# M-300 Laser Platform
## Installation and Operations Manual

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# Introduction

We would like to thank you for purchasing the M-300 Laser Platform.  Years of testing and refinements have made this unit the ultimate laser engraving and cutting system.  With it's small footprint design and industry standard 24" x 12" work area, the M-300 Laser Platform is now equipped with our unique "Rapid Reconfiguration Capability ™". This gives the user the ability to exchange it's "Quick Change Laser Cartridge ™ " with a lower or higher powered unit in minutes and without the use of tools. This feature, and many others make this unit truly the most flexible, easiest to use, and the most user serviceable piece of equipment in its class.

To begin with, we highly recommend that this entire manual be read before attempting to use the M-300 Laser Platform.   The manual includes important information about safety, assembly, use, and maintenance.  **We cannot emphasize the importance of reading this ENTIRE manual.**

# How To Get Help

**Step 1:**
Determine exactly what the problem is. Refer to "Section 8 – Troubleshooting" for a possible solution.

**Step 2:**
Try to recreate the problem and write down the circumstances in which the problem occurred. Be prepared to describe all pertinent information about the computer being used with the laser cutting and engraving system such as software, operating system and computer type.  Have the serial number of the laser system available. The serial number tag is located on the back of the machine in the lower right corner.  There is a second serial tag located behind the front door on the right side when you open it.

**Step 3:**
Contact your local Sales Representative first to assist you in diagnosing the problem. If possible, call from a phone that is close to the laser engraving system so that the system can be operated while talking to our representative.

**Step 4:**
If your local Sales Representative is unavailable, contact our Customer Service Department at:

Universal Laser Systems, Inc.
Technical Support/Parts Department
16008 North 81$^{st}$ Street
Scottsdale, AZ  85260
Phone: 480-609-0297
Fax: 480-609-1203
Email: service@ulsinc.com
M-F 7am – 5pm Arizona Time

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**SECTION 1**

# Safety

This section describes hazards that may occur if the laser is installed or used improperly.

⚠️ **WARNING:** Failure to follow these guidelines can result in injury to yourself, others, or may cause severe damage to the equipment and your facility. Use of the equipment in a manner other than what is described in this manual may increase this risk. Operation and care of the laser must be followed in strict accordance to this manual.

## Description of Appropriate Use

This device is designed for laser cutting and engraving of the materials listed in this manual, in laboratory, workshop or light duty manufacturing environments. This equipment must be properly installed and connected to an appropriate exhaust system meeting the specifications outlined in this manual. Materials to be processed must fit completely inside the system for proper operation.

## General Safety

- **Exposure to the laser beam may cause physical burns and can cause severe eye damage**. Proper use and care of this system are essential to safe operation.

- **Never operate the laser system without constant supervision of the cutting and engraving process**. Exposure to the laser beam may cause ignition of combustible materials and start a fire. A properly maintained fire extinguisher should be kept on hand at all times.

- **A properly configured, installed, maintained, and operating fume/smoke exhaust system is mandatory when operating the laser system**. Fumes and smoke from the engraving process must be extracted from the laser system and exhausted outside.

- **Some materials, when engraved or cut with a laser, can produce toxic and caustic fumes**. We suggest that you obtain the Material Safety Data Sheet (MSDS) from the materials manufacturer. The MSDS discloses all of the hazards when handling or processing that material. **DISCONTINUE** processing any material that shows signs of chemical deterioration of the laser system such as rust, metal etching or pitting, peeling paint, etc. Systems damaged from this abuse will **NOT** be covered under warranty.

- **Care should be taken when moving or lifting this device**. Obtain assistance from 1 or 2 additional people when lifting or carrying. Severe bodily injury may occur if improper lifting techniques are applied or the system is dropped.

- **Dangerous voltages are present within the electronics and laser enclosures of this system**. Although access to these areas is not necessary during normal use, if it becomes necessary to open one of these enclosures for service reasons please remember to disconnect the power cord from your electrical supply.

- **This device is specifically designed to comply with CDRH performance requirements under 21 CFR 1040.10 and 1040.11**.  CDRH is the Center for the Devices of Radiological Health division of the Food and Drug Administration (FDA) in the USA.  It also complies with CE (European Community) safety regulations.  No guarantees of suitability or safety are provided for any use other than those specified by Universal Laser Systems, Inc.

# Laser Safety

- The device contains a sealed carbon dioxide ($CO_2$) laser in a Class I enclosure that produces intense invisible and visible laser radiation at a wavelength of 10.6 microns in the infrared spectrum. For your protection, this enclosure has been designed to completely contain the $CO_2$ laser beam.  However, the intense light that appears during the engraving or cutting process is the product of material combustion or vaporization. **DO NOT STARE AT THE BRIGHT LIGHT OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS.**

- This device may contain a visible red laser diode (Class IIIa). **DO NOT STARE AT THE RED LIGHT OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS.**

- The user door is safety interlocked and will disable the invisible $CO_2$ laser beam from firing when the user door(s) are opened. The control panel will also display a flashing "RED" light to visually indicate that the safety interlock system has been activated (see diagram). However, since the red diode laser produces visible light, is **NOT** safety interlocked and can be activated with the door(s) either open or closed.

CO2 Interlock Indicator Light
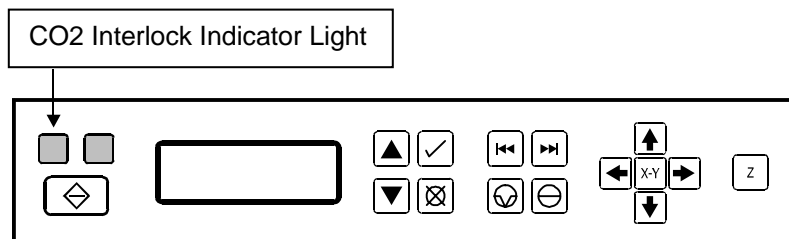
- The user door(s) are safety interlocked and will disable the $CO_2$ laser beam from firing when the user door(s) are opened. The red diode laser beam is **NOT** safety interlocked and can be activated with the door(s) either open or closed.



- Do not operate any system that has had its safety features modified, disabled, or removed as this can expose your eyes and skin to invisible and visible $CO_2$ laser radiation which can cause permanent blindness and/or severe burns to your skin.

- Improper use of controls and adjustments, or performance of procedures other than those specified in this manual, may invalidate the safety of this system.

# Safety Labels

CDRH and CE regulations require all laser manufacturers to affix warning labels in specific locations throughout the equipment.  The following warning labels are placed on the laser system for your safety. **DO NOT** remove them for any reason.  If the labels become damaged or have been removed for any reason, **DO NOT OPERATE** the laser system and immediately contact Universal Laser Systems, Inc. for a free replacement. Labels are NOT to scale

Laser Processing System Manufactured By:

**UNIVERSAL**
**LASER SYSTEMS INC.**
Scottsdale, Arizona

Model No: XXXX
Manufactured: XXXX
Serial No: XXXX                    CE
                    Made in USA

221-0004-0

SERIAL #:   02500A
DATE :  MAY  2000

221-0007-0

WARNING
NEVER OPERATE THE LASER SYSTEM
WITHOUT CONSTANT SUPERVISION

EXPOSURE TO THE LASER BEAM MAY
CAUSE IGNITION OF COMBUSTIBLE
MATERIALS WHICH CAN CAUSE SEVERE
DAMAGE TO THE EQUIPMENT

221-0012-0

WARNING
THIS SYSTEM CONTAINS A
CO2 LASER IN A CLASS I ENCLOSURE.
THE LASER SYSTEM HAS BEEN
CLASSIFIED AS CLASS 3A DUE
TO THE PRESENCE OF A
VISIBLE LASER DIODE.

221-0013-0

THIS EQUIPMENT CONFORMS
TO PROVISIONS OF
US 21 CFR 1040.10
AND 1040.11

221-0015-0

**DANGER**
INVISIBLE AND VISIBLE LASER RADIATION
WHEN OPENED AND INTERLOCK FAILED OR
DEFEATED.  AVOID EYE OR SKIN EXPOSURE
TO DIRECT OR SCATTERED RADIATION.

221-0016-0

**DANGER**
INVISIBLE AND VISIBLE LASER
RADIATION WHEN OPEN
AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED RADIATION

221-0017-0

**AVOID EXPOSURE**
INVISIBLE LASER RADIATION IS
EMITTED FROM THIS APERTURE

221-0018-0

**WARNING**
TURN THE LASER SYSTEM OFF BEFORE
CONNECTING OR DISCONNECTING
THE ROTARY FIXTURE

221-0019-0

**WARNING**
TO AVOID THE RISK OF ELECTRICAL SHOCK
ALWAYS DISCONNECT POWER CORD
BEFORE REMOVING THIS COVER

221-0020-0

221-0021-0

INPUT POWER:
110 VAC; 50/60 Hz; 10 A

221-0022-0

INPUT POWER:
220 VAC; 50/60 Hz; 5 A

221-0036-0

THIS LASER MANUFACTURED BY
UNIVERSAL LASER SYSTEMS
16008 N. 81ST ST
SCOTTSDALE, AZ 85260 USA

IS DESIGNED FOR USE ONLY AS A COMPONENT IN A
ULS LASER SYSTEM. THIS LASER IS A CLASS IV DEVICE AND
DOES NOT COMPLY WITH U.S. CODE 21 CFR SUBCHAPTER J
OR EUROPEAN STANDARD EN 60825-1:1994.

THIS LASER PRODUCT IS MANUFACTURED UNDER
U.S. PATENTS 5,661,746; 5,754,575; 5,867,517;
5,901,167; 5,894,493; 5,881,087
OTHER U.S. AND INTERNATIONAL PATENTS PENDING.

221-0031-0

**DANGER**

LASER RADIATION - AVOID
DIRECT EYE EXPOSURE

LASER DIODE
WAVELENGTH: 630-680 nm
MAX. OUTPUT: 4 mW
CLASS IIIa LASER PRODUCT

221-0032-0

CAUTION LASER RADIATION
DO NOT STARE INTO BEAM OR VIEW
DIRECTLY WITH OPTICAL INSTRUMENTS
CLASS 3A LASER PRODUCT

LASER DIODE
WAVELENGTH: 630-680 nm
MAX. OUTPUT: 5 mW

221-0034-0

## Safety Label Locations

221-0016-0

221-0020-0

221-0004-0

221-0015-0

221-0020-0

221-0021-0

221-0016-0

221-0044-0
221-0045-0
221-0046-0
221-0047-0
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221-0050-0
221-0051-0

221-0031-0

221-0007-0

221-0017-0

221-0018-0
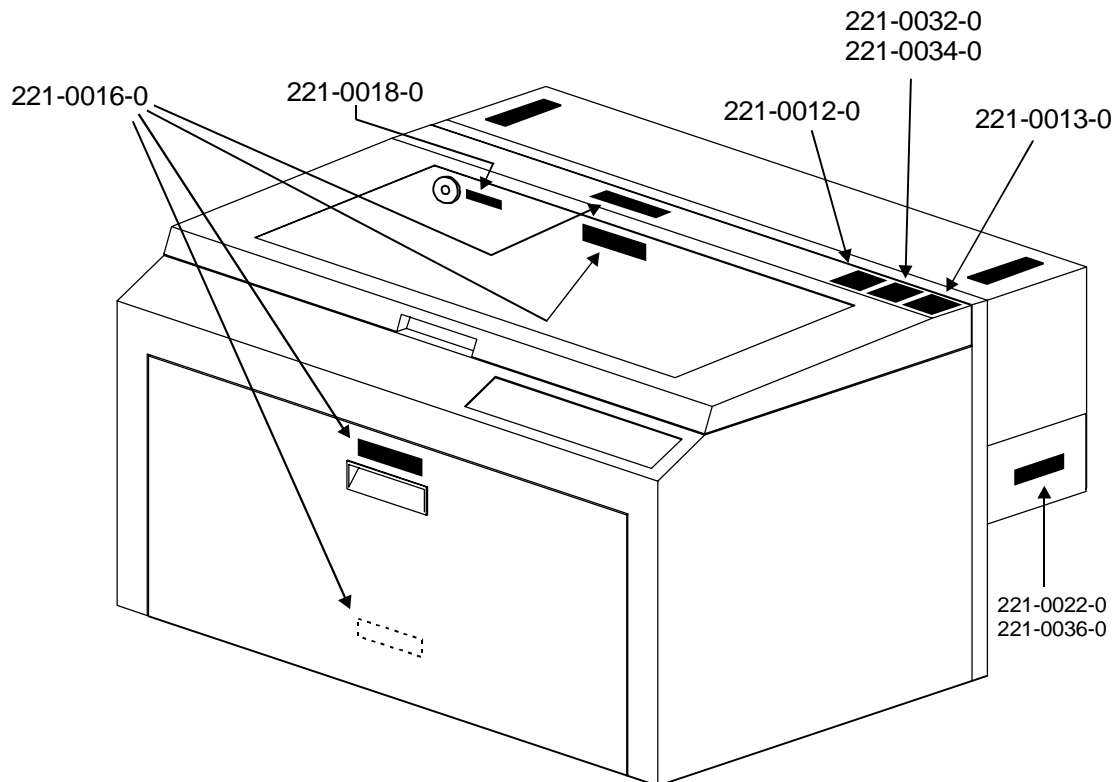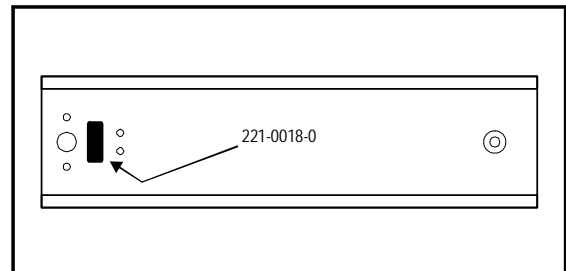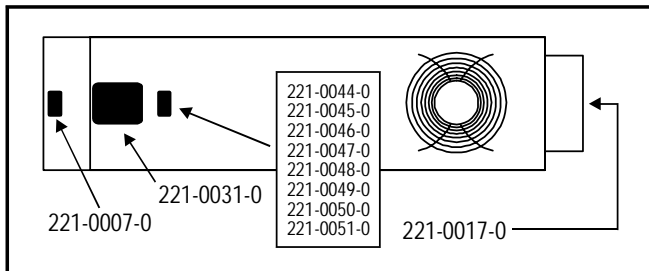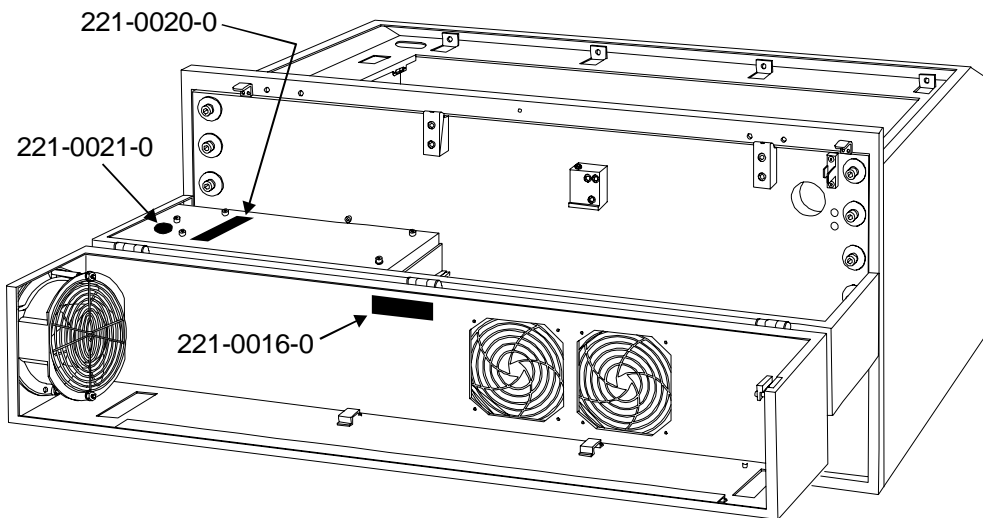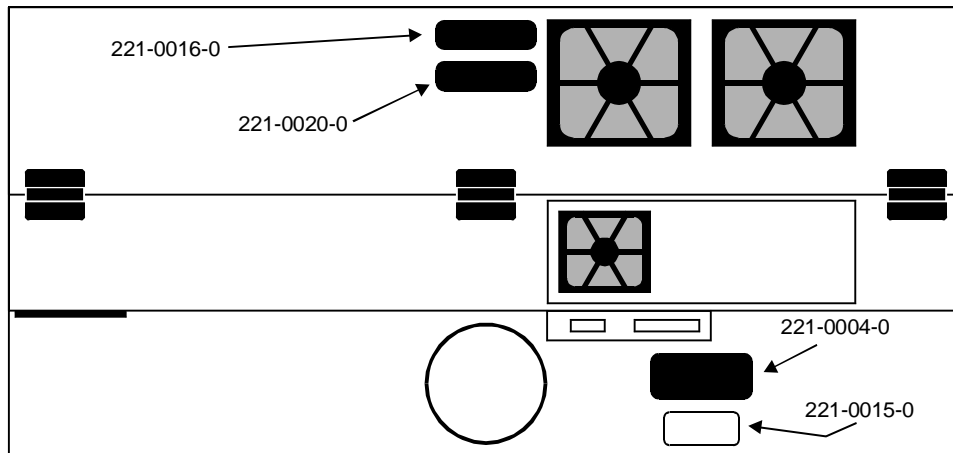
# EU Compliance (CE)

**UNIVERSAL**
L A S E R    S Y S T E M S    I N C.

**Product Identification**:    M-300 Laser Engraving and Cutting System

**Manufacturer**:    Universal Laser Systems, Inc.
16008 N. 81$^{st}$ St.
Scottsdale, AZ  85260
Phone: (480)483-1214  Fax: (480) 483-5620
USA

This equipment Is manufactured in conformity with the following directives:

    89/336/EEC    (EMC Directive)
    73/23/EEC      (Low Voltage Directive)
    89/392/EEC    (Machinery Directive)

based on the standards listed.

