



FS LASER  
**P-SERIES**

24 x 18 LASER SYSTEM

# User's Manual

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VERSION 2015.01



**Full Spectrum**  
LASER

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# Safety

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This section explains safety guidelines to use your laser.

# Thank You

Thank you for your purchase of a FSL P-Series 24x18 Laser System. It is our wish that this product adds value to your business or hobby activities for years to come. Please take time to read this manual in its entirety to safely use your laser to its full potential.

In order to guide you through these documents, we have provided you with these icons:



## **FIRE WARNING**

This fire warning icon calls attention to fire risks that are present while operating the laser.



## **WARNING & CAUTION**

This warning and caution icon are present when special attention to information is required.



## **USEFUL TIP OR INFORMATION**

This icon indicates a useful tip or information that will help you operate more efficiently.



## **ETHERNET**

This icon indicates information related to connecting your laser to your computer using an Ethernet connection.

# Laser Safety

The output of the CO2 engraving laser is fully contained in a Class 1 enclosure during normal operation. The laser cabinet has a safety interlock switch that deactivates the laser if the door is opened during operation, and no special precautions are necessary to operate the high power laser safely. However, the output beam of the Alignment Laser (visible red diode laser) is accessible to the operator during normal operation, giving the total system an overall rating of Class 3R. While this device employs the same technology as a handheld laser pointer, it is potentially hazardous if its beam is directed into the eye.

## GENERAL OPERATION PRECAUTIONS

The laser operator should observe the following:

- **NEVER** operate the machine with any of the panels removed. Be aware that removal of any portion of the cabinet will expose a Class 4 laser system and greatly increase the risk of injury and/or fire. *Personal injury and fire risks are especially pronounced if the machine is operated with the bottom panel removed.* Remember that the CO2 laser beam is invisible!
- **NEVER** engrave or cut any material containing PVC or vinyl. These materials (along with other chlorine/chloride containing materials) produce a corrosive vapor that is extremely harmful to humans and will destroy your machine. *Your warranty will be void if your machine is damaged by corrosion from engraving or cutting PVC or vinyl.*
- **NEVER** engrave or cut any unknown material. The vaporization/melting of many materials, including but not limited to PVC and polycarbonates, can give off hazardous fumes. Please refer to the MSDS sheet from the material manufacturer to determine the response of any work material to extreme heat (burning/fire hazard).
- **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** use the air assist, especially while vector cutting. Vector cutting movements are relatively slow and apply an extremely large amount of heat to the work piece. This buildup of heat can cause a significant fire risk.
- **DO NOT** disassemble the machine or remove any of its protective covers while the unit is plugged in.
- **DO NOT** defeat the door interlock.
- **DO NOT** look into the beam of the Alignment Laser (visible red diode laser)

- **DO NOT** 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.

**CAUTION**

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

The standard reference for laser safety is the American Standard for the Safe Use of Lasers, Z136.1-2000, developed by the American National Standards Institute (ANSI). This reference is the basis for many of the federal regulations for laser and laser system manufacturers, and for the Occupational Safety and Health Administration (OSHA) laser safety guidelines. It contains detailed information concerning proper installation and use of laser systems. While the ANSI standard itself does not have the force of law, its recommendations, including warning signage, training, and the designation of a laser safety officer, may be compulsory under local workplace regulations when operating laser systems above Class I. It is the operator's responsibility to ensure that the installation and operation of the Full Spectrum Laser Hobby Advanced Laser System is performed in accordance with all applicable laws. Copies of ANSI Standard Z136.1-2000 are available from:

**LASER INSTITUTE OF AMERICA**  
**12424 RESEARCH PARKWAY, SUITE 125**  
**ORLANDO, FL 32826**  
**(407) 380-1553**

# Electrical Safety

The AC input power to the Full Spectrum P-series laser systems are potentially lethal and is located on the far right within the cabinet.



- **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.
- **DO NOT** make or break any electrical connections to the system while the unit is turned on.
- **DO NOT** access the electronics area with hands or tools unless the unit is disconnected from power.

The power supply is capable of outputting DC 20,000V at up to 20mA—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.



# Fire Safety



Laser cutting and engraving systems represent 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 easily ignite. Usually this is a small flame of burning material issuing from the cut zone which self extinguishes due to the air assist or de-powering of the beam. However, it is possible for the flame to propagate and set fire to the machine and threaten its surroundings.

Experience shows that vector cutting with the laser has the most potential to create an open flame. Acrylic in all its different forms has been shown to be especially flammable when vector cutting with the laser. Please also be aware that stacking materials (especially organic materials such as paper) can lead to increased risk of flame propagation or work piece ignition.

Please read the following warnings and recommendations and follow them closely at all times!



- **NEVER** leave the laser system unattended during operation.
- **KEEP** the area around the machine clean and free of clutter, combustible materials, explosives, or volatile solvents such as acetone, alcohol, or gasoline.
- **ALWAYS** keep a properly maintained and inspected 5lb or larger fire extinguisher on hand. Full Spectrum recommends a Halogen fire extinguisher or a multi-purpose dry chemical fire extinguisher. Halogen extinguishers are more expensive than a dry chemical, but offer certain advantages should you ever need to use an extinguisher. The Halogen extinguisher discharges a clean, easily removable substance that is not harmful to the mechanics or wiring of the laser system. The dry chemical extinguisher discharges a sticky, corrosive powder that is very difficult to clean up.
- **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.
- **KEEP YOUR LASER SYSTEM CLEAN** – A build up of cutting and engraving residue and debris is dangerous and can create a fire hazard. Keep your laser system clean and free of debris. Regularly remove the cutting grid to clean any small pieces that have gotten stuck or fallen through.

# Compliance Statement

The FSL P-Series 24x18 Laser System is a class 3R laser product, as defined in International Standard IEC 60825-1.

The FSL P-Series 24x18 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.

# Getting Started

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This section guides you to assemble your laser for the first time.

# Setting Up Your Laser System

Setup of the FSL P-Series 24x18 Laser System usually takes less than 30 minutes, but there are a few things you will need to take care of before it arrives:

- Purchase distilled water for cooling the laser. Your laser comes with a pump and tubing for circulating the water through the tube and back into a reservoir. *Please make sure to only use distilled water—neither filtered nor deionized water will work and tap water will cause deposits that can destroy your tube and void the warranty.*
- Purchase a container to act as a reservoir for the distilled water. Be sure to check the container regularly to ensure that the water remains clean and deep enough to cover the pump.

Once your laser has arrived, you will need to do the following to set up your machine:

- Remove the laser and accessories from the box
- Connect the exhaust, cooling and air assist systems
- Remove the zip ties (3) that secure the drive belts during shipping
- Connect electrical power
- Connect the laser to your computer using an Ethernet cable
- Install the latest version of RetinaEngrave (download information can be found in the shipping box)

**NOTE**

Please do not throw away the laser's box and packaging, you may need it later.

