



EpilogLaser

FusionPro 32/48

Laser System Manual | Model 16000

Original Instructions



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FIRE WARNING

Fire Warning



Your laser system uses a high intensity beam of light that can generate extremely high temperatures when it comes into contact with the material being engraved, marked or cut. Some materials are extremely flammable and can easily ignite and burst into open flame setting the machine afire. This open flame is very dangerous and has the potential to destroy not only the machine, but the building in which it is housed.

Experience shows that vector cutting with the laser has the most potential to create an open flame. Many materials are susceptible to igniting, but acrylic, in all its different forms, has been shown to be especially flammable when vector cutting with the laser.

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

- **Stay with the laser.** Never operate the laser system while unattended.
- **Keep the area clear.** Clean around the machine and keep the area free of clutter, combustible materials, explosives, or volatile solvents such as acetone, alcohol, or gasoline.
- **Be prepared with a fire extinguisher.** Always keep a properly maintained and inspected fire extinguisher on hand. Epilog recommends a Halotron fire extinguisher or a multi-purpose dry chemical fire extinguisher. The Halotron extinguishers are more expensive than a dry chemical, but offer certain advantages should you ever need to use an extinguisher. The Halotron 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.
- **Use Air Assist.** Always use the system's Air Assist feature when vector cutting.
- **Use caution when vector cutting.** Many materials have the potential to suddenly burst into flames when cut with a laser – even materials that may be very familiar to the user. Always monitor the machine when it is operating.
- **Clean the laser.** A buildup of cutting and engraving residue and debris is dangerous and can create a fire hazard in its own right. Keep your laser system clean and free of debris. Regularly clean underneath the Vector Cutting Table to clean any small pieces that have fallen through the grid.

SECTION 1: GENERAL

Manual Use - General Information

Please read and follow this manual carefully, before installing and operating your Fusion Pro. Damage to persons and/or materials can result from not following individual points of this manual.

Icons Used in this Manual

Look for these symbols to help you find valuable information throughout the text:



This icon indicates helpful notes to keep in mind when running the laser!



This icon indicates advice you can try that will save you significant time.



This icon indicates current contact information for receiving help.



This icon indicates warnings and cautions to keep in mind when running the laser.



This icon indicates the potential for fire damage when operating the laser.

SECTION 1: GENERAL

Designated Use

The Epilog Fusion Pro laser engraver is used for engraving and cutting a wide variety of materials such as wood, acrylic, rubber, glass, leather, cork, and more.

- Use of this machine should only be performed with a well-maintained machine. **See “SYSTEM MAINTENANCE” on page 69.**
- For cutting applications the use of the Vector Grid or Slat Table is absolutely necessary.
- The system must only be operated, maintained and repaired by users that are familiar with the designated field of use and the potential dangers of the machine.
- Non-observance of the instructions for operation, maintenance and repair described in this Operation Manual excludes any liability of the manufacturer if a defect occurs.

Disposal Remarks

Epilog machines may not be disposed of with domestic waste. All electronic devices must be disposed of according to the regional directives on electronic and electric waste disposal. In case of further questions, refer to your local distributor.

SECTION 2: SAFETY

EU - Declaration of Conformity

(Machine directive 2006/42/EG, appendix II A)

Manufacturer:

EPILOG LASER
16371 Table Mountain Parkway
Golden, CO 80403, USA

Authorized person for the compilation of technical documentation:

NAME, EPILOG LASER, 16371 Table Mountain Parkway Golden, CO 80403, USA

We hereby certify that

Fusion Pro
Model 16000

in its conception, construction and form put by us into circulation is in accordance with all the relevant essential health and safety requirements of the EC machinery directive 2006/42/EEC.

Further valid guidelines/regulations for the product:

Applied harmonized standards:

Place, Date:

USA, XX.XX.2019

Personal data of the signer:

NAME, TITLE

Signature:

SECTION 2: SAFETY

General Safety Information



Please read this chapter before operating or servicing an Epilog Fusion Pro.

Any person involved in the installation, set up, operation, maintenance and repair of the Fusion Pro must first read and understand this manual, in particular the “Safety” section. The machine must only be operated by a trained and authorized person.

Laser Safety Information

To assess the potential dangers laser systems pose, they are classified into 5 safety classes: 1, 2, 3a, 3b, and 4. The Epilog Fusion Pro is a device of class 2 (USA: Class 2) and class X (USA: Class X) with pass through option.

Note: Improper operation of the device can override the status of safety Class 2 and can cause the emission of harmful radiation.

This laser engraving system contains a carbon dioxide (CO₂) laser of class 4 that emits intensive laser radiation. The CO₂ laser beam itself is invisible and operates at a wavelength of 10.6 microns. Without safety precautions the direct radiation or even diffuse reflected radiation is dangerous!

The output of the embedded laser is fully contained. The laser cabinet has safety interlocks that turn the laser off if any access door is opened during operation, and no special precautions are necessary to operate the laser safely. Access doors are interlocked and can be opened without the use of a tool. Any interlocked door that is opened while the machine is operating will immediately stop the laser from firing. Access panels are not interlocked and require a tool for opening or removal. Access panels should always be installed when the laser is operating. Never operate the laser system with an access panel removed.

The visible output beam of the Laser Diode Pointer (Red Dot Pointer) is accessible to the operator. While this device employs the same technology as the familiar laser pen-pointers, like them it is potentially hazardous if its beam is directed into the eye.

We have made every effort to make the Laser Diode Pointer (Red Dot Pointer) as safe as possible. Its beam path is located well inside the cabinet, and under normal conditions, no hazardous levels of laser radiation can escape.

The operator of the Epilog Model 16000 should observe the following general precautions:



DO NOT disassemble the machine or remove any of its protective covers while the unit is plugged in.

DO NOT attempt to defeat the door interlocks.

DO NOT view directly into the beam of the Laser Diode Pointer (Red Dot Pointer).

DO NOT operate the Laser Diode Pointer (Red Dot Pointer) without the machine’s focus lens in place. If the unfocused beam strikes a reflective surface, it could be directed out of the cabinet.

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

SECTION 2: SAFETY

Without safety precautions, the following risks exist with exposure to laser radiation:

- **Eyes:** Burns to the cornea for CO2 Laser.
- **Skin:** Burns
- **Clothing:** Danger of fire



Never try to modify or disassemble the laser, and do not try to start up a system that has been modified or disassembled! Dangerous radiation exposure can result from the use of operation or adjustment equipment other than that described here, and if different operational methods are performed.

Electrical Safety

The AC input power to the Epilog Model 16000 Laser System is potentially lethal and is fully contained 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.

Fusion Pro Electrical Specifications

Model	Wattage(s)	Voltage	Amp draw-MAX
Pro 32	50, 60, 80	120	13A
Pro 32	50, 60, 80	240	6.5A
Pro 32	120	240	10A
Pro 48	50, 60, 80	240	6.5A
Pro 48	120	240	10A

SECTION 2: SAFETY

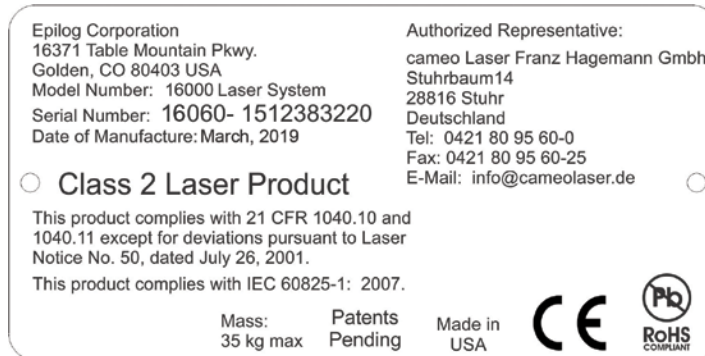
Safety Features and Regulatory Compliance

Epilog has incorporated specific safety features into the Model 16000 Laser System in order to meet the requirements of 21 CFR 1040 and the International Standard IEC 60825-1. These safety features include:

- A safety enclosure (cabinet), which fully encloses the engraving laser and its beam path.
- Dual redundant interlock systems that turn off the engraving laser when the window is opened.
- A visible emission indication when the Laser Diode Pointer (Red Dot Pointer) is operating.

21 CFR 1040 and IEC 60825-1 require that certification, identification, and warning labels be placed on laser products. Reproductions of labels on the Epilog Model 16000 Laser System follow, with their locations specified:

1. **Certification/Identification Plate:** This engraved plate is located on the right side of the machine's cabinet.



2. **Warning Logotype:** This label is located on the right side of the machine's cabinet, above the Certification/Identification plate.



SECTION 2: SAFETY



3. **Descriptive Label:** This label identifies the classification of the Model 16000 in accordance with 21 CFR 1040.10 and IEC 60825-1. It is located on the right side of the machine's cabinet, below the Warning Logotype.



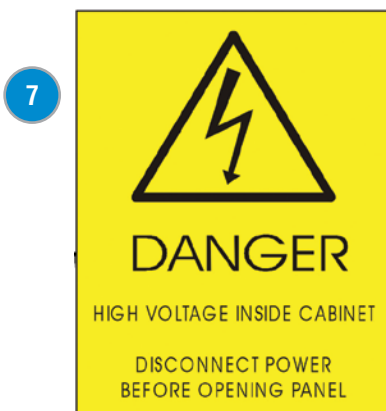
4. **Non-interlocked Protective Housing Safety Labels:** These labels are located on, or adjacent to, removable access covers on the machine's cabinet as shown in the diagrams to follow. Where a label is located on a removable cover, there is an additional label under the cover so that it will be visible when the cover has been removed.



5. **Defeatably-interlocked Protective Housing Safety Labels:** There is one label on each of the machine's cabinet doors; one on the front door and one on the top door.

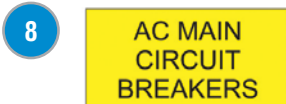


6. **Emergency Stop Label:** This label is located below the red Emergency Stop switch on the top right side of the machine.



7. **Electrical Safety Label:** This label is located on the back of the machine in the lower left hand corner.

8. **Main Breaker Label:** This label is located on or above the power module panel at the right side of the machine's cabinet.



9. **Aperture Safety Label:** This label is located above the aperture, inside the cabinet, where laser beams enter the machine's engraving area.

10. **Power Labels:** The appropriate label for the machine is located on or below the power module panel at the right side of the machine's cabinet.

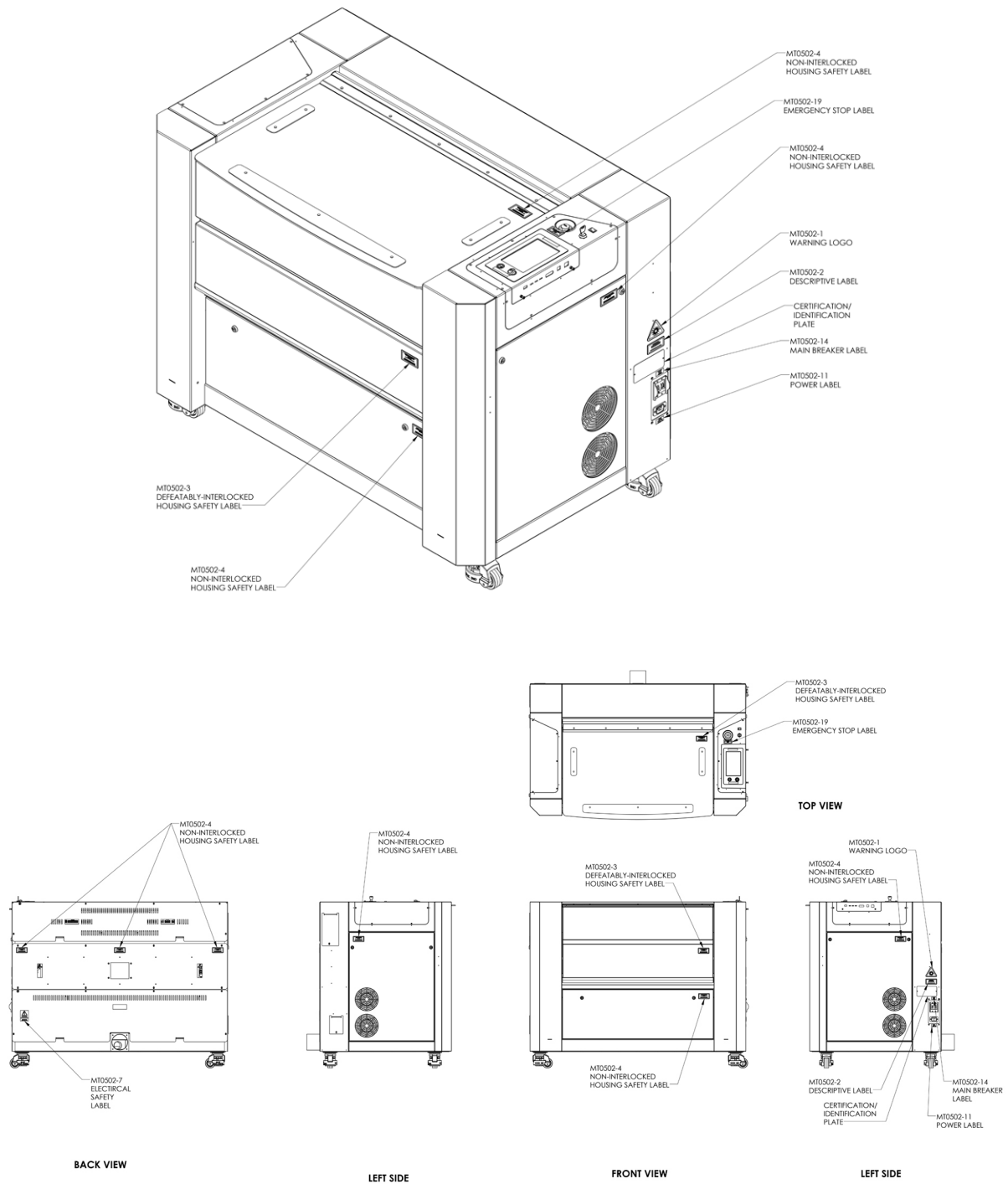


11. **Fire Warning Label:** There are two labels on top of the machine's cabinet; one to the left and one to the right of the top cabinet door.

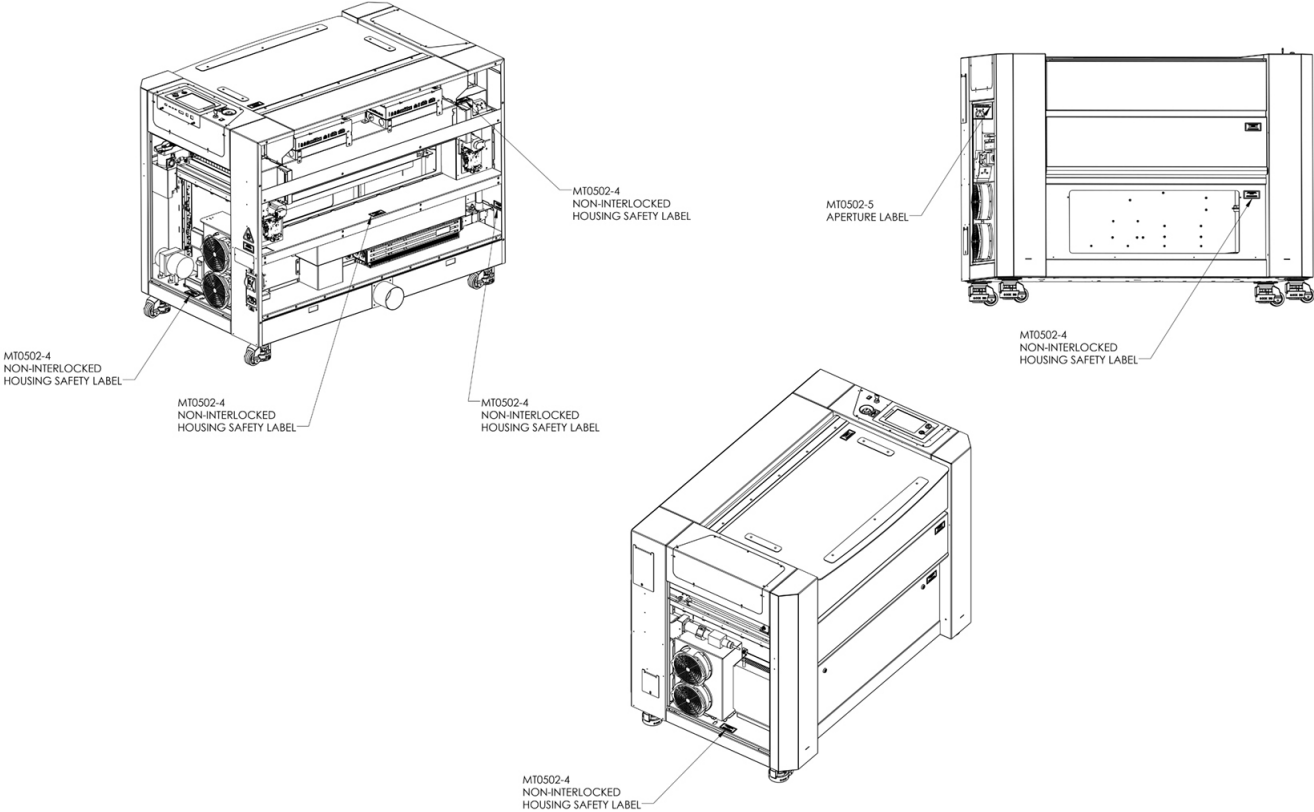
SECTION 2: SAFETY

The following diagrams show the location of each specific label.

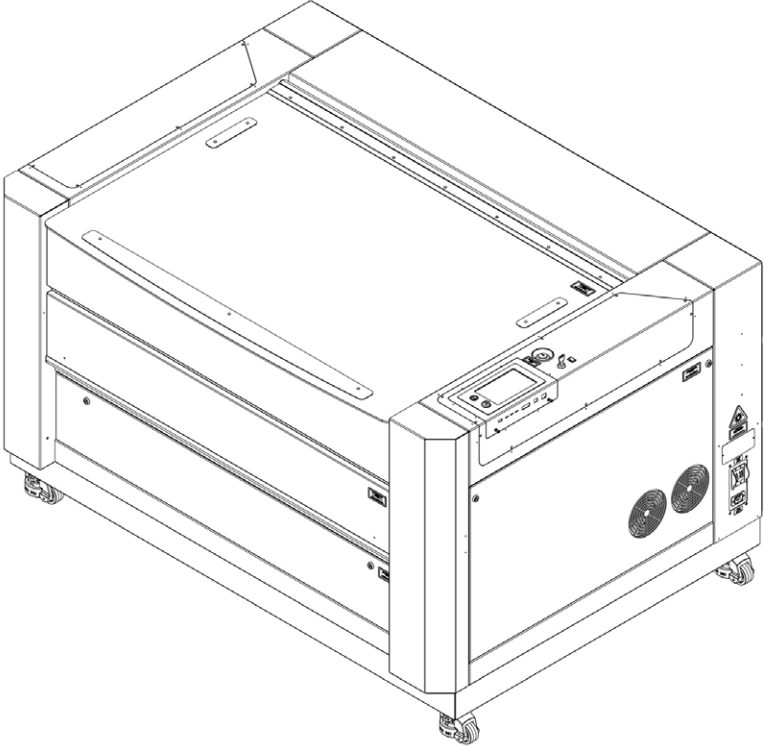
Fusion Pro 32:



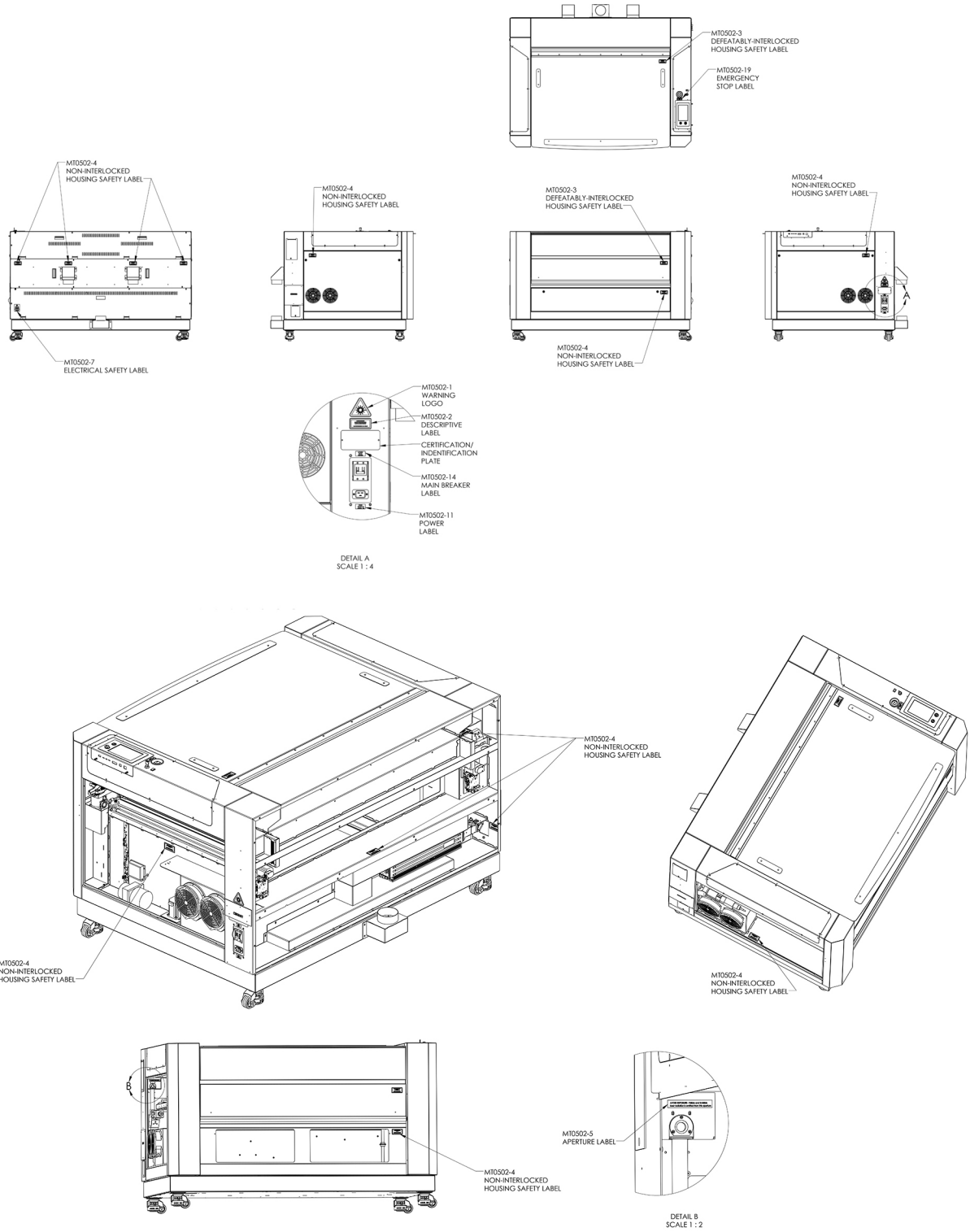
SECTION 2: SAFETY



Fusion Pro 48:



SECTION 2: SAFETY



SECTION 2: SAFETY

Dos & Don'ts



Don'ts

Do Not Run the Laser Unvented: Never operate the machine without a properly operating vent to the outside or to a filtration unit! Most material will only 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. A properly installed vent is the only way to ensure that problems do not occur.

Do Not Engrave or Cut PVC: Never engrave or cut **any material** containing PVC or vinyl. When engraved, a corrosive agent is produced that will destroy your machine. Your warranty will be void if your machine is damaged by corrosion from engraving or cutting PVC or Vinyl.

Do Not Operate Machine While Unattended: Never operate your machine without someone watching the system. 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.

Do Not Vector Cut While Machine is Unattended: Never laser cut any material with the laser without someone watching the system. Because vector cutting moves relatively slowly compared to raster engraving, a tremendous amount of heat is applied to the material being cut. This buildup of heat can cause significant fire risk and the machine should always be monitored. Additionally, the Air Assist should always be turned on when vector cutting to reduce the risk of fire.

Do Not Operate The System While Doors are Open: Never operate with any of the covers or enclosures removed, and never modify the enclosure. The laser beam is invisible and is very dangerous!



Dos

Clean the System: Please allow a few minutes a week for cleaning your machine. Just a small amount of effort at the end of the week will pay off with years of trouble-free operation of your machine.

See the section “**SYSTEM MAINTENANCE**” on page 69 for specific information.

SECTION 3: SPECIFICATIONS

Fusion Pro Laser Technical Specifications

	Fusion Pro 32 (CO2)	Fusion Pro 32 (Fiber)	Fusion Pro 48 (CO2)	Fusion Pro 48 (Fiber)
Maximum Engraving Area	32" x 20" (812 x 508 mm)		48" x 36" (1219 x 914 mm)	
Max Material Thickness	12.25" (311 mm) (2" lens)	11.25" (286 mm) (3" lens)	12.25" (311 mm) (2" lens)	11.25" (286 mm) (3" lens)
	Dual Source 11.25" (286 mm) (3" lens)		Dual Source 11.25" (286 mm) (3" lens)	
Laser Source Wattages	50, 60, 80, or 120 watt, CO2, air-cooled, 10.6 micrometers	30 or 50 watt, Fiber Laser. Air cooled, includes collimator. 1064 nm. Beam quality: M2 < 1.1.	50, 60, 80, or 120 watt, CO2, air-cooled, 10.6 micrometers	30 or 50 watt, Fiber Laser. Air cooled, includes collimator. 1064 nm. Beam quality: M2 < 1.1.
Standard Features	Radiance High Definition Optics (CO2), Air Assist, Red Dot Pointer, relocatable Home Position, LED lighting, integrated floor stand, brushless servo motors, Super-Silent Cooling Fans, Joystick controls, removable exhaust plenum.			
	Dual Source Fusion Pro: Available with combination of 50, 60, 80 or 120 watt CO2 and 30 or 50 watt Fiber.			
Intelligent Memory Buffer	Store unlimited files up to 1 GB. Rolling buffer allows files of any size.			
Operating Modes	Optimized Raster, Vector and Combined modes.			
Motion Control System	High-speed, continuous-loop, brushless DC servo motors using rotary encoding technology for precise positioning.			
X-axis Bearings	Ground and polished, stainless steel, Teflon coated, self-lubricating bearings. Dual blocks on X-axis for greater rigidity			
Belts	Advanced B-style Kevlar belts (X-axis) and steel cord (y-axis).			
Resolution	Fully-flexible and user-controlled from 75 to 1200 DPI.			
Speed and Power Control (engraving depth)	Computer-controlled in .001 increments up to 100%. Color mapping feature links Speed, Power, Frequency, Raster/Vector mode, & Air Assist On/Off settings to any RGB color			
Print Interface	10Base-T Ethernet, or USB. Compatible with Windows 7/8/10.			
Size (W x D x H)	54.6" x 34.2" x 42" (1387 x 869 x 1067 mm)		70.6" x 51.3" x 42.75" (1794 x 1304 x 1086 mm) Pedestal removed: 34" H (863 mm)	
Weight	400 lbs (182 kg)		650 lbs (227 kg)	
Electrical Requirements	110 to 240 volts, 50 or 60 Hz, single phase.		240 volts, 50 or 60 Hz, single phase, 15 amp AC.	
Ventilation Systems	735 CFM total		735 CFM total	
Exhaust Ports	One output Port 4" (102 mm)		Two output ports 4" (102 mm)	
Table Exhaust	Additional port for dedicated exhaust through table, 4" (102 mm)			
Laser System Classification	Class 2 Laser Product - 1 mW CW Maximum 600-700 nm.			