**Standards Used**:

    Safety:
        EN 60950: 1995
        EN 60825: 1994 (Class IIIa)

    EMC:
        EN 55022: 1995 (Class A)
        EN 50082-1: 1992
        EN 60801-2: 1993 (6kV CD, 8kV AD)
        EN 61000-3-2: 1996 (class A)
        EN 61000-3-3: 1995
        EN 61000-4-3: 1997 (3 V/m)
        EN 61000-4-4: 1995 (2 kV power line, 0.5 kV signal line)
        EN 61000-4-5: 1996 (class 2)

**Warning -** This is a Class A product.  In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

# FCC Compliance

This ULS laser system has been tested and found to comply with Federal Communication Commission (FCC) directives regarding Electromagnetic Compatibility (EMC). In accordance with these directives ULS is required to provide the following information to its customers.

## FCC Compliance Statement and Warnings

This device Complied with FCC Rules Part 15. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and

2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device as set forth in Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with manufacturer's instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his or her own expense.

Users should be aware that changes or modifications to this equipment not expressly approved by the manufacturer could void the user's authority to operate the equipment.

This equipment has been type tested and found to comply with the limits for a Computing Device per FCC part 15, using shielded cables. Shielded cables must be used in order to insure compliance with FCC regulations.

**SECTION 2**

# Installation
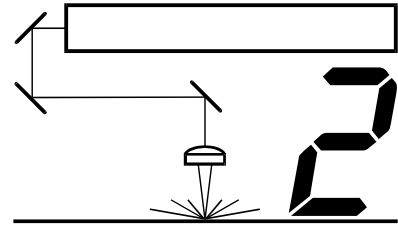
Proper operating conditions are vital to a safe and productive environment.  This section describes the ideal environment and setup of the laser system.

## Operating Environment

Follow these guidelines to ensure a proper operating environment for the laser system. Operating the laser system outside of these guidelines can seriously damage the laser system and damages from this type of abuse **WILL NOT** be covered under warranty.  Although conforming to these guidelines will greatly reduce the chance of a problem occurring, it does not guarantee it.  **It is your responsibility to provide a proper operating environment.**

- Ambient room temperature **MUST** be between 50 and 95 degrees F (10 and 35 degrees C).  If transporting the laser system from a very cold or very hot environment to the proper operating environment, the laser system must be allowed time to adjust to the ambient temperature.  To do this, turn ON the laser system (and chiller if applicable), and let the system idle for 15 minutes before processing materials.  This will allow the ambient temperature to circulate through the laser system to either warm it up or cool it off.

- Ambient room dewpoint temperatures **MUST** be less than 50 degrees F (10 degrees C).

- The laser system **MUST** be installed in an office type environment. Dusty or dirty air environments can damage the laser system.  Keep the laser system isolated from any type of sandblasting, sanding, or any other machinery that produces airborne particles.

- Avoid small, enclosed, non-ventilated areas.  Some materials, after laser engraving or cutting, continue emitting fumes for several minutes after processing.  Having these materials present in a confined, unventilated room can contaminate the room.

- Choose a place, which provides the shortest and most direct path to the exhaust ductwork (not provided).  Refer to exhaust requirements later on in this section.

- Have a work table or storage area next to or nearby the laser system.  This prevents the operator from using the system as a table or storage facility.

- Do not move, push, lean on, or jar the laser system while it is engraving.  The material you are engraving can shift and produce unsatisfactory results.

- If planning to connect the laser engraving system to a computer through the parallel port, choose a location where the computer will be placed within 6 feet of the machine since this is the maximum recommended parallel cable length.  Included with your system is a high quality, IEEE1284 compliant, 6-foot parallel printer cable.  **PLEASE USE THIS CABLE ONLY.  DO NOT SUBSTITUTE IT WITH A LONGER OR LOWER QUALITY CABLE OTHERWISE FILE TRANSMISSION ERRORS MAY OCCUR.**

- If connecting an additional laser system or other printer to the same computer, we recommend the installation of an additional parallel port into the computer.  **DO NOT** use a manual A/B type switch box.  This creates electrical noise, which can cause an engraving problem or can damage the laser system and/or the computer's electronics.

- It is possible to connect your computer to the laser system via the computer's USB port.  However, to do this, a special USB to Parallel Port adapter cable **MUST** be purchased.  We recommend only "Belkin" brand converter cables.  This cable can be purchased through your local computer store or purchased via the Internet through Belkin's web site, www.belkin.com.  Follow the manufacturer's instructions on how to install the cable.

# Electrical Requirements

Please refer to the "INPUT POWER" sticker near the system's ON/OFF switch and power inlet for your system's electrical requirements. Make sure that your electrical outlet is capable of providing the proper voltage, frequency and amperage that your laser system needs.

Noisy or unstable electricity as well as voltage spikes can cause interference and possible damage to the electronics of the laser system. Connect the laser system to a dedicated electrical line if this is a problem in your building.

An IT type of electrical supply is acceptable if a standard power source is unavailable.  An IT power system is a power distribution system having no direct connection to earth, the exposed conductive parts of the electrical installation being earthed.



L1
L2
L3
N

Impedance

Power system earth

Exposed conductive parts

PE
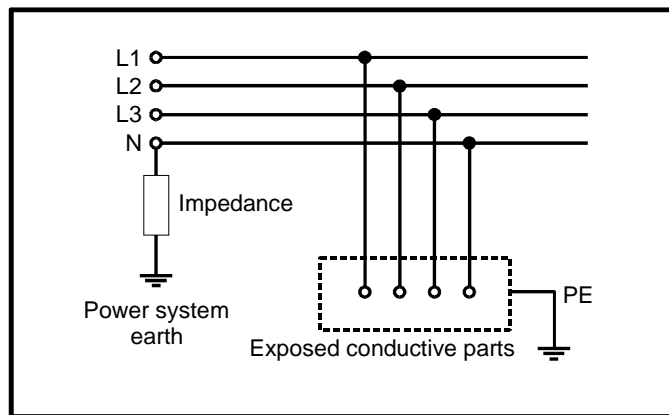
Example of IT power system



**WARNING**

**Never remove the ground lead to the electrical cord and plug the system into a non-grounded outlet**.  This is very dangerous and can lead to a severe, if not fatal, electrical shock.  Always plug the system into a 3 prong grounded outlet.

If electrical power fluctuations, brown outs, or constant power outages are a problem in your area, an electrical line stabilizer, UPS (Uninterruptible Power Supply), or backup generator might be required.  If installing any of these devices, make sure that they meet the electrical requirements of the laser system.

If there is any type of electrical problem present, please contact a locally licensed electrical contractor to correct the problem. If an incorrect electrical supply, voltage spike or surges damage the laser system, the damages **WILL NOT** be covered under warranty.  **It is your responsibility to provide a suitable electrical supply.**

# Exhaust Requirements

To properly exhaust fumes and smoke from the laser engraving system during operation, it is necessary for you to provide a proper exhaust system.  This system MUST be capable of supplying 250 CFM (cubic feet per minute) @ 6 inches of static pressure (water).

⚠️ **WARNING**

**Never operate the laser engraving system without a properly installed and operating exhaust system.  Some materials when cut or engraved can produce fumes that are hazardous in concentrated amounts.**

The blower **MUST** be mounted on the **OUTSIDE** of the building either on the roof or on a cement pad next to the building possibly mounted on vibration dampers.

Rigid tubing should be used for 90% of the distance traveled.  The tubing should be smooth walled and have as few 90 degree bends as possible.  Two 45 degree bends have better airflow than one 90-degree bend.  Use tubing with a diameter that matches the blower unit (usually 6 inches/1524 mm) and use a 6 inch (1524 mm) to 4 inch (1016 mm) reducer to couple the tubing down to 4 inches (1016 mm) to within a few feet from the laser system.  Do not connect the rigid tubing directly to the laser system.  Use a short piece of industrial grade, wire reinforced rubber tubing to connect the end of the gate, or rigid tubing, to the laser system.  This will provide mobility and will dampen blower vibrations.  Use only a few feet because it's spiral construction reduces airflow.  Install a hose clamp on both ends of the hose to prevent leaks and to prevent the hose from slipping off. Finally, have the blower wired to a wall switch in the same room for easy ON/OFF control.

Also consider installing a gate to control airflow and to close off the exhaust from the outside environment when the laser is not in use.  This is especially useful in colder climates where it can be damaging to the laser system to have cold air coming into it from the outside.

In order to meet the laser system's CFM requirements, a high-pressure, high static pressure rated, exhaust blower must be installed. This type of blower has self-cleaning blades and can maintain airflow even though restrictions are introduced.  Length of exhaust pipe, exhaust pipe diameter, number of 90-degree angles, and other restrictions must be calculated when determining the correct exhaust blower unit. Installing an incorrect or undersized blower is not only unsafe, but it can also lead to premature and excessive wear and tear to the laser system.

**DO NOT** install forward incline, backward incline, in-line, or ventilator fans because these types of air handlers are inadequate and inappropriate for this type of installation.  If your contractor has any questions concerning blower specifications or exhaust system requirements, please contact our Service Department directly before installation.

The following diagram shows a typical exhaust system layout.  Use this as a guideline to proper exhaust system installation.  Although these diagrams just serve as an example, we recommend installation of the exhaust system by a licensed contractor to meet safety and local code requirements as well as being able to calculate the correct size blower required for your particular installation.

(1) Exhaust Blower mounted outside the building
(2) Weatherproof shield
(3) Rigid ducting matching the diameter of the blower inlet
(4) Shut-off or air-flow gate
(5) Reducer to 4 inches
(6) Flexible, wire-reinforced, industrial grade rubber hose
(7) On/Off switch
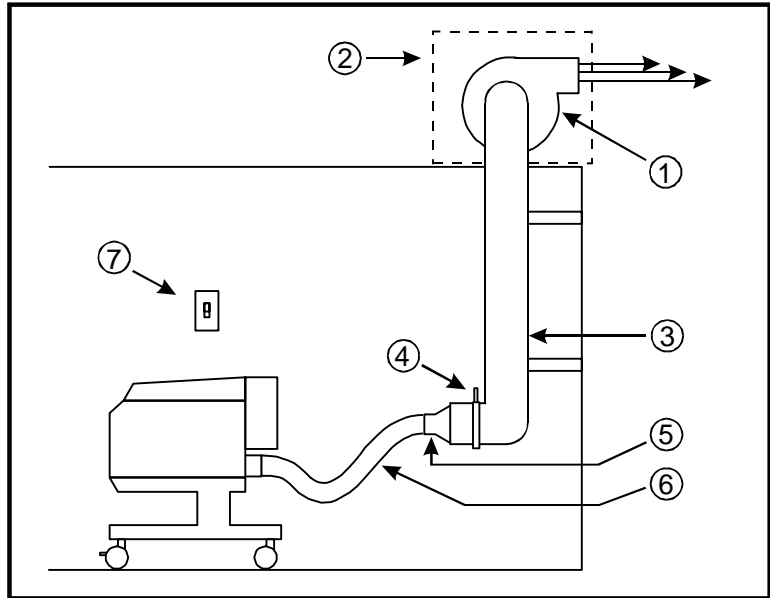
## Cart Assembly

Since packaging of this unit may vary from time to time, make sure that you locate the following items from within the crate or inside of the front door of the system:

(1) Back Panel
(2) Legs (both are identical)
(3) 1/4-20 x 1/2 socket head screws with lock and flat washers (8)
(4) Nuts (4)
(5) Non-locking Casters with nuts (2 - Rear)
(6) Locking Casters with nuts (2 - Front)
(7) 10-32 x 1/4 socket head screws (2) (these serve as guides for the main enclosure)
(8) 10-32 x 3/8 socket head screws with lock and flat washers (2)
(9) Connect to main enclosure
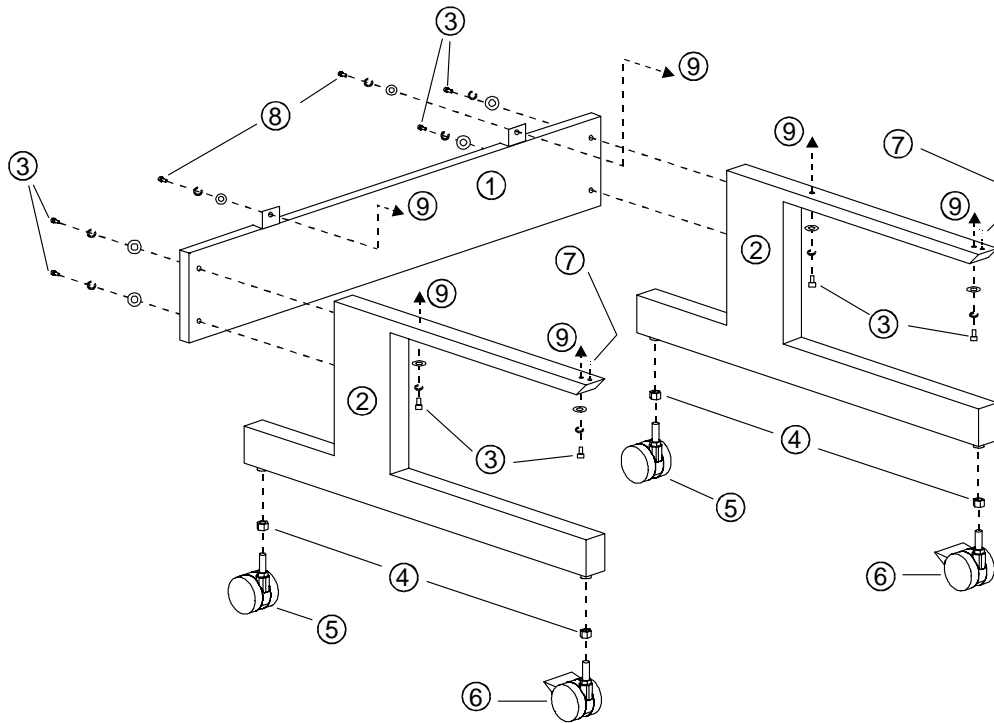
1. Attach the back panel (1) to the legs (2) with the 4 screws and lockwashers (3) using the allen wrench provided.
2. By hand, thread the 4 nuts (4) all the way down onto the caster shafts until they bottom out.
3. Carefully turn the stand upside down.
4. Install the non-locking caster (5) in the rear and the locking casters (6) in the front.
5. Tighten down the casters securely to the legs using the 3/4 inch wrench provided.
6. Carefully turn the stand right side up.
7. Lock the front casters by stepping down on the locking tab so the stand will not roll.
8. Note the lifting points as shown, (1) and (2), on both sides of the system. With the assistance of one or two other people, carefully lift the laser system and place it onto the cart assembly being careful not to drop it or pinch your fingers.
9. Thread the remaining two screws and lockwashers (C) through the tabs on the back panel (A) and into the backside of the laser system.  Do not tighten down completely yet.
10. Thread the 4 screws and flat washers (H) through the underside of the legs and into the bottom of the laser system.   Do not tighten down completely yet.
11. Gently open the front door and see if it comes in contact with the bottom part of the legs.
12. Space the legs apart to provide clearance for the front door (1)(next page).
13. Securely tighten all remaining screws.
14. Relocate the laser system to its final resting position next to the computer and exhaust system.
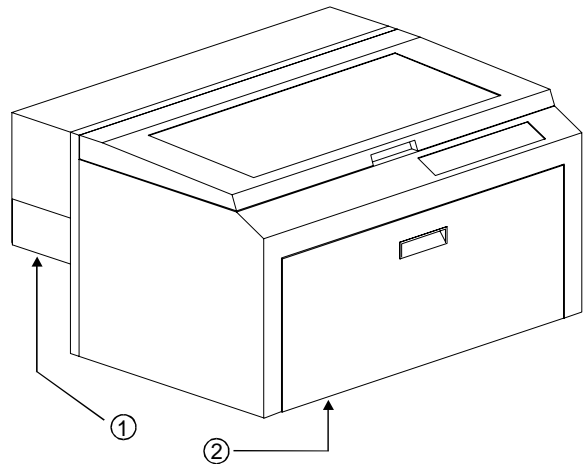
15. If the floor underneath the laser system is uneven, the casters must be adjusted. Refer to the following leveling instructions. Place a bubble level across the top of the legs directly above the front casters (2). Note the bubble position in its sight glass. Do the same for the back part of the legs and also note the position of the bubble in the sight glass (3). If the bubbles are in the same visual position, adjustment is not necessary and cart assembly is complete. If they are in different positions, adjustment is required.