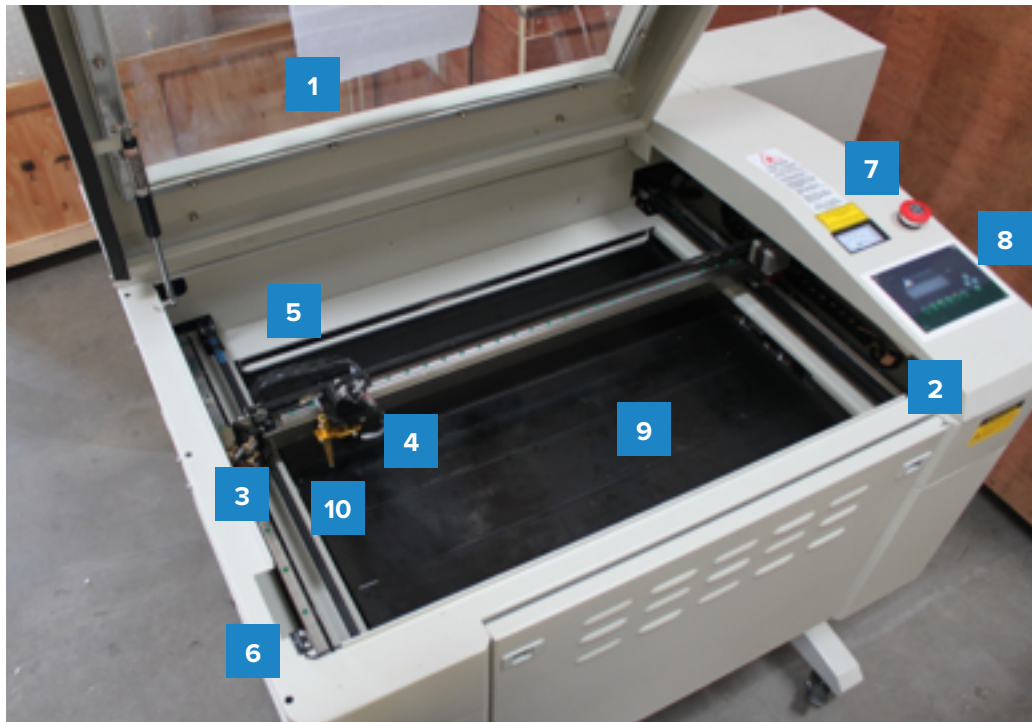
# Parts and Accessories

Your laser shipped with the following included parts and accessories:

	<b>DESCRIPTION</b>	<b>QTY</b>
#1	Pro LF laser engraving machine	1
#2	Exhaust Fan	1
#3	Exhaust Tubing	2
#4	Air Compressor	1
#5	Water pump + tubing	1 set
#6	Honeycomb cutting table and black slat table	1 set
#7	Power Cable	1
#8	Focus Ruler	1
#9	Software Download Sheet and QuickStart Guide	1
#10	Key sets (1 set for ignition and 1 for compartments)	2 sets
#11	Additional Accessories: Metal Square for lens removal + Hex Key/Screw Driver + Clamps	1 set

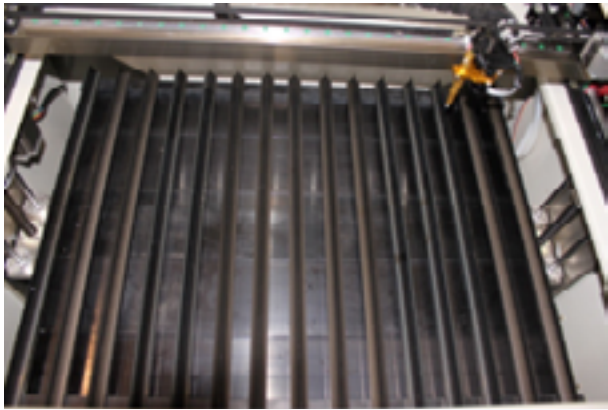
# Get to Know Your Laser

The following figures will introduce you to the important parts of your FSL P-Series 24x18 Laser System

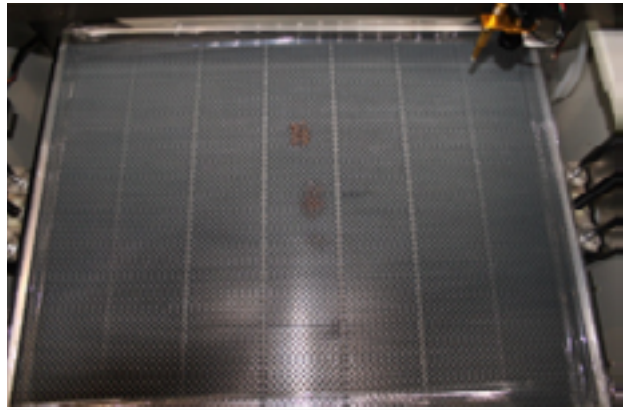


## MAIN ASSEMBLY

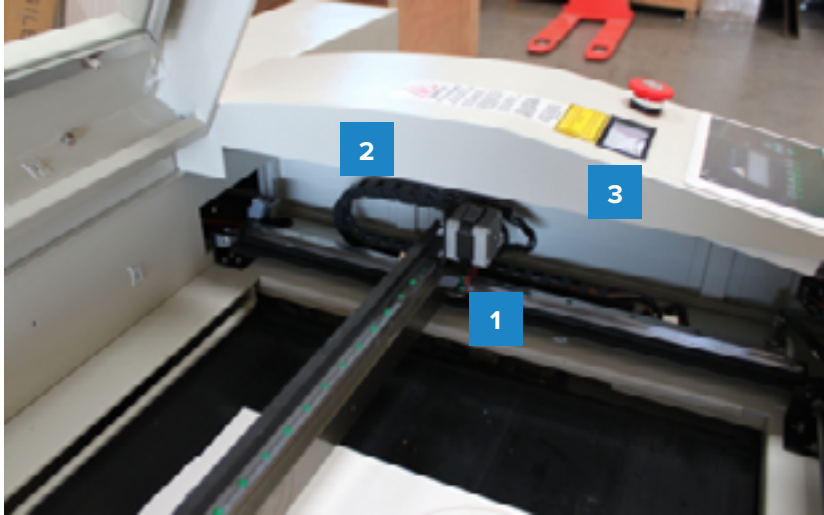
1. Work area lid with protective window
2. RetinaEngrave CapTouch Control Panel
3. Mirror 2
4. Laser Head
5. X cable carrier
6. Magnetic Safety Interlock Sensor
7. Emergency Stop (press to engage; twist to release)
8. Main power switch (not shown; right side of machine)
9. Work area base
10. Autofocus plunger