Technical specifications and product configurations subject to change without notice.

SECTION 3: SPECIFICATIONS

Compatibility

Your Epilog Laser has been designed as an “open architecture” product that can be run from almost any Windows based software.

Recommended PC

Operating System

Windows 7, Windows 8.1, or Windows 10.

RAM – Random Access Memory

4 GB RAM or greater.

Processor Speed

3.0 GHz processor or faster.

Graphics Card

Your computer’s graphics card will need to support OpenGL 3.0 (or higher) or OpenGL 2.0ES (or higher) to operate the Epilog Software Suite.

10/100 Network Interface Card (NIC)

All new computers have a 10/100 network connection as standard equipment. As well as allowing multiple computers to be linked together in a network, this technology also allows direct printing from the computer to the laser. Epilog supplies a network Crossover cable with each laser system that allows one computer to print to a single Epilog Laser system.

Hard Drive

This will depend on the size of your project files. 100GB or larger hard drive is recommended.

Software

Epilog does not guarantee compatibility with any software. Many Epilog users use CorelDraw as their graphics software. Other Windows software applications can also be used, although all software is different and may not be predictable, user friendly or functional. Consult with your Epilog distributor on software compatibility issues.

PhotoLaser Plus is a third-party software for converting photos to laser compatible format. This is an indispensable option for engraving photos.

Heavy Duty Surge Protector

The need for a surge protector varies greatly throughout the world. If the laser is operated anywhere that the electrical power is subject to spikes, outages, lighting, fluctuations, etc, a surge protector should be used on both the laser and the computer. A surge protector is a very cheap insurance policy against catastrophic electrical damage. A surge protector is designed to be an inexpensive device that absorbs any electrical problems before they can damage the expensive equipment (computer and laser) they are protecting.

SECTION 3: SPECIFICATIONS

About The CO2 Laser Source

Your Epilog CO2 laser system uses the latest in laser technology to provide a powerful tool that is simple and safe to setup and operate. The Epilog Laser can mark, engrave, and cut a variety of non-metallic materials.

The CO2 laser beam itself is invisible and operates at a wavelength of 10.6 microns. The beam is about half the diameter of a #2 pencil. Unfocused, it will just make an ugly burn, leaving lots of charred material behind. The focus lens gives the beam an hourglass shape. At the center point the energy density is concentrated, allowing the very precise and clean material removal that is characteristic of laser engraving. The center of the hourglass is the focal point.

The laser beam path is completely enclosed within the cabinet. Please do not disassemble or modify any of the covers or windows on the machine. If at any time you notice that the laser operates with a door or window open, please contact Epilog technical support immediately.

The laser has two basic operating methods. For cutting (vector), the laser is driven along a path and the laser is left on all the time. The path could be the outline of a letter or a geometric shape like a circle. The laser will cut entirely through the material, separating the part from the background. For marking (engraving), the laser is swept across the work from left to right, and the laser is turned on and off at the correct points to produce the first line of the image. Then the carriage advances one line and the process is repeated, eventually assembling a full image.

About the Fiber Laser Source

The fiber laser source generates a laser beam by pumping intense diode light into the end of fiber optic cables that have been doped with ytterbium. The energy from the diode light is absorbed by the ytterbium in the fiber optic cables. The ytterbium then releases the energy in the form of photons that travel down the optic cables. The photons that leave the optic cables create the laser beam. The wavelength of light generated from a fiber laser is 1062 nm.

The fiber laser source generates laser light by pumping intense diode light into fiber optics cables that are doped with the rare-earth element, ytterbium (Yb3+), which is referred to as the medium or gain medium. As this diode light energy travels into the fiber optic cable, it energizes the electrons in the ytterbium and the ytterbium electrons go from a ground or stable state, to an excited state.

Essentially, all that is happening in this first step is that the electrons in the medium are absorbing and storing the energy that's coming from the external energy source (diodes). For reference, the CO2 medium is the CO2 gas in the tube, and the external energy source is RF electrical current. In the fiber laser (and also most YAG lasers these days and YVO lasers) the external energy source is a laser diode.

The electrons in the medium don't really want to store the external energy they've absorbed, so they emit the extra energy by releasing a photon (a quantum packet of light). Once a photon has been emitted by one electron in the medium it stimulates other excited electrons to also emit photons, creating a chain reaction where the absorption and emission of energy is at a constant rate. The photons travel through the optic fibers and some are released through the end of the fibers as the laser beam.

By continually pumping energy into a medium, that medium tries to shed the excess energy by emitting photons. The type of medium is important because different mediums absorb different types of energy (for instance, a CO2 gas medium is not going to absorb the energy from a diode in a way that will make

SECTION 3: SPECIFICATIONS

the CO₂ gas lase). Different mediums also emit different wavelengths of photons, and hence, the different properties of different wavelength lasers.

SECTION 4: BEFORE OPERATION

Your Fusion Pro laser system consists of the following components:

1. Fusion Pro Laser System
2. Epilog Driver Disc
3. USB and Ethernet Cables
4. Power Cable
5. Exhaust and Vacuum Table Plenum Connectors
6. Quick Start Guide
7. Training Suite Signup Card
8. Laser Beam Alignment Target
9. Lens Cleaner
10. Bearing Lubrication Grease
11. Camera Calibration Mat
12. Vendor Material Sample Kit

You will also need:

1. A computer or laptop.
2. An exhaust fan: The exhaust fan is mandatory and is used to remove smoke and debris from the Fusion Pro work area. The exhaust air can be ported to the outside or into a filter box.

Follow these steps to setup your Fusion Pro Laser system:

1. Unpack the laser system.
2. Choose where to locate the system.
3. Connect the exhaust system to your laser.
4. Connect the electrical power.
5. Connect the laser to your computer through USB or Ethernet connection.
6. Sign up for driver updates and register your system at www.epiloglaser.com/register.

SECTION 4: BEFORE OPERATION

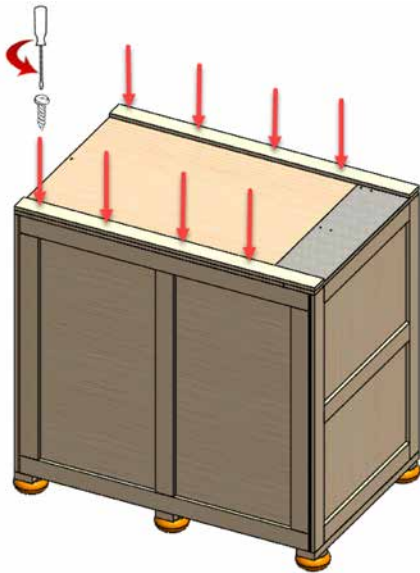
1. Unpacking the Laser System



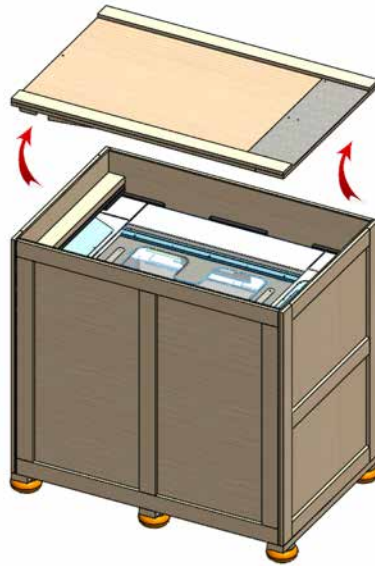
Unpack the laser system from the crate provided by Epilog. Please be sure to hold on to all packing materials and crating in case you need to move the system in the future.

Start by using scissors or a utility knife to cut the box straps. Stand clear of the straps, as they are under high tension and may pop out at high speed when cut. On top of the crate will be a box containing accessories for your Fusion Pro. Set it to the side for now.

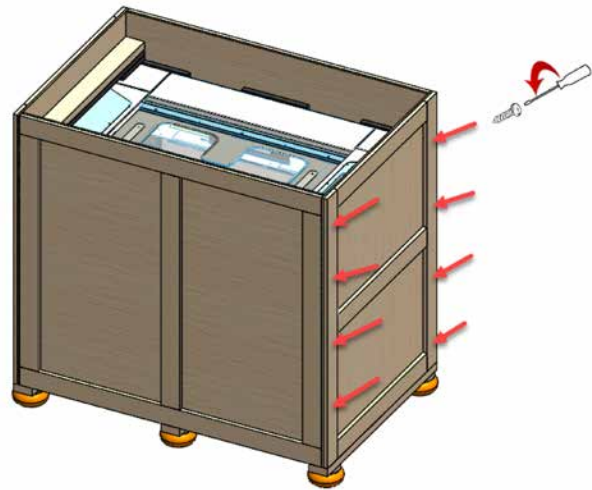
1. First, remove the screws securing the top lid using a screwdriver.



2. Remove the top lid and set it to the side.

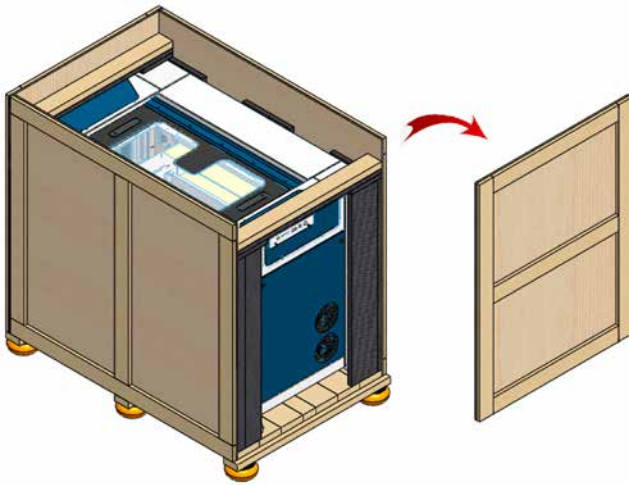


3. Remove the screws securing the front panel.

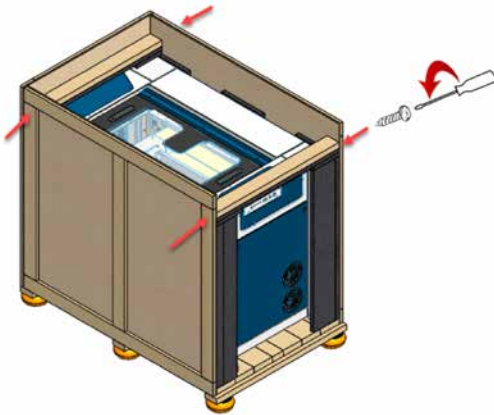


SECTION 4: BEFORE OPERATION

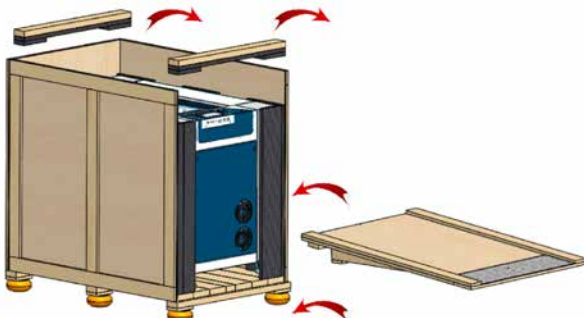
4. Slide the front panel out of the box.



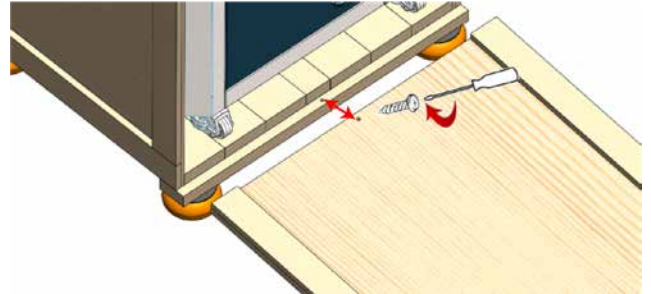
5. Remove the outer screws holding up the two braces.



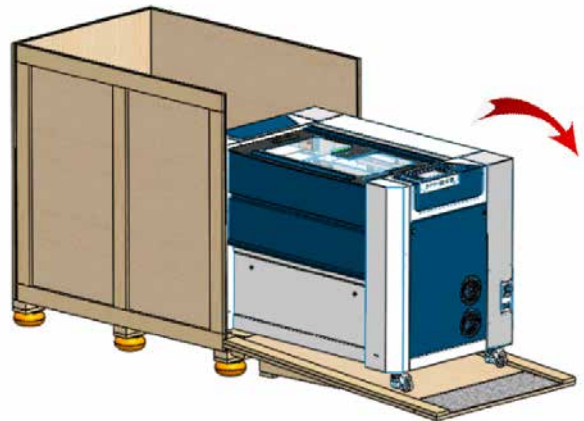
6. Remove the braces as well as the plastic bag, and any foam pieces around the machine.



7. Using the top panel you removed at the beginning, align its corners with the ledge on the bottom of the box, making a ramp. Secure the ramp with a screw.



8. Roll the machine down the ramp slowly and carefully until it is out of the box and on level ground.



SECTION 4: BEFORE OPERATION

2. Choose Where to Locate the System

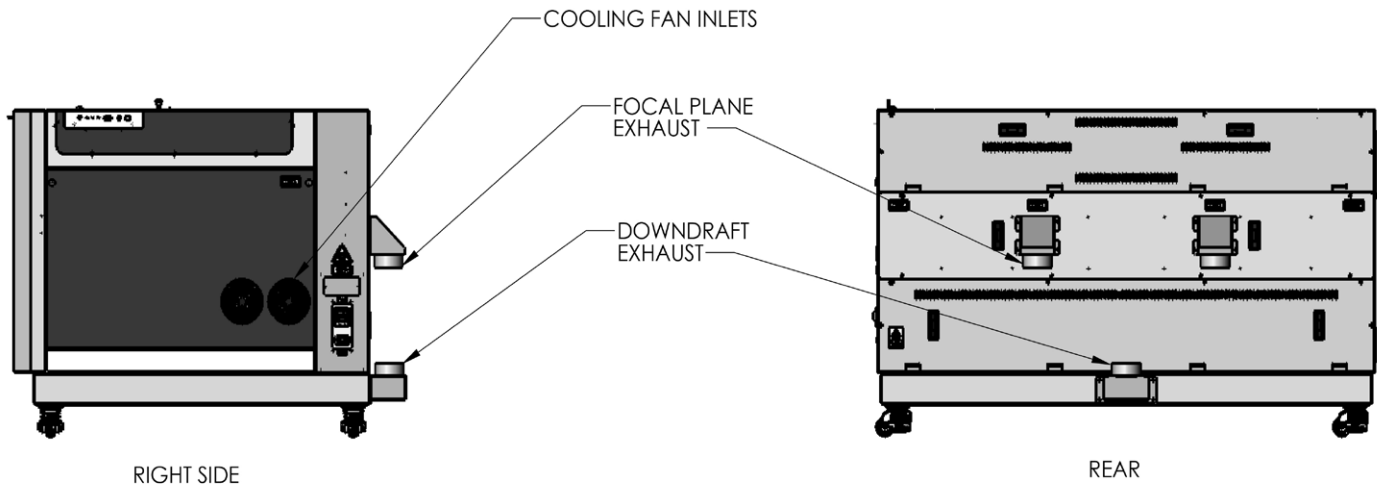
Cooling Requirements and Operating Temperatures

All Epilog Laser systems use air-cooled laser tubes. Laser technology is such that the laser tubes generate a lot of excess heat and the tubes must be cooled for proper operation. There are cooling fans located on both sides of the laser. The fans and vents should always be clear of restrictions and should never be covered.



Warning: The cooling fans and vents are located on both sides of the Fusion Pro and should never be covered or blocked in any way. Lasers that overheat will not operate properly and may begin to produce erratic laser output or possibly complete failure.

Ambient air temperature where the laser system is operating should not exceed 32 degrees C. Operating in an environment where the ambient air temperature is above 32 degrees C will void the Epilog warranty. **For more information, see the “Warranty Statement for the Fusion Pro Laser” on page 93.**



Note: In some cases, you may need to remove the pedestal from the bottom of the Fusion Pro to fit through narrow spaces in order to place the machine where you want it. Steps for this process can be found here: **“Removing the Pedestal from the Fusion Pro” on page 76.**

SECTION 4: BEFORE OPERATION

3. Connecting the Exhaust

It is mandatory that an exhaust unit or filter system is incorporated as part of your laser system. Never operate your laser system without a properly functioning exhaust. The exhaust removes the dust, debris and smell from the engraving cavity and exhausts it to the outside of the building or to the filter unit. Prior to the installation of the laser system, you may need a contractor to install the exhaust system. The blower should be mounted outside your building for noise considerations. Ideally, the blower should not be more than 6 meters from the laser. You should provide a metal duct (flexible aluminum or galvanized sheet metal) from the blower to the laser. All Epilog model 16000 laser systems require an exhaust fan that is rated at a minimum of **735 CFM** for external exhaust.

The exhaust requirements for the Fusion Pro 32 and 48 are the same:

- **The Fusion Pro 32** model requires a total of 735 CFM.
- **The Fusion Pro 48** model also requires a total of 735 CFM.

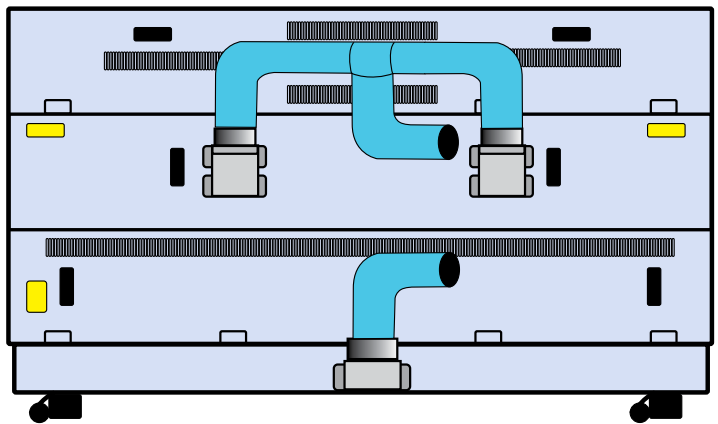
Please contact your Epilog distributor to match a filter to the Epilog laser system you are using.



Note: Remember to put the blower switch for the laser system in an obvious and accessible place so it can be routinely switched on prior to using the engraver. Please connect the exhaust blower to the laser as shown below and on the following pages.



Warning: It's important that either rigid or flexible metal ducting be used for all connections leading to and from the laser system and the exhaust fan. Vinyl, plastic, or any type of "soft" ducting is potentially flammable and should not be used unless provided by the filtration system manufacturer and made from fire-proof materials.



SECTION 4: BEFORE OPERATION

Epilog Exhaust/Filter Connections

There are two 102 mm ports attached to the back of the Fusion Pro 32 laser system, and three 102 mm ports attached to the back of the Fusion Pro 48 laser system. The exhaust port on the Fusion Pro 32 is approximately 368.3 mm from the top of the machine, and the downdraft port is approximately 825.5 mm from the top of the machine. On the Fusion Pro 48 the exhaust ports are approximately 349.25 mm from the top of the machine, and the downdraft port is approximately 876.3 mm from the top of the machine. Attach your ducting to the machine, and connect it to an exhaust fan recommended by your distributor.

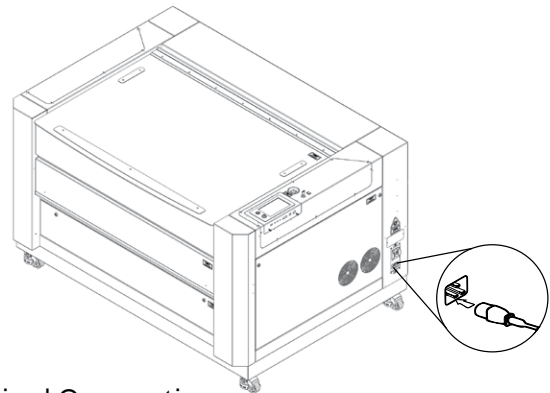


Check your exhaust system for leaks. **DO NOT OPERATE** your laser with inadequate or leaking exhaust.

4. Connecting Electrical Power

The Fusion Pro 48 laser system requires 208/220/240-volt electrical power. This system will not operate on 120-volt power. The Fusion Pro 48 power cord comes with a male plug type NEMA L6-15R (which is a Hubble HBL4570C equivalent).

We recommend using 208/220/240-volt electrical power on all systems to achieve maximum performance. For more information, see **“Fusion Pro Electrical Specifications”** on page 7.



Electrical Connection
220 V-50/60 Hz

5. Connect the Laser to Your Computer


The following connections can be used to connect the laser to your computer:

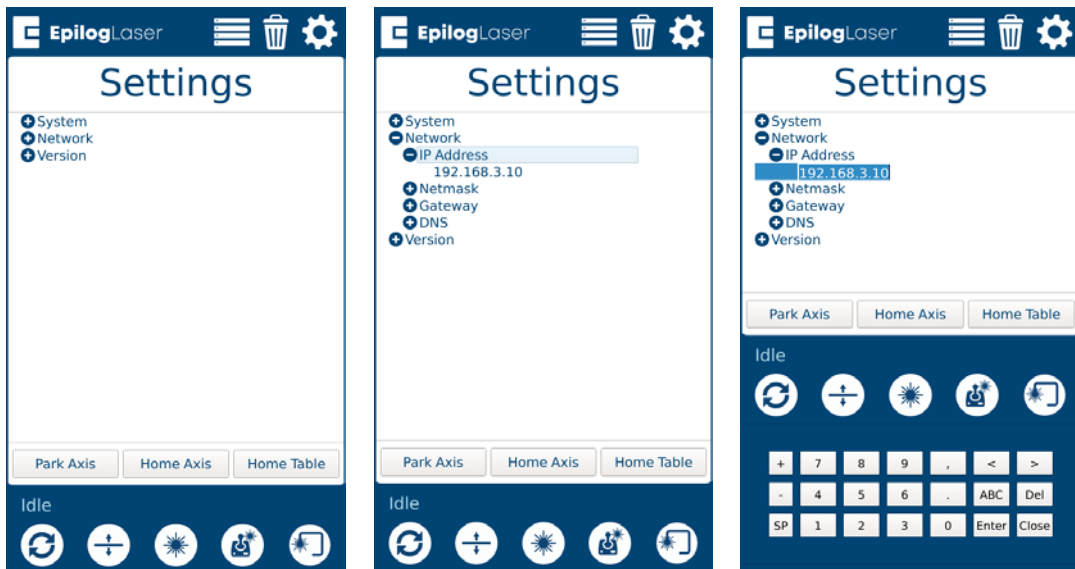
1. **USB only connection:** You can use the USB port for connecting to the Epilog Job Manager. Multiple laser systems cannot be operated from a single computer through the USB connections. If you are using the USB connection, you will need one computer for each laser system.
2. **Ethernet only connection:** With an Ethernet connection you can print from the Laser Dashboard and use the Epilog Job Manager.

SECTION 4: BEFORE OPERATION

6. Set the Fusion Pro's IP Address


Ethernet Cable Setup

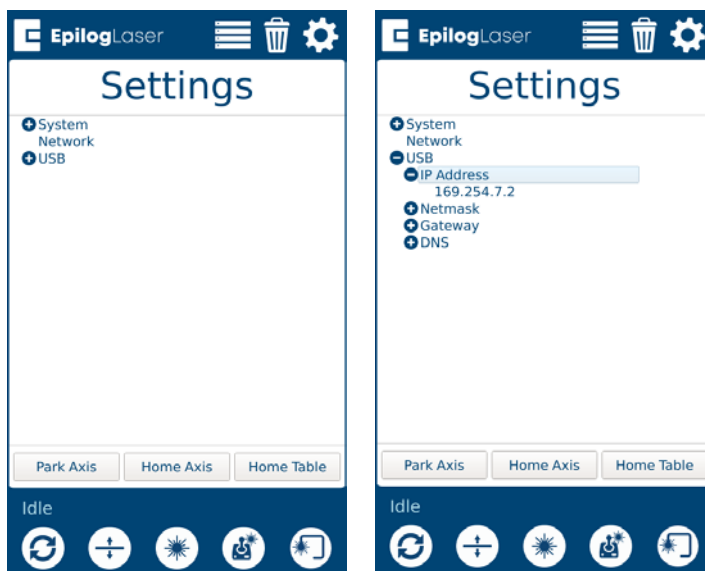
1. Once your machine is booted up, select the **Settings**  button in the upper right corner of the touchpad.
2. Select **Network** in the settings list.
3. Under Network you will see "IP Address" and "Netmask", press "**IP Address**" and then press the numbers that appear next to them. A keyboard should show up at the bottom of the screen.
4. Press the "**123**" Button in the bottom left corner of the keyboard to access the numerical keypad.
5. Type in whichever IP Address you prefer to use. Most Epilog users will use the IP Address of **192.168.3.4** which is what we use in this manual.
6. Press the **Close** key to close the keyboard, then press the **Job Menu Button** to return to the main screen and your settings should be saved.



SECTION 4: BEFORE OPERATION

USB Cable Setup

1. Once your machine is booted up, select the **Settings**  button in the upper right corner of the touchpad.
2. Select **USB** in the settings list.
3. Under USB you will see “IP Address” and “Netmask”, press “**IP Address**” and then press the numbers that appear next to them. A keyboard should show up at the bottom of the screen.
4. Press the “**123**” Button in the bottom left corner of the keyboard to access the numerical keypad.
5. Type in whichever IP Address you prefer to use. In this case we used **169.254.7.2**
6. Press the **Close** key to close the keyboard, then press the **Job Menu Button** to return to the main screen and your settings should be saved.



Note: If you do not see an option for either the Network IP Address or USB IP Address in the Settings menu, make sure the Ethernet or USB cord you are using is connected fully to both your computer and the laser.

7. Sign Up for Driver Updates and Register Your System

Go to www.epiloglaser.com/register and register your system. You can also sign up for our monthly e-newsletter, quarterly customer printed newsletter, and sign up for driver update notifications.

SECTION 5: OPERATION

Fusion Pro Features

1. **Top Door**

The Top Door is to remain shut when using the IRIS Camera or while running a job. If the Top Door is opened during operation, the laser will no longer fire and the job will continue running leaving an incomplete engraving.

2. **On/Off Key Switch**

The Key Switch feature is used to power the Fusion Pro on and off, and also allows you to lock out any unauthorized users by powering down the machine and removing the key.

3. **Light Switch**

The Light Switch is found next to the Key Switch. It provides additional light inside the machine if needed.