16. To adjust the casters, choose ONLY ONE (1) caster and adjust its height until the bubbles are visually identical when placing level over the front and rear casters. The Intent is to ensure that all casters lie in the same plane, not to level the laser system with the ground. If desired, you can level the laser system with the ground although it is not required.

17. Open the top door and remove the rubber band that is holding the arm in place.

18. Remove any remaining packing materials, accessories or any other items that may be located inside the cabinet or on top of the engraving table.

19. Gain access to the rear of the laser system to install the Laser Cartridge.
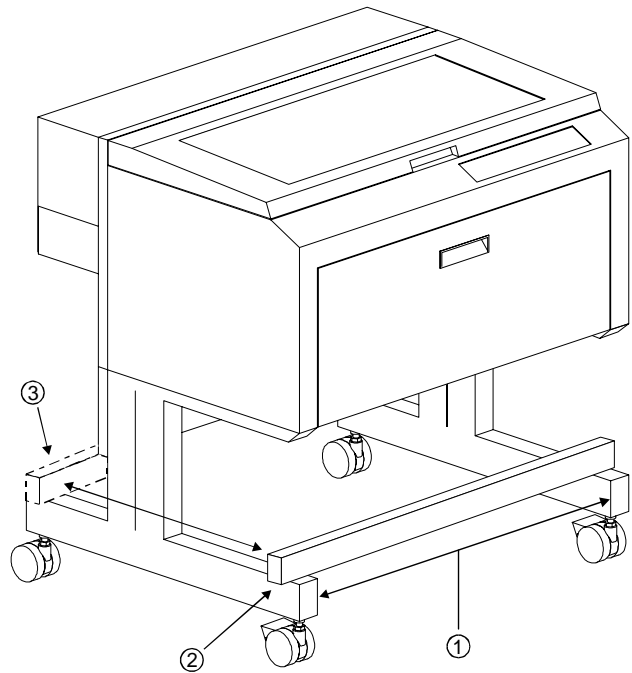
# Laser Cartridge Installation

Before connecting and powering on your system, you must install the Laser Cartridge. Make sure that your power cord **IS NOT** plugged in at this time.
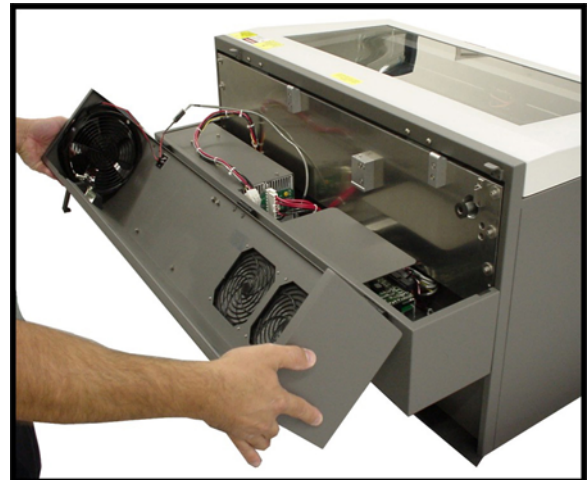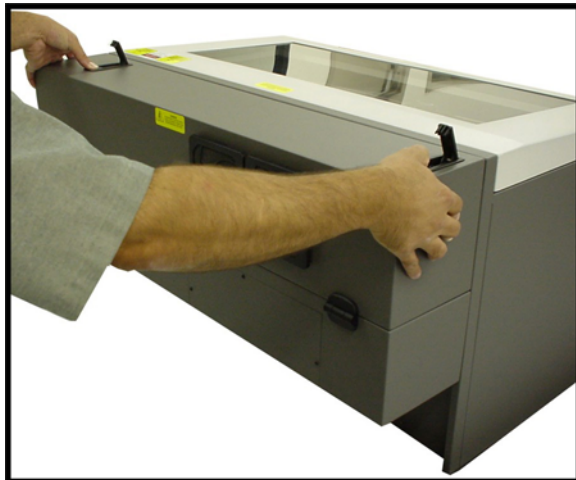
With your fingers, press on the backside of the two hinges to release the latch and gently fold back the rear cover.
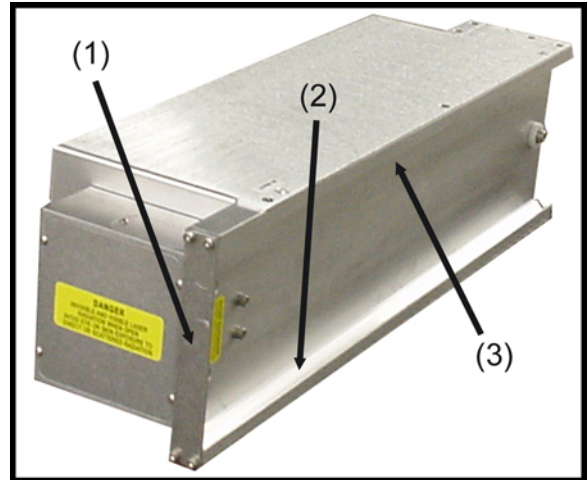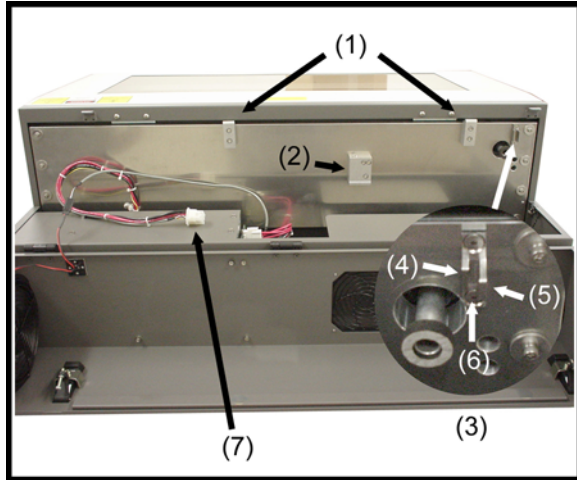
Visually locate the two Mounting Blocks (1), the Laser Latch (2), Alignment Fork (3), and Power Connector (7). Notice that the Alignment Fork has two plates, one small (4)and one large (5).  Locate the gap between the two plates (6).

Observe the "V" groove along the upper (3) and lower (2) part of the Laser Cartridge.  Also locate the Alignment Plate (1) at the end of the Laser Cartridge.
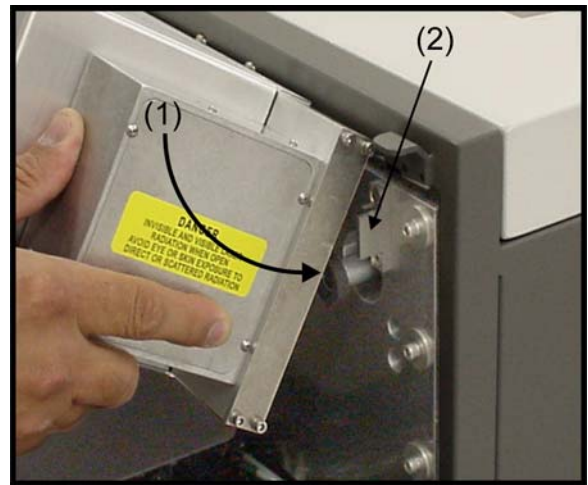




Pick up the Laser Cartridge by the sides.  Tilt the Laser Cartridge downward on a 30-degree angle. Mount the cartridge onto the Mounting Blocks by placing the upper "V" groove of the cartridge on top of the Mounting Blocks.  Slide the cartridge to the right until the **OUTER EDGE** of the Alignment Plate contacts the **INSIDE EDGE** of the large plate of the Alignment Fork.

Slowly rotate the Laser Cartridge making sure that the Alignment Plate is centered in the gap of the Alignment Fork between the small and large plates.  Keep rotating the laser until the Laser Latch "clicks" and locks the cartridge into place.  **Make sure that you do not pinch any wires or hoses during this process**.  This may require some slight force to actuate the latch.
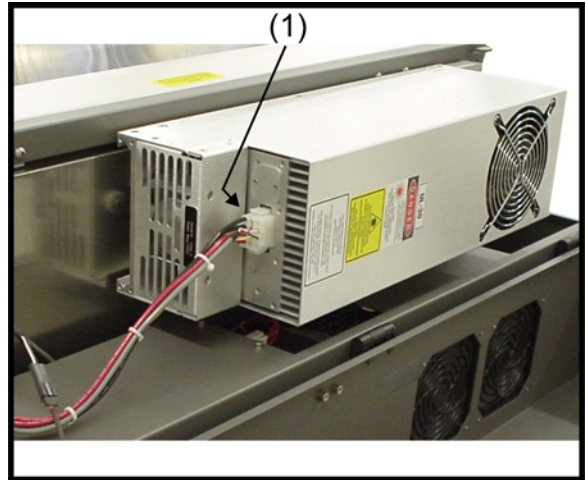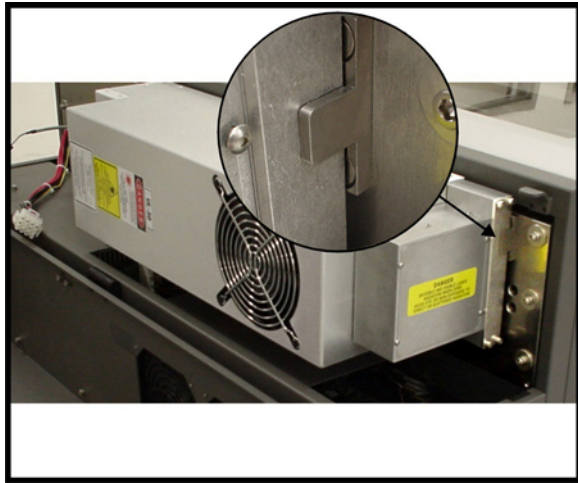
Verify that the cartridge is resting, un-tilted, and the Alignment Plate is centered within the Alignment Fork.

Plug in the Power Connector. The connector is keyed so it will only insert one way.

Close the Rear Cover and push down on the latches until they "click". Later on in this manual under the "Making the Connections" section, we will verify that you have installed the cartridge correctly. For now, let's assume that it is OK and move on to the next section.

# Laser Cooling Requirements

This type of laser system uses fans to keep the laser cartridge and electronics cooled during operation. Maintain the room temperature at the recommended ambient temperature range outlined previously in the Operating Environment section.

⚠️ **WARNING**  **Do not confine the back of the machine by surrounding it with furniture, shelving, backing it into a corner, etc. The backside of the laser system must be allowed to "Breathe" otherwise it can overheat the laser cartridge, power supply, and/or the CPU module. Overheating may cause serious and very costly damage to the laser system.**

# Computer Requirements

The following is the **MINIMUM** required computer configuration. Using a faster computer with more capacity will increase efficiency and throughput. Although using a computer that does not meet our minimum recommendation might be acceptable to you, a faster computer will definitely pay for itself in a short amount of time.

- Pentium 300 MHz or equivalent
- 32 MB of RAM
- 2 Gigabyte hard drive or bigger
- 17 inch color VGA monitor
- 3.5" floppy disk drive
- CD-ROM Drive
- Mouse or other pointing device
- Microsoft Windows 95
- 600 DPI Optical Resolution Scanner

> Remember that the laser system is an output device just like a printer is. The faster you can create graphics and manipulate your software, the faster you can download to the laser system to keep it producing.

# Software Suggestions

The following is a list of recommended software programs. We do not endorse any particular software program neither do we guarantee its full compatibility with the laser system. Please refer to the Appendices section on known bugs/anomalies related to these particular software programs, related versions, and ones that are not listed below.

**Graphics Programs**
- CorelDraw
- Macromedia Freehand

**Bitmap / Scanning Software**
- Adobe Photoshop
- Adobe Streamline - for raster to vector conversion

**CAD Software**
- AutoCAD for Windows
- AutoCAD LT for Windows
- Autosketch for Windows
- DesignCAD for Windows

> CAD users do not necessarily need Windows or Windows compatible programs. The laser system is compatible with any program that can output standard HPGL commands whether it is Windows based or not. Refer to the Appendices on using DOS based CAD programs.

When a software company updates their version of their programs, it can sometimes cause conflicts with our printer driver. Our programmers constantly test new software programs and updated versions for compatibility. We will update our printer driver to address issues that we have control of. For bugs or problems with your software not related to the laser system, please contact the software manufacturer.

# Font Requirements

**True Type**
We recommend using True Type fonts **ONLY**. TrueType fonts are the most versatile and should be used whenever possible. They provide the best print quality and will print well at any size.

**PostScript**
We do not recommend using PostScript fonts. The laser system is **NOT** a PostScript printer and therefore has no capability of printing PostScript fonts. Sometimes a PostScript font will print if you are running Adobe Type Manager (ATM). Adobe Type Manager converts PostScript fonts to bitmapped fonts before sending the information to our printer driver. Using ATM does not guarantee that the PostScript font will print properly therefore it is **NOT** recommended.

**Bitmap**
Bitmapped fonts only print well when used at the specific point size they were designed for. This point size is usually indicated in the font name such as Times Roman 12. If a font is only available in bitmap form, you must print it at the size it was created for. Scaling the font larger will result in a more jagged looking character although scaling it smaller produces good results.

**Helpful Tip**
If you are having any problems printing a font and you cannot figure out what is going on, select the font and "convert to curves" or "convert to paths" in your graphics software. This will convert the font into a bitmapped image and will print correctly to the laser system. Refer to your graphics software on how to convert fonts.

As you can see, we strongly recommend the use of True Type fonts only. Usually, most graphics programs, such as CorelDraw come with hundreds of fonts that you can install. For the average user there is more than enough to choose from.

# Making the Connections

Please use the parallel cable supplied with the system. It is a 6-foot, high quality, shielded, IEEE1284 compliant cable. If you use a printer cable other than the one provided, it will violate the laser systems FCC and CE rating and may also cause harmful interference when downloading files to the laser system.

Please make the following connections in the exact order described otherwise static electricity can damage the computer and/or the laser system's electronics.

- Connect the systems Power Cord and your computer Power Cord to the electrical outlet(s). Do not turn on either unit at this time.
- Connect the system to the computer using the parallel port connection.
- Connect the rubber flexible hose of your exhaust system to the exhaust port of the laser system.
- Turn on your computer ON and check your computers BIOS setting for your parallel port.
  Make sure that it is set to either "ECP" or "Standard Parallel Port". **DO NOT SET IT TO "EPP" or "Bi-directional".** The laser system does not support these modes. If your computer is set to an incorrect configuration, erroneous data will be sent to the laser system during printing. This can cause the system to lock up, print garbage information, or not print at all. For information on how to check or adjust your computers BIOS setting, please refer to your computer's owner manual or call their technical support department.