Knife-edge Table (included)

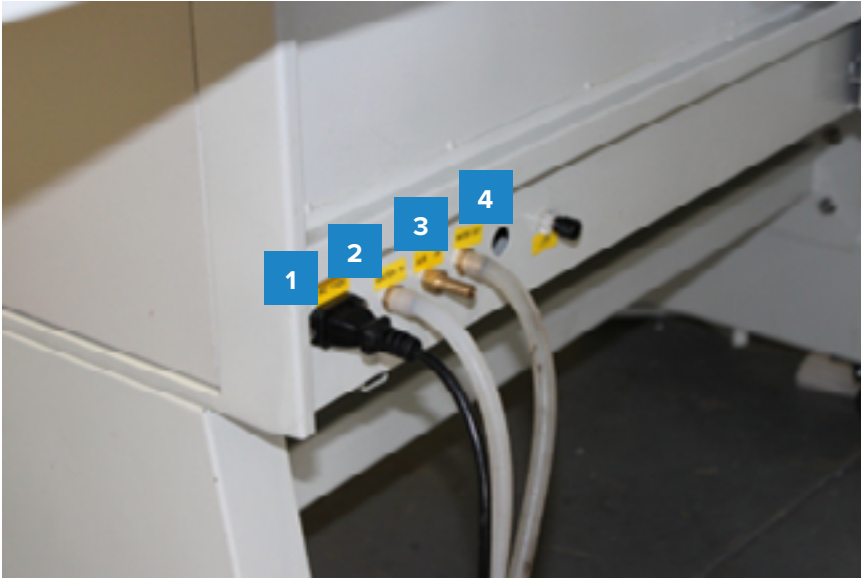


Honeycomb Table (included)



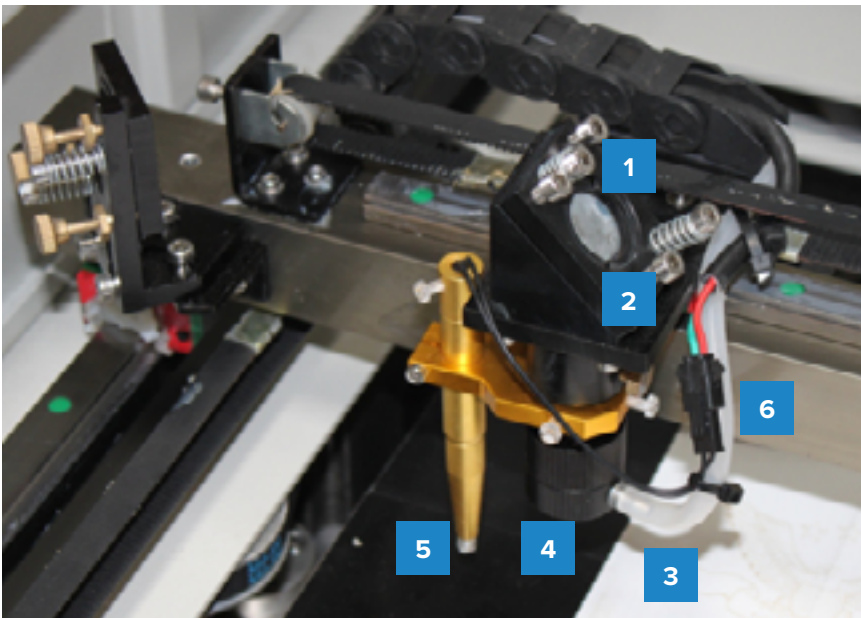
**WORK AREA INTERIOR**

- 1. X axis drive motor
- 2. Y cable carrier
- 3. Ammeter



#### REAR INPUTS

1. AC power input
2. Water inlet
3. Air inlet
4. Water outlet



#### LASER HEAD ASSEMBLY

1. Mirror 3
2. Mirror 3 adjustment screw
3. Air assist input
4. Air assist nozzle
5. Autofocus plunger
6. Autofocus wiring connection





### DRIVE MOTOR DETAIL

The Y drive motor is located in the front of the machine work area. It is coupled to the Y axis belts by two axles with flex couplings. If the laser head crashes, the gantry can become misaligned: if this occurs, turn off the machine and loosen the 4 hex screws on each coupler. Grab the left and right side of the gantry and adjust it back to a square position. Retighten the hex screws.

## Connecting the Exhaust

It is mandatory that the exhaust blower is connected and operating whenever you run a job on your laser. The exhaust blower removes smoke and fumes from the case and exhausts them to the outside of the building. You should never operate your laser without a working exhaust.

The exhaust port on your laser is a 6in flange, located on the rear of the unit (shown below). Use flexible metal tubing to connect the laser system to the exhaust system. Check your system for leaks—most can be remedied with duct tape.



**Exhaust Port**



**Exhaust Fan and Tubing**

# Connecting the Water Pump and Air Assist Compressor

Your laser uses a water-cooled continuous beam CO2 laser tube. The tube requires a flow of room-temperature water to regulate the temperature of the resonance chamber. Your purchase includes a water pump for cooling the laser tube. A low-flow air compressor for vector cutting gas assist is included with all P-Series lasers.



NEVER FIRE THE LASER WITHOUT A CORRECTLY CONNECTED AND POWERED WATER PUMP OR CHILLER. FIRING THE LASER WITHOUT TURNING THE PUMP ON OR, WORSE, WITH NO WATER IN THE SYSTEM, WILL SEVERELY DEGRADE OR DESTROY YOUR LASER TUBE AND VOID YOUR WARRANTY.

## WATER PUMP CONNECTION

Please make sure that there are no air bubbles inside of the water jacket of the laser tube. Air bubbles can create local hotspots in the resonance 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.

The tube is cooled by a circulation pump. The pump must be submerged in a container of distilled water (distilled water is available from any grocery chain—most customers use a 5gal paint bucket as the reservoir) with one of the two provided silicone tubes being connected from its output to the Water Inlet fitting. The other tube is connected to the Water Outlet fitting and is left to drain back into the reservoir.

## WATER CHILLER UPGRADE (OPTIONAL)

The water chiller replaces the water pump. If your laser is shipped with a water chiller then the pump is normally not included. Unscrew the cap at the top of the water chiller and fill with water.

The basic radiator style chiller takes approximately 3-5 gallons of distilled water; the advanced freon chiller requires 1-2 gallons.

The **CW-3000** is the basic passive water chiller that we provide. It simply intakes air at room temperature and keeps the water at such temperatures. It is an active water chiller that uses Freon and has its own refrigerating system that cools the water. Connect the water **OUTLET** on the water chiller to the water inlet of the laser. Connect the water **INLET** on the water chiller to the water outlet on the laser. Turn the water chiller on and the water will be flowing. The other buttons on the advanced freon chiller adjust the temperature and do not need to be adjusted. The ideal temperature for the water is between 55-80 degrees.