4. **Touchscreen**

The Touchscreen has many features and displays that control the Fusion Pro. For more information, **see “CONTROL PANEL” on page 29.**

5. **IRIS™ Positioning Camera**

The IRIS™ Positioning camera allows you to place artwork directly onto any item on the engraving table using the Epilog Dashboard. To learn about the camera features, see **“IRIS™ Camera Positioning System” on page 37.**

6. **Connection for Rotary Attachment**

Connection for installing the optional Rotary Attachment. This connection allows the machine to control the Rotary Attachment properly. The machine should always be powered off when installing or uninstalling the rotary attachment. For more information, **see “Fusion Pro Rim-Drive Rotary Attachment” on page 48.**

7. **Task Plate**

Pieces you want to engrave are put onto the Task Plate. A vertical and horizontal ruler line the edges of the table for lining up or measuring your pieces. The table is magnetic to help hold lightweight pieces on to the table. For more information, see **“Task Plate/Vacuum Hold-Down Table” on page 41.**

8. **Vector Grid/Slat Table**

The optional Vector Grid or Slat table (sold separately) are used for cutting jobs. For more information, **see “Vector Cutting Table” on page 47 or “Slat Table” on page 47.**

9. **Front Access Door**

The Front Access door allows for easier loading of large or heavy items you want to process. For more information, **see “Front Access Door” on page 40.**

10. **X Axis**

The part that performs the mechanical movements in the horizontal direction of the machine.

SECTION 5: OPERATION

11. **Power Socket**

For connecting the main power to the machine.

12. **USB Connector**

For connecting the Fusion Pro to a computer using a USB cable.

13. **Ethernet Connector**

For connecting the Fusion Pro to a computer using an Ethernet cable.

14. **Exhaust Hose Connectors**

For connecting your exhaust setup to the machine. For more information, **see “3. Connecting the Exhaust” on page 23.**

15. **Manufacturers label**

Displays the serial number and manufacturing date of the machine.

First Time Operation

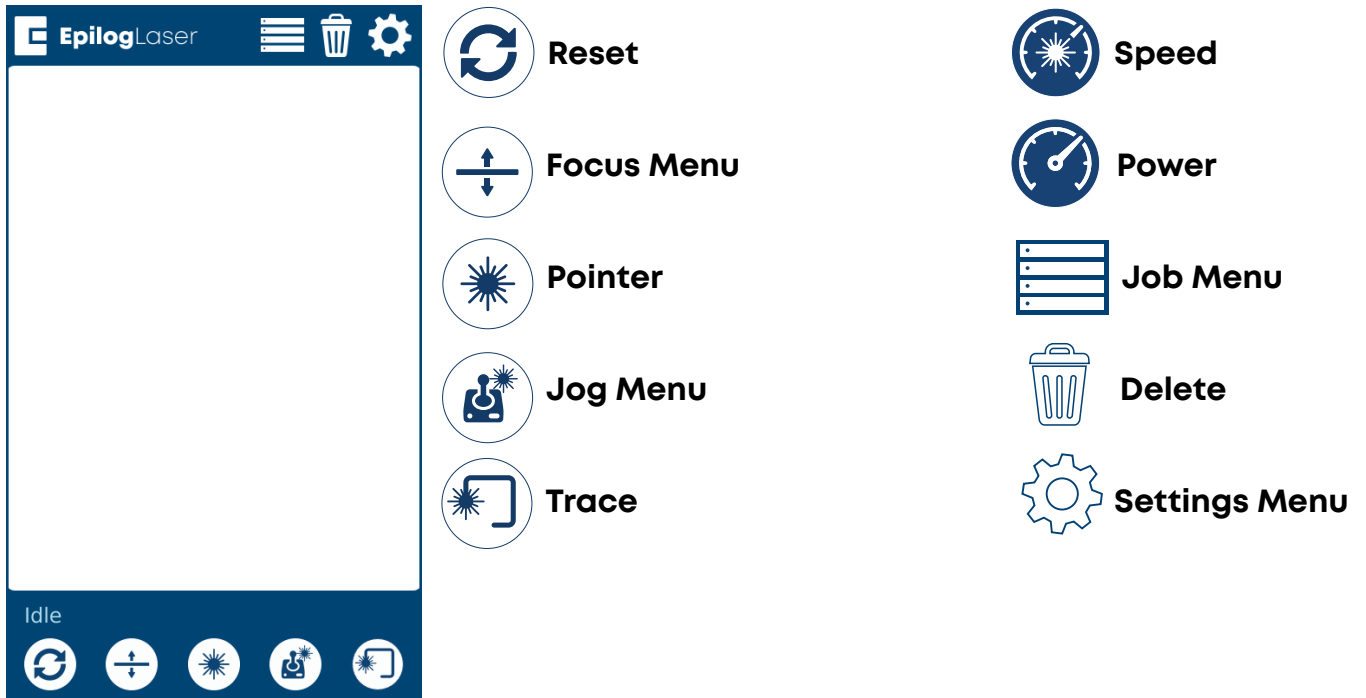
Follow these steps to run your first engraving job on the Fusion Pro.

1. Turn on the laser and wait for the Touchscreen to display “Idle” when it’s finished booting up.
2. Place an object to be engraved on the engraving table.
3. Focus the table to the object either using the Manual Focus Gauge or Auto Focus.
4. Create a graphic using your preferred graphics software.
5. Print the graphic to the Epilog Engraver to open it up in the Epilog Dashboard.
6. When the Dashboard loads, adjust and move the graphic as needed to fit your piece using the live camera view.
7. Apply your preferred laser settings to the job. Specify Power, Speed and Resolution settings that are meant for your material. For more information, **see “Fusion Pro Suggested Material Settings (Fiber)” on page 98.**
8. Once your settings are ready, print the job to the laser.
9. Hit the go button on the laser to begin the engraving.

SECTION 6: CONTROL PANEL

Display

The display shows valuable information associated with the highlighted Functional Menu items. We will explain the different information that will be displayed as we go through the description of each menu item.



Status Indicator

In the bottom left corner of the screen you will see text displaying the current status of the machine.

- **Homing:** This indicates the machine is still powering on. None of the functions are available until powering on is completed.
- **Idle:** The machine is inactive and ready to run or resume a job.
- **Running:** A job is in progress when this is displayed.
- **Parking:** The axis is returning to Home position.
- **Jogging:** Jog mode is active.


Symbols



Go/Stop Button

Press the Go/Stop button to start and pause a job.

SECTION 6: CONTROL PANEL

- Pressing the Go/Stop button during a running job will stop the lens carriage and the laser beam will be shut off. If the Go/Stop button is pressed during raster engraving mode, the lens carriage will pause on either the far left or far right of the engraving line that is in process. If the Go/Stop button is pressed while in vector cutting mode, the lens carriage will stop at the end of a line segment or at the next line node location.
- Once the lens carriage has stopped, you can open the door to examine the job. By closing the door and pressing the Go/Stop button, the job will commence where it left off. If the item being engraved/cut has not been moved, the engraving/cutting registration will not be affected.
-  **Note:** Opening the door on the laser during engraving or cutting will stop the laser from firing; however, the lens carriage will continue to move. It is important to stop the job before you open the door to ensure the engraving/cutting is completed.
- If you press the Go/Stop button while in vector mode it may take some time for the system to actually stop. The system needs to get to the next node in a vector before it can stop.

LED Status

The ring around the Go/Stop button will change certain colors depending on the Fusion Pro's status.

- **White:** The machine is booting.
- **Purple:** The machine is waiting for the touch screen configuration to load.
- **Multi-colored:** The machine is Homing.
- **Alternating Light Blue to Green:** Machine is Idle and ready to run a job.
- **Green:** Machine is actively running or tracing a job.
- **Red:** A drive has failed. The number of flashes determines the drive number that failed. If more than one drive has failed, it flashes for the first sequential drive.
 - 1 - X Axis
 - 2 - Y Left Axis
 - 3 - Y Right Axis

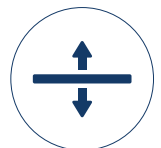
Reset Key

- Pressing the Reset key will move the carriage back to its Home Position. Press the Reset key after you have moved the carriage when in Jog mode.
- You may also press this key if you want to start a job over after pausing it with the Go/Stop button. Reset does not erase the job from the laser systems memory; rather it will stop the engraving job in process and send the carriage back to the Home Position.



Focus

The Focus function allows you to manually set the table to the correct height for engraving while using the Focus Gauge. With Focus highlighted, use the Joystick to move the table up or down. The display will show a digital readout of the table position. Press once to enable the Focus function and the icon will turn green. Press again to exit this feature.



SECTION 6: CONTROL PANEL

Pointer

The Pointer key is a toggle switch that turns the laser system's Red Dot Pointer on and off. **For more information visit “Red Dot Pointer” on page 40.**



Jog

The Jog function allows you to move the laser head around the table with the use of the Joystick. To make it easier to use, turn on the Red Dot Pointer for a visual indicator of where the carriage is moving. The carriage can be moved in X, Y or diagonally. The display will show a digital readout of the carriage position. This function is useful for bringing the focus gauge to any object on the table to ensure it's focused properly. **For more information see “Auto Focus vs Manual Focus” on page 38.**

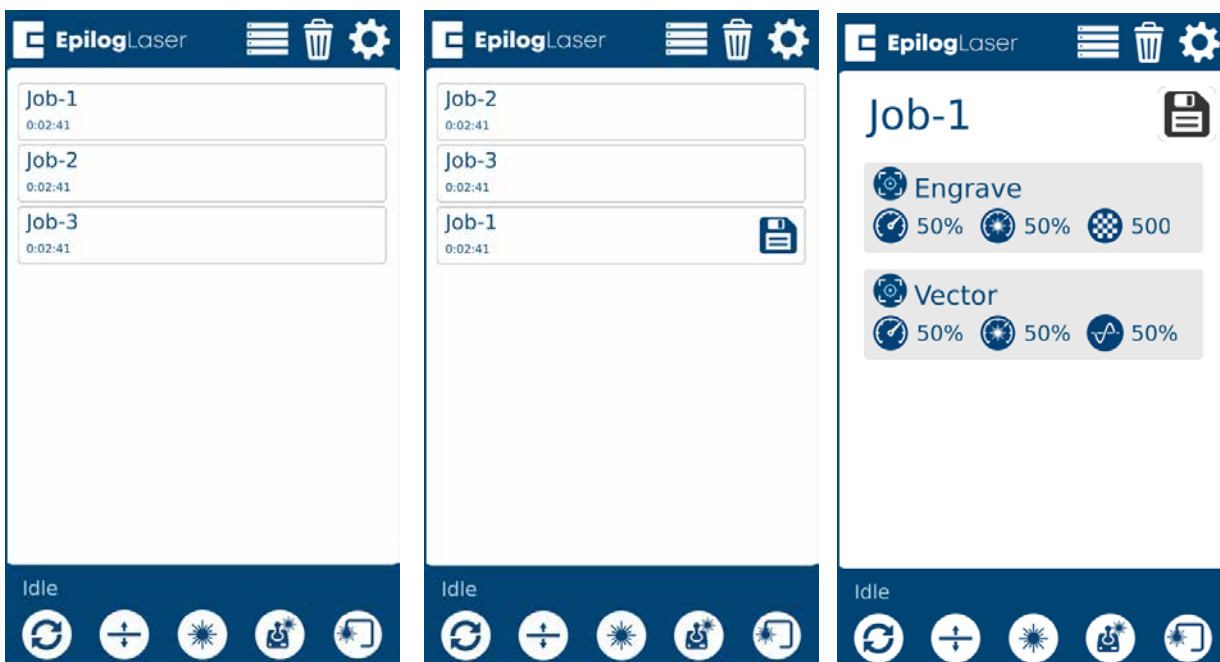


Trace

The Trace function allows you to preview the placement of your artwork on your work piece before you run the job. To use, turn on the Red Dot Pointer, select your job from the Job Menu, and press the Trace key. The laser head will begin tracing the entire outline of your job repeatedly. To stop tracing, press the Trace key again.




Job Menu



- The Job Menu allows you to scroll through the jobs in your laser system. You will be able to see a list of jobs that have been sent to the laser. The job name displayed is the same as the file name that you printed to the laser.
- When the job you want has been selected, it will be highlighted in blue. Press the Go/Stop button to start the job.

SECTION 6: CONTROL PANEL

- After the job starts, the job's settings and a timer will be activated and will be shown at the bottom of the display.
- Saved jobs will always be visible at the top of the list with a save icon next to the job name.
-  Pressing and holding down your finger on a job will pull up the job's settings, allowing you to view the Speed, Power, and Resolution or Frequency. A save button will also be visible in the upper right corner that allows you to save the job permanently to the laser.



Speed

This icon indicates the speed settings on the selected job. It ranges from 1-100%.



Power

This icon indicates the power settings on the selected job. It ranges from 1-100%.



DPI

This icon indicates the resolution settings on the selected job. It ranges from 75-1200.



Frequency

This icon indicates the frequency settings on the selected job. It ranges from 1-100%.

Delete Button



The Delete Button will permanently erase jobs from the Job Menu. To delete a job, select the job in the Job Menu, and then select the Delete Button. A dialog will pop up to confirm that you want to delete the file. Select "Yes" and the file will be removed from the Job Menu.



Note: If you have marked a job as "Saved" and delete the file, it will still be erased from the Job Menu.



SECTION 6: CONTROL PANEL

Settings/Config Menu

The Settings/Config menu has two sub-menus, System and Network Settings.



System

Once selected, the System Settings display detailed information about the machine. These are factory settings that should not be changed unless instructed by Epilog Technical Support.

Network

Once selected, the Network Settings allow you to change the IP Address and the Netmask. The IP Address on this screen should match the IP Address you have assigned your machine in the Job Manager. If you have multiple machines, each one will need its own IP Address. For more information, see **“6. Set the Fusion Pro’s IP Address” on page 25.**

Park Axis

Pressing Park Axis returns the Laser to the Home Position.

Home Axis

Pressing Home Axis repeats the Homing process that happens when the machine powers on.

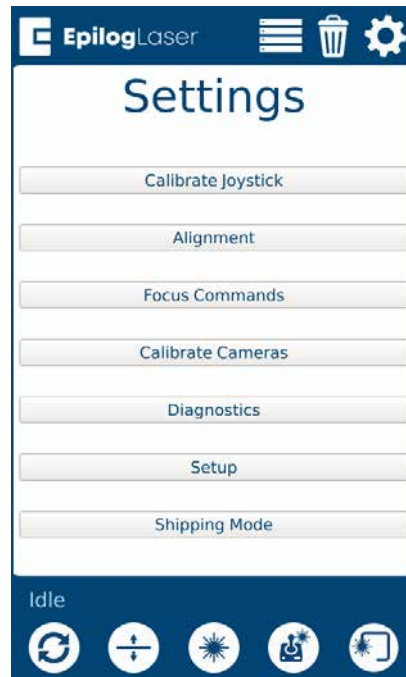
Home Table

Home Table resets the table height to its Home Position.

SECTION 6: CONTROL PANEL

Advanced Settings

Access the Advanced Settings Menu by first going to the Settings Menu, then long pressing the text “Settings” at the top of the screen.



In this menu you have options for calibrating various parts of the machine, including the Joystick, Cameras and Auto Focus. Each option provides step by step instructions for each process.

For more information about Camera Calibration, see **“Camera Calibration” on page 181.**

For more information about Auto Focus Calibration, see **“Calibrating the Auto Focus” on page 185.**

SECTION 6: CONTROL PANEL

Jog Menu

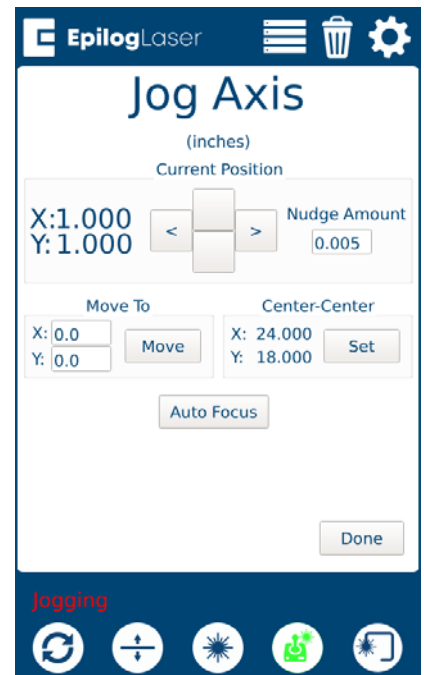
Access the Jog Menu by pressing the Jog key, which will turn green when active. The Jog Menu allows you to adjust the current X and Y axis positions of the laser head. You may change the current position of the laser head either using the Joystick, or by entering precise coordinates. The Nudge arrows allow you to fine-tune the position down to a thousandth of an inch. Once you are finished using the Jog Menu, press the Jog key again to return to the main Job Menu. Press the Reset key to return the laser back to its home position.

Auto Focus

When you have jogged the lens carriage above your material, press the Auto Focus button to use the plunger Auto Focus. The table will rise until the material touches the plunger, then set the table to the correct height. Your job should now be in focus.



Note: If you are running a Dual Source job, use Auto Focus to focus the table to the height of the fiber portion of your workpiece. For more information, see **“Focusing a Dual Source Job”** on page 55.

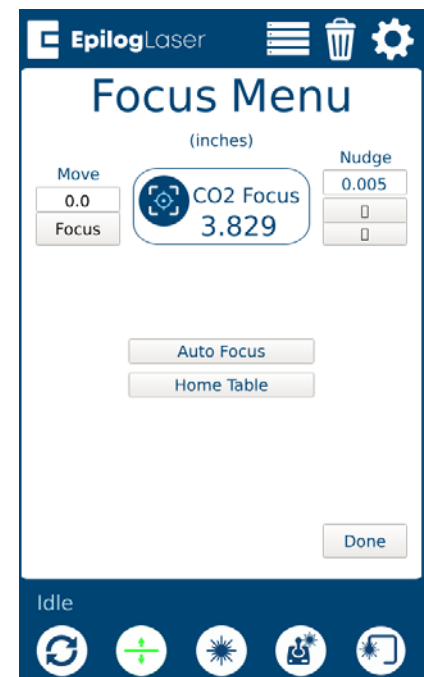


Focus Menu

To access the Focus Menu press the Focus key, which turns green when active. The Focus Menu is used for raising or lowering the table level to focus the laser precisely to your engraving or cutting material using the Focus Gauge. The height of the table is adjustable by either using the joystick, or using the Nudge arrows to fine-tune the height down to a thousandth of an inch. Once you are finished using the Focus Menu, press the Focus key again to return to the main Job menu.

Home Table

Pressing the Home Table button resets the table height to its home position, which is the default every time you turn on the machine.



SECTION 6: CONTROL PANEL

Joystick

The Joystick feature is used in Jog mode and Focus mode. The Joystick is progressive and touch sensitive and provides a continuously variable range of adjustments. It is sensitive to the degree of tilt that is being applied. The more you tilt the Joystick, the bigger your impact on the function you are using.

Job Storage

The Fusion Pro has 1 GB of permanent storage. While powered on, the machine will store any and all jobs sent until there is no free memory left. This feature allows you to save your most run jobs right at the laser without needing to first print them from the computer.

To save a job, press and hold down on a job in the Job Menu until it pulls up the job's settings. Select the save button in the upper right corner and the job will save permanently to the laser until manually deleted. If you do not save a job, it will be deleted upon powering down the machine.

SECTION 7: SYSTEM FEATURES

IRIS™ Camera Positioning System



The Fusion Pro includes the IRIS™ Camera Positioning System which allows you to precisely place your artwork on screen in seconds. The overhead camera(s) provide a live picture of the working area for accurate artwork placement, and a camera at the lens allows the system to find preprinted registration marks. Your Fusion Pro will either have 1 or 2 overhead cameras, depending on whether you have the 32 or 48 model.

Using the IRIS™ Camera

The live preview of your projects can be viewed within the Epilog Dashboard under the Preview tab. The IRIS™ Camera Positioning System will provide the most accurate results when:

1. The piece being cut or engraved is placed **directly underneath the camera(s)**, and
2. The table level is **focused to the piece**. If the piece is not in focus on the table, the artwork may not be aligned properly in the live preview.

The camera(s) may also be calibrated for improved accuracy. **For more information, see “Camera Calibration” on page 181.**



Note: The top door of the Fusion Pro must be completely shut to use the live preview in the Epilog Dashboard.

Touch Screen

The laser of the Fusion Pro is controlled by a 178 mm capacitive resolution touch screen. This feature allows you to select between jobs, change settings, and more. For more information on how to use the touch screen, **see “CONTROL PANEL” on page 29.**



SECTION 7: SYSTEM FEATURES

Air Assist



The Air Assist feature on the Fusion Pro Laser is used to keep combustible gases away from the cutting surface and to reduce flare-ups of more flammable materials as you cut through it, such as wood and acrylic.

The Air Assist directs a constant stream of compressed air across the material surface at the point of burn removing the heat and combustible gases from the work surface. The constant air stream helps reduce charring and scorching associated with materials, such as wood, rubber, and acrylic. The Fusion Pro systems also include an air compressor within the machine.

The Fusion Pro systems have two types of Air Assist:

- **Cone:** This feature directs air through the cone shaped part of the assembly, and permanently remains on while running any job to help keep the lenses clean.
- **Sweep:** This feature directs air through the Air Assist tube to the side of the cone. This feature has the option to be turned on or off by the switch directly on top of it. When the switch is pointing outward toward the front of the machine, the Sweep Air Assist is **ON**. When it is pointing toward the right side of the machine and adjacent to the lens tube, the Sweep Air Assist is **OFF**.



Both types of Air Assist should always be activated during vector cutting operations to reduce the risk of fire! **For more information, see “FIRE WARNING” on page 1 of the manual.**

Auto Focus vs Manual Focus

In order to engrave or cut a crisp, clean image, your material must be the correct distance from the bottom of the focus lens. Setting the distance from the bottom of the focus lens to the top of your material is the process of focusing, and is accomplished by placing your material on the table and moving the table up or down.

Auto Focus

Activating the Auto Focus can be done on your computer in the Auto Focus box in the Dashboard. The default setting is “Off”, however you may also choose between Thickness mode or Plunger mode.

SECTION 7: SYSTEM FEATURES



Note: If you have a Dual Source machine and are running a Dual Source job, you will need to enable the Auto Focus setting on the Dashboard. The table will lower automatically to adjust the focus for the CO2 portion of your job. For more information, see **“Focusing a Dual Source Job”** on page 55.

Thickness Mode: If you select this mode, you must enter the thickness of your object in the Processes Section under each individual process in the Dashboard. If all processes in your job need to be focused at the same level, it may save you time to enter the thickness before splitting the job into multiple processes.



Please note: The material thickness is still required when using the Vector Cutting Table. If a thickness is not specified the system will Auto Focus to the top of the grid, not to the top of your material. To enter the material thickness of the object you will be engraving/marking/cutting use a pair of calipers for an accurate measurement and enter this value in the “Thickness” box in the driver.

Plunger: When you enter Jog mode and have jogged the lens carriage above your material, press the Auto Focus button to use the plunger Auto Focus. The table will then rise until the material touches the plunger (pictured below), then set the table to the correct height. Your job should now be in focus. You may also set up Plunger Mode in the Dashboard.

Manual Focus

This photo shows the Manual Focus Gauge that is used to determine the correct distance from the focus lens to the top of your material. This gauge is included with your system.

Place the object to be cut or engraved anywhere on the table of the machine. Select the **Jog** button on the touch screen and use the **Joystick** to bring the Manual Focus Gauge to the object. Select the **Focus** button on the touch screen and move the **Joystick** up or down to move the table appropriately until your material just touches the bottom of the gauge. The speed at which the table rises or lowers can be controlled by applying varying pressure upwards or downwards on the **Joystick**.

You may also fine-tune the table height in the Focus Menu. Once the focus position has been established, flip the gauge back up into its locked position. Press the **Focus** button to leave the menu and then press the **Reset** key to bring the laser head back to its Home Position.



If your material has a taper or curve, pick an intermediate point between the highest and lowest points being engraved and focus on that point. In general, the area of the material being engraved needs to be relatively flat. If the area being engraved differs in height by more than about 3 mm, the image will begin to look “fuzzy” or out of focus.



WARNING: Do not leave the Manual Focus Gauge down when running jobs or when using Auto Focus!

SECTION 7: SYSTEM FEATURES

Key Switch

The Key Switch feature is used to power the Fusion Pro on and off, and also allows you to lock out any unauthorized users by powering down the machine and removing the key.



Red Dot Pointer

The Red Dot Pointer is a visible laser beam that runs in the same line as the invisible CO2 laser beam. It is useful for showing the location of the laser head when using Jog or Focus mode.

Emergency Stop Button

On the top of the laser you will see a large, red Emergency Stop Button. If there is an emergency, such as a fire, immediately press the Emergency Stop Button. The laser carriage will immediately stop and the system will shut down.

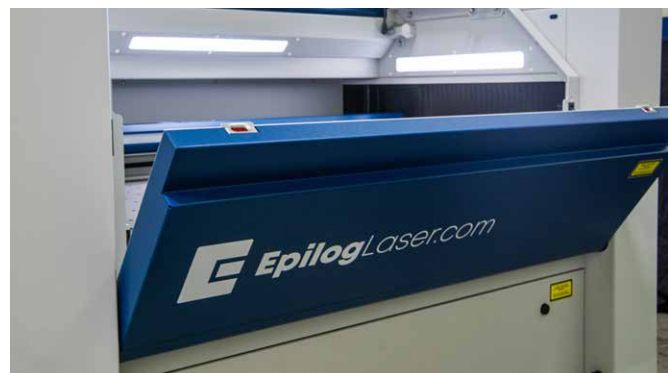
To reset the system, you must **turn off the system** using the Key Switch, then twist the **Emergency Stop Button** clockwise to release the system, then **turn on the laser**.



If your laser ever stops running and you can't turn it on, check to see if the Emergency Stop Button has been pressed by accident.

Front Access Door

The Front Access Door will open up to 180 degrees, and is usually used for easy loading and unloading of palletized materials. The door is interlocked and the laser will not fire if the door is open.



SECTION 7: SYSTEM FEATURES

Task Plate/Vacuum Hold-Down Table

Task Plate

On the Fusion Pro, the task plate is used as the standard engraving table for jobs that do not include vector cutting. The task plate is stainless steel and allows you to use magnets to hold oddly shaped items in place. On the Fusion Pro 48 there are two taskplates, allowing you the option to split your table to both engrave and cut materials in the same process with a Vector Grid or Slat Table.



Vacuum Hold-Down Table

The holes in the Task Plate provide vacuum hold-down capability that keeps thin materials flat while engraving. The exhaust system is designed so that it evacuates from both the top and the bottom of the task plate when the task plate is at its highest position. The exhaust pulls air through the holes and forms enough of a vacuum that it will flatten slightly warped paper, wood, aluminum sheet stock and other materials. As long as the exhaust is operating and the task plate is no more than an inch (25.4 mm) below its highest point, the vacuum table will work.



If you have a piece of sheet stock that does not flatten out because it is not covering enough of the vacuum holes, you can use any material (including paper) to cover some of the exposed holes. Simply blocking most of the vacuum holes will be enough to flatten most sheet stock as long as it is not too severely warped, bent or too rigid. Magnets can be used to hold oddly shaped items in place if needed.