Serial          Parallel
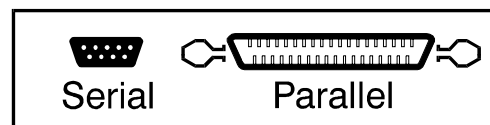
- Turn ON the laser system.  After the system finishes initializing, "Ready" will appear displayed on the Control Panel of the laser system.
- We will now check if the Laser Cartridge was installed properly. To do this, open the top door and place a small piece of masking tape across the ¾" hole in the focus carriage (1). Gently rub the tape around the edge of the hole so that you can see the outline of the hole through the tape (2).
- Now press the "X-Y" button on the Control Panel.  The red diode pointer will illuminate and a red dot will appear on the masking tape (3).  The dot should appear centered, or close to the center of the hole, within 1/8".  If not, remove and re-install the laser cartridge and try again.  If the red dot still does not appear within 1/8" of the center of the hole, please contact our Service Department.
- If the red dot is centered, installation is complete.  Remove the masking tape.
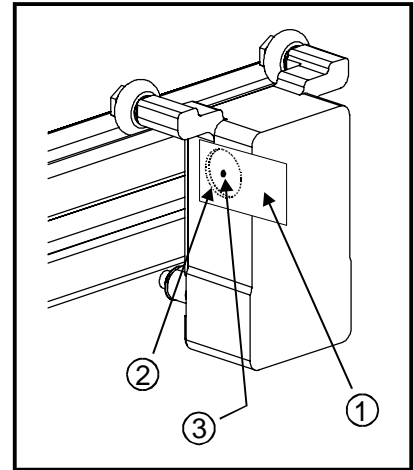
# Problem Prevention

## The following are things that you <u>MUST NEVER</u> do:

**1) Never connect or disconnect the printer cable while either the computer or the laser system is powered ON**. Always power down both units and leave them plugged into the wall outlet when connecting or disconnecting the printer cable.

**2) Never connect the laser system through a manual switch type A/B switch box.** If connecting an additional laser system or other printer to the same computer, we recommend the installation of an additional parallel port into the computer.  Using a switchbox can create electrical noise that can cause an engraving problem or can damage the laser system and/or the computer's electronics.

**3) Never use any device that is installed between the computers parallel port and the parallel port of the laser system such as a ZIP drive or parallel port CD-ROM drive.** This can not only damage the laser systems electronics but it usually will not work and will cause file transmission errors.  Again, install an additional parallel port for other peripheral devices.

Computer Controlling the Laser System

At this time, you will need to read the second manual supplied with your system.  It is called "Computerized Controls".  This manual contains Windows 95/98 printer driver installation and operation instructions as well as setup instructions for graphics software to properly work with the laser system.  Please read this other manual before continuing on to Section 3.

**SECTION 3**

# System Operation
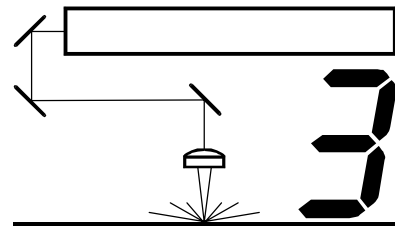
In this section you will learn how the laser system actually works and will familiarize you with laser system terminology.  We will then start working with the control panel and learn how to get around in the menu system.  Since there are many features in this laser system, the menu system may seem complicated at first, but once you start using it, you will find out that it is a very simple system to operate.

## How it Works

There are five (5) basic components that make up the laser system, the control panel, the CPU, the DC power supply, the laser cartridge, and the motion system.
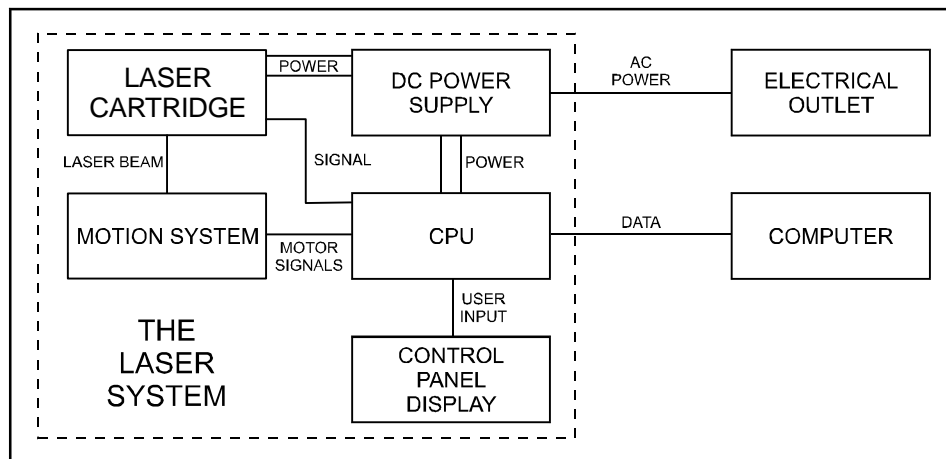
### DC Power Supply

The DC power supply converts the incoming AC electricity to 48 volts DC.  This is used to power both the laser cartridge and the CPU.

### CPU

The CPU is the "brains" of the system and controls everything.  Located on the CPU are standard computer memory SIMMS.  This is where incoming files, from the computer, are stored while the power is on.  The CPU gets input from the computer and the control panel.  It outputs precisely timed signals to fire the laser beam and to move the motion system simultaneously.

### Control Panel

This is where the operator controls the laser system.  It is composed of tactile feel push buttons and a LCD display.  From this panel, the operator can position the motion system, move around through the menu system in the LCD display, and run the laser system.

**Laser Cartridge**

The laser cartridge is a very sophisticated device. It is composed of a plasma tube filled with a special mixture of $CO_2$ and other gases, and RF (radio frequency) electronics. The function of the entire assembly is to turn electrical energy into concentrated light energy. The word LASER is an acronym for Light Amplified Stimulated Emission of Radiation.

## LASER CARTRIDGE

| | |
|---|---|
| GAS FILLED PLASMA TUBE | |
| ELECTRODES | |
| RF ELECTRONICS | |

#1 MIRROR
BEAM WINDOW
BEAM DIAMETER
#3 MIRROR
#2 MIRROR
FOCUS LENS
FOCAL LENGTH
FOCAL RANGE
MATERIAL
SPOT
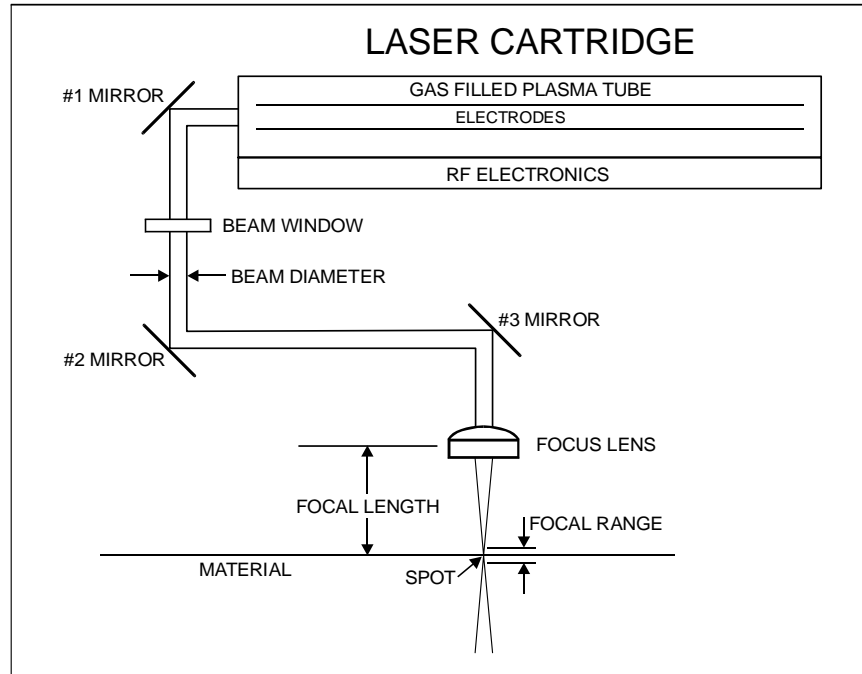
The laser cartridge It receives power from the 48VDC power supply and its "trigger signal" from the CPU. When the laser system is power on and the trigger signal comes from the CPU, the RF electronics produce a high frequency AC signal across the electrodes located inside the plasma tube. This causes spontaneous photon emissions from the gas mixture that produces an invisible, infrared light beam at a frequency of 10.6 microns.

The laser beam exits the laser cartridge through its output optics, bounces off the #1 mirror, passes through the beam window, bounces off the #2 and #3 mirror, and finally passes through the focus lens. The #2 and #3 mirror and the focusing lens are all mounted to the motion system. The width of the laser beam as it exits the tube, called the "Beam Diameter", is about 4 mm. The focus lens focuses the beam into a very small spot whose "Spot Size" is dependent on the "Focal Length" of the lens. The "Focal Length" is the distance from about the center of the lens to the point where it converges the beam into the smallest spot possible. Using a standard 2 inch focal length lens, the spot size produced is approximately .005 inches.

The "Focal Range" of the lens, where the beam is considered to be "in focus", is equivalent to +/- 5% above and below the focus point. Shorter lenses produce a smaller spot size but also have a very narrow focal range. This means that it would only be useful for engraving very flat objects. The longer lenses have a much wider range of focus but also produce a larger spot size that would prohibit the engraving of fine detail. This can be related to trying to write small text with a wide, felt tip marker. There are pros and cons to the different lenses that are available for different applications. Please refer to the Appendices section on available lenses and their operating characteristics.

"Wattage" signifies the amount of heat energy that the laser light is producing over a period of time. Laser energy is measured with a laser power meter.  Do not confuse the electrical wattage rating of a light bulb or a hair dryer with the wattage rating of the laser system.  They are two different types of measurements.

**Motion System**
The motion system consists of the mechanically moving parts of the laser system.  It is made up of rails, motors, bearings, belts, mirrors, a lens, and other parts.  There are two directions of motion, left and right is called the "X" direction and front to back is called the "Y" direction.



MOTION SYSTEM
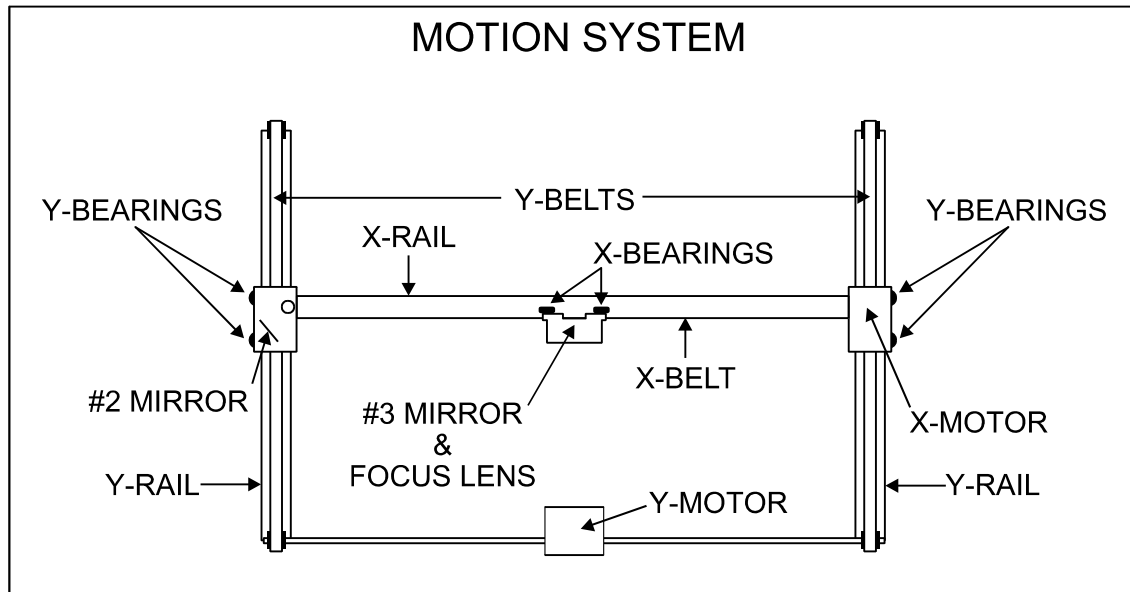
The CPU controls the movement of the motors, which moves the mirrors and focus lens across the engraving area and over the material.  At the same time, it is synchronizing the laser pulses with the position of the focus lens.  It is this precise positioning and timing of the laser pulses that produces the highest quality and fastest speed of engraving.

In summary, the five (5) components work together to take the graphic image that is downloaded to the laser system from your computer and burn it into the material located on the engraving table inside of the laser system.

# The Control Panel

The control panel on the laser system provides easy access to all of the controls necessary for cutting and engraving operations.  The control panel consists of a liquid crystal display (LCD), indicator lights, and selection buttons.  The following section will describe, in detail, how to maneuver through the menu system and the significance of each item in the control panel.
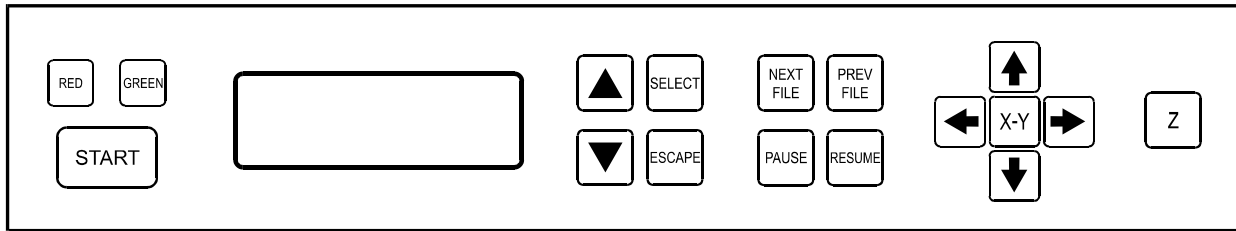
**The Liquid Crystal Display (LCD)**
The LCD is a four line display that displays the menus that control the laser system.  It is a backlit type of display that enhances visibility even under low light environments.

When the laser system is powered on, the laser system will perform a series of routines. "INITIALIZING" will display until the motion system and electronics have finished their routines.  When completed, the display will then read "READY", signifying that the laser system is ready to accept files.



**WARNING**

**DO NOT** download files until the display reads "READY" as this can lead to an incorrect or corrupted file download.  Corrupted file downloads can lead to an incorrect firing of the laser which can destroy the material you are engraving.



The two up and down arrow buttons to the right side the LCD give complete access to the menu control system.  Use these arrow buttons to move the cursor up or down through the items in the display.



Both of these buttons each serves two purposes.  Depending on which menu you are in at the time, the "SELECT" button either enters you into that menu item the cursor is currently on, or it toggles that menu item to display different choices.  Some items in the display lead to other menus and some are settings that can be adjusted.  The "ESCAPE" button, depending on which menu you are in at the time, either exits you back to the previous menu or it nullifies or cancels any changes that you have made to that menu item.  Continuously pressing the "ESCAPE" button will eventually bring you back to the "MAIN" menu.



The indicator lights will act differently depending on the current state of the laser system.  The chart below describes the conditions of the indicator lights during different modes of operation.

**Green Indicator Light**

| CONDITION | REASON |
|---|---|
| ON | The laser system is powered up, the top door is closed and the system is ready to receive a file |
| | The laser system has finished processing a file and has returned to the home position |
| | The laser system has been paused while running a file |
| OFF | The top or front door is open |
| | The laser system is firing the beam in the Alignment Mode |
| FLASHING | The file is running |

**Red Indicator Light**

| CONDITION | REASON |
|---|---|
| ON | The laser system is initializing |
| | The laser system is firing the beam in the Alignment Mode |
| OFF | The laser system has finished initializing and is ready to receive a file |
| | The top or front door is closed |
| FLASHING | The top or front door is open |

**The Process Controls**
These control the actual running of the laser system.

> START

Runs the current file displayed in the "File Display" menu.