## AIR ASSIST

Air is used as a pressurized gas to assist in cutting and engraving operations. The pressurized air is critical to safe and efficient cutting operations as it not only helps cut through material, but also helps prevent the formation of flames. The air assist connection is a barbed brass fitting located on the rear of the laser.



## THIRD-PARTY AIR ASSIST SYSTEMS

If you choose to attach your laser to a 3rd party air compressor, make sure to use at least one stage of air drying and air cleaning (5 micron filter recommended) and limit the input pressure to no more than 30psi. Low-quality compressed air can damage your focus lens.

# Connecting Electrical Power

The FSL P-Series 24x18 Laser System 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](mailto:support@fslaser.com)

The electrical cord is found among the accessories. The power cord plugs into a C14 power receptacle located on the right side of the machine in the rear. The laser system itself can be run off of most circuits without modification. However please be aware that the accessories will increase the circuit load; the most significant power draw usually comes from the blower/exhaust system. Consult the manufacturer's information and manual for the operating parameters of your exhaust system.



## NOTE

**Power On/Off:** the laser's main power is controlled by a key-lock switch on the front panel, near the control panel interface. The control system power is controlled by 2 switches: a large red button (e-stop) located on the front of the unit and a small black rocker switch located on the right panel in the upper left corner. The e-stop 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.

# Quick Start & Setup

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This section is the next step to ensure that your laser is working properly

# Overview

Now that you have set up your laser and accessories and have installed the control software, the next step is to ensure that your laser is working properly. The tube test and mirror alignment procedures should take less than 30 minutes and will ensure that your laser is performing optimally. Your laser's main power is controlled by the twist-release switch on the top of the case.

The first thing we are going to verify is that your laser tube did not crack during shipping. This should take less than 2 minutes. The second test will check the mirror alignment and if necessary, adjust the mirrors so they are once again aligned. The laser's mirrors are aligned during assembly at our location, however shipping subjects the laser system to a great deal of vibration which can cause the mirrors to vibrate slightly out of alignment.

These tests require the following tools and materials:

- **Scissors or small wire cutters** (for removing axis zip ties.)
- **Thermal paper** (This is the same paper that receipts are printed on. Used receipts work.)
- **Masking/painters tape** (For taping the thermal paper to mirrors and apertures.)

Before we begin testing the laser, we need to free the motion system from its shipping restraints and remove the accessories from the work area. The accessories are zip-tied to the front beam attenuator—cut the zip tie and remove the accessories. The motion system is restrained by 6 zip ties: one on the X axis drive belt, two on each Y axis drive belt and two securing the head slider. Carefully cut the zip ties, avoiding damage to the drive belts. The focusing sub-assembly is also restrained by zip ties; they must be cut in order to perform alignment.

## 80W+ Laser Tube Install

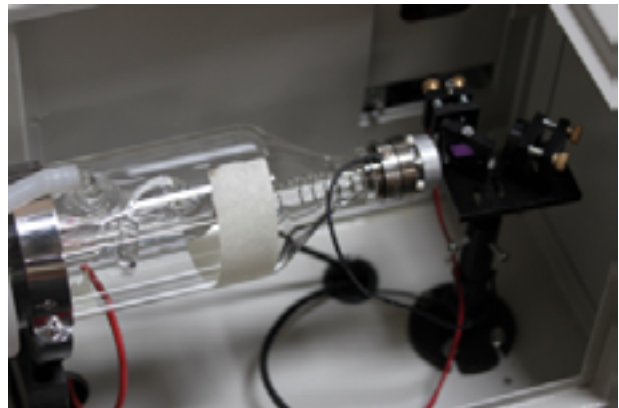
Ensure the laser is powered off before starting this process. Place the tube in the mounts. The end of the tube with a plastic cap should be facing towards the left (away from the optics). When viewing the machine from the back. **IMPORTANT** – Orient (rotate) the tube so that the water inlet is facing down. This will allow air bubbles to escape and prevent the motor from colliding with the inlet nub on 36x24 and 48x36 models.

Remove the plastic cap and attach the RED wire ring terminal to the left end of the tube with the included screw. Ensure the screw is tightened firmly and then reinstall the plastic insulating cap. Make sure the cap is pressed on as far as it will go or there is a possibility of arcing. Ensure there are no kinks in the red laser wire and there are no breaks in the insulation. The red laser wire conducts 25,000V and must be treated carefully not to arc. Avoid sharp bends or 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.

The left to right position of the tube is somewhat arbitrary. Use your best judgment to ensure the tube has adequate clearance from the left wall and the optics on the right. If you have a 120 or 150W tube, your laser likely shipped with an extension box that fits on the left side of the machine. After getting the tube in the correct position and orientation, tighten the tube clamps using the allen screws.



**Left end of laser tube with red wire and plastic cap installed correctly.**



**Right side of the laser tube**



Attach the black wire with the single screw to the right end of the tube as shown. The black wire does not need to be covered as all the energy is absorbed after passing from the red wire to the laser tube. Point this end toward the mirrors. Infrared laser light exits this end when activated. The distance between the end of the tube and the first optic is not crucially important.

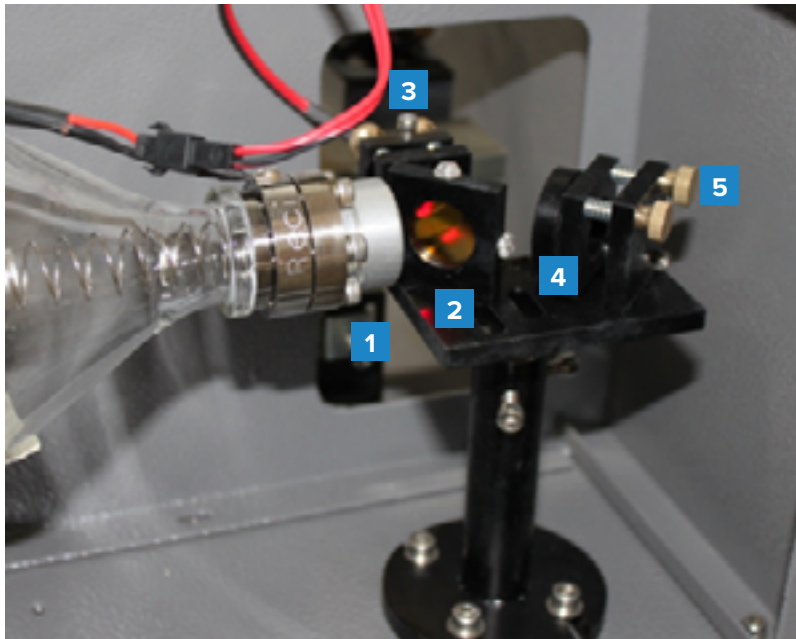
After attaching the electrical connections, attach the rubber tubing sections to each end of the laser. These hoses allow the cooling water to flow from the pump or chiller into the tube's water jacket. The left end of the tube is the water input and the right end is the water exit. After installing the water tubes, keep the laser powered off and turn on your pump or chiller to ensure that water flows through the tube properly and inspect for any leaks. The tube is now installed properly and ready for use.