Exhaust Plenum

The Fusion Pro incorporates an exhaust plenum and an integrated Vacuum hold-down table. Both the exhaust plenum and the hold-down table use the airflow from the exhaust fan for two distinct functions.

1. **Exhaust Plenum:** The exhaust fan moves air from the front towards the rear of your machine and out the exhaust plenum. This air removes combustible gases and smoke through the exhaust plenum. The Fusion Pro has risers underneath the Task Plate(s) with funnels that are larger toward the front of the machine and smaller toward the back of the machine to provide uniform air flow through the entire table area. There is one exhaust port at the back of the Fusion Pro 32 and two at the back of the Fusion Pro 48.
2. **Vacuum Hold-Down Table:** There is a single exhaust port on the back of the Fusion Pro 32 and 48 that pulls air down through the table.

SECTION 7: SYSTEM FEATURES

Center Engraving

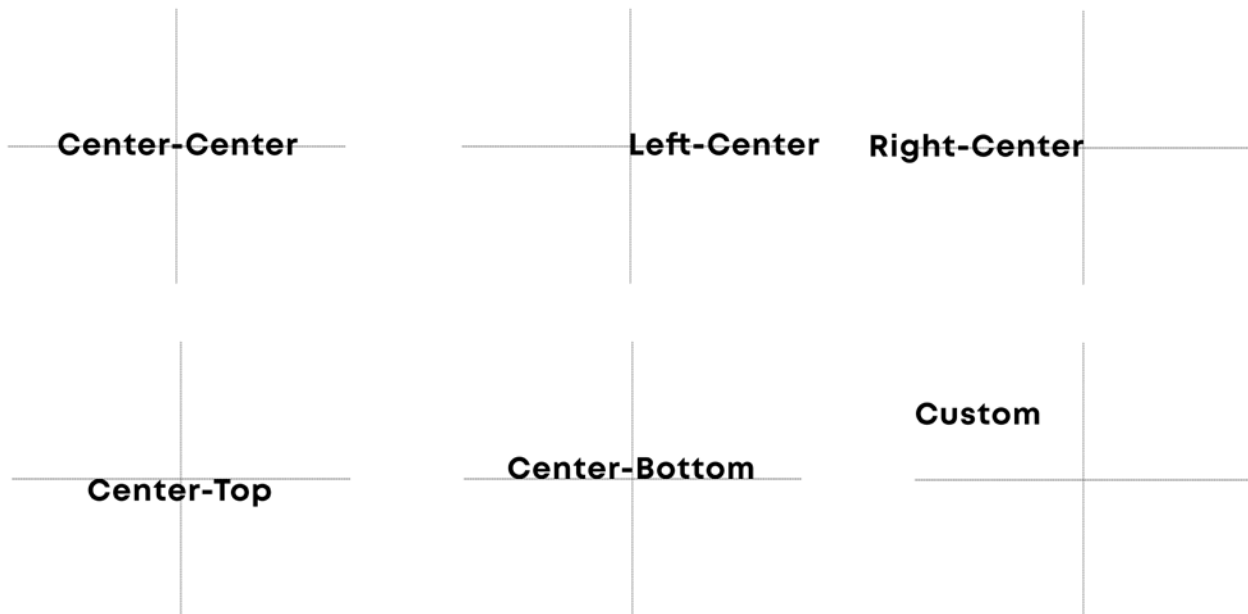
The Center Engraving feature allows you to define the center of your artwork as the primary reference point (Home Position) of your engraving or cutting. The Center Engraving feature has been designed to be used in conjunction with the red dot pointer, using the Jog feature on the Fusion Pro Control Panel. Center engraving differs from standard printing, where the upper left corner of the page and the upper left corner of the laser table define your primary reference point.

- You can identify a Center Engraving job at the laser when you see a target icon at the end of the job name.



If you get a Position Error reading on the display screen, your artwork is going to go outside of your available work space.

- **There are six choices for Center Engraving:**
 - Center-Center
 - Left-Center
 - Right-Center
 - Center-Top
 - Center-Bottom
 - Custom



SECTION 7: SYSTEM FEATURES

Center-Center

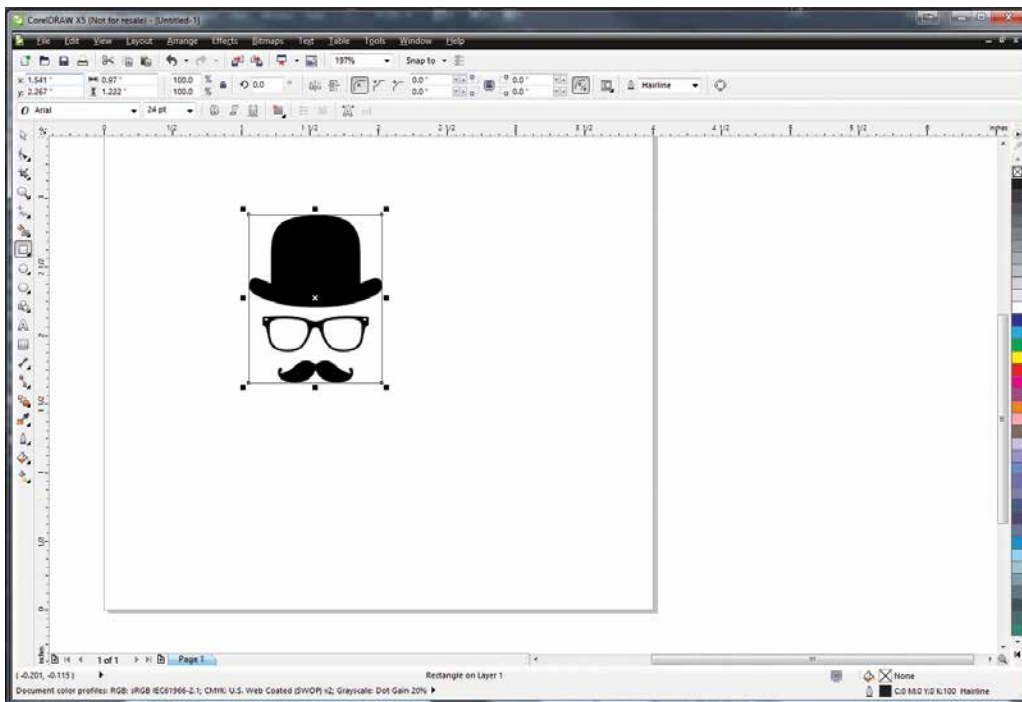
When using Center-Center, the overall size of your work piece and the upper-left corner reference point are not used. With Center-Center engraving, the important starting points are the size of your artwork and the available space for it on your work piece. With Center-Center you're interested in positioning the center of your artwork to a specific point on your work piece, no matter where your work piece is on the laser table.

With the Center-Center option you can place your artwork on almost any size of page and almost anywhere on that page. At the laser using the touch screen, you are able to jog the laser head to your work piece on the table with the red dot pointer turned on, and set the center point wherever you want.

The detailed examples on the next few pages show how easy it is to think differently about Center-Center jobs.

Example: A customer brings you a small electronic item to engrave, such as an iPhone. To quickly engrave the item without extensive measuring, follow these quick steps:

1. Measure the area you have available for engraving. For the iPhone we have about 2" x 1.5" (51 x 38 mm) of engraving area.
2. In your graphic software, create a new page. Page size is not important, so set the page size to larger than the area you want to engrave. We have created a page 4" x 4" (101 x 101 mm). Place your artwork anywhere on the page and size it to fit in the 2" x 1.5" (51 x 38 mm) engraving area.



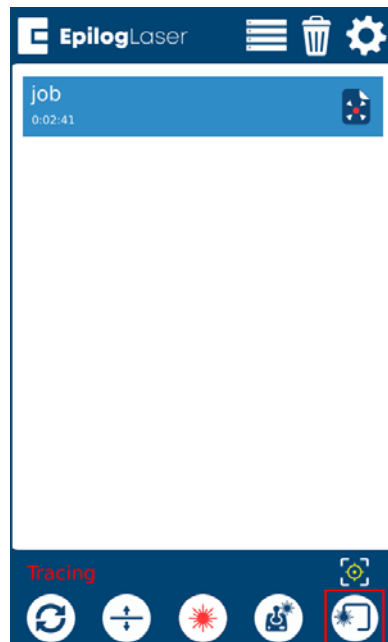
3. **Print** the artwork to the Dashboard.
4. Disable the live camera, you do not need to use it for Center Engraving.
5. Click the **Advanced Tab** on the Dashboard.

SECTION 7: SYSTEM FEATURES

6. In the drop-down box next to **Centering Point**, select **Center-Center**.
7. Print the job to the laser.
8. Make sure your laser is focused to the work piece.
9. Jog the laser head to your work piece on the table with the red dot pointer turned on, and press "Set" to set the center point wherever you want.



10. Back at the Job Menu, select the job and press the Trace button with the Red Dot Pointer on to check the outline of your artwork. The laser head will continue outlining the artwork until you press the Trace button again.



11. Once you are happy with the position of your artwork, select the job and press the Go/Stop button

SECTION 7: SYSTEM FEATURES

to start the job.

12. After the job is complete, you can re-use the same center point for additional jobs, or set a new center point for any future jobs by jogging the laser and pressing “Set” again.

While Center-Center is the most common use for the Center Engraving features, you can also use **Center-Left, Center-Top, Center-Bottom, Center-Right** or **Custom**. Depending on the object you are engraving, these options may be easier to find than the center point of the engraving area.

SECTION 8: OPTIONAL FEATURES

Vector Cutting Table/Slat Table

Vector Cutting Table

The optional Vector Cutting Table is primarily used for vector cutting jobs where the laser penetrates all the way through the material being cut. The Vector Cutting Table lifts your work material off of the crumb trays and allows the laser beam to penetrate all the way through the material without reflecting back up onto the backside of your work.

On the Fusion Pro 48, a divided table allows you to use a vector grid on half of the bed and engraving table on the other half for increased versatility.



Slat Table

The optional Slat Table is a second option for vector cutting jobs. The Slat Table has bars that are adjustable and removable to help avoid any kind of grid marks appearing on the back of the piece you're engraving.

On the Fusion Pro 48, a divided table allows you to use a slat table on half of the bed and engraving table on the other half for increased versatility.



Whenever you are vector cutting there is the potential for small pieces to fall through the grid and collect in the bottom of the Vector Cutting Table. These small pieces present a very dangerous fire hazard. Remove and dispose of the debris in the Vector Cutting Table on a regular basis.

SECTION 8: OPTIONAL FEATURES

Fusion Pro Rim-Drive Rotary Attachment

The optional Fusion Pro Rim-Drive Rotary Attachment allows you to mark and engrave on cylindrical objects.



Note: Using the IRIS™ Camera to place artwork on the rotary is not suggested. The rotary will be far away from the camera, so the image will become distorted.

Rotary Attachment Installation

1. Lower the engraving table far enough so the Rotary Attachment will not interfere with the lens carriage.



An important note: Turn off the power to the engraver. It's important that the laser system is turned off before installing (or removing) the Rotary Attachment.

2. Place the Rotary Attachment in the upper left corner of the table so that the baseplate is positioned against the sides of the left and top rulers. The rotary rests on the table against the rulers and does not need to be locked in place.



3. With the Fusion Pro powered off, mate the cable connector to the plug located at the right side of the cabinet as shown in the photo.

4. Once the Rotary Attachment cable is connected, you can power on the laser system. The Fusion Pro senses that the Rotary has been installed. During machine initialization the lens carriage will find its new Home Position over the center of the Rotary Attachment, as shown below.

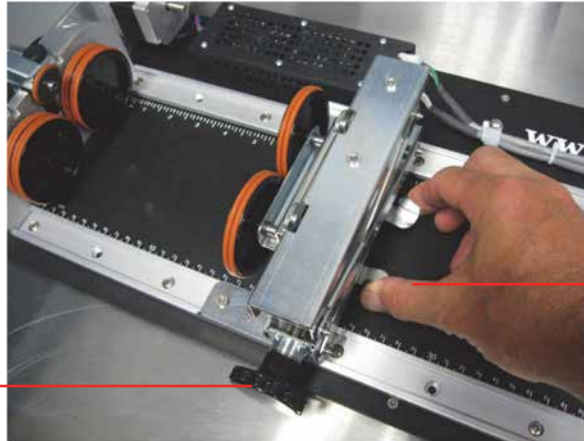


SECTION 8: OPTIONAL FEATURES

Rim-Drive Rotary Setup

The wheels on the left are the drive wheels which spin the cylinder. The wheels on the right are for support. The right side wheels are mounted on a scissor jack so they can be raised or lowered to level the top surface of your cylinder with the X-beam. The scissor jack can be moved left and right to accommodate cylinders of different lengths.

Rotate the knob to lift or lower the scissor jack.



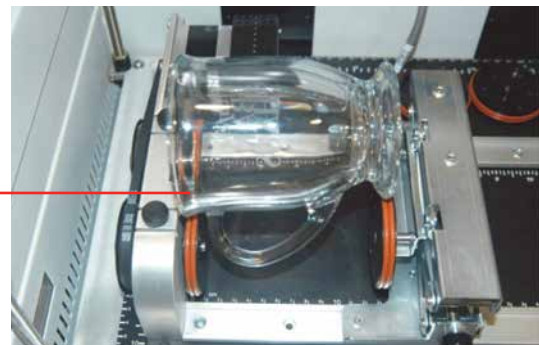
Squeeze the tabs to move the scissor jack left and right.

In most cases you will want to load your cylinder with the larger diameter on the left (drive wheel side). The scissor jack is used to elevate the right side of your cylinder so that the top surface is horizontal. Load your cylinder onto the Rotary Attachment so that it is just touching the black bumper. Using the clamp to hold the glass in place is optional. Some odd shaped glasses rotate better if they are clamped to the drive wheels, but most glasses and other cylindrical objects do not require clamping.

This photo shows the clamp holding a glass against the drive wheels. Use the thumbscrews to adjust the clamp in and out.

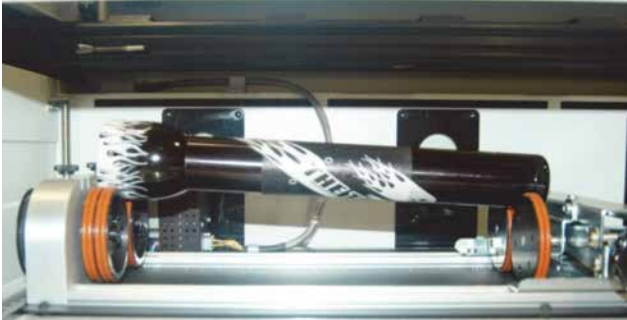


Many glasses, like this one, do not require the use of the clamp. The clamp is used mostly for hard to rotate cylinders or very lightweight objects that need more than just gravity to hold them in place.

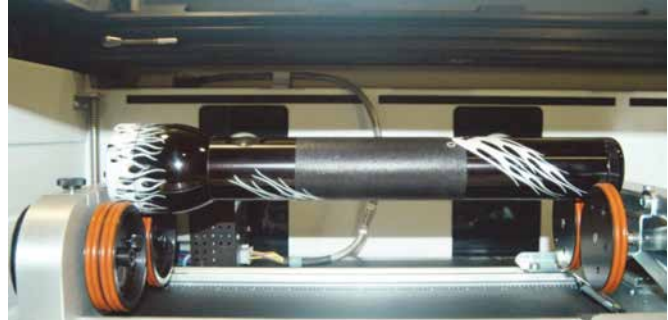


SECTION 8: OPTIONAL FEATURES

Use the scissor jack to raise the right side of the cylinder so that the engraving/cutting surface is horizontal. The photos below show the same flashlight at a severe angle to horizontal. If your cylinder is not horizontal to the X-beam the laser will lose focus as the carriage head moves across the flashlight. This causes the engraving quality on the right-hand side to suffer dramatically.



Incorrect Setup: The flashlight is not horizontal. Raise the right side of the flashlight by turning the jack screw.



Correct Setup: The flashlight is horizontal to the X-beam

Setting Focus with the Rotary Attachment

With your cylinder in place on the Rotary Attachment, select the Jog menu and move the lens carriage above the cylinder. Check your focus with the focus gauge, or by using the Plunger to focus by pressing the **Auto Focus** button on the Jog menu.

To check that the focus is even across the entire surface, use the focus gauge while jogging the carriage back and forth across your cylinder.

When you are finished focusing, press the **Reset** key on the Touch Screen. Pressing Reset will send the lens carriage back to its standard Home Position at the front of the black bumper. You are now ready to start the job.



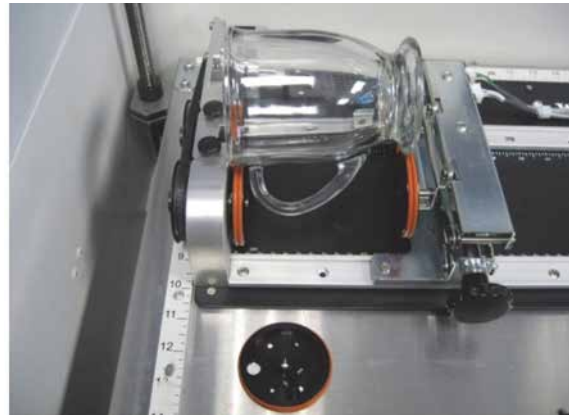
SECTION 8: OPTIONAL FEATURES

Removing the Drive Wheel

The drive wheels are each two-piece assemblies when fully assembled. Removing the front part of the drive wheel enables the user to accommodate a wide variety of mugs with handles. Not all mugs with handles require the front drive wheels to be removed, but for certain types of mugs removing the front wheels adds flexibility to the Rotary Attachment.



There are two small thumbscrews that attach each front drive wheel to the back drive wheel. Loosen the two small thumbscrews on each wheel to remove the front wheel.



This photo shows a mug with a handle positioned on the Rotary Attachment with the removable portion of the drive wheel shown in the foreground.

Artwork Layout

Because the Rotary Attachment automatically compensates for the diameter of the glass, artwork setup is relatively easy. The most important thing to remember when working with the rotary is that your artwork needs to be rotated 90 degrees to the way it would normally be setup for flat work. There are several visual tools later in this procedure that will help make artwork setup easy.

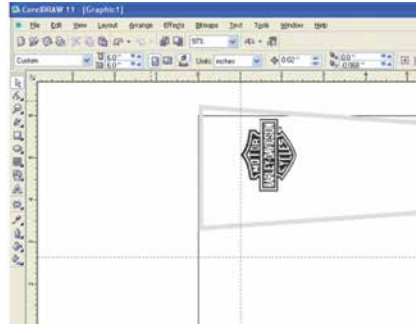
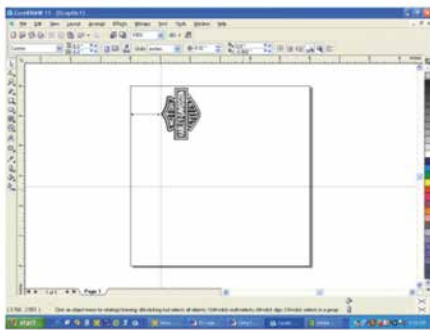
1. **Set the width of your page (in the X direction) to the length of the glass you are engraving.** For this glass the width of the page is 152 mm.
2. **Set the height of your page (in the Y direction) to the circumference of the glass you are engraving.** Use a flexible tape measurer to find the circumference of the glass at its largest diameter. For this glass, the height of the page is 279 mm.



SECTION 8: OPTIONAL FEATURES

3. **Place your artwork close to the top edge of the page.** When the job starts, the first part of the process is for the cylinder to rotate through any white space that is between the top of your page and the top of your artwork. Once it has rotated through the white space it will begin to laser your artwork.

The edge of the black bumper on your Rotary Attachment corresponds to the left edge of your page in CorelDraw. Set your cylinder on the Rotary Attachment so that it just touches the black bumper. The “top” of a cylinder can be at either end of the Rotary Attachment. It is useful to visualize the orientation of the cylinder when it is being engraved.



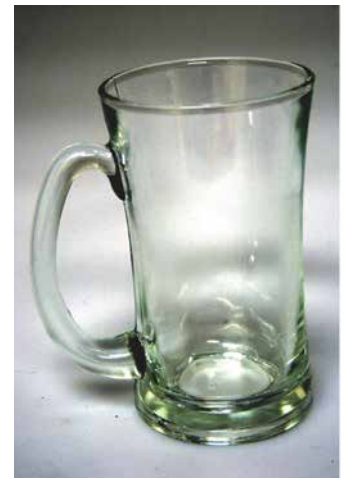
In this example, the bottom of the logo will engrave 100 mm up from the bottom of the bottle.



Stretching or Shrinking Your Artwork for Objects with Multiple Circumferences

The instructions below show you how to shrink or expand your artwork to accommodate a cylinder where the area being engraved is a different circumference than the circumference at the drive wheels. The Rotary Attachment works with the assumption that the cylinder is the same circumference from end to end and that your artwork doesn't need to be stretched. But some cylinders have a big difference in circumference from the middle to the end that affects how the engraved image looks. It is sometimes necessary to stretch or shrink your artwork so it looks proportional on odd shaped items. The photo below shows a glass that fits this category.

This glass has a circumference of 100 mm at the ends and a circumference of 81 mm in the middle where we want to engrave. Most artwork will look acceptable on this glass without stretching or shrinking, but because the middle of the glass is a smaller diameter than the ends, some artwork will look compressed (more as an oval than a circle), so we'll want to adjust the artwork before engraving. To determine how much to adjust your artwork,



SECTION 8: OPTIONAL FEATURES

we'll need to do a simple calculation that tells us the percentage of stretch or shrinkage we need to perform. You can use either the diameter or the circumference to make the calculation; just don't mix the two.

Determining whether you use diameter or circumference is a matter of which one is easier to measure. If you want to measure circumference, use a flexible ruler and wrap it around the glass. To calculate circumference, measure the diameter and multiply by Pi (3.1416):

Circumference = Diameter x 3.1416.

For objects with a larger middle section:

Shrink the artwork by dividing the drive wheel side diameter by the middle diameter and multiply by 100 to calculate the percentage of adjustment. For our example the calculation is:

Because our calculation percentage is less than 100, we need to shrink the artwork to 71.5% of its original size. Adjust the size of your artwork in one axis only.

For objects with a smaller middle section:

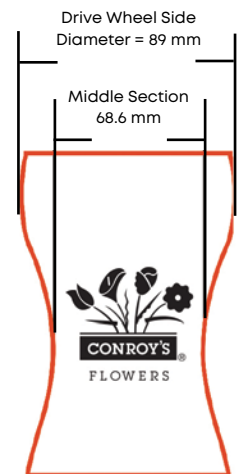
Expand the artwork by dividing the drive wheel side diameter by the middle diameter and multiply by 100 to calculate the percentage of adjustment. For our example the calculation is:

$$\frac{89}{68.6} = 1.296 \times 100 = 129.6\%$$

Because our calculation percentage is greater than 100, we need to expand the artwork to 129.6% of its original size. Adjust the size of your artwork in one axis only.

Other considerations:

In these two examples you'll notice that the "middle" varies depending on where you measure. Because of this, you'll never be able to get every piece of artwork perfectly sized. Depending on how much room the artwork takes up, you may want to experiment with the expansion or shrinkage of your artwork to fit your particular glass shape.



Rotary Removal

1. **Turn off the power** before removing the Rotary Attachment.
2. **Unplug and remove** the Rotary Attachment.
3. **Turn on the machine** and the Home Position will return to the 0,0 point.

SECTION 8: OPTIONAL FEATURES

Dual Source Option

If you have chosen the dual source option on the Fusion Pro, you get the benefit of a CO2 and fiber laser source both in one system. The operation of this system is fundamentally the same as running either the CO2 or fiber laser separately. In a typical job when you are using only the CO2 or only the fiber laser, you will set your laser source in the Process Settings of the Epilog Dashboard.



Important Note about Focus:

There are two separate laser types – CO2 and Fiber – in the Dual Source Fusion Pro system. Each laser type has a different focus distance from the focus lens to the work surface. This means that the fiber laser focus point is closer to the focus lens than the CO2 focus point by approximately .250" (6mm).

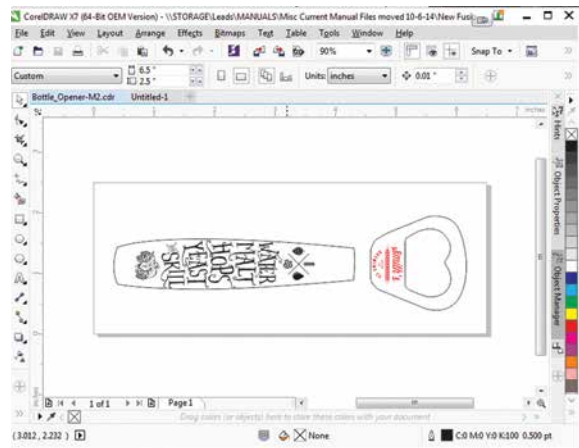
Because there is only a single focus lens in the dual source system, we need to accommodate for the difference in focus distance when running a job that incorporates both the CO2 and fiber laser. We do this by automatically moving the table down when the job switches from Fiber to CO2 or moving the table up when switching from CO2 to fiber.

What does this mean for you? Focus the system using either the manual focus gauge or auto focus as you normally would and the system will automatically adjust the table to the correct focal position. You will notice the table lower or raise slightly when changing between processes, but this is completely normal.

Setting Up a Dual Source Job

If you are doing a project that requires both CO2 and fiber laser sources in the same job, you must use the Split by Color (Color Mapping) feature in the Dashboard to determine which parts of the job should use CO2 and which should use the fiber laser source.

In this example we are engraving a bottle opener with a wooden handle and metal opener. We've set up the file to use the color black for the CO2 wood engraving, and red for the fiber metal etching.



1. When your file is ready, print it to the laser. In the Laser Dashboard, turn on Auto Focus and set to Thickness, then select **Split by Color**.
2. Click on the Black process and set the speed, power, frequency and thickness settings. For the Laser setting, select CO2.
3. Click on the Red process and set the speed, power, frequency, thickness and offset for the fiber graphic. For the Laser setting, select Fiber.

SECTION 8: OPTIONAL FEATURES

Color Mapping Order of Operation

When printing a dual source job with Color Mapping, it's important to understand the order that the laser will follow for engraving and cutting.

In the Processes list, you can move any CO2 or fiber engraving processes into any order you prefer. Any Vector cutting processes will run last and cannot run before engraving processes.

Focusing a Dual Source Job

1. If you are using the Fusion Pro IRIS Camera for this job, focus the job using either the Manual Focus Gauge or the plunger Auto Focus, and focus to the fiber portion of the piece. You must do this before positioning artwork to ensure accuracy.
2. In the Laser Dashboard, turn on Auto Focus on the General tab and set your piece thickness for each process.
3. If you are annealing a part or need to adjust the focal point into the object (such as if you are cutting acrylic), you can also set an offset amount for any process. For more information, **see “APPENDIX B: MATERIAL SETTINGS” on page 95.**

SECTION 9: ENGRAVING MATERIALS

CO2 Laser Materials/Techniques

Your Epilog Laser system is very versatile. It can mark and cut many different materials. Following is information regarding some of the materials the laser will mark and cut. Check the Epilog website periodically for new laser applications, tips and techniques to use with your laser.