> PAUSE    RESUME

If a file is running, the "PAUSE" button halts the engraving or cutting process.  When paused, the motion system arm will move to its home position in the upper right corner of the engraving area.  When ready to continue operation, press the "RESUME" button and the system will begin cutting or engraving again exactly where it left off.  If you wish to run the file from the beginning after pressing the "PAUSE" button, press the "START" button.  **When "Curve Enhancement" mode is selected in the driver, the "Resume" button acts like the "Start" button and will start your file from the beginning.**

During slow raster or vector motions, the motion system might not pause immediately after the "PAUSE" button is pressed.  It can take a few seconds or several seconds to stop the system because it needs to complete the motion commands that it is currently running.  Opening the top door also works similar to the "PAUSE" button but not exactly.  The first thing the laser system will do is turn off the laser beam immediately after the door is opened.  The next thing it will do is pause the motion system.  Since opening the door and the pausing of the motion system are not precisely synchronized if you do this, resuming the file might cause an area of missed engraving.  Opening the door to turn off the laser and to pause the motion system should only be used for safety or emergency reasons.
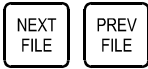
NEXT FILE    PREV FILE

The "NEXT FILE" button displays the next file in the systems memory and makes it the current file and will stop at the last file in memory.  The "PREV FILE" button displays the previous file in the systems memory and makes it the current file and will stop at the first file in memory.  These buttons are inoperative if a file is currently running.

**The Motion Control System**
The motion control section of the control panel (the four directional arrow buttons) enables the user to manually control motion system movement.
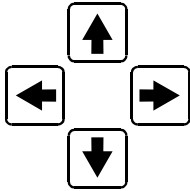
Pressing and holding down an arrow button will cause the focus lens assembly to move in the respective direction.  The motion system starts off slowly, but if you continue to hold down the button, you will see it accelerate to a faster speed.  Pushing the button once and letting it go quickly will move the motion system in .001 inch increments.  Pressing two adjacent buttons will move the assembly in a diagonal direction.  This part of the control panel is primarily used to position the focus lens assembly directly over the engraving material and to use the focus tool to set the proper focus height.  Other uses for these buttons will be discussed later in this manual.

X-Y

You must be in the "FILE DISPLAY" menu or the "MAIN" menu for this button to be operable.  Pressing it enables the "ORIGIN POSITION" menu to appear.  It also turns on the optional red laser diode that shows where the focus lens assembly is positioned in the field by shining a bright red "dot" on the engraving area.  Further details on how to use this button will be covered later in this section.

Z

This button positions the focus carriage slightly away from the upper left hand corner at the default (1,1) position in the engraving area.  This is where the majority of focusing will be done.  Once the focus carriage is positioned, using the motion control arrow buttons can still move the motion system.  Pressing the button again will move the focus carriage back to the home position in the upper right corner of the engraving area.  You can set the default position to anywhere in the field that you desire.  Relocating the focus position is covered later on in this section.

# The Menu System

The LCD displays the menus of the laser system.  Since this laser system has many features, we have included a "Menu System Flow Chart" on the next three pages.  It diagrams and displays the menu items in the entire system and the button selections needed to access them.  A description of each menu item follows the flow chart.

## POWER ON

```
INITIALIZING
```

30 SECOND DELAY

```
READY
```

ESCAPE    MAIN MENU    SELECT    DOWNLOAD FIRST FILE

```
■ FILE DISPLAY
  MEMORY CONTROL
  DOS POWER SETTINGS
  PREFERENCES
```

SELECT

ESCAPE

```
■ 001)FILENAME.XXX
  PWR  100%    0:00:00
  SPD  100%    COPIES  0
  PPI   500     500  DPI
```

```
  FILE DISPLAY
■ MEMORY CONTROL
  DOS POWER SETTINGS
  PREFERENCES
```

SELECT

ESCAPE

```
■ 001)FILENAME.XXX
  DELETE THE FILE
  DELETE ALL FILES
  FREE MEMORY   3.7MB
```

```
  001)FILENAME.XXX
■ DELETE THE FILE
  DELETE ALL FILES
  FREE MEMORY   3.7MB
```

SELECT

ESCAPE

```
  001)FILENAME.XXX
  --- ARE YOU SURE ---
■ CANCEL
  YES DELETE THE FILE
```

```
  001)FILENAME.XXX
  DELETE THE FILE
■ DELETE ALL FILES
  FREE MEMORY   3.7MB
```

SELECT

ESCAPE

```
  DELETE ALL FILES
  --- ARE YOU SURE ---
■ CANCEL
  YES CLEAR MEMORY
```

```
  FILE DISPLAY
  MEMORY CONTROL
■ DOS POWER SETTINGS
  PREFERENCES
```

SELECT

ESCAPE

```
■ PEN SETTING      1#
  POWER         100%
  SPEED         100%
  PPI            500
```

```
  FILE DISPLAY
  MEMORY CONTROL
  DOS POWER SETTINGS
■ PREFERENCES
```

SELECT

ESCAPE

```
■ OPTIONS
  CONFIGURATION
  DIAGNOSTICS
  ABOUT
```

PRESS X-Y BUTTON FROM EITHER READY, MAIN, OR FILE DISPLAY MENUS. TURNS ON RED LASER DIODE

X-Y

```
  ORG 24.000X  12.000Y
  POS 00.000X  00.000Y
■ SET NEW ORIGIN
  RE-HOME X-Y
```

```
  SET NEW ORIGIN
  POS 01.000X  01.000Y
■ CANCEL
  YES  SET NEW ORIGIN
```

PRESS Z BUTTON FROM EITHER READY, MAIN, OR FILE DISPLAY MENUS. PRESS AGAIN TO ESCAPE

Z

```
  Z POSITION      0.00
  CURRENT LENS   2.0
  SET FOCAL LENGTH
  RE-HOME Z
```

...continued from previous page

```
■ OPTIONS
  CONFIGURATION
  DIAGNOSTICS
  ABOUT
```
SELECT →
ESCAPE ←
```
■ ONE FILE MEMORY OFF
  AUTOFOCUS      OFF
  AIR ASSIST     AUTO
  DUAL HEAD      OFF
```

▼  ▲

```
  OPTIONS
■ CONFIGURATION
  DIAGNOSTICS
  ABOUT
```
SELECT →
ESCAPE ←
```
■ SET FOCUS POSITION
  SET ROTARY AXIS
  TICKLE
  PORTS
```
SELECT →
ESCAPE ←
```
  SET FOCUS POSITION
  POS  1.000X 1.000Y
■ CANCEL
  YES SAVE POSITION
```

▼  ▲

```
  SET FOCUS POSITION
■ SET ROTARY AXIS
  TICKLE
  PORTS
```
SELECT →
ESCAPE ←
```
  ROT           6.000Y
  POS           0.000Y
■ CANCEL
  YES SAVE Y AXIS
```

▼  ▲

```
  SET FOCUS POSITION
  SET ROTARY AXIS
■ TICKLE
  PORTS
```
SELECT →
ESCAPE ←
```
■ TICKLE FREQ    X KHZ
  TICKLE WIDTH   X US
```

▼  ▲

```
  SET FOCUS POSITION
  SET ROTARY AXIS
  TICKLE
■ PORTS
```
SELECT →
ESCAPE ←
```
  PARALLEL
```

SELECT ↓  ESCAPE ↑

```
  SERIAL
■ BAUD RATE     57600
  STOP BITS          1
  PARITY          NONE
```

▼  ▲

```
  SET ROTARY AXIS
  TICKLE
  PORTS
■ LANGUAGE    ENGLISH
```

▼  ▲

```
  OPTIONS
  CONFIGURATION
■ DIAGNOSTICS
  ABOUT
```

```
  TICKLE
  PORTS
  LANGUAGE    ENGLISH
■ UNITS        INCHES
```

▼  ▲

...continued on next page

...continued from previous page

```
OPTIONS                    ■ ALIGNMENT MODE              ■ POWER        5%
CONFIGURATION                MEMORY TEST                   KHZ          2
■ DIAGNOSTICS
ABOUT                        MOTOR STATUS
```
SELECT / ESCAPE

▼ ▲

```
ALIGNMENT MODE              MEMORY TEST
■ MEMORY TEST                PAGE 63     FAILS 0
                           ■ CANCEL
MOTOR STATUS                 YES (CLEARS MEMORY)
```
SELECT / ESCAPE

▼ ▲

```
ALIGNMENT MODE
MEMORY TEST
                            X:OK        Y:OK
■ MOTOR STATUS              Z:OK        R:NO MOTOR
```
SELECT / ESCAPE

▼ ▲

```
OPTIONS                     UNIVERSAL LASER SYSTEMS
CONFIGURATION               COPYRIGHT ULS 1997
DIAGNOSTICS                 MODEL NAME
■ ABOUT                     VERSION XX-XX-XX-XX
```
SELECT / ESCAPE

# Menu Descriptions

The remainder of this section will describe each one of the menus and their significance.

## POWER ON → INITIALIZING → READY

**READY Menu**
When the system is first powered on "INITIALIZING" will appear for approximately 30 seconds until the laser system finishes performing its routine. When the system has finished initializing, "READY" will appear in the display, indicating that the laser system is ready to accept files.

```
■001)FILENAME.XXX
 PWR  100%   0:00:00
 SPD  100%   COPIES  0
 PPI   500   500  DPI
```

**FILE DISPLAY Menu**
Appears automatically after the first file is downloaded completely into the laser systems memory.  This is the menu that you will remain in most of the time when operating the laser system.  It has been designed to show all pertinent operating information at a glance so that constantly jumping from menu to menu is not needed.

The first line indicates the filename.  If more than one job has been downloaded, you can move to the next file in memory by pressing the "NEXT FILE" button.  You can page through the list of files available in memory by placing the cursor on the first line of this display and pressing the "SELECT" button which move the cursor to the right side of the display.  The up and down arrow buttons can then be used to move through the list of files in memory.  When the desired file is found, simply press the "SELECT" button to make that file the current file.  This will move the cursor back to the left side of the display.  To run the currently selected file, simply press the "START" button.  Changing the current file is not possible while the laser system is running.  For experimental purposes, Power, Speed, and PPI settings can be altered while the file is running allowing you to adjust these settings until the desired depth or effect is achieved.  To do this, press the up or down arrow button until the cursor is on the desired item.  Press the "SELECT" button, which moves the cursor to the right, and then use the arrow buttons to increase or decrease the values.  Pressing the "SELECT" button again will accept the change but pressing the "ESCAPE" button nullify the change and restore it to the original setting.  It is possible to adjust the settings while engraving on some scrap material until the desired "POWER", "SPEED", and "PPI" settings are obtained.  Note these settings, change them in the driver and re-send the file to the laser system for the final run.

**NOTE:**  Since the file has the settings stored in the beginning of the data, you must first start the file before you can change the settings.  You can then either pause the file, change the settings, and then resume the file or you can change the settings on the fly while it is running.  Remember, these are only temporary changes so if you pressed the "START" button to start the file over again, it will take on the original settings that you sent down from the driver.

The display contains a timer to time files as they are run (this is useful for job costing).  The timer will pause when the "PAUSE" button is pressed and starts up again when cutting or engraving has been "RESUME"d.  If the same file is run again, the timer will count backwards displaying how much time is remaining.  The "COPIES" feature indicates the number of completed runs of the file that is displayed.  The DPI section displays the DPI setting from the driver.  The "TIMER", "COPIES", and "DPI" readouts are for display purposes only and cannot be altered.

Since the laser system is equipped with a unique way of storing multiple jobs in memory, special provisions are made to distinguish one job from the next.  When using the printer driver, an end-of-file (EOF) marker is automatically sent to the laser system after each file is downloaded.  An end-of-file marker is needed by the memory buffer in order for it to recognize the end of one file, the beginning of the next file, and to calculate the remaining free memory space.  Without an EOF, the memory buffer will not operate properly.

There are two ways that a downloaded file will have a missing EOF.  The first is if printing through the printer driver and printing is canceled, interrupted, or file size exceeds the remaining free memory space. If this occurs, chances are that the EOF never made it to the memory buffer and the memory buffer will show that it is empty or that the file does not exist. Part of the file might still remain in memory and might become mixed up with other files.  This is why having the ability to insert an EOF marker from the control panel of the laser system is very important.  In order to delete that partial file, the memory buffer must either be cleared entirely or an EOF must be manually inserted into the memory buffer.  Inserting an EOF is the better choice here because the partial file can be deleted without disturbing the other files in memory. Secondly, when using DOS based programs, a printer driver other than the Windows printer driver must be used.  DOS printer drivers do not know to send the required EOF to the laser system after file downloading.  Again, the memory buffer will not recognize any file that exists if it does not have an EOF.  In this case, an EOF must be manually entered into the memory buffer after each and every file download from a DOS based program.  Since DOS printer drivers also do not send the name of the file within the file data, every file will be called "NONAME" once an EOF marker has been inserted.  To distinguish one "NONAME" file from the next, the display will number the files in the order from which they were downloaded.

To insert an EOF marker in either case, position the cursor on the first line of the display where the filename is.  Press and hold down the "NEXT FILE" button and then press the "SELECT" button at the same time.  The word "NONAME" will appear if there is a partial file in memory or any DOS based file that does not have an EOF marker.  What has happened is that the laser system searched for any file information that had entered into the memory buffer since the last completed file was downloaded.  If it finds information, it scans to the end of the last bit of that information and inserts an EOF.  The file then shows up on the display as "NONAME" and will allow either its solitary deletion without having to delete the other files in memory or it will allow the file to be run just as if it was downloaded from the Windows printer driver.

```
■ FILE DISPLAY
  MEMORY CONTROL
  DOS POWER SETTINGS
  PREFERENCES
```
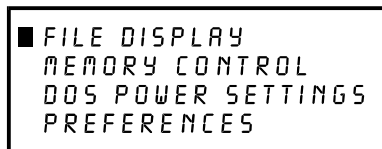
**MAIN Menu**
Allows access to all other menus.

```
  FILE DISPLAY          SELECT →   ■ 001)FILENAME.XXX
■ MEMORY CONTROL                     DELETE THE FILE
  DOS POWER SETTINGS                 DELETE ALL FILES
  PREFERENCES          ← ESCAPE      FREE MEMORY   3.7MB
```
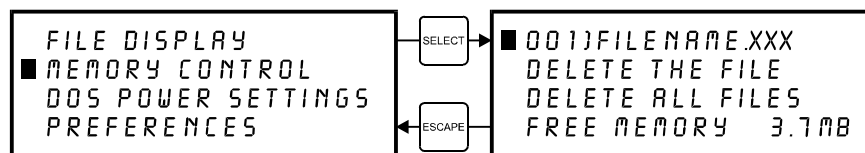
**MEMORY CONTROL Menu**
The laser system is equipped with an intelligent memory buffer that has built-in file compression.  The amount of RAM installed in your system is optional at the time of purchase. The minimum is 4 Megabytes and the Maximum is 32 Megabytes.