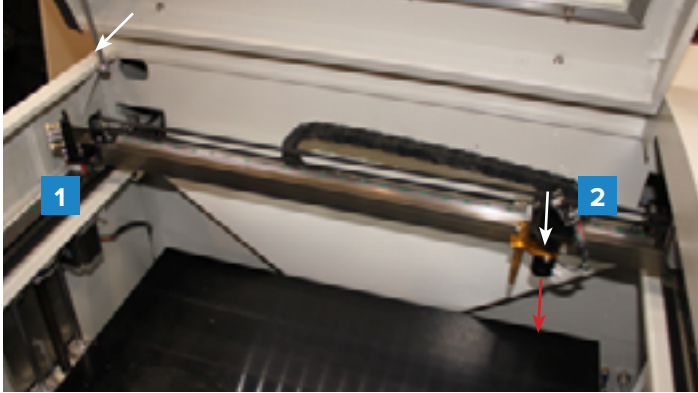
**Laser tube properly installed**

## BEAM PATH

The following figures detail the path of the laser beam through the laser's chassis. The beam path and direction are defined by the white arrows while the focused beam is denoted by the red arrow.

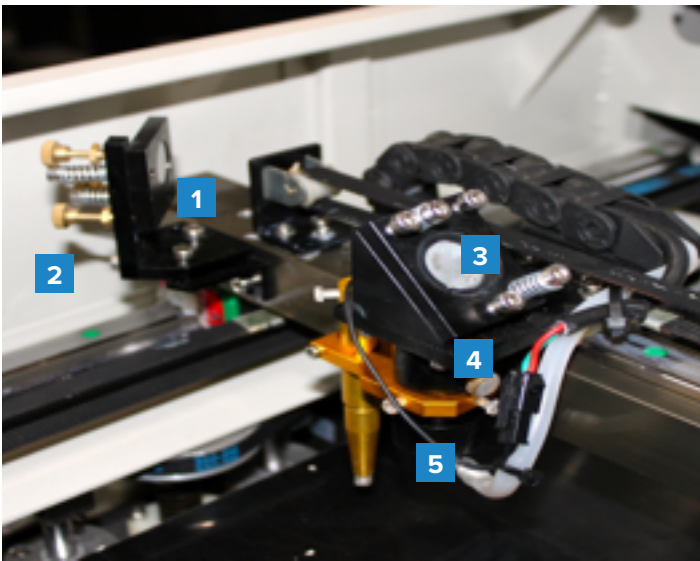


1. Laser tube emission aperture
2. Beam combiner
3. Visible red diode laser mount with adjustment thumbscrews
4. Mirror 1
5. Mirror 1 adjustment thumbscrews



### WORK AREA: OPTICS SETS 2 AND 3

1. Optics set 2 (Mirror 2 and adjustment screws)
2. Optics set 3 (Laser head: mirror 3, autofocus, focus lens and air assist)



### DETAIL OF OPTICS SETS 2 AND 3

1. Mirror 2
2. Mirror 2 adjustment thumbscrews
3. Mirror 3
4. Mirror 3 adjustment screws
5. Focus Lens (internal)

# Laser Tube Test

In this test we are going to tape a piece of thermal paper between the laser tube aperture and the beam combiner aperture and then test fire the tube.

1. Make sure that the proper accessories are attached and engaged (water pump)
2. Open the work area cover.
3. Take a piece of thermal paper and tape between the Beam Combiner and mirror 1 with the sensitive (shiny) side facing the laser tube output. Alignment is not critical, but make sure that there is a large enough white space that can capture the beam output; the beam is approximately 5mm in diameter and will exit from the center of the tube.
4. Close the cover.
5. Place the laser into test fire mode (FS/Z button, toggle until menu reads "Align Mode").
6. Press the Test Fire button.
7. A circular black mark with diffuse edges should appear on the thermal paper. If there is interference, the mark will be occluded and/or have a very sharp edge. If this is the case, your tube is working but has come out of alignment.

You should hear a 'click' and/or see a plasma arc inside the tube (may require more than one button press). The click is from the power supply switching rapidly on then off for the test pulse. If you observe either of these actions but no mark on the thermal paper, the paper was most likely reversed or incorrectly placed. If you do not mark the paper and are not observing a noise during a test fire attempt, it is possible that the cover interlock was not properly engaged; try shifting the cover or magnet closer to the sensor. If these solutions do not solve the problem, please contact technical support at [support@fullspectrumlaser.com](mailto:support@fullspectrumlaser.com)

# Mirror Alignment

Your laser was aligned during assembly and test in Las Vegas—the CO2 beam and Alignment Laser beams were matched to follow the same path through the mirrors and fire down the center of the focusing head. However, shipping is a high-vibration environment and it is sometimes necessary to re-align mirrors. Before going through a full re-alignment process, check and see what the current alignment is:

## ALIGNMENT TEST

1. Take a piece of thermal paper and place it in front of mirror 3, covering the aperture. Tape two edges so that the paper will stay relatively taut over the hole. Press your finger firmly along the edge of the aperture to make a mark on the thermal paper to show the aperture's outline.
2. Jog the laser to the upper left corner.
3. Close the lid and test fire.
4. Observe the location of the mark on the thermal paper.
5. Jog the gantry halfway along the Y axis towards the lower (front) left corner. Test fire and observe the mark.
6. Jog the gantry the remainder of the way along the Y axis and test fire at the lower left corner and observe.
7. The burn mark should be relatively close to the center and should not “walk” after jogging the laser head.