For specific information regarding materials not mentioned below, please contact your local Epilog representative. See “Contacting Technical Support” on page 89.

Acrylic



Fire Warning: Your laser system uses a high-intensity beam of light that can generate extremely high temperatures when it comes into contact with the material being engraved, marked or cut. Some materials are extremely flammable and can easily ignite and burst into open flame setting the machine afire. This open flame is very dangerous and has the potential to destroy not only the machine, but the building in which it is housed.

Experience shows that vector cutting with the laser has the most potential to create an open flame. Many materials are susceptible to igniting, but acrylic -in all its different forms - has been shown to be especially flammable when cut with the laser.

For more information on fire hazards associated with lasers, please **read the full “FIRE WARNING” on page 1 of the manual.**

Choosing the Right Type of Acrylic

There are two types of acrylics and each is suitable for different applications. **Cast acrylic** sheets and objects are made from a liquid acrylic that is poured into molds that can be set into various shapes and sizes. This is the type of acrylic used for the awards you see on the market. Cast acrylic is ideal for engraving because it turns a frosty white color when engraved. While it can be cut with a laser, it will not give you flame-polished edges.

The second type of acrylic that you will use with your laser is formed into sheets by a machine and is called **extruded acrylic**. It is formed through a higher-volume manufacturing technique, so it is typically less expensive than cast, and it reacts very differently with the laser. Extruded acrylic will cut cleanly and smoothly and will have a flame-polished edge when laser cut. But when it is engraved, instead of a frosted look you will have a clear engraving.

Acrylic Engraving Techniques

- Most acrylic is engraved on the backside to produce a look-through effect from the front surface.
- Remove the protective adhesive paper from the back of the acrylic before engraving. Leave the front protective cover layer on to prevent scratching while handling the acrylic. Since you are engraving the backside of the acrylic, you will need to reverse or mirror your artwork before sending the job to the laser.

SECTION 9: ENGRAVING MATERIALS

- Engrave the acrylic at a high speed and low power. A small amount of power is all it takes to mark acrylic and high power levels tend to distort the acrylic when engraving.
- There are a large number of acrylic products that are painted on one side to add color. You can engrave directly through the paint into the acrylic for a very nice presentation effect. Leave the speed the same as if you are engraving clear acrylic, and increase the power about 10% to get completely through the paint. Applying too much power to the paint will melt it and cause distortion.

Acrylic Cutting Techniques

Acrylic is one of the most popular cutting materials available. It comes in a variety of colors and thickness. Laser cutting produces very nice edge quality without the need for polishing or secondary clean up.

- Use the Vector Cutting Table to elevate the acrylic before cutting. Air Assist will greatly reduce flaming when cutting acrylic and should always be used for this material. Information on accessing the Vector Cutting Table is included in “**Vector Cutting Table**” on page 47.
- To find the perfect settings for cutting acrylic, you will need to experiment. Test different speed and power settings by cutting a small shape from a scrap piece of acrylic you will not be using.
- Cutting acrylic is usually best achieved with relatively slow speed and high power. This combination allows the laser beam to melt the edges of the acrylic and produce an almost flame-polished edge.
- Acrylics generally require only a single pass to cut, but thicker acrylics may need two passes. Some users find that spritzing the protective adhesive paper with water produces a better edge when laser cut.
- Setting the focus distance at the center of your acrylic sheet will produce better edge quality than focusing on top of the acrylic sheet.



Warning! Never leave your laser unattended when vector cutting any material! Acrylic is very flammable. **Read the full “FIRE WARNING” on page 1 of the manual.**

Anodized Aluminum

Anodized aluminum is a coated aluminum that comes in a variety of colors and can usually be easily engraved with a CO2 laser.

- Black anodized aluminum is great to work with because it turns white when engraved and provides the best contrast of all of the colors of anodized aluminum.
- Some colors of anodized – red for instance – will not turn completely white when laser engraved. Red anodized will produce a light pink color. Performing a second pass can result in some improvement, but usually a slight shadow of color will remain.
- Engrave anodized aluminum at high speeds and low powers for crisp, clean results. Too much power applied to the anodized coating will distort the engraving and tends to over-burn the image.



Warning! Metals are reflective. Using full power with them can potentially cause damage to the machine.

SECTION 9: ENGRAVING MATERIALS

Brass - Painted

Since the frequency of the CO2 laser is not compatible with bare metals, uncoated brass cannot be laser engraved. For bare-metal marking you will want to use an Epilog FiberMark system. In order to engrave brass with a CO2 laser you need to use brass that has some sort of coating – typically paint. The laser removes the paint and exposes the brass substrate.

There are two basic types of engravable brass available, but they are not all compatible with the laser.

- By far, the most popular laser brass is actually brass-coated steel. First, a steel substrate is coated with a thin layer of brass. Next, the brass is polished to a reflective finish and a coat of lacquer is applied to the brass – Victory’s LaserBrite™ product has a lacquer finish. Finally, a paint coating is applied on top of the lacquer for the finished product. When laser engraving brass-coated steel, you are removing only the paint and exposing the polished brass coating that is protected by the lacquer. The lacquer prevents the brass from oxidizing and the bright reflective surface will stay bright for years.
- Some manufacturers also sell painted brass that is solid brass, not brass-coated steel. If the brass is polished before the paint is applied you will have a bright, reflective engraved surface. If the brass is not polished, the result will be a dull, tarnished brass that will require a secondary polishing process after laser engraving. This is time consuming and most engravers do not want to spend the time and effort necessary to turn this into an acceptable product.
- **Note:** Always ask before lasering painted brass if you don’t know the substrate! If you are unsure if your piece is brass-coated steel or genuine brass, you can test the material with a magnet. A magnet will stick readily to brass-coated steel, but since solid brass is not magnetic, a magnet will not adhere to solid brass.

Painted Brass Engraving Techniques

- Engrave painted brass with a high speed and low power setting. It takes very little power to remove the paint coating and too much power will melt the paint and distort the image. If your mark on brass is turning out “fat” or has a balloon appearance to it, you are probably using too much power. Reducing the power will bring back the nice sharp images that are normally produced with painted brass.
- **Note:** Use caution when trying to engrave brass coated pens. Many pens have a very hard epoxy paint that is completely unacceptable for CO2 laser engraving. You should only use pens that you have experimented with or that are specifically designed for CO2 laser engraving. Be aware that there are many pens that can be laser engraved with a fiber laser but these pens are usually not compatible with the CO2 laser that you are using.
- Some paints are “almost” CO2 laser engraveable. If you engrave through the paint and there is a slight shadow remaining, try to clean the engraved area with alcohol or lacquer thinner. Depending on the paint, there is a good chance that the shadow will disappear and an excellent engraving result achieved.
- Use caution when trying to engrave blue painted brass. Blue paints contain very aggressive pigments that penetrate the metal surface and it can be extremely difficult to remove all of the blue color, but again, try alcohol or lacquer thinner to remove the shadow.

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Glass

When a laser strikes glass it fractures the surface but it will not engrave deeply or remove material. The fracturing of the glass surface will produce a frosted appearance but can cause roughness and chipping depending on the type of glass being engraved. While the frosted appearance is desired, the roughness and chipping are not. Below we explain how to eliminate the roughness and produce a very smooth frosted finish.

The composition and quality of glass varies widely and you cannot always predict the effect that you will achieve. It is always best to experiment with an unfamiliar glass source. Generally speaking, flat glass tends to have a very consistent hardness throughout, and the engraved areas do not tend to have lighter and darker areas. Bottles on the other hand, tend to have soft and hard spots that will cause the engraved area to appear lightly frosted in one area and heavily frosted in another. Engraving at medium speed and high power will somewhat compensate for this, as will two or more engraving passes.

While the laser beam itself is very hot, the heat does not build up easily and it should not prevent you from engraving onto full bottles of wine, champagne or other filled glass bottles. Laser engraving filled bottles is a very popular method of creating custom presentations for special occasions. The laser will not damage the liquid inside the bottle, and as long as you are not completely engraving away a large section of bottle you have very little chance of breaking the bottle.

Glass Engraving Techniques

To produce a smooth frosted finish, here are some tips:

- **300 DPI:** Using a lower resolution, around 300 DPI, produces a better result on glass as you separate the dots you are engraving.
- **80% Grayscale:** Change the black in your graphic to 80% black to improve the engraving quality.
- **Jarvis Dithering:** Running with a Jarvis dithering pattern in the driver (you'll find this under the raster speed and power settings) will also help provide a smoother finish.
- **Masking:** Some people find that applying a thin, wet sheet of newspaper or paper towel a little larger than the engraving area also helps with heat dissipation and improves the engraving. Just be sure that there are no wrinkles in the paper after it is applied.
- **Dish Soap:** Using your finger or a paper towel, apply a thin coat of liquid dish soap – any kind will do – over the area to be engraved. This will dissipate the heat when engraving.
- **Polish:** If there are small shards of glass, you can polish the area with a ScotchBrite pad or something similar.

Note: You need to be especially careful when laser engraving leaded crystal. The lead in the crystal expands at a different rate than the crystal does and this can cause cracking and breakage of the crystal. Using a lower power setting can help this problem, but we always recommend having a spare in case of breakage.

SECTION 9: ENGRAVING MATERIALS

Combining Laser Engraving with Sandblasting

Combining the best of both processes, you can use your laser to engrave the artwork then use sandblasting to provide a deep etch into glass. Using the laser to create the artwork mask is an ideal process for one-of-a-kind custom pieces as well as large production runs. This eliminates the photo process usually associated with sandblast mask.

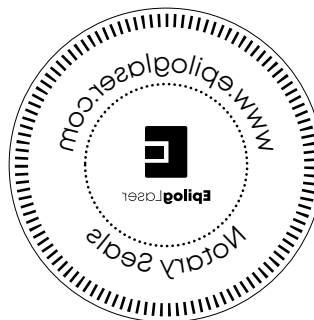
1. Apply an adhesive-backed mask material to the glass that you are going to engrave.
2. Laser completely through the mask and into the glass.
3. Remove the glass from the engraver and sandblast to the desired depth.
4. You now have a sandblasted glass presentation with the detail of laser engraving!

Notary Seals: Delrin

Notary seals can be easily manufactured using 1.5 mm thick delrin plastic. A seal consists of two pieces - a male die and a female die, both shown below. The male die consists of white lettering on a black background and the female die is an inverted and mirrored image of the male. Inverting and mirroring are easily accomplished in most graphics software packages. Simply duplicate the male die, invert the black and white colors, and then mirror the image.



Male Artwork



Female Artwork

The male image should be produced without the use of outlines around the text or graphics. Add a 0.178 mm to 0.254 mm outline to the text and graphics of the female die. This outline creates a large enough void between the male and female dies to emboss paper without tearing.

Apply a .001 outline around the seal to define the outside edge of the seal. Use the Combined Mode to first raster engrave the seal and then vector cut out the seal.

Plastic Engraving/Cutting

There are two types of available engraving plastics: rotary plastics and laserable plastics. Rotary plastics are designed for rotary engraving systems that use a mechanical spinning bit to remove material. Therefore, the depth of the top layer or "cap sheet" was designed to make it easy to rotary engrave. Cap sheet thickness was approximately 0.254 mm thick and laser engraving was nearly impossible because by the time you applied enough power to get through the cap sheet the laser melted and deformed the plastic.

SECTION 9: ENGRAVING MATERIALS

Laserable plastics have been developed with a thinner cap sheet that is 0.051 mm to 0.076 mm thick, providing much better engraving and cutting characteristics. These plastics are commonly referred to as micro laminates; micro-surfaced, or simply laser engraveable plastics. These plastics are generally very easy to engrave with a laser since they all have similar characteristics.

Because there is such a broad range of plastics it is necessary to experiment to determine if a particular type of plastic is laser compatible. Different color plastics, even if they are from the same manufacturer, will have unique speed and power settings. Use the guidelines in this manual as a starting point when determining the correct speed and power settings. If you do not get acceptable initial results with the recommended speed and power settings, start experimenting by first changing only the power setting. If adjusting the power setting does not work, start over and adjust only the speed setting. Once you have acceptable results, record those settings for that particular plastic so that you do not have to repeat the experimentation process.

Plastic Engraving Techniques

- Always remove the clear protective cover layer before engraving.
- Once you have the correct speed and power settings you can improve your engraving results even more by taking the focus lens out of focus (lower the table) by about 1.5 mm. This technique enlarges the focus beam a little bit and provides more beam overlap on each pass of the laser. The greater overlap produces a smoother engraved surface on the plastic and eliminates the grooves that you sometimes see when engraving plastic.
- With some plastics it is best to engrave using two passes. The first pass cuts through the cap layer and the second pass cleans away the residue that some plastics leave behind.
- Another technique that can be useful is to mask the plastic before engraving with transfer or masking tape. This will prevent a buildup of residue on the plastic surface. Misting the transfer tape with water will reduce heat buildup and melting on sensitive plastics.


Plastic Vector Cutting Techniques

- Use a Vector Cutting Table to elevate the plastic before cutting. Air Assist will greatly reduce flaming when cutting plastic.
- Vectoring plastics is similar to vectoring other materials. First, experiment to determine if the plastic can be cut with the laser. Plastics that are up to 1.5 mm thick can usually be cut in a single pass. Thicker plastics may need two passes.
- As with engraving, it is sometimes necessary to mask and dampen the plastic before cutting. Even masking and wetting both front and backsides of the plastic is desirable on sensitive plastics that have very low melting points.



WARNING! Never leave your laser unattended when vector cutting plastics! Plastic can be very flammable. **Read the full “FIRE WARNING” on page 1 of the manual.**

SECTION 9: ENGRAVING MATERIALS

-  **WARNING!** Do not engrave PVC (Polyvinyl Chloride). PVC will destroy the optics and mechanics of your Epilog system. Cutting or engraving PVC will void your warranty. The only way to find out if there is PVC in your plastic is to check the manufacturer's Material Safety Data Sheet (MSDS).

Wood

Solid Wood

Wood is by far the most laser friendly material available because it can be engraved or cut very easily. When engraved, lighter colored woods like Cherry or Maple produce very nice contrast where the laser burns away the wood. This high visual contrast is what makes lighter woods so popular when combined with a laser. There are many types of other wood products that are designed for use with the laser and many more that are waiting to be discovered by you.

Every type of wood has its own characteristics. Some wood is denser than other wood, with the denser, harder woods requiring more laser power to cut or engrave. Epilog recommends that when working with wood other than the ones listed in this section that you investigate the engraving and cutting characteristics before committing to use. There are woodworking shops in nearly every large city that will have a wealth of information on nearly all woods. If you have access to the Internet, search on wood to see what you find.

- The most common woods used with the laser are Cherry, Walnut, Maple, Alder, & Oak. These woods are considered hard woods, and have grains that work well with lasers.
- Grain can vary greatly in density. Cherry, Alder, Walnut & Maple all have fairly little veins of grain in them, while Oak has medium to large veins in it. For example: If a large box was engraved into a piece of Cherry and a piece of Oak, the box engraved into the Cherry would have a very uniform appearance, the area engraved or the background would be smooth with little variation in height. The Oak on the other hand would vary greatly in height and have a very non-uniform appearance.
- Cherry and alder are the most popular woods for engraving. The light, red color of these two woods provides an excellent contrast when engraved.
- **Engraving bare wood:** When engraving bare wood, the smoke and debris produced while engraving can become embedded into the grain of the wood. To reduce this effect, always engrave with the Bottom-Top setting in the driver.
- **Engraving stained wood:** A stained wood is preferable for engraving because excess smoke and debris can be wiped off the surface of the wood after engraving with water.

Manufactured Wood Products

When choosing a manufactured wood product for engraving and cutting, we have found MDF to be vastly superior to plywood when working with a CO2 laser. Since plywood is constructed of layers of wood glued together and the grain of the wood chips in the plywood run in different directions, it is difficult to obtain a consistent depth when engraving. Air bubbles within the plywood cause problems because they severely disrupt the laser beam when cutting. Because of the glue, air bubbles and other factors it is virtually impossible to cut cleanly through plywood.

SECTION 9: ENGRAVING MATERIALS

MDF is an engineered wood product with glued together wood fibers. Since there are not layers of wood glued together, like in the plywood, the engraving and cutting is much better. You will produce some charring on the edge of MDF when cut, so you may need to sand the edges after cutting.

Wood Engraving Techniques

- To create a quality image on wood, contrast and depth are usually desired. The higher the power levels, the higher the contrast and depth will be.
- **Speed and Power Settings:** Wood is a great material to laser engrave because it discolors when engraved and the depth of engraving is greater than most materials. The downside is that it takes a lot of power to deeply engrave wood at high speeds. Most wood can be engraved using full power no matter whether you are using a 30-watt laser or a 120-watt laser. Depending on the wattage of your laser, the best approach is to set the laser power at 100% and adjust the speed to obtain the desired depth.
- **Resolution Settings:** Wood is a very easy material to work with and you can produce very nice detail with as little as 300 DPI engraving. 600 DPI engraving into wood produces fabulous results, especially on photos.
- **Gray Scales:** Gray scales look wonderful when engraved into wood. The reason for this is that the wood will react much differently to each level of gray scale, providing amazing contrast. Experiment! Take a piece of clipart and ungroup it and change the colors so that they range from a dark color like red, to a light color like yellow, then engrave it. This will create a shading effect that is almost 3-D in its appearance.

Wood Vector Cutting Techniques

Epilog Laser Systems are ideal for cutting through solid wood material. The thickness of the wood that you can cut varies with the wattage of the laser and the hardness of the wood, but in general you can cut approximately 6.35 mm wood with a 30-watt laser and up to 12.7 mm wood with a 120 watt laser.

- When cutting wood of any thickness, Epilog recommends the use of the Vector Cutting Table and Air Assist options. The Vector Cutting Table raises the wood off of the solid metal engraving table and supports the wood on an aluminum grid. The grid greatly reduces backside burning of the wood and also provides ventilation that allows the fumes and smoke to be exhausted to the rear of the engraving cabinet. Information regarding accessing the Vector Cutting Table is located in “**Vector Cutting Table**” on page 113.
- Air assist greatly reduces flaming that may occur if too much laser power is applied to the wood piece being cut.
- Depending on the type of wood being vector cut, it is sometimes advantageous to apply a cover of masking or transfer tape to the surface before cutting. The masking tape will reduce residue buildup on the top surface of the wood surrounding the cut line.
- Reduce the frequency settings in the driver to around 20 for a better laser cut edge. The laser will pulse less frequency, reducing the charring and burning on the side of the wood.
- If you are cutting through thicker materials, focus the table up so that the new 2” focal distance will be to the center of the wood.

SECTION 9: ENGRAVING MATERIALS

Warning: Wood is a combustible material. Never leave your laser unattended while vector cutting any material. Air assist greatly reduces flaming that may occur if too much laser power is applied to the wood piece being cut. **Read the full “FIRE WARNING” on page 1 of the manual.**

Wood Cleaning Techniques

When laser engraving or cutting wood, resin in the wood comes to the surface, mixes with the smoke and is deposited as a residue. If the wood has a coating of polyurethane or lacquer the coating protects the surface of the wood from the resin/smoke damage. You can remove the resin from coated materials with a wet chamois or a sponge with a web cover. Some people like to use 409, Windex or other mild cleaning product, but water works well and is usually the most readily available wetting agent. The chamois that Epilog recommends has a sponge in the middle of it, and is available in the automotive car wash section of many Target stores or many automotive supply shops.

- If the wood is not coated with polyurethane, the resin and smoke will stain the surface and you will need to sand the surface to remove the resin.
- Never use a paper towel to clean the wood surface. The paper towel will shred and it is impossible to get the shredded fibers out of the engraved recesses of the wood. Most wood products that are designed for laser engraving will have a polyurethane coating so that they are very easy to clean.

Wood Color Filling Techniques

Color filling engraved areas of wood adds either greater contrast or a splash of color to your wood presentation. Normally, color filling is not required for lighter colored wood materials such as maple or cherry, but walnut can often benefit from adding a black color fill to provide more contrast. You will need to take some precautions when color filling wood, because if you are not careful, the liquid color fill material will absorb into the grain of the wood on the surface of the plaque where it is not wanted.

The best way to add a black color fill is shown below:

1. Apply a thin coat of Johnson’s Paste Wax to the surface of the wood before you engrave it.
2. Engrave through the paste wax into the wood. Do not wipe off excess paste or residue after engraving.
3. Fill the engraved voids with Turtlewax “Color Core” black liquid car polish. The car polish will absorb into the engraved wood grain, but will not absorb into the wood grain that is covered with paste wax.
4. Wrap a paper towel around a block of material that has a flat surface. Rub the flat surfaced paper towel over the surface of the wood to clean off the excess car polish and paste wax. The flat surface prevents the paper towel from getting into the engraved recesses.

SECTION 9: ENGRAVING MATERIALS

Fiber Laser Materials/Techniques

The fiber laser can etch and mark a wide variety of metals and plastics. Below are a few techniques for creating different marks including annealing, polishing and etching into metals, as well as information on plastic marking with the fiber laser.

Metal Annealing

Annealing can be done on most metals that contain high levels of carbon and metal oxides. These are generally, but not limited to, steel alloys, iron, titanium, cobalt, molybdenum, and chrome-plated iron/steel. To anneal, you must use a slow rate of speed to heat and change the surface color of the material, but a higher wattage Fiber laser will help reduce the cycle times.

To change the surface color without penetrating the metal, the laser beam's focal point is crucial in achieving a dark mark. An annealed mark is accomplished with the focal point up (closer to) 1.778 to 2.794 mm or down (further away) -1.524 to -2.286 mm from zero. Adjusting the speed, focus and frequency setting will vary the contrast of mark generally resulting in shades of blue, purple and black.

The frequency is the amount of laser power per pulse. The lower the frequency, the more burst of power is being applied. Because we're intentionally applying a broader beam of laser light to achieve an annealed mark, frequency is almost always set in the lower 1-5% range.

For best results, print at 600 DPI. 1200 DPI should be considered for metals that are more difficult to anneal, if there is inconsistent color change at the recommended settings, or when cycle times aren't a concern. The extra overlapping of pixels offered at 1200 DPI will assure a deeper, darker mark.

Metal Etching

Deep metal engraving is a common application for the fiber laser. Using a slow speed setting doesn't necessarily equate to depth. Longer laser dwell time typically results in more eruption of metal, leaving a raised mark instead of deep penetration.

We find for the best deep metal etching, moderate speed settings (20-30%) and more passes slowly chip away at the metal for a better mark. Deep metal engraving requires maximum wattage. For these applications, a 30 or 50-watt fiber laser is recommended.

Frequency is generally set between the 1-5% range. A lower frequency range provides more bursts of laser power per pulse and is crucial to ablating the metal. We've found that focusing "into" the metal by .254 to .762 mm helps in the removal of metal. No technical data is available on whether refocusing after each pass is helpful or not. To better assist in removing metal cleanly, higher resolution (1200 DPI) with more overlap of laser pulses tends to provide a cleaner, more defined etch.

Deep engraving will require multiple passes, which can be easily accomplished by changing the number of copies in the print dialogue box for CorelDRAW. As with all materials including metals, the hardness or grade will ultimately determine what settings and how many passes are needed to achieve a certain depth. Use the guidelines above as starting points and experiment for best results.

SECTION 9: ENGRAVING MATERIALS

Metal Polishing

Polishing of metals is accomplished by quickly heating up the metal's surface, changing its color, resulting in a mirror-like finish. Polishing can be done on just about any metal including, but not limited to, raw alloys, heat-treated metals, plated metals and precious metals.

For a high-contrast mark, polishing is best done on darker, matte finish metals. Cleaning the surface prior to processing is recommended as oils, grease and other chemicals can affect the consistency and finish of the final marks. Dialing in the settings for a polished mark is the most difficult of the three most popular metal marking techniques. Speed, power and frequency play the biggest role.

- Speed is generally set on the high side, 50-100%, depending on wattage.
- The power is set in the 30-60% range, depending on wattage.
- Frequency is also set on the higher side, typically around the 50-100% range. A higher frequency setting equates to less power per laser pulse. Too strong of a laser pulse and the laser beam starts penetrating the metal instead of polishing, resulting in a dull or browning effect.

Focus should be set at zero. Printing resolution is in the range of 300 to 600 DPI but is mostly done at 400 or 600.

Start by determining your base speed, frequency and resolution setting. From there, select a power setting and start fine tuning by adjusting the power in 1% increments or decrements.

Plastic Marking

The term "plastics" is commonly used to describe various grades and types of polymers. To keep things simple, we'll refer to all polymers as plastic. There are many plastics that are compatible with the fiber laser's 1062 nm wavelength of light. We refer to these as "engineered plastics" because many were designed to be laser-etched at some point during the manufacturing life cycle. These plastics are doped with an additive that results in a contrasting mark when the 1062nm wavelength of light is applied. There are many other plastics that work just as well as the engineered ones. It's amazing how many different plastics we receive for applications testing, most of the time their trade name and chemical composition aren't disclosed or are unknown. The guidelines below will help in your quest to provide the best possible mark.

Most plastics that tend to work on the FiberMark are those that are mold-injected and are physically hard. Industries where injection molded parts are common include automotive, aerospace, medical device and general manufacturing, to name a few.

Some of the more common compatible plastics include PET, ABS, polycarbonate and colored delrin. Some that are more difficult to mark using this wavelength of light include polyethylene, polypropylene and nylon.

Settings for processing plastics:

- Moderate to fast speed, typically in the 50-80% range.
- Moderate power, generally around the 30-60% range, depending on wattage.

SECTION 9: ENGRAVING MATERIALS

- Medium to high frequency (50-100%) is helpful for processing plastics as it provides a steadier stream of laser power per pulse. Using a low frequency would result in inconsistent contrast and possibly cause foaming of the surface.
- Focus is generally left at zero. Adjusting the focus up or down in 0.254 mm increments can provide slightly better contrast but instead, consider adjusting the speed / power / frequency for the same effect.

Most plastics are processed at 600 DPI for high contrast and detail. Cycle times are generally fast, so dropping the resolution would only affect print quality. Increasing resolution may prove helpful only on those plastics that are difficult to mark. The majority of compatible plastics will provide a high-contrasting mark using the above settings. Darker plastics will turn white or varying shades of gray. Lighter plastics will turn dark gray to black. Fine tune the mark by increasing/decreasing power or frequency. Speed and focus can be left alone.

Incompatible plastics will either be transparent to the 1062 nm wavelength of light or will require the use of metal marking settings (low to medium speed, high power, and low frequency). The final mark for these plastics isn't as appealing, consistent or contrasting as their compatible counterparts.

Pigmentation of plastic can also dictate what settings are needed to produce a nice mark. The core polymer may be compatible, but due to chemicals used to add color, some colors may mark better than others. Having to adjust the printing parameters for different colors of the same compatible plastic is not uncommon.

SECTION 10: SYSTEM MAINTENANCE

Reduce Fire Risk with a Clean Laser



Cleaning the Fusion Pro is an excellent way to prevent fire with the laser. A buildup of cutting and engraving residue and debris is dangerous and can create a fire hazard in its own right. Keep your laser system clean and free of debris. Regularly remove the Vector Cutting Table to clean any small pieces that have fallen through the grid. **For more information on fire safety, see “Removing the Pedestal from the Fusion Pro” on page 76.**

Cleaning the Optics

Periodically, or if you notice dust building up, you will need to clean the optics of your laser. If smoke, resin, or other contaminants are allowed to accumulate they will reduce the available laser power and may cause damage to the lens.