The Printer Driver compresses the file while it downloads to the laser system and the laser system decompresses the file while it runs.  The amount of compression can be as little as 4 to 1 or as great as 48 to 1.  This means that with 4 MB of RAM in the laser system, the buffer could hold the equivalent of 192MB worth of files provided they can be compressed 48 to 1. This gives the laser system the ability to store either larger or more files in memory.  It also provides for quicker downloading because the files are much smaller than normal.  The memory buffer can hold up to 999 files providing that the memory space is not exceeded.  The memory also has built in file handling intelligence enabling each individual file in memory to be run in any order.  The files are stored sequentially based on the order in which they were sent from the computer and each one is assigned a number to keep them in order.  A running total of the free memory space available is provided at the bottom of the display. The file name displayed is always the currently active file and there are two methods for looking through the list of files to choose another one.  The first method is to press the "NEXT FILE" button on the control panel.  Each time the "NEXT FILE" button is pressed, the next file in memory becomes the current file.  The second method is to move the screen cursor to the file name line and press the "SELECT" button to move the cursor to the right side of the display.  Then, use the up and down arrow buttons to move backward or forward through the list until the file desired is displayed.  Now, press the "SELECT" button again to bring the cursor back over to the left side of the display.

```
  001)FILE NAME.XXX          SELECT →      001)FILE NAME.XXX
■ DELETE THE FILE                          --- ARE YOU SURE ---
  DELETE ALL FILES                       ■ CANCEL
  FREE MEMORY   3.7MB        ← ESCAPE      YES DELETE THE FILE
```
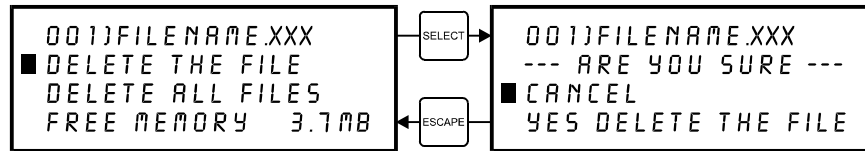
Eventually the memory will fill up with files that will need to be deleted to free up space for more files.  It is possible to select each individual file and delete them one at a time.  To accomplish this, make the desired file for deletion the current file in the same manner as previously described.  Use the up or down arrow buttons to position the cursor on the "DELETE THE FILE" menu item and then press the "SELECT" button. The display will then ask if you are sure and will expect a "CANCEL" or a "YES" response.  Use the up and down arrow keys to position the cursor on the appropriate choice and press the "SELECT" button.

```
  001)FILE NAME.XXX          SELECT →      DELETE ALL FILES
  DELETE THE FILE                          --- ARE YOU SURE ---
■ DELETE ALL FILES                       ■ CANCEL
  FREE MEMORY   3.7MB        ← ESCAPE      YES CLEAR MEMORY
```
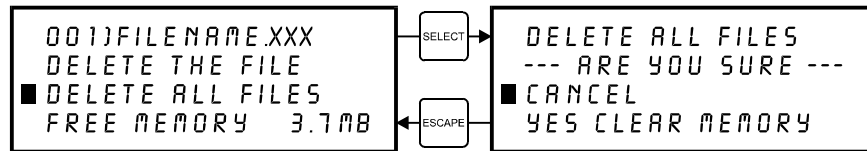
To completely clear out the entire memory buffer all at once, use the up and down arrow keys to position the cursor on the "DELETE ALL FILES" option and press the "SELECT" button.  The laser system will again ask if you are sure so respond accordingly.

**⚠ WARNING**

**Deleted files cannot be undone.**  They must be re-downloaded if you accidentally delete them.

```
  FILE DISPLAY                        ■ PEN SETTING        1#
  MEMORY CONTROL          SELECT        POWER            100%
■ DOS POWER SETTINGS                    SPEED            100%
  PREFERENCES            ESCAPE         PPI               500
```
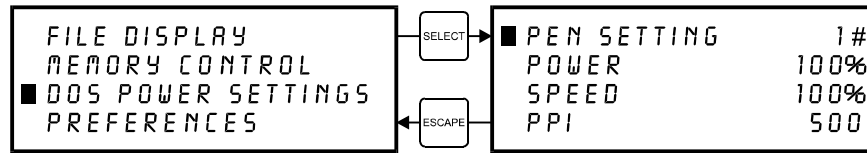
**DOS POWER SETTINGS Menu**

The laser system allows eight different power settings to be saved, in non-volatile (permanent) memory, and used when processing a DOS based file.  Since DOS based printer/plotter drivers do not have the ability to set the "POWER", "SPEED", and "PPI" settings, the settings must be set manually on the laser system.  Think of it as being able to assign laser "POWER", "SPEED", and "PPI" to the pen numbers of a flatbed plotter.

To access these settings, move the cursor to the "DOS POWER SETTINGS" menu and press the "SELECT" button.  Press the "SELECT" button again to bring the cursor to the right side of the display where it sits on top of the pen numbers.  Now use the up and down arrow buttons to scroll through settings 1 through 8.  When the desired pen number is found, press the "SELECT" button again to bring the cursor over to the left side of the display.  Bring the cursor down to the item you want to change, again press the "SELECT" button to bring the cursor to the right and use the arrow keys to adjust your settings.  Remember, to accept the setting that you have made, press the "SELECT" button to bring the cursor back over to the left side of the display.  Pressing the "ESCAPE" button nullifies your change. Once you have set the correct settings for all of the pen numbers that you will be using in your DOS software, press the "ESCAPE" button to bring you back to the "MAIN" menu.  Your settings will be permanently stored just as long as you exit back to the "MAIN" menu before turning off the laser system. For more information on how to use DOS based programs with the laser system, please refer to the Appendices section in the back of this manual.

```
  FILE DISPLAY
  MEMORY CONTROL
  DOS POWER SETTINGS
■ PREFERENCES
```
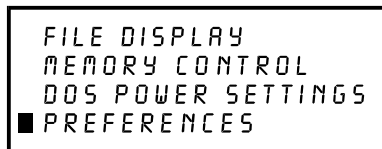
**PREFERENCES Menu**

The primary function of this menu is to allow access to other menus that can reconfigure the laser system. It also allows access to diagnostic and maintenance features.  Selecting this option will lead to other menus of which some are adjustable and others that are display only.



**WARNING**

Always escape back to the "MAIN" menu before turning off the laser system.  This will permanently store your changes in non-volatile memory.  If you turn off the laser system without escaping completely back to the "MAIN" menu then your changes would not have been stored and the system will revert back to its previous settings.

```
 FILE DISPLAY          ┌──────┐     ■ OPTIONS
 MEMORY CONTROL        │SELECT│──▶    CONFIGURATION
 DOS POWER SETTINGS    └──────┘       DIAGNOSTICS
■ PREFERENCES          ┌──────┐       ABOUT
                    ◀──│ESCAPE│
                       └──────┘
```
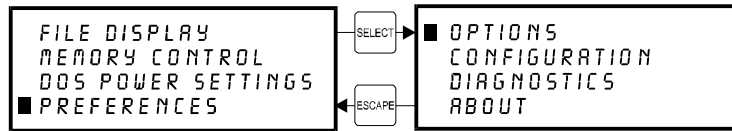
**OPTIONS Menu**
Selecting this menu will allow the access to turn on certain options that the laser system might have.

```
■ OPTIONS             ┌──────┐     ■ ONE FILE MEMORY OFF
  CONFIGURATION       │SELECT│──▶    AUTO FOCUS       OFF
  DIAGNOSTICS         └──────┘       AIR ASSIST      AUTO
  ABOUT               ┌──────┐       DUAL HEAD        OFF
                   ◀──│ESCAPE│
                      └──────┘
```
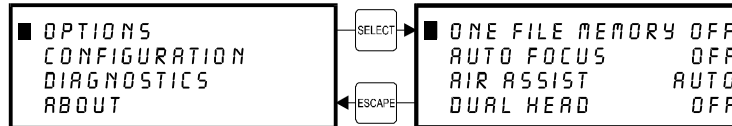
**ONE FILE MEMORY Menu**
Pressing "SELECT" key while cursor is on this line will toggle the setting on and off.  When off, it enables the multiple file memory buffer system (default).  When on, it disables the multiple file memory buffer and stores only one file at a time.  How it works when it is turned on:

When you download a file to the laser system that file will appear in the "FILE DISPLAY" menu.  Press the "START" key and run the file just as you would as if you were in the multiple file memory mode.  You can run this file as many times as you want because it remains in memory.

Now, as you download the second file, observe the display and you will see "MEMORY EMPTY" flash momentarily and then the new file appears.  Basically what has happened it that the laser system clears out the entire memory as the new file comes in to replace the first file.  You can now run that second file as many times as you want.  If you download another file, it dumps the entire memory again and the new file becomes the only file in memory, and so on.

While in this mode, the parallel port is turned off so no new files can be received until the file is finished running.  This is to prevent the incoming file from erasing the file that is running.

**Helpful Hint**
You will notice that while in this mode of operation, all files downloaded will be labeled as the #1 file in memory.  This might be confusing especially if you continuously download files with the same name.  If you do this, you might question yourself whether or not you downloaded the next file because if you look on the display, it shows the same file number and the same name as the previous file that you ran.  But if you look further, the timer will show 0:00:00 and the "COPIES" will be 0 if the file has never run.  If the file did run, the "COPIES" will be greater than 0 and the time will show the amount of time that the file took to run.

```
  ONE FILE MEMORY OFF
■ AUTOFOCUS        OFF
  AIR ASSIST      AUTO
  DUAL HEAD        OFF
```

**AUTOFOCUS Menu**
Pressing the "SELECT" key while the cursor is on this line will toggle this option ON and OFF.  Later in this section, we will explain how to use this option in more detail.

```
ONE FILE MEMORY OFF
AUTOFOCUS        OFF
■ AIR ASSIST      AUTO
DUAL HEAD        OFF
```

### AIR ASSIST Menu
This class of laser system does have Air Assist as an option, but it is not computer controlled.  Since we use the same menu system on other models, this menu selection for your model does absolutely nothing. If you did purchase the Air Assist option for this model, please refer to the instructions that came with that option.

```
ONE FILE MEMORY OFF
AUTOFOCUS        OFF
AIR ASSIST      AUTO
■ DUAL HEAD      OFF
```

### DUAL HEAD Menu
This option is not available for this model of laser system.

```
FILE DISPLAY          │SELECT│→    OPTIONS
MEMORY CONTROL                   ■ CONFIGURATION
DOS POWER SETTINGS               DIAGNOSTICS
■ PREFERENCES        ←│ESCAPE│    ABOUT
```
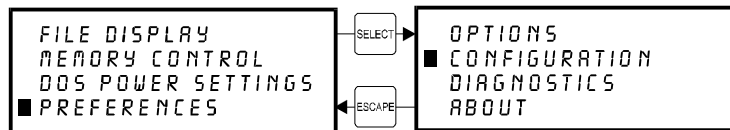
### CONFIGURATION Menu
Selecting this menu will allow the reconfiguration of certain features of the engraving system and will lead to other menu items.

```
■ SET FOCUS POSITION  │SELECT│→    SET FOCUS POSITION
SET ROTARY AXIS                   POS  1.000X 1.000Y
TICKLE                           ■ CANCEL
PORTS              ←│ESCAPE│       YES SAVE POSITION
```
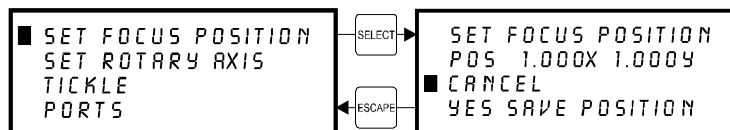
### SET FOCUS POSITION Menu
This option allows you to set the focus position to anywhere in the field that you desire.  Normally, the factory default setting for the "Z" button is (1,1).  If you would like to change the factory default setting, go to this menu and press the "SELECT" button.  If you have the optional red laser diode pointing device, the light will appear on the engraving table to assist you in determining the position desired.

Using the motion control arrow buttons to position the focus carriage assembly.  While you are doing this can observe the coordinate display change as you move the focus carriage.  These coordinates are the current position of the focus assembly in the engraving field.  Once the desired position has been located, bring the cursor down to the "YES SAVE POSITION" line and press the "SELECT" button.  Press the "ESCAPE" button twice to exit back to the "MAIN" menu.  Your settings will automatically be retained permanently in memory.

To restore the focus position back to the original factory setting, go back into this menu and press the up and down arrow keys simultaneously.

▲  ▼

You will see the motion system move to the 1 inch horizontal and the 1 inch vertical position (factory default).  Now select "YES, SAVE POSITION".  Press the "ESCAPE" button twice to exit back to the "MAIN" menu.  Your settings will automatically be retained permanently in memory.

```
  SET FOCUS POSITION          ROT        6.000y
■ SET ROTARY AXIS     SELECT   POS        0.000y
  TICKLE                    ■ CANCEL
  PORTS                ESCAPE   YES SAVE Y AXIS
```
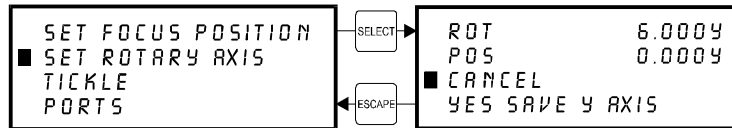
**SET ROTARY AXIS Menu**
The Rotary Fixture Axis is a setting that is pre-set at the factory.  The laser system will sense when the Rotary Fixture is plugged in and will position the X-Axis arm directly over the centerline of rotation automatically when it begins to engrave.  This setting can be altered if you position the Rotary Fixture in a location **OTHER** than the factory set position.  Please refer to the section on the optional Rotary Fixture for a full description on how to set up and use this device before altering any factory setting.

To change the factory default setting, turn the laser system OFF, place the Rotary Fixture on the engraving table in the desired position, and **DO NOT** plug the Rotary Fixture into the electrical socket.  Now turn the laser system on and with the motion system arrow buttons, position the X-Axis arm's focus lens carriage directly over the Rotary Fixtures centerline of rotation as the following diagram illustrates:



X-AXIS ARM

CENTERLINE OF ROTATION

FOCUS LENS CARRIAGE

TOP VIEW
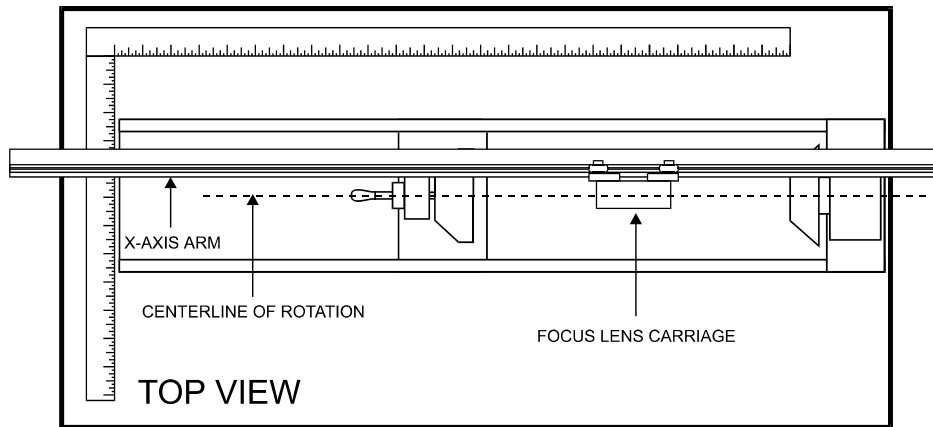
The left and right position (X-position) of the focus carriage is irrelevant in this setting and is not shown in the display.  Now select the "YES SAVE Y AXIS" choice.  If you change your mind and do not wish to alter the "ROTARY AXIS" position, select "CANCEL" instead and the original settings will be restored.  Remember, always escape back to the "MAIN" menu before turning the system off so that your settings will be permanently stored in memory.

▲  ▼
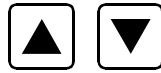
If you would like to get the Rotary axis back to the original factory default setting, go back into the "SET ROTARY AXIS" menu.  While in this menu, press the up arrow and down arrow keys simultaneously. The arm move will move back to its original factory default setting.  Select "YES SAVE Y-AXIS", and then press the "ESCAPE" key twice to exit back to the "MAIN" menu to store this setting permanently.

```
  SET FOCUS POSITION          ■ TICKLE FREQ    5 KHZ
  SET ROTARY AXIS     [SELECT]   TICKLE WIDTH   3 US
■ TICKLE
  PORTS               [ESCAPE]
```
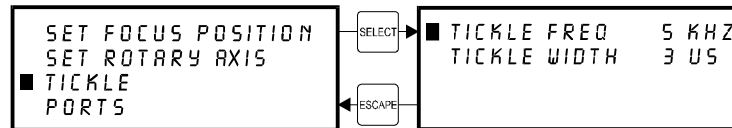
### TICKLE Menu
TICKLE is the term used for small pulses, which are fed to the laser to keep the plasma inside energized. This allows the laser to respond quickly and strongly for high speed cutting and engraving.

TICKLE keeps the laser "warmed up" at times when the laser system is powered on but not firing and the top door is closed.  We suggest keeping the door closed at all times when the laser system is powered on as this keeps the laser warmed up.  If the door is open, the power to the laser cartridge itself is turned off and the tube will cool down.  The laser runs best after being warmed up for 15 to 20 minutes.