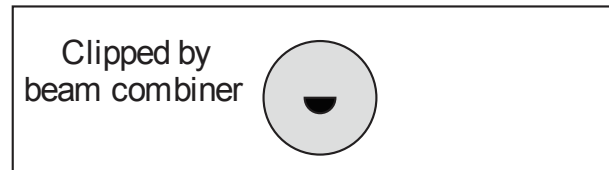
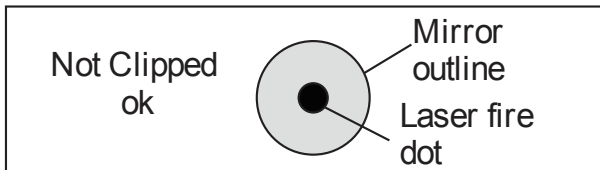
If there was a great deal of variation in the location of the burn marks (more than 2mm of drift) you will need to align your laser. We recommend first aligning the invisible cutting beam with the visible Alignment Beam—this saves a great deal of time lost in opening and closing the lid for safe access while firing the laser. The procedure for this is the following:

## ALIGNMENT PROCEDURE

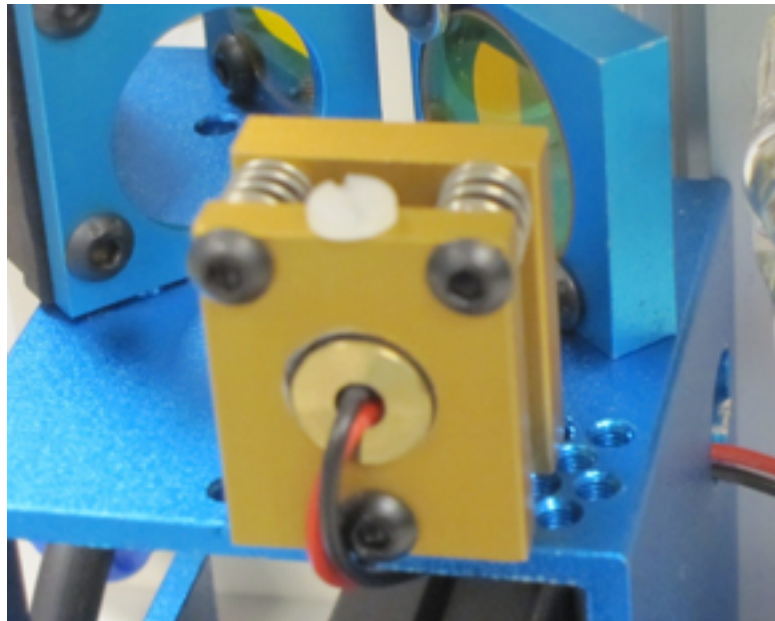
The New 5th Generation Hobby laser has an integrated beam combiner which greatly simplifies beam alignment. The general procedure is to first align the red beam with the invisible beam then use the red beam as the primary indicator for alignment.

1. Put a piece of thermal paper on mirror #1.
2. Press the UNLOCK button on the laser control panel. In the unlocked state, you can move the laser head around by hand and fire test dots using the TEST FIRE button.
3. Close the lid then press the TEST FIRE button on the laser control panel. A black dot should appear on the mirror. Check that this dot is round and not clipped. You may need to press the test fire button several times

to get a dot. In the unlikely case the dot is still clipped after multiple test fires, the tube may be sitting at an angle causing it to hit the beam combiner. Adjust one of the clamps of the laser tube to move the tube down so it is not clipped by the beam combiner. This should not happen normally unless you changed the tube so contact FSL tech support for more details.

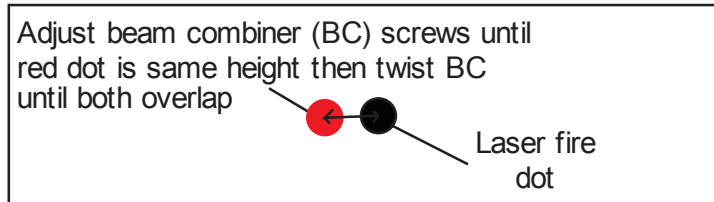


4. Move the X gantry (the long black bar) down to the lowest Y position as shown in the following picture. Put a piece of thermal paper on location #2. Fire a test pulse and observe where the black dot appears on the thermal paper.
5. Without moving the gantry and without touching any of the mirrors, adjust the red dot pointer so that the red dot overlaps with the black dot. Do this by adjusting the screws that hold the red laser in place.

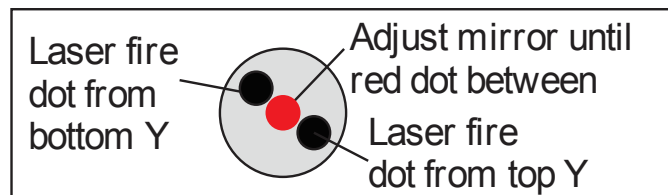


Revision 2 Diode Mount

6. Once the red dot overlaps with the black dot, the red is travelling along the same path as the invisible laser beam and can be used to align the rest of the laser instead of relying on the invisible black dot.

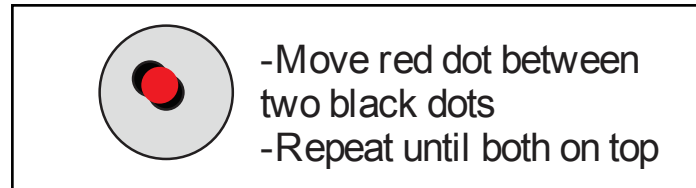
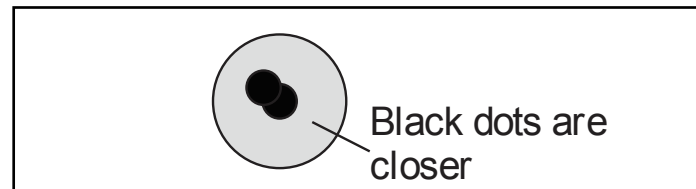
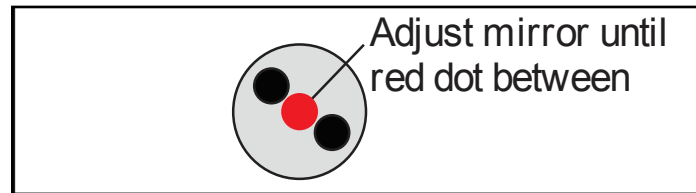


7. Move the X gantry to the top Y position. Fire another black dot onto the thermal paper. You should now have two black dots (one from the upper Y position and one from lower Y position). Move the X gantry up and down and verify that the red dot tracks from one black dot to the other black dot.
8. Move the X gantry to the lowest Y position. The red dot should now overlap with one of the black dots. Adjust mirror #1 until the red dot is in the middle of the two black dots.

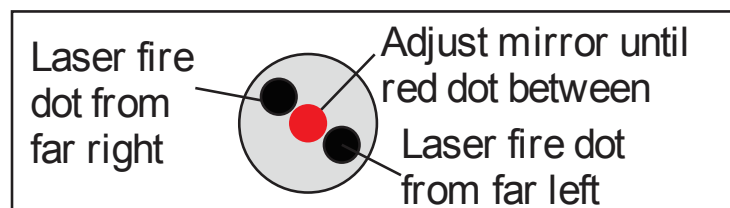


9. Use a fresh piece of thermal paper and fire a test dot with the X gantry still in the lowest Y position. Move the X gantry to the top position and fire another test dot. Now the two black dots should be closer together than in step #6.
10. Move the X gantry back to the lowest Y position. Now adjust the red dot until it moves to the center of the two black dots.
11. Repeat the process of firing two black dots on the top and on the bottom Y positions and adjusting mirror #1 to move the red dot to the center of the two black dots until the two black dots from the top and bottom Y positions are centered on top of each other.