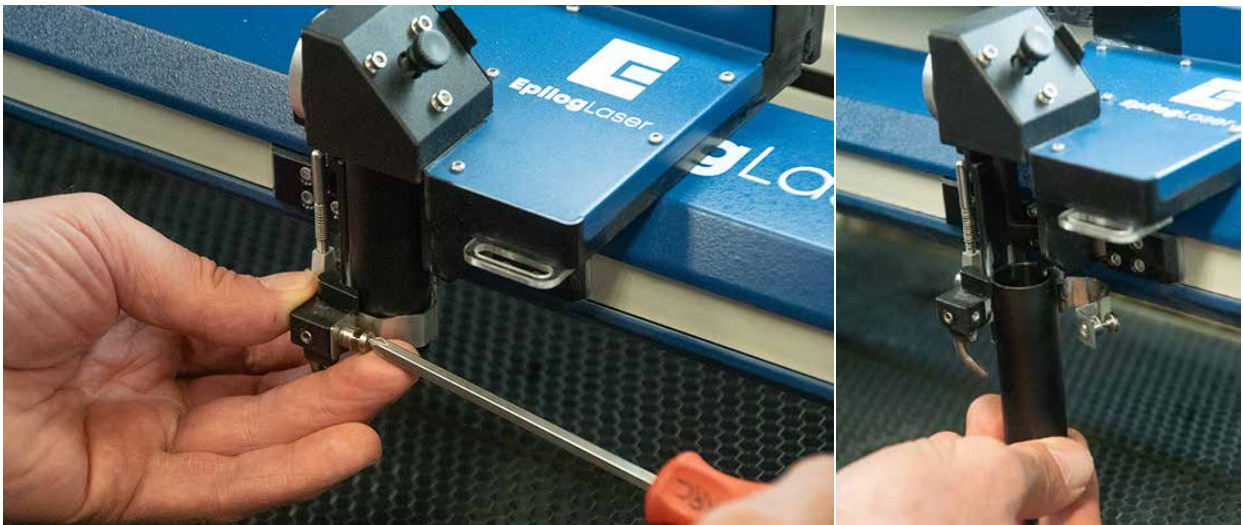


Note: When cleaning the optics, jogging the laser closer to the front of the machine will allow for easier access.

Cleaning the Lens

The focus lens is contained within the lens tube. The lens tube is a single assembly and is fairly easy to clean.

Remove the lens tube from the machine for cleaning by unscrewing the captive screw on the front lens clamp using a #1 Philips screwdriver. Hold the lens tube from the bottom while unscrewing the captive screw, as the tube may come out easily.



SECTION 10: SYSTEM MAINTENANCE

Once the captive screw comes out you may remove the lens tube. Twist off the cone piece at the bottom of the tube to reveal the lens.



To clean the lens, use a high-quality cotton swab moistened with the optics cleaner supplied in the accessory kit. Please read the label on the bottle carefully.

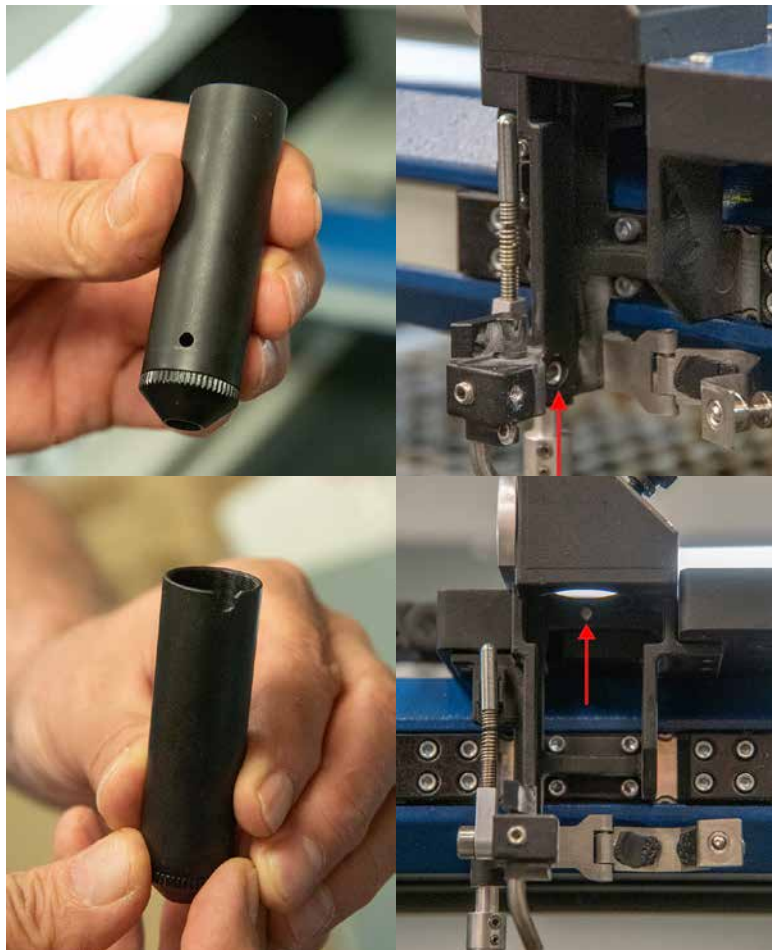


SECTION 10: SYSTEM MAINTENANCE

Allow the optics to dry, then twist the cone piece securely back on to the bottom of the lens tube.



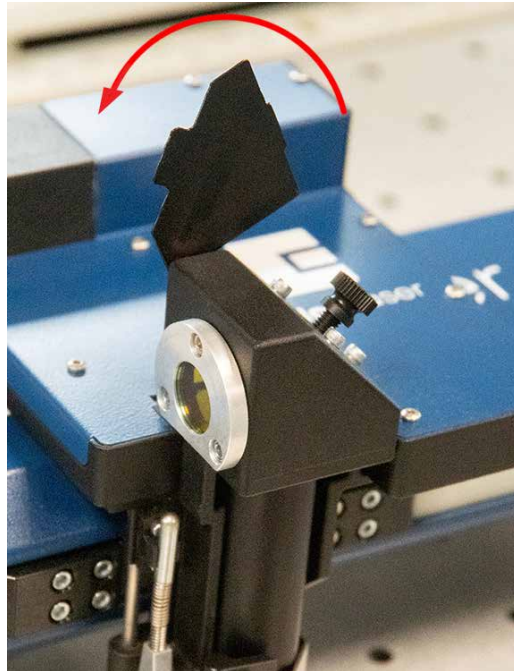
When placing the lens tube back into the assembly, make sure that the hole near the bottom of the tube lines up with the air assist hole on the assembly. Make sure the notch at the top of the lens tube lines up with the insert on the assembly as well. When the tube is in place it should only shift slightly when twisted side to side. Wrap the clamp back around the tube and tighten the captive screw.



SECTION 10: SYSTEM MAINTENANCE

Cleaning the Mirror

The mirror is located on the back side of the assembly and also has a simple cleaning process. Start by opening the door latched onto the back of the assembly. The door will rotate counterclockwise to open.

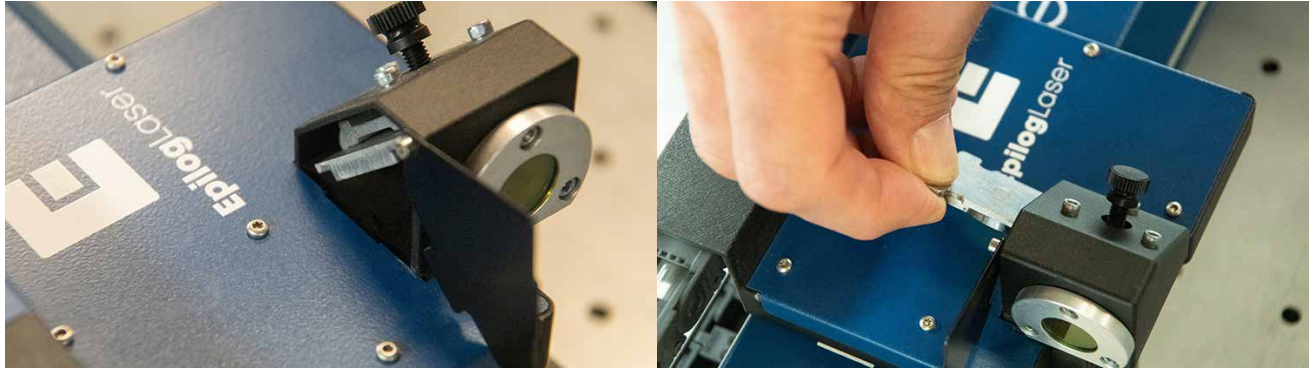


Next, twist the knob on the right side of the assembly counterclockwise to loosen the mirror, preparing it for removal.

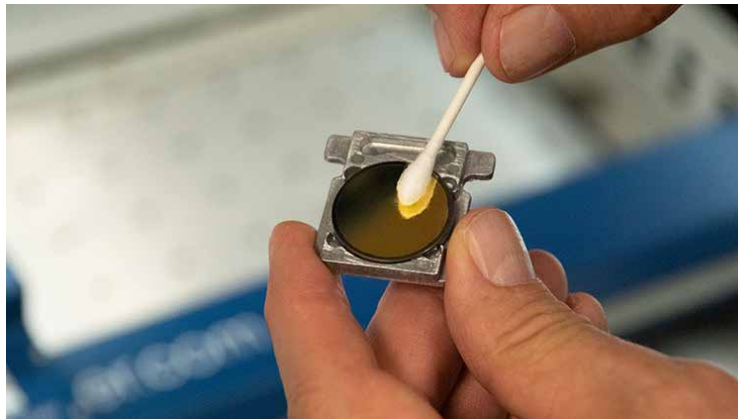


SECTION 10: SYSTEM MAINTENANCE

Now remove the mirror from the assembly by sliding it out towards the back of the machine.



To clean the mirror, use a high-quality cotton swab moistened with the optics cleaner supplied in the accessory kit. Please read the label on the bottle carefully.



After the mirror has been cleaned and is completely dry, place it back into the assembly with the mirror angled down towards the table. Tighten the knob that secures it, and close the small door on the back of the assembly.

If you run out of the cleaner supplied by Epilog, Reagent or laboratory grade Acetone can be substituted. Another option is a 10 to 1 water to white vinegar mixture. This is very good at removing fingerprints and other minerals which can be left behind on the optics. Also, if “Golden Grain” or “Everclear” are available in your area these are also good substitutes for the optical cleaning solution.



Note: Never use Alcohol or Hardware grade Acetone, they contain impurities which can damage the optics in your machine.

Wet the swab thoroughly with the solvent, and then blot it against a piece of cotton so that it is no longer soaking-wet. Then daub the lens gently, rotating the swab after each daub to expose clean cotton to the surface until the optic is free of visible contamination. At that point, prepare a fresh swab and clean the surface with a gentle zigzag motion across it. Avoid any hard “scrubbing” of the surface, especially while there are visible particles on it, and try not to use repetitive circular motions. When you are done, be careful to remove any cotton threads that may have snagged on the mountings.

SECTION 10: SYSTEM MAINTENANCE

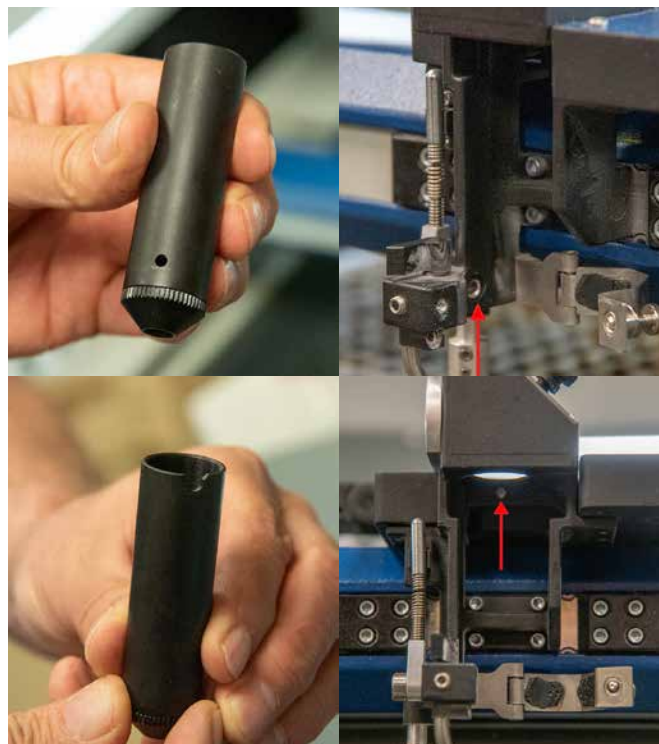
Replacing the Lens

Whether you are replacing an old lens with a new one, or switching from a 2-inch lens to a 4-inch lens, the process is quick and easy. The lens always comes contained within the lens tube, so replacing it is as simple as removing one tube, then placing the new one in and securing it properly.

Remove the lens tube from the machine by unscrewing the captive screw on the front lens clamp using a #1 Philips screwdriver. Hold the lens tube from the bottom while unscrewing the captive screw, as the tube may come out easily.



Place the new tube into the assembly, making sure that the hole near the bottom of the tube lines up with the air assist hole on the assembly. Make sure the notch at the top of the lens tube lines up with the insert on the assembly as well. When the tube is in place it should only shift slightly when twisted side to side. Wrap the clamp back around the tube and tighten the captive screw.



SECTION 10: SYSTEM MAINTENANCE

Cleaning the Exhaust Plenum

Make sure the exhaust blower you are using receives proper maintenance. Periodically clean the exhaust blower and duct system to remove built-up debris. If you detect odor while engraving, or if the smoke in the cabinet is visible in the area of the lens carriage, inspect the exhaust system. Check for loose or broken pipe/hose connections, or obstructions. The following photos show where to clean the duct work of your machine. You should also occasionally check your exhaust blower and the connected duct work.

Cleaning the Vents

Clean the vents from the inside of the machine. It is best to use a flexible or wire brush that can access the inside of the vent.



Cleaning the Exhaust Plenum

In addition to cleaning the inside of the machine you should occasionally clean the exhaust plenum on the back of the system. The exhaust plenum can be completely removed from the Fusion Pro by unscrewing the mounted screws on the back of the machine.

Laser Tube

The laser tube used in your system does have a maximum service life, and there is very little maintenance that is required. At some point in the life of the laser you will need to replace it for gas recharge, electrical repair or mechanical repair. Replacing laser tubes is common practice and Epilog has made the process of changing tubes extremely easy for users to perform with a minimum amount of effort. The laser tubes can be refurbished and are available on an exchange basis by contacting Epilog technical support.

Ensure that all of the laser cooling fans are properly working at all times. The fans keep the laser tube cool and prevent it from overheating. An overheated laser tube will produce erratic output and may fail completely.

If the laser system is in a dirty or dusty environment, make sure that the cooling fins on the laser tube are kept free of dust buildup. Use compressed air to blow the dust and debris off of the laser tube fins. Be sure that the system is unplugged before performing any maintenance on the machine!

SECTION 10: SYSTEM MAINTENANCE

Removing the Pedestal from the Fusion Pro

The Fusion Pro 48 is capable of fitting through a standard 36" door once its pedestal is removed. In some cases, you may need to remove the pedestal from the Fusion Pro in order to place it in a desired location.

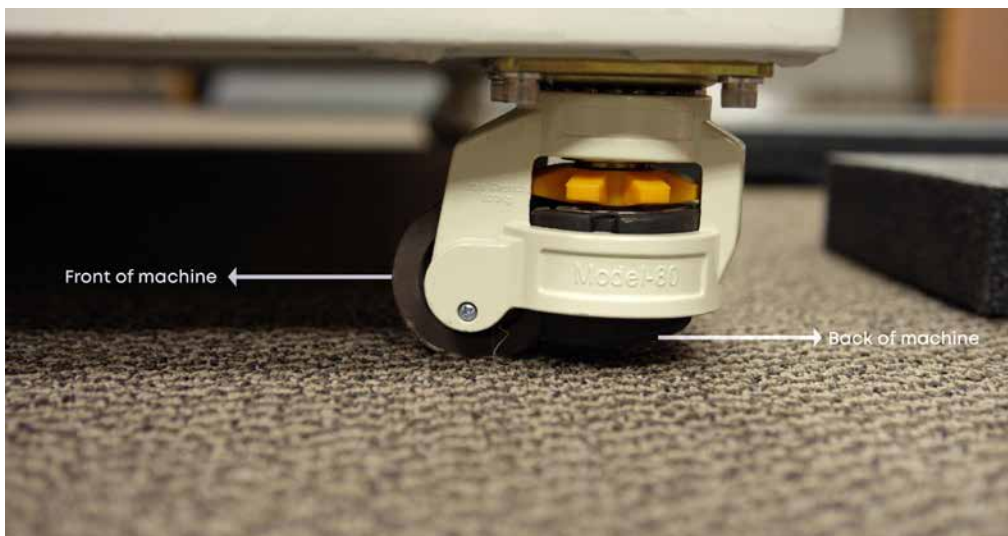


Note: Please read all of the steps below in full before beginning this task. You will need around 4-5 people to complete certain steps. Make sure all exhaust vents are removed from the back of the machine and the machine is unplugged before you begin.

1. Position the machine in an open space on the floor. Place the foam pads from the shipping crate on the floor behind the machine.



2. With the caster feet in the up position, roll the machine backwards so the caster wheels face the front of the machine and the rubber feet are positioned toward the rear of the machine.

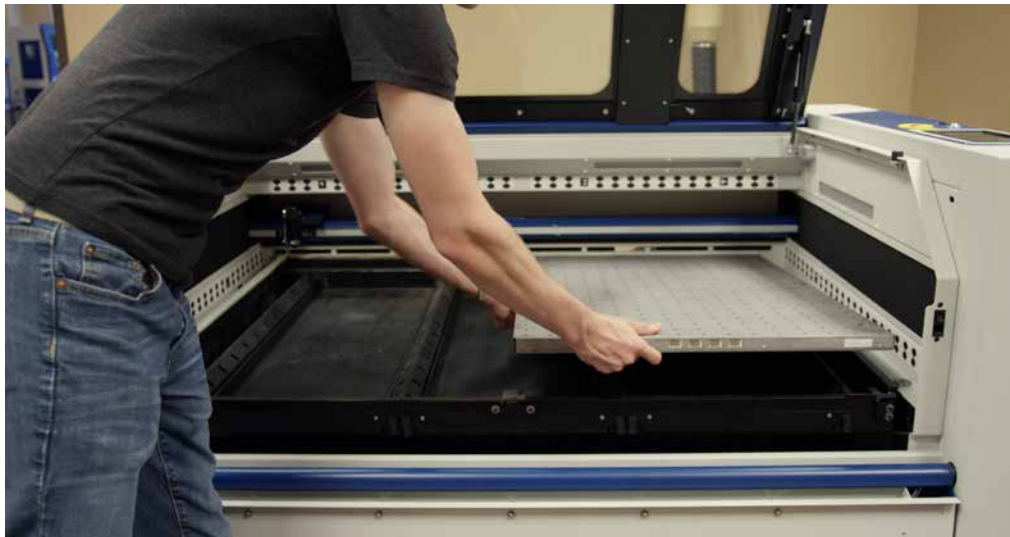


SECTION 10: SYSTEM MAINTENANCE

3. Lower the rear wheel casters until the rubber pad contacts the floor and raises the wheel off of the floor. This will be the pivot point when the machine is tilted onto its back..



4. Open the main door on the machine and remove any table platforms from the machine, such as the Engraving Table, Vector Cutting Grid or Slat Table.



SECTION 10: SYSTEM MAINTENANCE

5. Push the X-Axis Rail to the rear of the machine.



6. Close the door and secure it in its closed position.
7. Remove both the left and right side panels using a 5/32" Allen wrench.

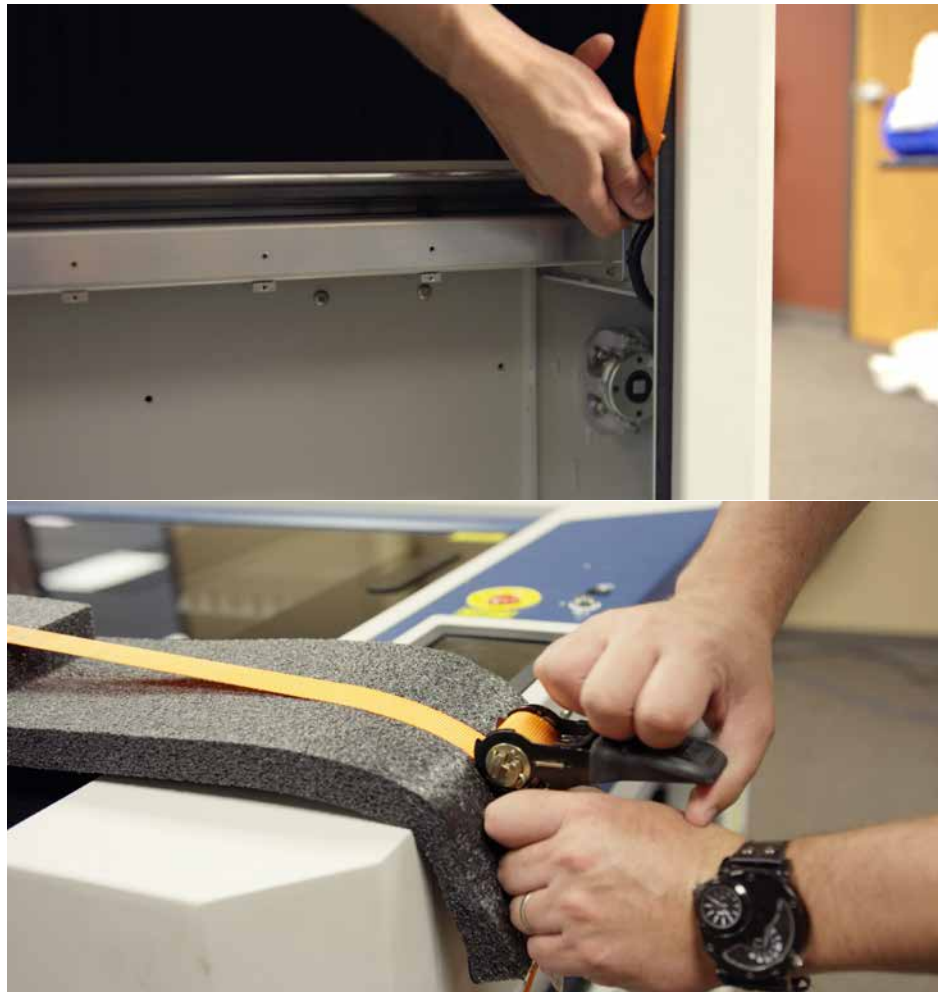


SECTION 10: SYSTEM MAINTENANCE

8. Use a ratcheting strap and more of the internal foam from the crate to provide protection against the door opening.



9. Position the hooks as close to the front corners of the opening for the side covers as possible. Use washcloths or small towels to cushion that area if needed. Tighten the ratcheting strap as much as possible.



SECTION 10: SYSTEM MAINTENANCE

10. With at least 4 people, tilt the machine backwards using the caster rubber feet as a pivot point. Tilt the machine all the way up until it is on its back.



11. Using an Allen key, remove the long screws around the perimeter of the underside of the pedestal.



SECTION 10: SYSTEM MAINTENANCE

12. With two people, lift the pedestal up, then out of the keyhole hanger slots.



13. Move the machine to its final location.
14. Once the Fusion Pro is in its desired location, reinstall the pedestal making sure not to over-tighten the attachment screws. They should be tightened just enough to compress the lock washer.

SECTION 10: SYSTEM MAINTENANCE

15. Use strips of tape to position the caster wheels so that the wheels are pointing upward, and the rubber feet are positioned down toward the back of the machine.



16. With at least 4 people, tilt the machine forward using the caster rubber feet as a pivot point, until the machine is in its original upright orientation.
17. Once the machine is fully upright again, adjust the rear casters so that both rear wheels are back on the ground. Remove the tape from the wheels.



18. Remove the ratcheting strap, any protective materials around the machine, as well as all tape used to secure the door.
19. Place any table platforms back inside the machine and finish setting up your machine as instructed in **“BEFORE OPERATION”** on page 19.

SECTION 11: UPGRADING FIRMWARE

How to Upgrade Your Firmware

Your laser system is capable of having its operational firmware upgraded. The firmware is the command software in your laser system that controls how your laser system operates. A firmware upgrade reprograms your laser system to take advantage of new capabilities or enhancements to the system. The steps for upgrading the Fusion Pro firmware are explained below.

Note: Choose a time that's convenient for you to update the firmware, updates can take up to 10 minutes depending on the size of the update file.

Upgrading your laser is a two-step process:

1. Download the new firmware to your computer and unzip it.
2. Transfer the new firmware from your computer to your laser.

Downloading New Firmware onto Your Computer

Start by checking your current firmware version by powering on the laser. The current version is displayed on the **Settings** menu, which is accessible by pressing the **gear icon** in the upper right corner of the screen. Then click on **"Version"** to view the current Firmware version number.

Downloading: From the Epilog website download the new firmware under **Support + Service > Driver and Firmware Downloads** and save the Fusion Pro firmware file.



You can also join our Driver Notification mailing list on the download page to be automatically notified when new versions of firmware or the driver become available.

When you download the firmware it comes as a compressed file in the following format: **X.X.X.X.zip**. The X's designate the actual version of the firmware. Once downloaded, unzip the file by right-clicking on the file and selecting **"Unzip To"** or **"Extract To"**.

You will need to pay attention to the folder it is extracted to:



Important! Keep track of the folder where you saved the extracted **.swu update file**. You will need to access this file again in the next step.

Transferring New Firmware from Your Computer to Your Laser

When transferring the updated firmware file to your laser you have two options:

1. Transfer by USB
2. Transfer by Ethernet Cable

USB Transfer

1. Load the .swu update file onto a USB drive from your computer. **We recommend using an empty USB drive** to find the update file easily.

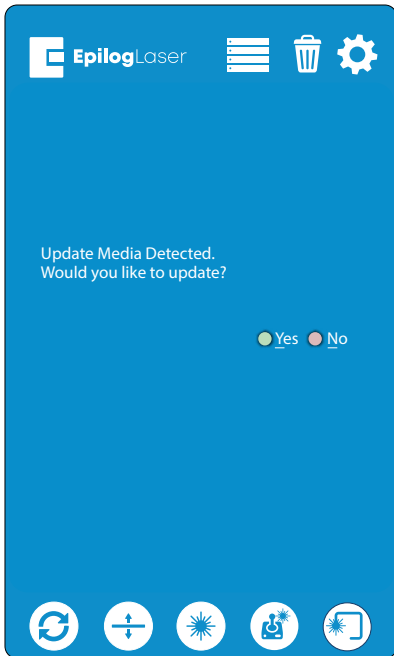


Note: It's easiest if you put the update file in the root directory of your USB drive. If the update file is not located in the root directory of the USB drive, the machine may not detect the update file automatically. If you decide to put the update file into its own folder, make sure the folder name contains no spaces.