TICKLE is pre-set at the factory and usually does not require adjustment. The setting shown above is only an example.  Your laser platform may have a built-in Tickle setting control inside the laser cartridge.  If your laser cartridge has built-in Tickle, then the setting in the control panel will read "Tickle Freq. = 5 kHz" and "Tickle Width = 0 us".  If your laser cartridge does not have built-in Tickle, then you will see a "Tickle Width" greater than "0 us" and the "Tickle Freq." That can be anything from "2Khz" up to "10 kHz". However, it is possible that it may need adjustment after the laser cartridge ages.  DO NOT attempt to adjust the TICKLE setting.   Please contact our Service Department for the correct diagnosis and corrective procedure.

```
  SET FOCUS POSITION              PARALLEL                SERIAL
  SET ROTARY AXIS     [SELECT]                  [SELECT] ■ BAUD RATE   57600
  TICKLE                                                  STOP BITS        1
■ PORTS               [ESCAPE]                  [ESCAPE]  PARITY        NONE
```

### PORTS Menu
Two ports are provided on the back of the system for interface with a computer, a serial and a parallel port.  Only one port can be used at a time.  To activate a port, use the up and down arrow keys to position the cursor on the menu item "PORTS" and press the "SELECT" button. The menu that appears indicates the currently active port on the laser system.  To toggle between ports press the "SELECT" button.

In order to use the "SERIAL" port, the communication settings **MUST** match those of the computer. Refer to the computer's hardware and software manuals for details on setting up the computer's serial port. If using the "SERIAL" port, select the fastest possible "BAUD" rate for communication since this effects how quickly the computer can send files to the laser system. For "BAUD" rates of "9600" and above, set the number of "STOP BITS" on the computer to a higher value than the number of "STOP BITS" selected on the laser system. For example if the number of "STOP BITS" on the laser system is set to "1", then set the computer's stop bits to "1.5" or "2".

"PARITY" of the laser system and the computer MUST match exactly and the choices are "ODD", "EVEN", or "NONE". Pressing the "SELECT" button while the cursor is on "PARITY" will toggle through these choices.

**Helpful Hint**
Since the serial port works much harder than the parallel port does, it uses much more of the laser systems computer processors power to take in the files. Since this is the case, it is **NOT** recommended that you download a file while the laser system is running a different file. This can cause data corruption to occur to the file coming in to the computer. Either pause the laser system or wait until it finishes engraving the file before downloading the next one. This situation is for the serial port only. Disregard this warning message if you are using the parallel port for communications. The fastest method of file transmission to the laser system is the parallel port. Its use is highly recommended.

```
SET ROTARY AXIS
TICKLE
PORTS
■ LANGUAGE   ENGLISH
```

**LANGUAGE Menu**
Use the "SELECT" button to toggle through many different language choices. When the desired language is displayed, press the "ESCAPE" button twice to exit back to the "MAIN" menu. Your settings will automatically be stored permanently in memory. When the cursor is on this menu item, continuously pressing the "SELECT" button will toggle the languages in a loop fashion and will always bring you back to the original language.

```
TICKLE
PORTS
LANGUAGE   ENGLISH
■ UNITS     INCHES
```

**UNITS Menu**
Use the "SELECT" button to toggle between "INCHES" and "METRIC" units. Once the desired unit is displayed, press the "ESCAPE" key twice to exit back to the "MAIN" menu. Your settings will automatically be retained permanently in memory. When the cursor is on this menu item, continuously pressing the "SELECT" button will toggle the units in a loop fashion and will always bring you back to the original units.

```
┌─────────────────────────┐           ┌─────────────────────────┐
│ FILE DISPLAY            │  ┌──────┐  │   OPTIONS              │
│ MEMORY CONTROL         │  │SELECT│▶ │   CONFIGURATION        │
│ DOS POWER SETTINGS     │  └──────┘  │ ■ DIAGNOSTICS          │
│ ■ PREFERENCES          │◀ │ESCAPE│  │   ABOUT                │
└─────────────────────────┘  └──────┘  └─────────────────────────┘
```
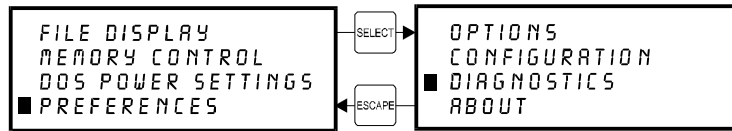
### DIAGNOSTICS Menu

This menu leads to other menus that enable you to help diagnose problems, if they occur, with the laser system.  It also will help our technicians solve problems that you may be experiencing.

```
┌─────────────────────────┐           ┌─────────────────────────┐
│ ■ ALIGNMENT MODE       │  ┌──────┐  │ ■ POWER          5%    │
│   MEMORY TEST          │  │SELECT│▶ │   KHZ            2     │
│                        │  └──────┘  │                        │
│   MOTOR STATUS         │◀ │ESCAPE│  │                        │
└─────────────────────────┘  └──────┘  └─────────────────────────┘
```
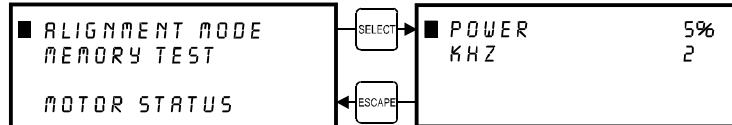
### ALIGNMENT MODE Menu

This menu allows access to firing the laser beam manually to determine if the laser systems optical alignment is correct.  The factory setting is a very low power setting that is just strong enough to check the laser beam alignment.  Please refer to the maintenance section on how to safely check the laser systems beam alignment.

```
┌─────────────────────────┐           ┌─────────────────────────┐
│   ALIGNMENT MODE       │  ┌──────┐  │   MEMORY TEST          │
│ ■ MEMORY TEST          │  │SELECT│▶ │   PAGE 63    FAILS 0   │
│                        │  └──────┘  │ ■ CANCEL               │
│   MOTOR STATUS         │◀ │ESCAPE│  │   YES (CLEARS MEMORY)  │
└─────────────────────────┘  └──────┘  └─────────────────────────┘
```
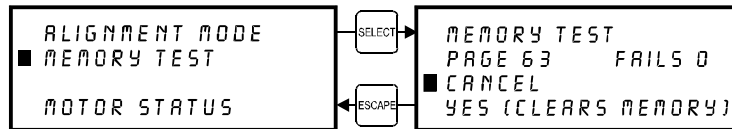
### MEMORY TEST Menu

It may be necessary to use the diagnostic tests if instructed to do so by a member of our technical support staff.  The "MEMORY TEST" is a memory buffer test to test the RAM in the laser system.  This is very similar to the RAM test that your computer performs when it first gets powered on.  In the process of testing memory, all files in memory will be erased.  Once the "MEMORY TEST" is started it will continue to run until it is canceled.  To start the test select "YES (CLEARS MEMORY)".  To end the test, select "CANCEL".  This test will continuously pass through the memory.  If you are going to run this test, start it and let it run for about 10 minutes.  If it finds memory that is bad, it will show up as a number other than a "0" in the fails column and the SIMM module will need to be replaced.  Please contact technical support if there is a problem with the memory.

```
┌─────────────────────────┐           ┌─────────────────────────┐
│   ALIGNMENT MODE       │  ┌──────┐  │                        │
│   MEMORY TEST          │  │SELECT│▶ │                        │
│                        │  └──────┘  │   X:OK       Y:OK      │
│ ■ MOTOR STATUS         │◀ │ESCAPE│  │   Z:OK       R:NO MOTOR│
└─────────────────────────┘  └──────┘  └─────────────────────────┘
```
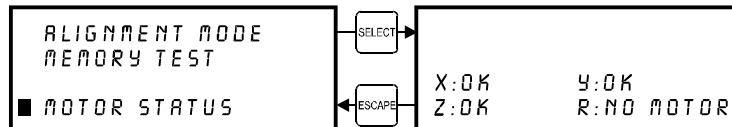
### MOTOR STATUS Display

The last two lines of this display show the conditions of the stepper motors in the motion system.  If there is a problem there will be an error message displayed next to the troubled motor.  If the motor is completely disconnected, "NO MOTOR" will show in the display.

```
OPTIONS
CONFIGURATION
DIAGNOSTICS
■ ABOUT
```
[SELECT] [ESCAPE]
```
UNIVERSAL LASER SYSTEMS
COPYRIGHT ULS 1997
MODEL NAME
VERSION XX-XX-XX-XX
```
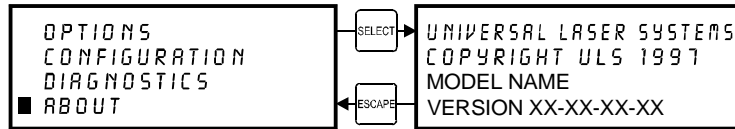
### ABOUT Menu
Use the up and down arrow buttons to position the cursor on this menu item.  Press the "SELECT" button and our copyright notice along with the current versions of firmware will be displayed.  The firmware version numbers are a diagnostic aid to our service technicians.  If you are having a problem with the laser system, a technician might ask you to read out the numbers in this display.

**To access the following menus, the cursor must be located either in the "MAIN" or the "FILE DISPLAY" menus.  They are not accessible if the cursor is in the "DOS POWER SETTINGS" or the "PREFERENCES" menus.**

```
ORG 24.000X 12.000Y
POS 00.000X 00.000Y
■ SET NEW ORIGIN
RE-HOME X-Y
```
[SELECT] [ESCAPE]
```
SET NEW ORIGIN
POS 01.000X 01.000Y
■ CANCEL
YES  SET NEW ORIGIN
```
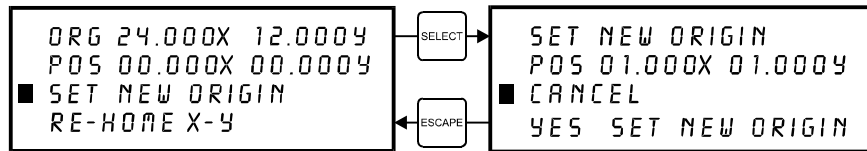
### ORIGIN POSITION Menu
The laser systems default origin position is in the upper left hand corner of the engraving area at the (0,0) position of the rulers.  You can, however, position the origin to any other point in the engraving area.  To do this you must first get into this menu.  From either the "MAIN" menu or the "FILE DISPLAY" menu, press the "X,Y" button in the middle of the four motion system directional arrow buttons.
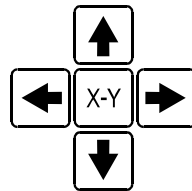


The red laser diode will appear on the engraving table.  Using the directional arrow buttons, position the red dot at the location you would like to store as the new origin position.  If you tap the motion control buttons, you will observe the motion system move at .001 inch increments.  The longer that you hold down the button, the faster it moves. You can use either the digital display or the red dot as a reference for the new origin.  When you have moved the red dot to the correct position, bring the cursor down to the "SET NEW ORIGIN" menu item and press the "SELECT" button.  If you are sure with this position, move the cursor down to "YES, SET NEW ORIGIN" and press "SELECT" again.  Escape out of the menu and your settings will be saved permanently in memory.

**WARNING**

Setting a new origin other than the default (0,0) position will shrink your field size.  If you already have files already loaded into memory that utilize the entire engraving area, and you set a new origin, part of that graphic might fall out of the effective printing area.  If you run this file, unexpected results can occur that might destroy your material in the engraving area.  We suggest that you use this feature cautiously and make sure that you do not set a new origin that would cause you graphic to print off the engraving area.

If you would like to reset the origin back to the original factory settings of (0,0) in the upper left corner, a quick way to get the motion system back to the upper left corner is to simply press the up arrow and down arrow keys simultaneously while in this menu.



You will see the carriage move to the upper left hand corner automatically.  Again, select "SET NEW ORIGIN", then select "YES, SET NEW ORIGIN" and your settings will automatically be stored in memory permanently.

# Focusing the Laser Beam

To properly focus the laser beam onto the surface of the material, you need to perform two tasks.  First position the focus carriage directly above the material and then use the focusing tool or the digital display to adjust the Z axis table level until the material is at the proper distance away from the focus lens.

Place your material into the upper left corner of the engraving field against the rulers.  From either the "MAIN" or FILE DISPLAY" menus, press the "Z" button located on the control panel.



You will observe the focus carriage move to a pre-set focusing position of (1,1).  The display will now show the "CURRENT LENS" that you are using and the current vertical "Z POSITION" of the engraving table.

```
Z POSITION      0.00
CURRENT LENS   2.0
SET FOCAL LENGTH
RE-HOME Z
```

The cursor in the display will be flashing on top of the tenths digit.  You can now move the table up or down by pressing either the up or down arrow button.  If you push the button once and let go quickly, the table will move in .1 inch increments.  If you hold down the button, it will move fluidly.  To make finer moves, press the "SELECT" button to bring the cursor over to the hundredths digit.  Pressing the up or down arrow button once and letting go quickly will move the table in .01 inch increments.  Holding down the button will make it move fluidly.  Practice moving the table up and down to get the feel of it before you attempt to focus on a material.  We will explain the significance of the numbers in the display a little later on but for right now, press the "Z" button to bring the focus carriage back into the home position.

Essentially, there are three ways to focus on your material.  One is to use the focus tool, another is to enter in the thickness of the material, and the other is to use AUTOFOCUS.

**The Focus Tool Method**
Place you material onto the engraving table.  Visually make sure that the height of the material will not interfere with the focus carriage when you move it over the material to set focus.  Press the "Z" button and observe the focus carriage move to the (1",1") position in the engraving area.  If this is not a good focus position for you, use the motion system directional arrow buttons to position the focus carriage directly over your material.  Use the up or down arrow buttons to move the table so that the flat side of the tool can sit flat up against the side of the focus carriage.  Slowly raise the table until you observe the tool either tilting or sliding away from the focus carriage.  This will occur when the bottom edge of the focus carriage meets with the top of the beveled edge of the focus tool.  The objective is to stop the table at the point where the tool just starts to move or tilt.
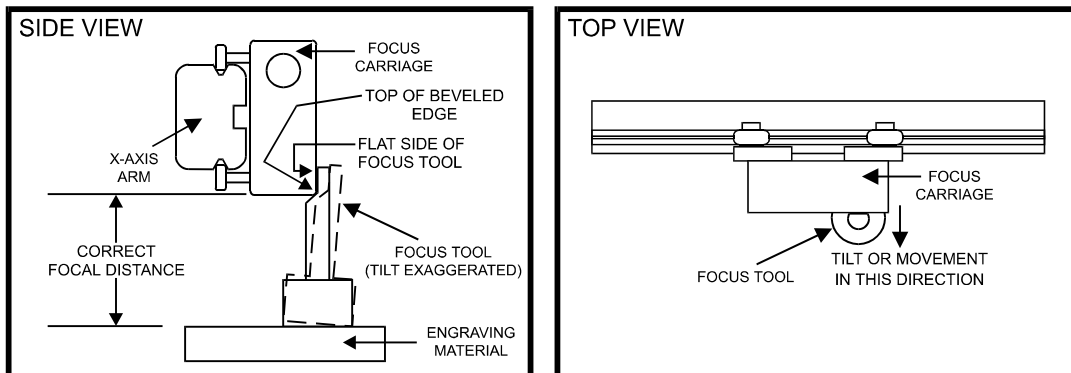


Remember, having the cursor, in the display, located on the tenths digit will move the table quickly and having it on the hundredths digit will move it more slowly.  After focus has been established, remove the focus tool and press the "Z" button to move the focus carriage back into the home position.

If you find that you need to place your materials in a position other than the upper left hand corner, you can change the default focus position to anywhere in the field that you like.  Please refer to that menu item selection earlier in this section.

**The Material Thickness (Z POSITION) Method**
The second method is to enter in the thickness of the material into the "Z POSITION" display.  This method does not involve the use of the focus tool.  For example, using a caliper or some other thickness measuring device, measure the thickness of your material and enter that thickness into the "Z POSITION" display.  For example, if your material is 1 inch thick, use the up or down arrow button to raise or lower the table until the digital display reads "1.00".  That is all you need to do.  Now press the "Z" button again to bring the motion system back to the home position.  The beam is now precisely focused on the surface of your material.  Think of it as using an imaginary focus tool.

The laser system table has been set up at the factory to read "0.00" when the beam is focused to the surface of the table when the lens that is installed on the focus carriage matches the "CURRENT LENS" in the display.

The factory has only set the "0.00" point for the lenses that you purchased at the time the system was shipped.  If you purchase additional lenses, you will need to set the "0.00" point, also called the "FOCAL HEIGHT", for each lens.