The idea is that when the laser is not aligned, you will have two black dots from the test fires in the top and bottom positions. The red laser pointer is aligned with the invisible laser pointer so gives you immediate feedback on the mirror adjustment. By adjusting it into the middle of the two black dots, you are splitting the error difference. Usually after 1 or 2 iterations, the black dots will be exactly on top and this axis is aligned. The goal is to have the two black dots overlap exactly. **IT IS NOT NECESSARY THAT THE DOTS BE IN THE CENTER OF THE MIRROR BUT THEY SHOULD BE SOMEWHERE ON THE MIRROR.** Mirror #1 is now aligned.

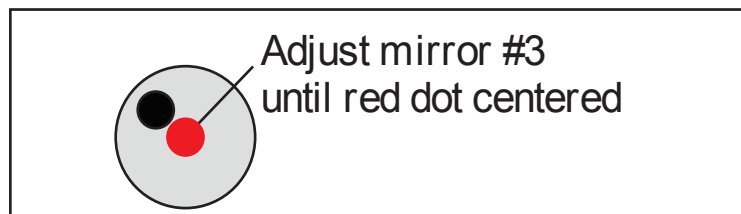


12. Once the mirror #1 is aligned, we will adjust mirror #2. Put a piece of thermal paper on mirror #3. Using the red dot, adjust the mirror until the red laser is somewhere on the mirror.
13. Move the laserhead to the far right position. Fire a test dot here producing a black dot. The red and black dot may be off slightly because the distance travelled by the laser beams is longer so any small errors are amplified. Without touching any of the mirrors, adjust the red dot to overlap with the black dot through the screws on the red laser diode mount or twisting the red laser diode mount.
14. Put on a new piece of thermal paper. Move the laserhead to the far left and fire a black dot. Move the laserhead to the far right and fire a second black dot.
15. Now you should have two black dots on the thermal paper and the red dot. Verify as you move from the left side to the right side that the red pointer tracks between the two black dots.
16. Move the laserhead to the far right. The red laser dot should overlap with one of the black dots. Adjusting only mirror #2, move the red dot between the two black dots.





17. Replace with a new piece of thermal paper and fire dots in the far left and far right positions. Again move to the far right position then adjust the red dot between the two black dots. Repeat until the two black dots are exactly on top of each other. Mirror #2 is now aligned.
18. Once mirror #2 is aligned, put a piece of thermal paper on top of the lens. Adjust the screws on mirror #3 until the red dot is in the center of the lens. Fire a black dot into the thermal paper.
19. Move the laser head around and verify the red dot does not move away from the black dot anywhere on the laser bed. The closer you get the dots stationary, the better aligned the laser will be. You can fire black dots at the 4 corners of the laser bed and verify none of them are more than 2mm away from each other.

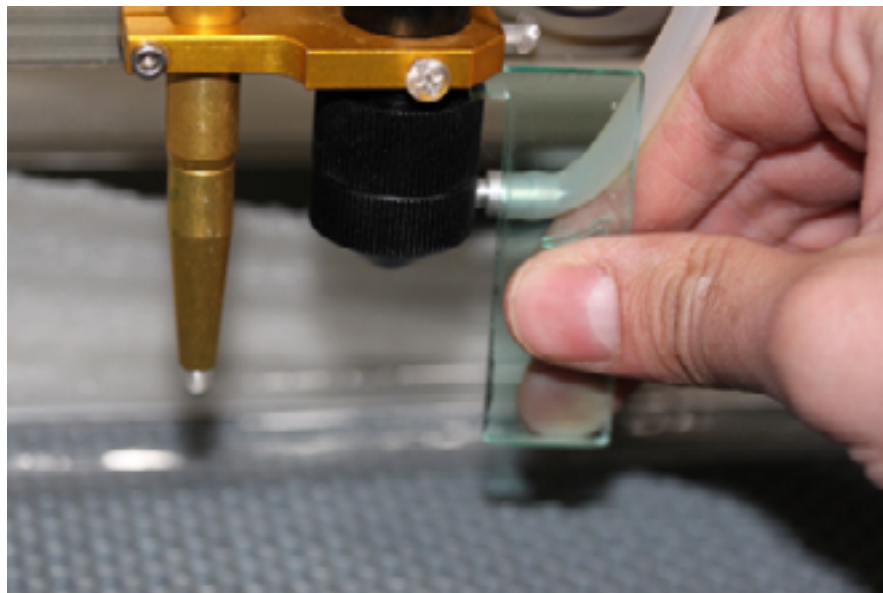


**Congratulations, your laser is now aligned!**

# Focusing

The laser must always be in focus when in operation. Not only will you not have full power but low power out of focus laser beams will burn or start fires instead of cutting through materials. Focusing the FSL P-Series 24x18 Laser System is quick and easy. Your laser included a focus ruler sized for the included 2-inch focal length lens. To focus for engraving or cutting, simply place the ruler on the top of the engraving plane and jog the Z table up or down until the small notch rests evenly with the flange of the air nozzle (shown below).

As an alternative to the focus ruler, you can use the included autofocus mechanism. Full Spectrum Laser recommends using the focus ruler to achieve best results. Note that for thin or delicate materials you should always use the focus ruler.



Using Focus Ruler

# Quick Start

Your FSL P-Series 24x18 Laser System is ready to use if you have read the manual to this point and followed all of the foregoing instructions. Please remember to use caution while operating the laser and make sure that all accessories are functioning properly before running any job. The following instructions provide a general workflow for taking an original design and turning it into a laser cut part:

1. Create your artwork/design in the software program of your choice (e.g. CorelDraw) or use the Design View tab of RetinaEngrave.
2. Turn on the machine and accessories and wait for it to find an IP.
3. Once the machine has an IP (approx. 30s), launch RetinaEngrave.
4. Place your piece of sample material on the honeycomb.
5. Focus the laser head onto the sample piece.
6. Close the cover.
7. From CorelDraw, call up the print menu.
8. Select the "Full Spectrum Engineering" Driver.
9. If the "Pre-flight check" fails, check that both your document page size and printer page size match the size of the work area, and that no artwork is outside the boundaries of the page.
10. Once the pre-flight check is clear, continue printing to the software.
11. Your design will be loaded and then rendered by RetinaEngrave under the default raster tab.
12. Once you have set the power levels and layer ordering to your liking, you can run the job. If you plan to run it often, you can save the project file to a location on your hard drive.

## RetinaEngrave3D Software

The latest version of RetinaEngrave3D can be downloaded using your credentials from <http://Full Spectrum Laser.com/resources/software-manual-downloads>. This page also has the latest version of the software manual, which includes installation, setup and use instructions.