2. Eject the USB Drive with the update file from your computer.

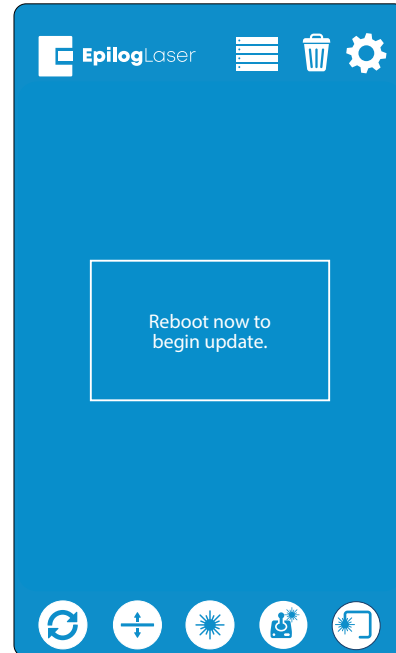
SECTION 11: UPGRADING FIRMWARE

3. Plug the USB drive into the Fusion Pro and it will detect the drive as it powers on. The machine will ask if you would like to update. Press **“Yes”**.



Note: If this screen does not appear after plugging in your USB drive, the update file is not being automatically detected by the machine. You may reboot the machine while pressing down on both the **joystick** and **Go/Stop** button until the screen goes blank. This will cause the machine to boot into **Update Mode**.

4. The machine will need to reboot to run in **Update Mode**. Turn the machine off and then back on again.



5. Once the machine has booted back up, you will see a screen with three options: Factory Reset, USB Update, or Cancel.

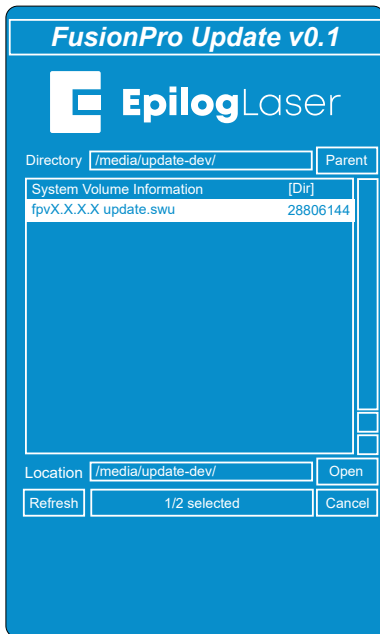


SECTION 11: UPGRADING FIRMWARE



Note: Canceling will prompt you to power cycle the machine to reboot into the current firmware version you have loaded on the machine.

6. Select “**USB Update**” and a directory folder should appear showing your .swu update file. Select the file **fpvX.X.X.X.update.swu** and then select “**Open**”.

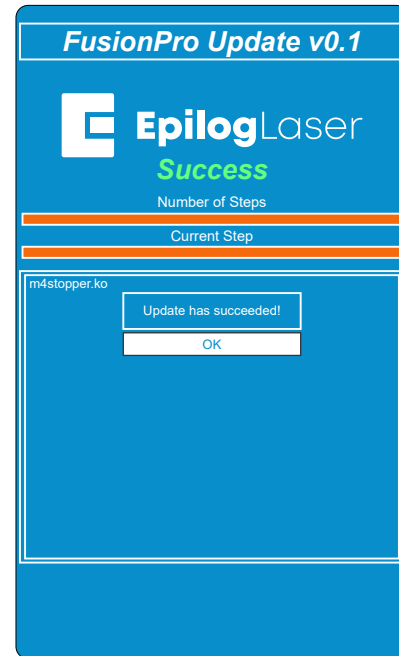


7. The update should begin and may take up to 10 minutes, depending on the size of the update file. Keep track of the time the update begins.

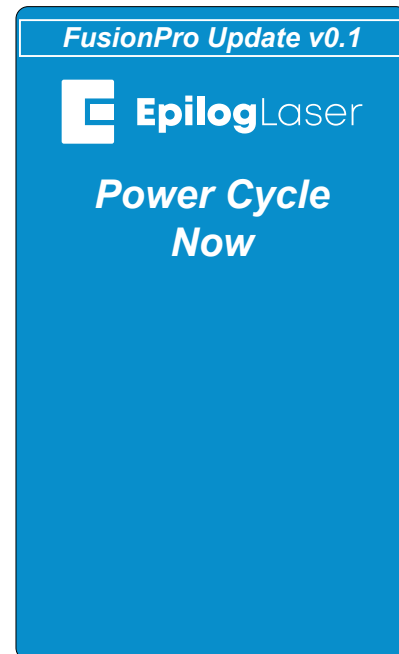


Important: The screen may turn off temporarily while updating, sometimes for several minutes. Please **DO NOT** turn off the machine in the middle of an update! The update is still active if the **LED light number 4** is flashing on the system status light panel located on the right side of the machine.

8. Once the update has completed you will see “Success” on the screen. Click “**Ok**”.



9. The next screen will prompt you to power cycle in order to boot into the new firmware. Turn the machine off, unplug the USB drive, and then turn the machine back on again.



10. Your firmware update should now be complete once the machine boots up.

SECTION 11: UPGRADING FIRMWARE

Ethernet Transfer

1. With an Ethernet cable you may transfer the firmware update file (.swu) directly from your computer to the machine. Please make sure the Ethernet cable is plugged in completely on both ends.
2. Power on the machine and press down both the **joystick** and **Go/Stop** button until the screen goes blank. This will cause the machine to boot into **Update mode**.



3. Open your web browser and in the search bar, type **“http://”** followed by the IP address currently displayed on the Fusion Pro’s screen next to **“eth0:”**. After the IP address, add **“:8080”** and hit **“Enter”**.

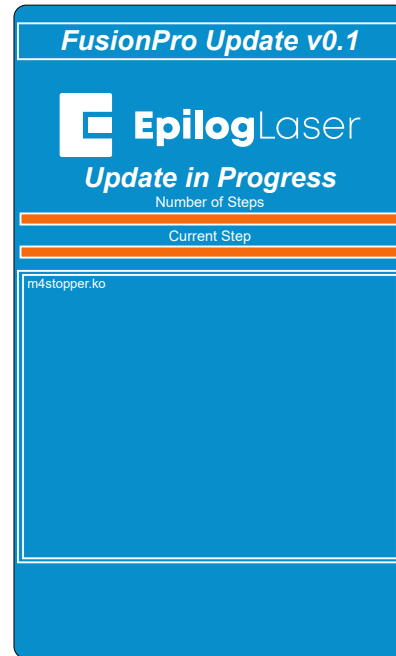
Example: http://192.168.3.4:8080



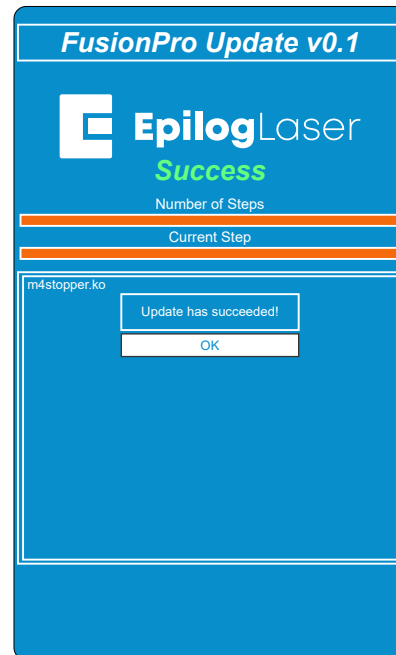
Note: If there is no IP address next to **“eth0:”**, Ethernet transfer will not work.

4. A screen will load on your computer’s web browser with a box to drag and drop the update file into.

5. Put the .swu file in the upload box and this will initiate the update.

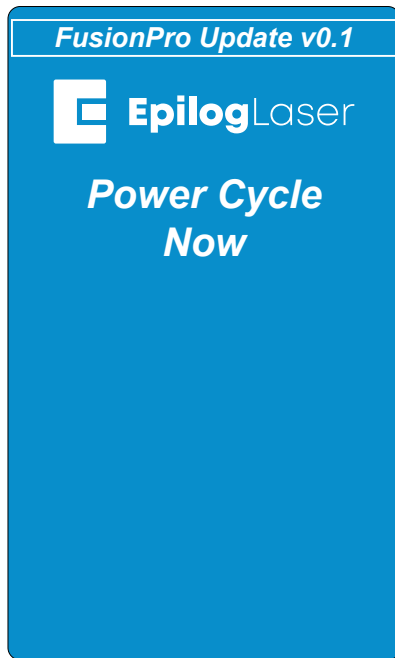


6. Once the update has completed you will see **“Success”** on the screen. Press **“Ok”**.



SECTION 11: UPGRADING FIRMWARE

- The next screen will prompt you to power cycle the machine in order to boot into the new firmware. Turn the machine off and then back on again.



- Your firmware should now be updated and be ready to use once the machine boots up.

Performing a Factory Reset

The Factory Reset option is for resetting your machine to its default factory settings.



Note: This reset completely removes all previously saved data from the machine, therefore should only be used as a last resort to restore your machine's factory settings.

- Begin by powering on the machine and pressing down on both the **joystick** and **Go/Stop** button until the screen goes blank. This will cause the machine to boot into **Update Mode**.
- You will see a dialog appear on the screen asking you three options: Factory Reset, USB Update, or Cancel.



- Select **Factory Reset**. A prompt will appear requesting confirmation. Hit "**OK**".
- The machine will begin the factory reset. When completed the screen will display "Success". Press "**OK**".
- The next screen will prompt you to power cycle the machine in order to complete the Factory Reset. Turn the machine off and then back on again, and it should now be ready to use once it boots up.

SECTION 12: TECHNICAL SUPPORT

Contacting Technical Support

The technical support department at Epilog is available to assist with solving problems you may encounter using your Epilog. Please review first the common problems and solutions as noted below, then if you are still in need of assistance you may contact Epilog's technical support department at the number or website listed below. Technical support is available in Golden, Colorado USA during the hours of 6 a.m. and 6 p.m. Mountain Time.



Technical Support Direct Line: 1 (303) 215-9171



Email: tech@epiloglaser.com

Technical Support Online: support.epiloglaser.com

What to do prior to contacting Epilog Technical Support:

1. Have the machine serial number available.
2. Have time to work on the machine. Many issues will require troubleshooting.
3. Clean your machine (especially the optics), this will solve many issues.

The machine serial number can be found on the Certification/Identification Label. This engraved plate is located on the back of the machine's cabinet. The ID label shown is for the Model 16000 60-watt product.

Epilog Corporation 16371 Table Mountain Pkwy. Golden, CO 80403 USA Model Number: 16000 Laser System Serial Number: 16060- 1512383220 Date of Manufacture: March, 2019	Authorized Representative: cameo Laser Franz Hagemann Gmbh Stuhrbaum14 28816 Stuhr Deutschland Tel: 0421 80 95 60-0 Fax: 0421 80 95 60-25 E-Mail: info@cameolaser.de
<input type="radio"/> Class 2 Laser Product This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001. This product complies with IEC 60825-1: 2007.	<input type="radio"/>
Mass: 35 kg max	Patents Pending
Made in USA	 

SECTION 12: TECHNICAL SUPPORT

Frequently Asked Questions

Engraver Will Not Vector

1. Verify that the print driver is set to Vector or Combined mode.
2. Verify that the lines that you want to vector are set to 0.077 mm or less in CorelDraw, or 0.025 mm or less in Adobe Illustrator. You may also separate the desired Vector line and set it to a Vector process in the Dashboard.
3. Make sure the images are vector lines. Scanned and raster images will not vector.
4. Filled or solid images will not vector (outlines only).

Engraving Appears Lighter Than Usual

1. All mirrors and lenses need to be cleaned and inspected for damage.
2. Verify that the lens is in correct focus.
3. Verify correct Speed, Power and Frequency settings for the type of material that you are engraving.

The Exhaust Is Not Pulling Enough Air

1. Move the blower closer to the machine. The closer the two are, the better exhaust you will receive.
2. Clean your exhaust system on a regular basis, including the engraver and blower. Use a bottle-brush and a vacuum on the areas where the exhaust buildup accumulates.

The Engraving Quality is Poor/Blurry/Double Image

1. If you feel you are not getting quality you once were, this is probably a maintenance issue.
2. Clean the lenses of the system.
3. If you are experiencing a double image problem or other quality issue, it is best to run a sample and send a photo to: tech@epiloglaser.com.

The Laser Won't Turn On

Make sure the Emergency Stop Button on the top of the machine is not pressed in.

SECTION 12: TECHNICAL SUPPORT

IP Address is not visible in the Settings Menu of the Fusion Pro

Make sure that your Ethernet or USB cable is plugged in fully, both at the machine and your computer.

How Can I Increase the Life of my Laser System?

- **Clean your system:** Debris in the laser and on the mechanics of the system can reduce the life of parts in your system. Wipe down your system on a regular schedule to keep the mechanics clean and long lasting.
- **Clean the lenses:** Lens life is greatly increased by keeping them clean and free of debris. Get in the habit of wiping them off on a regular schedule to keep them clean and well maintained.
- **Reduce speed when running very small items:** When you run at 100% speed on a graphic with a very short stroke, the lens assembly comes up to speed and slows down extremely quickly, which can place wear on the mechanics of the laser. Slow down to 80 - 90% speed and increase the lifetime of your laser system.

How to Shorten Your Engraving/Cutting Time

- **Lower the Resolution:** How important is the highest resolution image? Processing jobs at 400 DPI vs. 600 DPI can reduce cycle times by up to 30%, and processing at 300 DPI could mean half the cycle time.
- **Reduce White Space:** Orientate the parts to minimize engraving dead space (area where head travels, but has nothing to engrave).
- **Horizontal Layout:** If an option, horizontal text will engrave faster than vertical or curved (fit text to curve) text.
- **Split by Color:** Use the Split by Color feature on the Epilog Dashboard to save time by adjusting the order in which the objects engrave/mark.
- **Run Multiples:** If you need to engrave multiples of the same image. You'll find you have a time savings per piece.

If these do not correct your issue or your issue is not listed, please contact the Technical Support Team at +1 303-215-9171 or tech@epiloglaser.com.

APPENDIX A: WARRANTY STATEMENT

Warranty Statement for the Fusion Pro Laser

Epilog Corporation warrants to the original purchaser of Epilog Fusion Model 16000 that the product will be free from defects in material or workmanship when purchased, and under proper, normal use within two (2) years from the original date of purchase, with the exception of the motors which are warranted for three (3) years from the original date of purchase.

Epilog will replace or, at its option, repair the defective part(s). Normally, Epilog will supply a replacement part for the customer to replace. Once the replacement has been performed, the replaced part must be returned to Epilog. In the case where repair is required, Epilog requires that the defective part, or machine, be returned to the Epilog factory or other Epilog designated facility. Epilog will be responsible solely for the cost of repairs, including parts and labor, which are made at an authorized Epilog facility. All other costs for replacement or repair, including, but not limited to, packaging and shipping both to and from Epilog, shall be paid by the owner. A "Core" charge may be required by Epilog to insure the return of replacement and repair parts. This warranty excludes any damage from abuse (including, without limitation, incorrect voltages, power surges, fires, improper or insufficient ventilation "acts of God" or other situations out of the control of Epilog), failure to operate in accordance with instructions provided in the Owner's Manuals for the Epilog model 16000, including specific safety and operational warnings contained therein, cosmetic damage sustained in use, and damage caused by unauthorized modifications of any equipment. All warranties to original purchasers are non-transferable. The registered owner must initiate warranty claims within the warranty period.

THE ABOVE AND FOREGOING IS THE ONLY WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED; INCLUDING BUT NOT LIMITED TO ANY WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, THAT ARE MADE BY EPILOG ON MODEL 16000. ANY WARRANTIES IMPLIED BY LAW ARE HEREBY EXPRESSLY DISCLAIMED.

No oral or written information or advice given by Epilog, its dealers, its distributors, agents, officers, or employees shall create a warranty or in any way increase the scope of this warranty. Neither Epilog nor anyone else who has been involved in the creation, production, or delivery of the Epilog Fusion Models 16000 shall be liable for any direct, indirect, consequential, or incidental damages, including but not limited to damages for loss of business profits, business interruption, loss of business information, adverse health impacts, fire, and the like, arising out of the use or inability to use these products.

Epilog Corporation provides no warranties whatsoever on any software used in connection with Epilog Fusion Model 16000.

APPENDIX B: MATERIAL SETTINGS

Fusion Pro Suggested Material Settings (CO2)					
Material	DPI/Freq.	50 watt	60 watt	80 watt	120 watt
Acrylic					
Photo Engraving	300 DPI	100s 50p	100s 45p	100s 40p	100s 30p
Text/Clipart Engraving	300 DPI	100s 70p	100s 65p	100s 60p	100s 55p
Text/Clipart Engraving	500 DPI	100s 65p	100s 60p	100s 55p	100s 50p
Cutting 1/8" (3 mm)	100 f	6s 100p	8s 100p	12s 100p	20s 100p
Cutting 1/4" (6 mm)	100 f	3s 100p	4s 100p	6s 100p	10s 100p
Cutting 3/8" (9.5 mm)	100 f	2s* 100p	2s* 100p	3s 100p	5s 100p
Cutting 1/2" (13 mm)	100 f				2s 100p
Cutting Note: Adjusting the standard focus distance so it is closer to the lens by about .080" (2 mm) will produce better edge quality when cutting 1/4" (6mm) acrylic and thicker. Two passes can be used for cutting thicker materials. There are two types of acrylic: cast is better for engraving (it creates a frosted look when engraved) and extruded acrylic produces a much better flame polished edge.					
Alumamark					
Engraving	300 DPI	100s 35p	100s 25p	100s 20p	100s 15p
Engraving	500 DPI	100s 25p	100s 15p	100s 10p	100s 5p
Anodized Aluminum					
Photos/Clipart	400 DPI	100s 45p	100s 40p	100s 35p	100s 30p
Photos/Clipart	500 DPI	100s 40p	100s 35p	100s 30p	100s 25p
Text	500 DPI	100s 50p	100s 45p	100s 40p	100s 35p
We find when engraving anodized aluminum, text appears best at 500 DPI, but photos and clipart can be engraved with great detail down to 400 DPI.					
Cork					
Engraving	300 DPI	100s 40p	100s 35p	100s 30p	100s 25p
Fleece					
Engraving	200 DPI	100s 25p	100s 20p	100s 15p	100s 10p
When engraving fabric, try changing the graphic to 80% gray and use the Jarvis dithering pattern for the best results. Every fabric you are cutting will need to have adjusted setting - find a small swatch of the fabric you can test first.					
Glass					
Engraving	300 DPI	25s 100p	30s 100p	35s 100p	40s 100p
When etching glass, try changing the graphic to 80% gray before engraving and using the Jarvis dithering pattern. You can also diffuse heat by covering the glass with a thin sheet of dish soap.					
Leather					
Photo Engraving	300 DPI	100s 30p	100s 25p	100s 20p	100s 15p
Text/Clipart Engraving	500 DPI	100s 35p	100s 30p	100s 25p	100s 20p
Cutting 1/8" (3 mm)	50 f	40s 100p	50s 100p	60s 100p	75s 100p
Mat Board					
Cutting	50 f	25s 40p	25s 30p	30s 40p	30s 30p

APPENDIX B: MATERIAL SETTINGS

Fusion Pro Suggested Material Settings (CO2)					
Material	DPI/Freq.	50 watt	60 watt	80 watt	120 watt
Marble					
Photo Engraving	300 DPI	100s 45p	100s 40p	100s 35p	100s 25p
Text Engraving	500 DPI	100s 55p	100s 50p	100s 45p	100s 35p
Every marble is very different for settings. Start low and increase the power with a second run if you haven't used that marble before.					
Painted Brass					
Engraving	300 DPI	100s 35p	100s 30p	100s 25p	100s 15p
Engraving	500 DPI	100s 30p	100s 25p	100s 15p	100s 10p
Plastics					
Engraving	300 DPI	100s 30p	100s 25p	100s 20p	100s 15p
These settings work well with many plastics, including plastic phones and covers. Even one color plastics can achieve a great look when engraved.					
Plastic (2 Layer Laser Engraveable)					
Engraving	300 DPI	100s 70p	100s 65p	100s 40p	100s 35p
Engraving	500 DPI	100s 50p	100s 35p	100s 25p	100s 20p
Cutting 1/16" (1.5 mm)	100 f	10s 65p	10s 55p	10s 40p	20s 40p
Stainless Steel w/Cermark					
Engraving	500 DPI	30s 100p	35s 100p	45s 100p	55s 100p
Twill					
Cutting	25 f	70s 100p	90s 100p	90s 80p	90s 60p
Wood					
Photo Engraving	500 DPI	50s 100p	60s 100p	70s 100p	100s 100p
Clipart/Text Engraving	300 DPI	40s 100p	50s 100p	60s 100p	90s 100p
Clipart/Text Engraving	500 DPI	45s 100p	55s 100p	65s 100p	85s 100p
Deep Engraving	500 DPI	20s 100p	25s 100p	30s 100p	60s 100p
Thin Veneer (Cutting)	10 f	40s 100p	40s 90p	50s 80p	50s 60p
Cutting 1/8" (3 mm)	10 f	6s 100p	8s 100p	12s 100p	20s 100p
Cutting 1/4" (6 mm)	10 f	3s 100p	4s 100p	6s 100p	10s 100p
Cutting 3/8" (9.5 mm)	10 f	2s* 100p	2s* 100p	3s 100p	5s 100p
Cutting 1/2" (12 mm)	10 f				2s 100p
When cutting wood, multiple passes may allow cutting of thicker materials. Using Color Mapping you can adjust the focus point between passes down to the center point of the cut for the best results. Always use the additional Sweep Air Assist when cutting.					

APPENDIX B: MATERIAL SETTINGS

- **These are only suggestions:** Every type of material will react differently with the laser, even from one plastic to the next. Use these settings as your starting point then adjust one variable at a time until you achieve the result you desire. Settings for any material are a matter of personal preference. Not every material that can be run at high speed should be run at high speed. A better mark can often be achieved by slowing your laser and giving the laser longer to react to your material.
- **Test your material:** If you have a small area of the material you won't be using, or an extra item, take advantage of this area to test out your settings by engraving a small square or cutting a small circle. You can fine tune your settings in these areas.
- **Similar materials use similar settings:** When you are working with a material you aren't familiar with, think about a similar material and what settings you would use with that product. Most anodized aluminums will react well with similar settings, as will most plastics.
- **When in doubt, start low:** Remember, you can always re-run your job as long as you don't move it in the machine. Let's say you're running a photograph in a one-of-a-kind wood plaque. Start with a lower power setting, look at the engraving, then run the project a second time at high speed and lower power a second time to add a little more depth if needed.
- **Run only one part of the file:** If running a job on a new material, you can always just select one piece of the engraving, like a piece of text, and run that part first to make sure your settings are perfect before running the whole file.



To print a copy of these settings to keep next to your laser, go to www.epiloglaser.com/material-settings.htm.

APPENDIX B: MATERIAL SETTINGS

Fusion Pro Suggested Material Settings (Fiber)			
Material	DPI/Freq.	30 watt	50 watt
Aluminum (Anodized)			
Etching/Marking	600 DPI	Speed: 30% Power: 75% Frequency: 1% Focus: 0	Speed: 50% Power: 100% Frequency: 1% Focus: 0
Polishing	600 DPI	Speed: 30% Power: 80-100% Frequency: 25% Focus: +.05"	Speed: 30% Power: 100% Frequency: 1% Focus: .05"
<p>The contrast / brightness of marks achievable on the fiber laser are excellent and can often be much brighter than marks from a CO2 laser. Taking the fiber laser out of focus by +.03" - .09" broadens the beam and produces a very bright mark on anodized coating. Lower frequency and higher power settings help offset the change in focal point. Different grades of anodized & core aluminum alloy will affect how the final marks look.</p>			
Aluminum (Bare)			
Etching/Marking	600 DPI	Speed: 10 - 15% Power: 100% Frequency: 50 - 60% Focus: -.01 to +.01"	Speed: 20 - 25% Power: 100% Frequency: 50 - 60% Focus: -.01 to +.01"
<p>Engraving aluminum will result in various shades of gray, not black. Fine tuning the settings can provide a bit more contrast but the range of applicable marks is very narrow. If the application calls for a black etch, consider using an oxidizer after engraving. Oxidizers are used most commonly if the aluminum has a protective coating (urethane, clear coat, clear anodized) covering the area that is not engraved. Deep metal engraving on aluminum can be done using multiple passes. Consider deep engraving and using a black epoxy/color fill. Although the marks on aluminum are not black like they are on steel, we have no difficulty getting 2D, UID barcodes to scan and verify.</p>			
Brass			
Etching/Marking	600 DPI	Speed: 15 - 20% Power: 100% Frequency: 5 - 20% Focus: 0	Speed: 20 - 25% Power: 100% Frequency: 5 - 20% Focus: 0
Laserable Plastic			
Etching/Marking	600 DPI	Speed: 50 - 60% Power: 60-70% Frequency: 50% Focus: 0	Speed: 60 - 70% Power: 60-70% Frequency: 50% Focus: 0
Stainless Steel			
Annealing	600 DPI	Speed: 2.5% Power: 100% Frequency: 1% Focus: +.09"	Speed: 4% Power: 100% Frequency: 1% Focus: +.09 to +.12"
Etching/Marking	600 DPI	Speed: 10% Power: 100% Frequency: 1% Focus: 0	Speed: 10 - 15% Power: 100% Frequency: 1% Focus: 0
Polishing	600 DPI	Speed: 30% Power: 75% Frequency: 50% Focus: +.03"	Speed: 30% Power: 50% Frequency: 50% Focus: +.03"

APPENDIX B: MATERIAL SETTINGS

Fusion Pro Suggested Material Settings (Fiber)			
Material	DPI/Freq.	30 watt	50 watt
<p>Etching: Like our CO2 counterparts, the slower the speed setting, the deeper the etching. However, many metal applications can be processed at higher speed settings. Again, consider the marking requirements.</p> <p>Annealing: To achieve an annealed mark, the focal point should be significantly away from zero. The unfocused, broader beam provides the heat to change the surface color without actually penetrating the metal. The focal point can be either closer to or away from zero. Focusing away from the material should be in the range of .060" to .090". Focusing closer to the material is generally in the range of -.070" to -.110". Both focusing methods will result in annealing of the metal. Focusing up typically results in a slight indentation of the metal. Multiple passes can darken the mark even more (no data to confirm whether multiple passes offer more permanency).</p> <p>Polishing: Some steel alloys are easier to polish than others. For best results, clean off the surface with alcohol prior to processing. Any leftover grease, oils or residue can affect how well the polished mark turns out. Polishing the metal where the final marks result in a bright white engraving requires finer tuning of settings, more so than the etched or annealed marks. Determine a base speed and frequency setting and adjust the power in small increments/decrements. If you are unable to get a white bright mark, increase the frequency setting and try again by adjusting only the power.</p>			
Titanium			
Annealing	600 DPI	Speed: 3.5 - 6% Power: 100% Frequency: 1% Focus: +.08 to +.110"	Speed: 5.5 - 7.5% Power: 100% Frequency: 1% Focus: +.08 to +.110"
Etching/Marking	600 DPI	Speed: 15 - 20% Power: 100% Frequency: 1-5% Focus: -.01 to +.01"	Speed: 20 - 25% Power: 100% Frequency: 1-5% Focus: -.01 to +.01"
<p>Titanium and Ti alloys are highly amenable to marking at this wavelength. Similar to aluminum, a black mark from the etching process is difficult to achieve. Various shades of gray can be made, from very dark gray to light gray. Annealed marks can also be made on titanium materials using the same processing parameter described for stainless steel. Depending on the Ti alloy, marks of various colors can be achieved by changing the frequency values for 1% up to 100%. It is common to see red, blue, green, orange, yellows and purple marks, depending on the frequency selected.</p>			
Plated Metals			
Etching/Marking	600 - 1200 DPI	Speed: 10 - 15% Power: 100% Frequency: 1 - 5% Focus: -.09 to -.100" +.09 to .100"	Speed: 15 - 20% Power: 100% Frequency: 1 - 5% Focus: -.09 to -.100" +.09 to .100"
<p>Metals are often plated to assist with conductivity, to provide a protective coating against rust and elements and for aesthetic purposes. Plating thickness will depend on application and purpose. Most of the plated metals processed through the applications lab are electronic components (to enhance conductivity) and various fittings (protection against environment & rust). The typical plating thickness varies from .001" up to .005". Our recommended settings for general metal engraving works well for ablating through the plating; exposing the base metal. Ablating the plating will also provide high contrast. Using an oxidizer will enhance the look.</p> <p>Our recommended settings for polishing of metals are a good starting point where ablating through the plating isn't an option. This is likely the most common plated metal application as exposing the raw metal underneath will break continuity and / or expose the bare metal to rust and other elements. Note that the contrast of polishing of plated metals won't be as consistent or contrasting as a direct ablation. Multiple passes will help and end results will vary based on the metal used for plating, thickness of plating & size of mark. Our recommended settings for annealing will often work for plated metals where the plating has a thicker wall and material used has high levels of carbon or metal oxides.</p>			

APPENDIX B: MATERIAL SETTINGS

Fusion Pro Suggested Material Settings (Fiber)			
Material	DPI/Freq.	30 watt	50 watt
Powder Coating			
Etching/Marking	600 DPI	Speed: 20 - 25% Power: 100% Frequency: 100% Focus: +.05 to .07"	Speed: 25 - 30% Power: 100% Frequency: 100% Focus: +.05 to .07"
Two to three passes are suggested (one pass to ablate the powder coating, 2nd or 3rd pass to polish up the metal underneath). A little less power, higher frequency and less focus adjustment will be required for the 2nd or 3rd pass, depending on the base metal. The idea is to ablate then polish. An alternative to running two or more passes is to run one pass and then use a common cleaner such as Simple Green or a citric-based cleaner with short, stiff bristle brush to scrub out the residual material remaining in the mark area. If using this technique, it may be necessary to raise or lower the marking table from around 0.07" to 0.10".			

