-Series Laser System. 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 (PST)  
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 (PST)  
sales@fslaser.com  
702.802.3101



### SOFTWARE

Access RetinaEngrave v3.0 software by typing the IP address on your touchscreen into your Internet browser.

## ORDER ACCESSORIES & UPGRADES

### LASER TUBES

45W; 90W (PS24 only)

### 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, Chuck Rotary

### WATER ASSIST

Water Chiller, Advanced Water Chiller

# Appendix C: Workflow Checklist

## Project Workflow

The RetinaEngrave v3.0 software works with your Pro-Series PS to create a simple and intuitive set of operations that is easy to learn and use. With experience, you will find your laser 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.



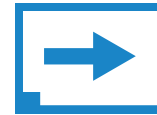
### 1. Create Design:

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



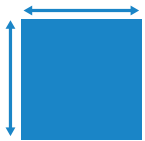
### 2. Connect to Software:

Link your PS 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 v3.0 workspace, import your design to the software.



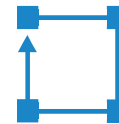
### 4. Place Material:

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.

# Appendix D: Focus Lenses

There are a variety of lenses available for your Pro-Series Laser System, 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>.

# Appendix E: 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 if you paid FSL for shipping. Overnight shipping is available at extra charge. If you picked up in person or used your own shipping methods, FSL considers the parts to be sold FOB our warehouse and you must arrange your own shipping or pickup replacement parts as FSL did not make the original shipping arrangements.

Outside the first 30 days, Full Spectrum Laser will replace or repair any defective 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.

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 ProLF lasers have a 90 day warranty on all items and a free extended 1 year warranty which excludes consumable items/shipping included in their price.

3D Printers have a standard 1 year base warranty that covers all parts/labor (including laser diode, galvos, motors, electronics) except consumables (build plate, resin, VAT) and shipping/handling. 3D printers do not come with an accuracy guarantee but are designed for full end user calibration/adjustment. 3D Printer and 3D Printer software license may be only be used in conjunction with authorized consumables from FSL3D. After market consumables are not supported and may damage your printer, void your warranty/software license. Due to the increase reliability data using FSL's RetinaEngrave controller, ProLF lasers purchased and shipped with RetinaEngrave have a 2 year limited warranty (excludes shipping) on the RetinaEngrave controller portion of the laser.

Replacement parts purchased separately from machines have a 90 days warranty excluding shipment.

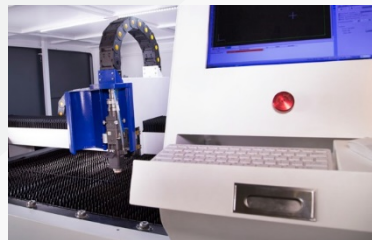
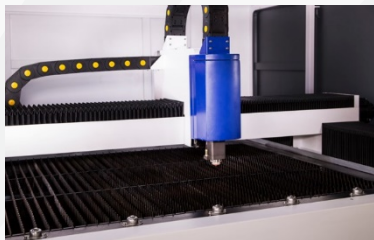
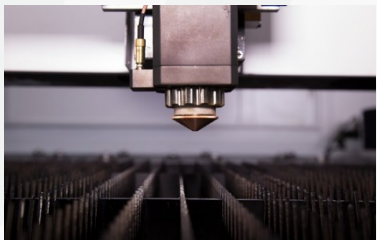
The limited warranty excludes shipping and consumables and other normal wear and tear items. All electronic items (control cards, power supplies, motors) and most mechanical items are covered under the extended warranty unless damaged by abuse/fires. Consumables not covered include, but not limited to, 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.

# MC-SERIES

## Looking for a laser system that can cut & mark steel?

The MC-Series Fiber Systems by Full Spectrum Laser have the precision and power you are looking for. Rapidly cut many metals with a kerf less than 25um (0.001"): alloy/carbon/stainless steel, copper, aluminum, gold, silver, and titanium.



**Full Spectrum**  
LASER

Applications include sheet metal enclosures, car bodies, jewelry, and more. Meets ATF requirements of a marking variance, medical thermal marking regulations, and NASA-JSC/M&P standards.

*ATF engraving for a fraction of the cost of other machines.*



Go to <http://fslaser.com/Products/Lasers>