# Troubleshooting

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This section contains a list of potential problems and techniques to solve them

PROBLEM	POSSIBLE CAUSE	SOLUTION
Machine and Control panel does not turn on.		<ol style="list-style-type: none"> <li>1. Disengage large red emergency stop safety switch on front panel. Turn it clockwise to disengage.</li> <li>2. Turn ON/OFF switch to the ON position.</li> <li>3. Disconnect the fluorescent light bulb in case of any shorts.</li> </ol>
Machine and control panel respond, but cutting beam does not discharge	The water and magnet switch are not activated.	<ol style="list-style-type: none"> <li>1. Check that the water IN line on the laser is connected to the water source and the water flows OUT of the laser</li> <li>2. Ensure the lid is closed and the black magnetic switch is being activated by the magnet on the top lid. It is common for the magnet of the switch to slip slightly during the shipping. You can remove the magnet completely from the lid and place it directly on the black magnet switch. Try 3 positions for the magnet: center, bottom and top. Often times the magnet switch needs to be tilted slightly so that one end faces the magnet to activate.</li> <li>3. Open the back and look for the blue power supply. This has 2 LEDs. When both the magnet and the water switch are activated, the YELLOW led will be lit. This will turn off if you open the lid. If the YELLOW LED is not lit then either the power supply is not functional or one of the protection switches is not activated.</li> <li>4. The RED led turns on when the laser is activated. If neither the red nor the yellow LED turn on then the fuse inside the power supply may have been blown.</li> </ol>

PROBLEM	POSSIBLE CAUSE	SOLUTION
Power appears low		<ol style="list-style-type: none"><li>1. Ensure the laser is focused using the ruler. Always use the ruler even if you used the autofocus tool</li><li>2. Clean mirrors</li><li>3. Check alignment</li></ol>
Power is uneven from top left corner to bottom right corner (weaker on bottom right)		<ol style="list-style-type: none"><li>1. Check alignment</li></ol>

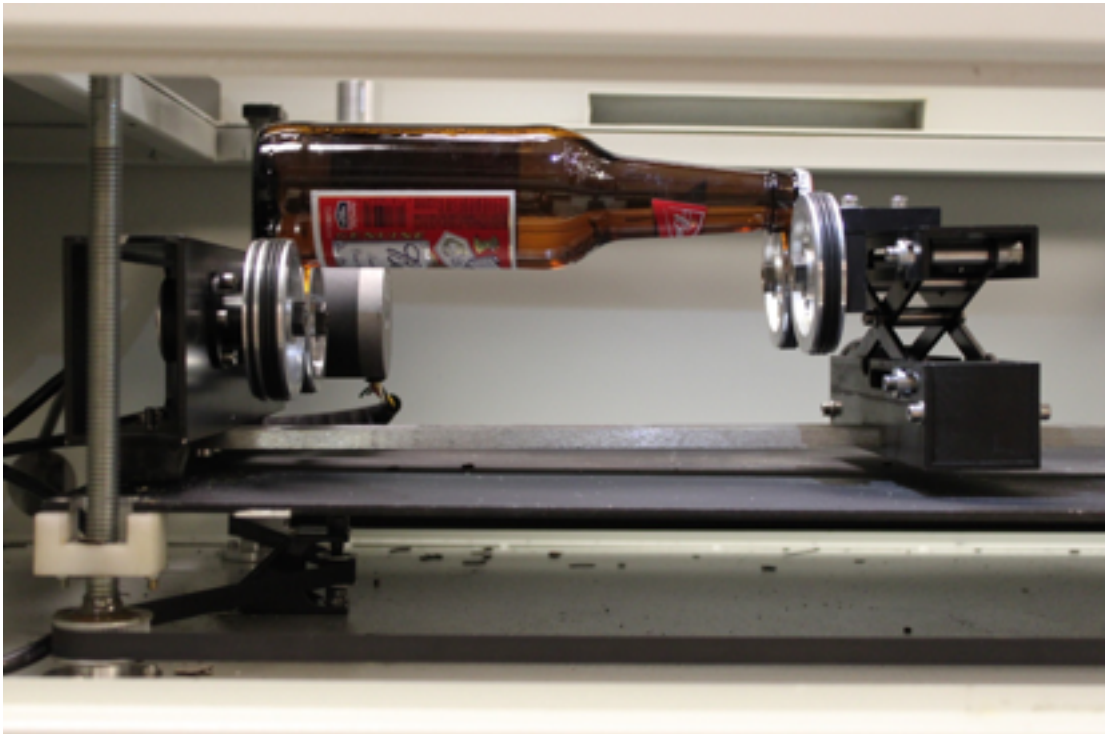
# Appendix

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## APPENDIX A: ROTARY ATTACHMENT SETUP

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.

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. Raise the jack (on the right in the image below) until the work piece is level. Use a level to check the surface.

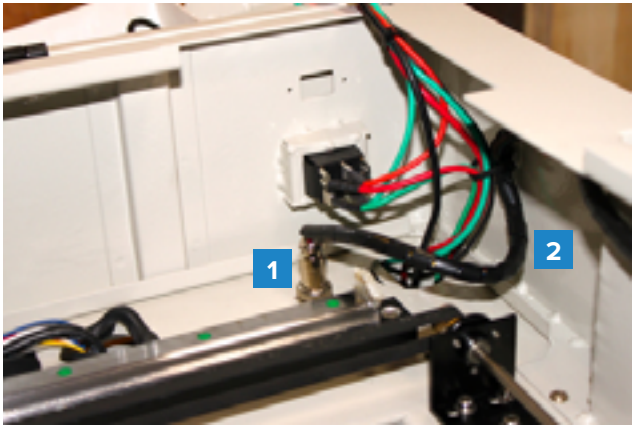


Rotary Attachment with Glass Work Piece



## ROTARY ATTACHMENT CONNECTION

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 (Figure 16). 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, simply power off the unit and switch the 4 pin rotary connector with the 4 pin you created for the Y axis.



Rotary Attachment Connection



Rotary Attachment Loose Electrical Connection Detail

1. Rotary attachment/Y motor electrical connection
2. Y motor wire harness

## APPENDIX B: WARRANTY STATEMENT

Please note that the most current warranty agreement can be found at [http://Full Spectrum Laser.com/service-and-support](http://FullSpectrumLaser.com/service-and-support).

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

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

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

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

After 8/7/2012, the Hobby lasers have a 60 day warranty on all items and a free extended limited 1 year warranty which excludes consumable items/shipping included in their price.

The limited warranty excludes shipping and consumables and other normal wear and tear items. All electronic items (control cards, power supplies, motors) and most mechanical items are covered under the extended warranty unless damaged by abuse/fires. Consumables not covered include, but are not limited to, rubber parts such as tubing, belts, plastic wheels, lenses, mirrors, other optics, and laser tubes.

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



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