- **These are only guidelines:** Brightness or darkness of a mark is a matter of personal preference and can be very dependent of the type of material being marked. As such, there is no “correct” setting. Working with the four different fiber settings becomes fairly intuitive in a very short period of time for most users. If you have a material that is not listed, try to compare it to similar materials listed and use those settings as your starting point.
- **Speed Settings:** The speed setting scale of 1% to 100% is not linear – i.e. 100% speed will not be twice as fast as 50% speed. This non-linear scale is very useful in compensating for the different factors that affect engraving time.
- **Power Settings:** The power settings are linear – i.e. 50% power is half as much as 100% power.
- **General Metal Engraving / Base Settings:** In the world of metals the grade, type, hardness and chemical composition are endless. Metal alloys are engineered for specific applications and have their own strengths and weaknesses. Metals can be engraved at just about any settings. Of course, there are many variables to consider for metal engraving. The lasers wattage, hardness of metal, desired mark (etch, polish, anneal) and the required time/contrast/depth will have to be considered when deciding on the final settings.
- **General Annealing Settings:** Producing an annealed mark is very dependent on the material being out of focus. Run the laser at slow speed and full power then adjust the focus while the machine is running until you achieve the annealed mark you need.
- **Test your material:** If you do not achieve the results you are looking for with the recommended settings, try resending the job and start by changing only one variable at a time. Changing only one variable at a time will help to determine the correct setting for your material.
- Laser settings can sometimes be confusing because many materials can be marked over such a broad range of settings. If you have difficulty in finding the correct setting you can send a sample to the Epilog Laser Applications lab. We will determine if the material can be marked and provide appropriate setting for your laser.



To print a copy of these settings to keep next to your laser, go to www.epiloglaser.com/material-settings.

APPENDIX C: SYSTEM CALIBRATION

Camera Calibration

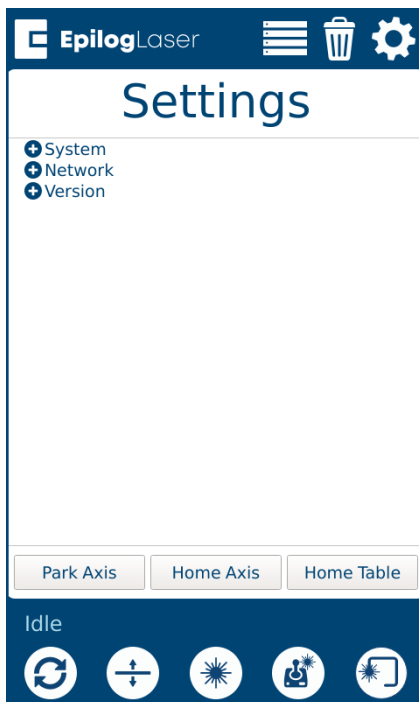


Note: Camera calibration on the Fusion Pro is only necessary if recommended by Epilog's Technical Support.

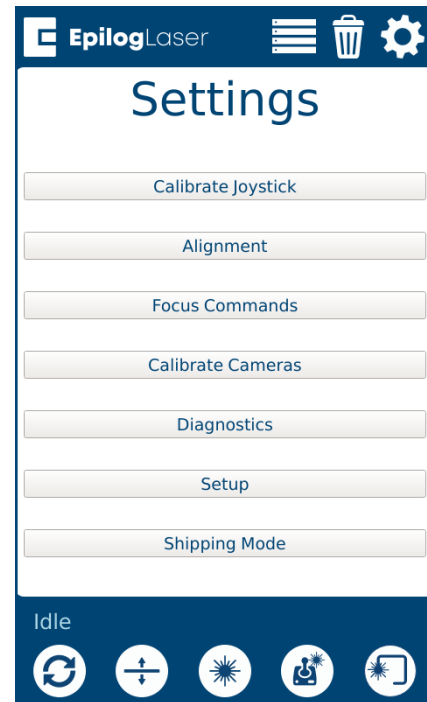


Note: Before beginning, reboot your machine if you have recently run any jobs.

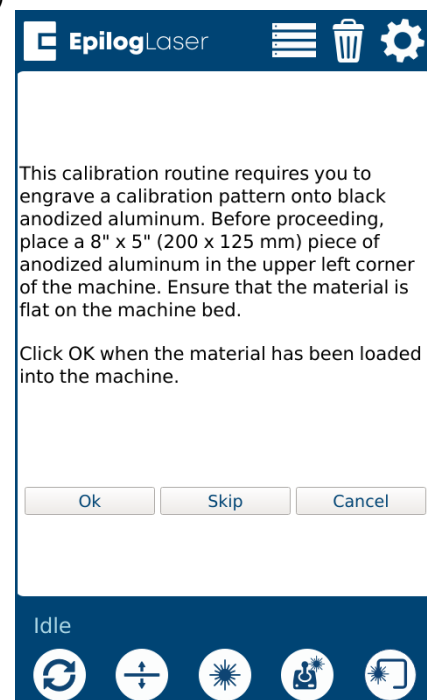
1. Click the **Settings**  button to enter the Settings menu.
2. Long Press the **"Settings"** text for 5 seconds to enter the Advanced Settings Menu.



3. Click on **"Calibrate Cameras"** to enter the Camera Calibration menu

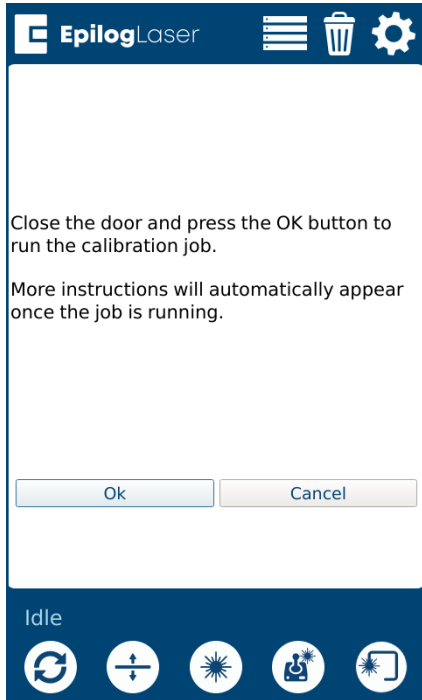


4. While the machine is Idle, follow the prompt, and begin the calibration routine by selecting **"OK"**. The calibration pattern mentioned in the prompt will be used by the single camera at the laser head. Use an 8" x 5" (203 x 127 mm) or larger piece of anodized aluminum. (You can also optionally skip this step by clicking Skip.)

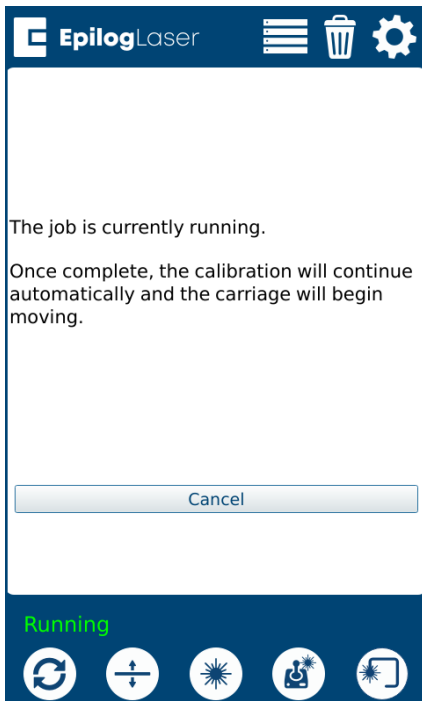


APPENDIX C: SYSTEM CALIBRATION

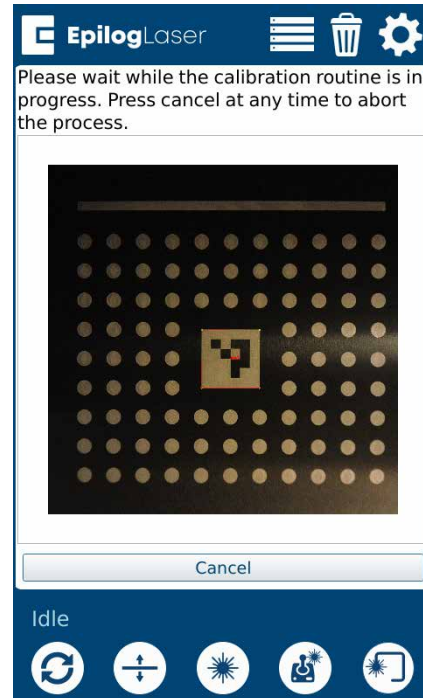
5. Follow the prompt and close the top door of the engraver. Once **“OK”** is pressed the laser will start engraving the calibration pattern. The engraver will automatically focus to the 0.635mm thickness of the anodized aluminum, then engrave a calibration pattern.



6. Allow the job to run until completion.

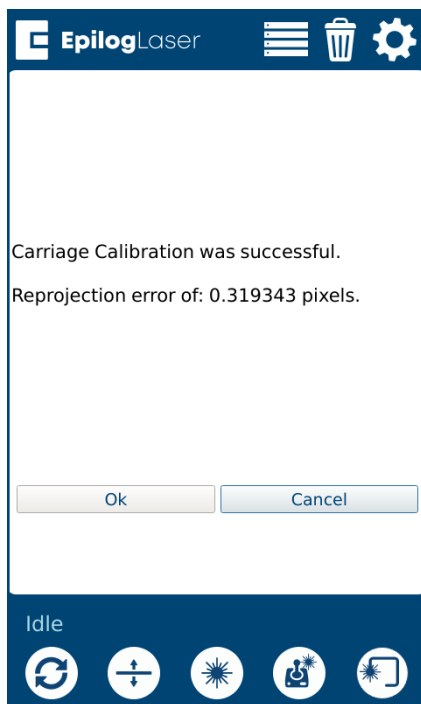


7. Once the job has finished engraving, the camera at the laser head will take pictures of the engraving to calibrate itself. This process takes several minutes.

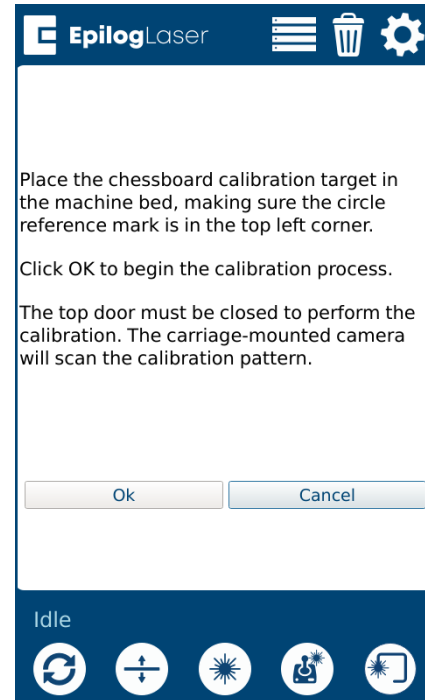


APPENDIX C: SYSTEM CALIBRATION

8. Once the calibration has successfully finished, a dialog will appear. The “Reprojection error” will be listed and is used to determine the quality of the calibration. The lower the value, the better. If the reprojection error is above 2.0, the user will see an error “Calibration unsuccessful. Error too high”. A value of 0.6 or lower is desired. At the end of this stage, the table will move down several mm, to make room to place the Calibration Mat on the table.

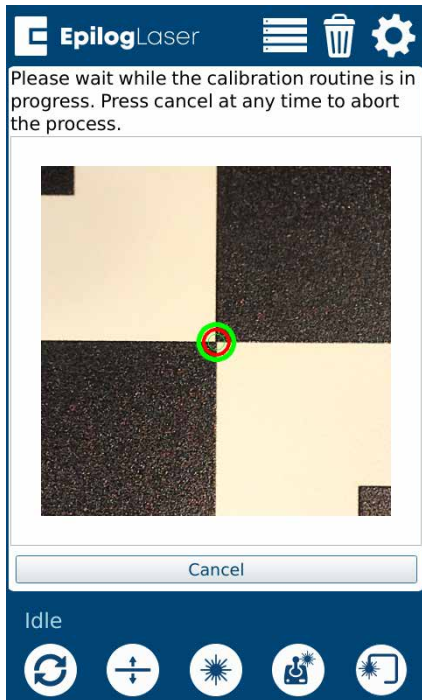


9. Place the Calibration Mat flat on the table. The machine will now calibrate the overhead camera(s). The Fusion Pro 32 has 1 overhead camera(s). The Fusion Pro 48 has 2 overhead cameras. Click “Ok” to continue.

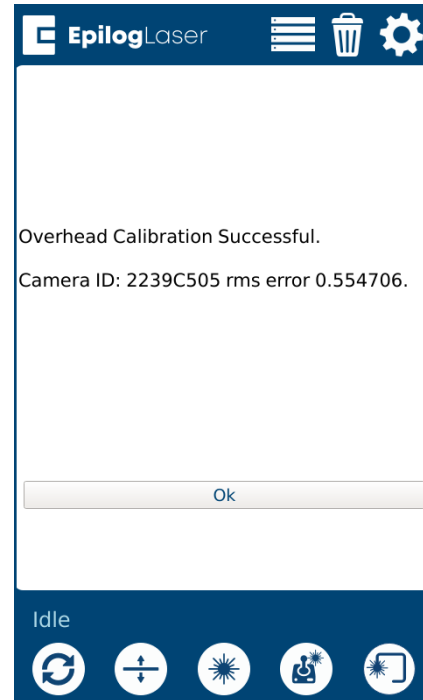


APPENDIX C: SYSTEM CALIBRATION

10. This process will take 10-15 minutes on a Fusion Pro 32, and 20-25 minutes on a Fusion Pro 48. The table will move back up into focus, and the carriage camera will begin scanning features on the chessboard calibration target.



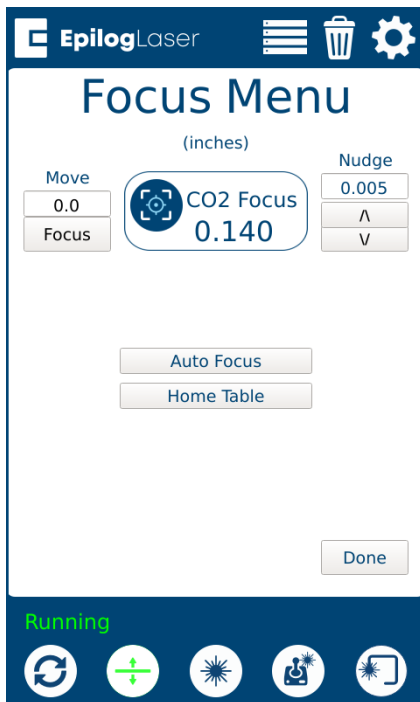
11. Once the calibration has successfully finished, a dialog will appear. The "rms error" will be listed and is used to determine the quality of the calibration. The calibration will fail if the rms error is above 2.0. The lower the value, the better. A value below 0.6 is desired. Click "Ok" to finish calibration and use the supplied results.



APPENDIX C: SYSTEM CALIBRATION

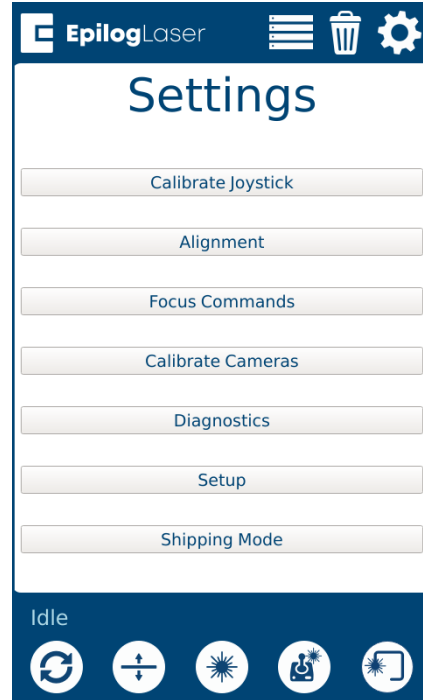
Calibrating the Auto Focus

1. Run a test job with a piece of anodized aluminum. Set up a small solid square as your artwork and run the job based off of your recommended settings for your machine's wattage, with the power taken down 5-10%.
2. Once the job is running, press the Focus Menu button on the touch screen, and slightly raise and lower the table with the joystick while keeping an eye on the spark coming from the laser hitting the anodized aluminum.

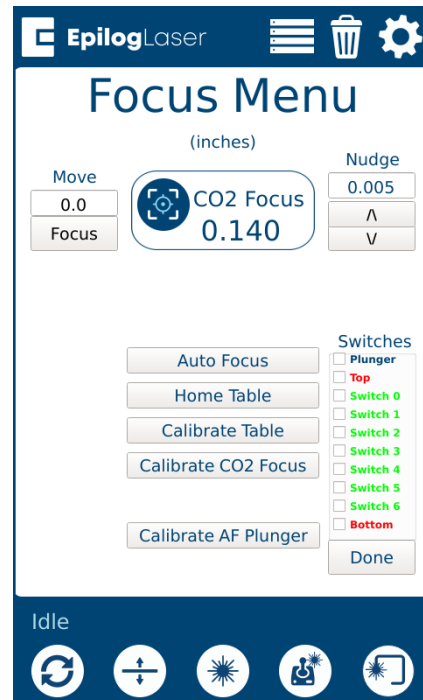


3. While raising the table up and down, find the height where the spark appears the brightest. If it's difficult to tell, turn off any overhead lights in the room. Once you've found the brightest spark, let go of the joystick and stop the test job.

4. Press the Settings button, and then long press the "Settings" text until the Advanced Settings menu appears.

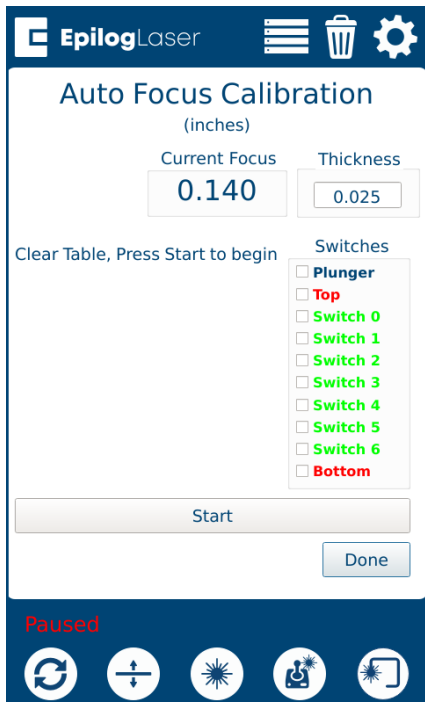


5. Select "Focus Commands" from the menu.

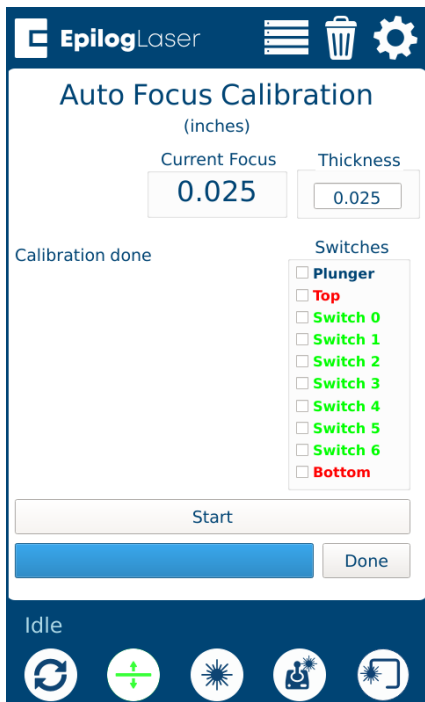


APPENDIX C: SYSTEM CALIBRATION

6. Select “Calibrate AF Plunger” and then press “Start.”



7. Once the calibration is complete, press “Done”.



8. The Auto Focus should now be calibrated properly.

APPENDIX C: SYSTEM CALIBRATION

Machine Settings:

- **Acceleration Match Offset [cnts]**
 - Number of encoder counts to delay firing laser when accelerating. Used for raster quality adjustments
- **Deceleration Match Offset [cnts]**
 - Number of encoder counts to delay firing laser when decelerating. Used for raster quality adjustments
- **Bed Margins [in]**
 - The margins around the bed, in inches that the carriage can travel to.
 - Format is as follows: TOP,LEFT,BOTTOM,RIGHT
- **Bed Size [in]**
 - The size of the bed in the machine in inches
 - Format is as follows: WIDTH,HEIGHT
 - Requires “Home Axis” to take effect
- **Disable Table Homing**
 - Setting to disable homing the table when the machine boots. For optimal operation, leave this at a value of 0
 - A value of 1 will disable table homing
 - Will take effect after reboot
- **Rotary Encoder [cnts/in]**
 - The number of encoder counts per inch of travel for the rotary device
 - Requires “Home Axis” to take effect
- **X Axis Encoder [cnts/in]**
 - The number of encoder counter per inch of travel for the X Axis
 - Requires “Home Axis” to take effect
 - Must recalibrate cameras if this changes
- **Y Axis Encoder [cnts/in]**
 - The number of encoder counter per inch of travel for the Y Axis
 - Requires “Home Axis” to take effect
 - Must recalibrate cameras if this changes
- **Home Offset [in]**
 - The offset of the table origin, relative to the X and Y limit switches
 - Requires “Park Axis” to take effect
 - Must recalibrate cameras if this changes
- **Joystick Center X**
 - The center X position of the joystick, in joystick units
- **Joystick Center Y**
 - The center Y position of the joystick, in joystick units
- **Joystick Deadzone [%/100]**
 - The percentage of dead zone around the center of the joystick
- **Joystick Limit X**
 - The MIN and MAX limits for the X axis of the joystick, in joystick units

APPENDIX C: SYSTEM CALIBRATION

- Format is as follows: MIN,MAX
- **Joystick Limit Y**
 - The MIN and MAX limits for the Y axis of the joystick, in joystick units
 - Format is as follows: MIN,MAX
- **Laser Match [cnts]**
 - Adjustment to synchronize left to right and right to left raster lines. Units are in number of encoder counts
- **Laser Match Offset [cnts]**
 - Offset of the raster data in X. Used to align raster and vector if needed. Units are in number of encoder counts
- **Velocity Match Offset [cnts]**
 - Offset of the raster data proportional to velocity. Units are in number of encoder counts
- **Park Position [in]**
 - The position in inches to park the laser head when the machine is idle
 - Requires “Park Axis” to take effect
- **Plunger Offset [cnts]**
 - The number of table encoder counts from the laser zero focus position, to the auto focus plunger
- **Rotary Offset [in]**
 - The offset of the rotary origin, relative to the X and Y limit switches
- **Rotary Table Height [in]**
 - The distance in inches to clear the rotary device
- **Scale [mm/in]**
 - A scale factor to adjust the scale of the X and Y axis
 - Format is as follows: X,Y
 - Requires “Home Axis” to take effect
 - Must recalibrate cameras if this changes
- **Table Switch Locations [cnts]**
 - A list of the locations in which the table switches were located
- **Table Current [A]**
 - The current in Amps to run the table drive
- **Table Resolution [cnts/in]**
 - The number of encoder counts per inch of travel for the table
 - Must “Home Table” if this value is changed
- **CO2 Tickle Duration [us]**
 - The duration of the laser tickle pulse in microseconds
- **CO2 Tickle Frequency [Hz]**
 - The frequency of the laser tickle pulse in hertz
- **CO2 Tickle Holdoff [us]**
 - The duration in which the laser tickle is stalled after a laser pulse in microseconds
- **CO2 Pulse Stretch [us]**
 - The amount to stretch all laser pulses in microseconds

APPENDIX C: SYSTEM CALIBRATION

- **Table Focus Offset [cnts]**
 - The distance in table encoder counts from the top crash switch, to the laser focus position
- **RHS Y Skew [cnts]**
 - The number of encoder counts to skew the right hand side of the Y axis after homing
 - Requires “Home Axis” to take effect
- **Air Assist Delay [s]**
 - The number of seconds to delay turning ON and turning OFF the air assist before and after a job finished
 - Format is as follows: ON,OFF

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