**CURRENT LENS Menu**
There are 4 lenses available, 1.5, 2.0, 2.5, and 4.0 inch lenses.  All of them have different focal lengths so this is why we need to have a different "FOCAL HEIGHT position for each lens.  If you press the "SELECT" button while the cursor is on this menu item, you will see the right side of the display toggle into the different lens heights.  You will also notice that the "Z POSITION" display change to reflect the difference in focal lengths.  If you have purchased all of the other optional lenses with the laser system, all of the focal lengths have been set for you.  If you just purchased the standard 2.0 lens, only that "FOCAL HEIGHT" was set at the factory.  This is due to the fact that all lenses have slightly different focal lengths even if they are both 2.0 inch lenses so each one's "FOCAL HEIGHT" must be calibrated on the machine.

**SET FOCAL HEIGHT Menu**
Use this selection to set the "0.00" for each lens.  Using the focus tool that matches the "CURRENT LENS" displayed, position the table so that the laser will be focused on the table's surface.  If the display does not read "0.00", move the cursor down to the "SET FOCAL HEIGHT" menu item and press the "SELECT" button.  The display will ask "ARE YOU SURE?".  Move the cursor down to "YES" and press the "SELECT" button.  The "Z POSITION" display will now read "0.00" and will be **PERMANENTLY STORED IN MEMORY** until you do this procedure again.  If you have purchased other lenses, you can set each of their focal heights by making that lens the "CURRENT LENS" and repeating this procedure.

**The AUTOFOCUS Method**
In order to use this method, you must first turn it ON.  We described how to turn it ON earlier in this section.  After you turn it ON, please follow the step by step instructions below.

*To Use AUTOFOCUS:*

- The AUTOFOCUS sensor sends out an invisible beam across the table between the 1 inch and the 3 inch mark in the Y axis ruler for the M-300 Platform and the 2 and 4 inch mark for the V-400, X-600 and X2-600 Platform laser systems.  You will notice that it is indented slightly.
- Place your object between these two points vertically and anywhere on the table horizontally.  Refer to the diagram below.
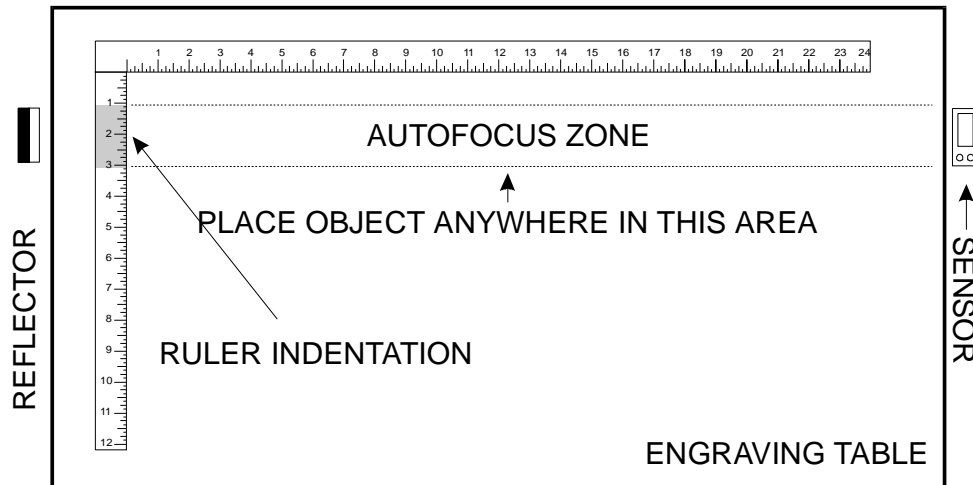


- Make sure that the laser system is in the main menu screen or the "File Display" menu. AUTOFOCUS will not work in the other menus.
- Press the "Z" button once on the control panel of the laser system.  You will observe the Z-axis Table (Engraving Table) move down and then up again, adjusting the table to the proper focusing height.  If the "Current Lens" choice in the menu system is not the same as the lens you have installed, correct it by placing the cursor on the second line of the display, and pressing the "Select" button to toggle you through your choices. Once the desired lens is displayed, escape out of the menu and AUTOFOCUS again.  This will bring the table up to the correct height.  The display will now show that the "Z Position" is "0.00" for that Focus Lens.
- If you desire to adjust the "Z Position" so that you are slightly out of focus, without exiting out of the menu, simply bring the cursor over to the "0.00" part of the display and adjust the table to the desired offset.  The display will now show you how much you are out of focus.  If you were to escape out of the display and perform the AUTOFOCUS procedure again, the "Z Position" will again show "0.00" to remind you that you are precisely in focus.
- If you have purchased additional lenses besides the 2.0 inch lens upon original delivery of the laser system, those other lens heights have been set at the factory.  If you purchase additional lenses after you have received your machine and need to set the 'Focal Height" of that lens, or you need to adjust your AUTOFOCUS, please follow the next procedure.

### *To Adjust AUTOFOCUS:*

From time to time, you may need to re-adjust your AUTOFOCUS.  The only time that you should need to re-adjust the AUTOFOCUS is when you have received a new or different length Focus Lens, have recently Flash upgraded the operating system of the laser, or had a dirty sensor or reflector and are adjusting it after you have cleaned those parts.

- Place a very flat object on the Engraving Table, within the AUTOFOCUS Zone, that is at least 1 inch thick.
- AUTOFOCUS on this object by pressing the "Z" button once.
- While you are still in the "Z Position" display, move the Focus Carriage using the motion control keys so that it is above your object that you placed on the table.
- Place your Focus Tool on top of your object and compare the Focus Tool reading with the actual height that the AUTOFOCUS set the Engraving Table to.  If it is not the same, bring the cursor up to the first line of the "Z Position" display and press the "Select" button.  Now focus on your object by using your Focus Tool and adjusting the "Z Position" until your are manually focused on top of your object.
- Press the "Escape" button, move the cursor to the "Set Focal Length" line and press "Select".  It will ask you if you are sure so move the cursor down to the "YES" line and press "Select".  The AUTOFOCUS will now have been re-adjusted to be exactly at the same height as your Focus Tool. The purpose of "Setting the Focus Length" is to calibrate AUTOFOCUS with your Focus Tool so that whether you use AUTOFOCUS or use the Focus Tool, you will always be putting the Engraving Table at the correct focusing height.
- If you have purchased additional lenses, repeat this procedure for each lens by changing the "CURRENT LENS" on the display and your focus tool, to the one you are calibrating.

### *AUTOFOCUS Maintenance:*

If the AUTOFOCUS reflector or sensor becomes dirty from engraving smoke, it may malfunction.  A sign of AUTOFOCUS malfunction is upon activation, the table either moves all the way down to the bottom or all the way up to the top and will try to keep on moving until you power the machine off.  If this did happen, you will need to clean your sensor and reflector and then perform the AUTOFOCUS adjustment procedure.  An indication that the sensor and reflector are clean is that you will see a little green light appear on the side of the sensor.  If you see both green and red lights, the sensor and/or reflector are dirty or blocked. **NOTE: Make sure that the table is down far enough so that the sensor "sees" the reflector before assuming that there is a problem.**

To clean, dampen a tissue with water and gently wipe across the sensor and reflector in one direction. Gently wipe again with a dry tissue.

**SECTION 4**

# Running the System Step by Step
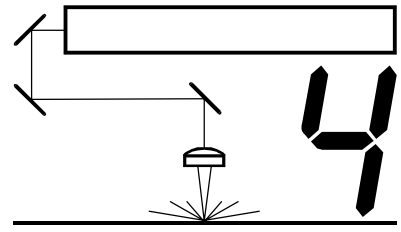


In this section we will cover how to completely use the laser system to create a product from start to finish. From powering on everything to removing the finished product from the system, we will cover the entire process step by step. As an example, let's engrave and cut out a key chain from a 2 by 4 inch, 1/8 inch thick piece of hardwood.



**WARNING**

**Before continuing, please ensure that you have completely read and understood the entire manual up to this point. It is essential that you know how to safely operate the laser system before you actually engrave or cut any material.**

## Powering Up

We recommend that you turn on your computer first and let it boot up completely before powering up the laser system. This will prevent any garbage information that might have traveled out the printer port from entering the laser system during power up. This common practice should be utilized for all output devices whether it is a laser printer or a laser engraver. If you happen to power up the laser system first and then power up your computer afterwards, there is a possibility that some garbage information gets transmitted to the laser system. If you then send down a file to print, that garbage may confuse the laser system and cause it to engrave erroneously which could damage your material. This is why we recommend turning on your computer first before the laser system as a safe practice.

## Loading and Positioning the Material

The next step is to load and position the wood on top of the engraving table inside the laser system. Open the top door and position the piece of wood into the upper left hand corner of the table against the rulers as the diagram below indicates.

Inside the laser system
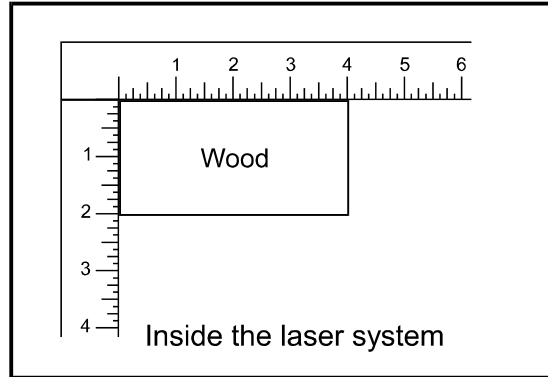
# Focusing

Before attempting to adjust the focal height, visually check to make sure that the table is down low enough to prevent the focus carriage from hitting into the piece of wood.

With the top door still open, press the "Z" button on the control panel of the laser system. You will see the focus carriage move to the (1,1) position directly over the piece of wood. Using the focus tool, material thickness, or the Autofocus method, adjust the table until the proper focal height is achieved.
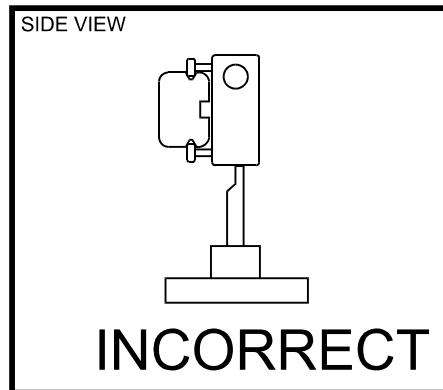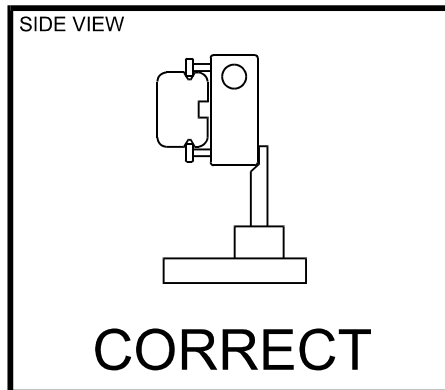


**WARNING:  Be careful not to position the tool underneath the focus lens as this can damage the lens if the table is driven up into it.**

Sometimes it is desirable to be slightly out of focus when engraving or cutting. It widens the beam at the surface of the material to soften the image or create a wider cut line.



WARNING

**WARNING:  DO NOT engrave or cut too far out of focus, as this can be a potential fire hazard. A maximum of .1 inches above or below precise focus should be the limit.**

It does not matter whether you bring the table up to go out of focus, or down, the effect is the same.  You should experiment on some scrap material at another time and note the difference.  In this example, we will engrave in precise focus.  Once you have established focus, store your focus tool and close the top door.

# Creating the Graphic

In your graphics program set your page size to the maximum size of the engraving area, 24 inches wide by 12 inches tall in the Landscape mode.  Create some text with a **BLACK** colored fill and **NO** outline.  For example, type in the word "Keychain".  Draw an outline box around the text, color the outline **RED**, give the outline a thickness of .00005 inches (or the smallest possible line width), remove the fill color (if any), and round the edges if desired.  Now add a circle with the same **RED** outline .00005 inches (or the smallest possible line width) and **NO** fill, for the key ring.  Place the graphic into the upper left corner of the page, on screen, relative to how the piece of wood is positioned in the engraving area as the following diagram illustrates:



On your computer screen
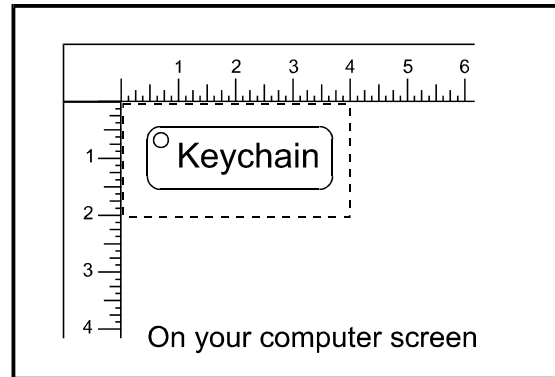
# Setting the Drivers Properties

The next step is to set the drivers properties.  From within your graphics program, get to where you can see the driver parameter screen.  Usually, there is a menu item called "Print Setup" or "Print Options" that allows access to the printer driver screen from your graphics software.  For specific instructions on how to access the printer driver from your graphics software, please refer to your graphics software instruction manual or online help screens.

Once the printer driver is visible, click on the appropriate tabs and set the drivers parameters to the appropriate settings.  For an example of power settings for a particular material, please refer to Section 8 of this manual.

# Downloading the File

You are now ready to print to the laser system. Make sure the laser system is powered on and the display reads " READY".

Find the "PRINT" command within your graphics program and click on it.  Depending on which graphics program you are using, the menu command "PRINT" may be in various locations within your program. Usually after clicking on "PRINT", you will then need to click on "OK".

A status screen may now appear showing a percentage of completion.  Once this status screen disappears, it does not mean that the file is totally in the laser systems memory.  If you have the Windows 95/98 print spooler turned on, it can take several seconds to even minutes, depending on your file size and the speed of your computer, before the entire file loads into the laser systems memory.  Once the entire file is completely loaded, the display on the laser system will automatically update and will display the file's name and the power settings that you assigned to the first color.  One this appears, file download is now complete.

# Starting the Engraving Process

Before pressing the "START" button on the control panel:

- Turn on your exhaust system.

- Make sure your material is positioned correctly within the engraving area.

- Make sure that you are properly focused.

- Make sure that the doors are closed and the RED light on the control panel is not flashing.

- Make sure the display shows the name of the file that you are going to run.

If all of the above has been verified, press the "START" button on the laser systems control panel to begin the engraving process.



WARNING

Observe that the laser system is functioning as desired.  If any abnormalities are present, including but not limited to, flaming, sparking, melting, or excessive smoking of the material you are engraving, **STOP THE ENGRAVING PROCESS IMMEDIATELY BY EITHER PRESSING THE "PAUSE" BUTTON OR OPENING THE TOP DOOR!**  Re-check your settings in the printer driver as well as the laser system.  If everything seems to be correct, the material is not suitable for laser engraving or cutting and you **MUST DISCONTINUE** processing this material or any material that shows impending signs of damage to the equipment.

We will also remind you again to please comply with the warning label below.

WARNING
NEVER OPERATE THE LASER SYSTEM
WITHOUT CONSTANT SUPERVISION

EXPOSURE TO THE LASER BEAM MAY
CAUSE IGNITION OF COMBUSTIBLE
MATERIALS WHICH CAN CAUSE SEVERE
DAMAGE TO THE EQUIPMENT

# Material Removing and Reloading

Once the laser system has completed processing you material, the laser beam will turn off, the motion system will move to its home position in the upper right hand corner, the system will beep twice, and the green light on the control panel will glow continuously.

Before opening the top door, wait a few seconds to let any remaining fumes that are leftover from the engraving or cutting process, evacuate through the exhaust system.

Open the top door and remove your material.  Some materials will continue to out gas for several minutes to sometimes hours after the engraving or cutting process is completed.  We recommend that you move these materials to a well-ventilated and unoccupied area.

## WARNING

**Some materials, when engraved or cut with a laser, can produce toxic and caustic fumes.  We suggest that you obtain the Material Safety Data Sheet (MSDS) from the materials manufacturer. The MSDS discloses all of the hazards when handling or processing that material.  The law requires all manufacturers to provide this information to anyone who requests it.  DISCONTINUE processing any material that shows signs of chemical deterioration of the laser system.  Systems damaged from this abuse will NOT be covered under warranty.**

While the top door is still open, load in your next piece of material.  If it is the same as the previous one and you want to run the file again, simply close the top door and press the "START" button again to start the process from the beginning.

For further information on running the laser system in a different manner other than what has been described in this section, please refer to the previous section on "System Operation".

# Options & Accessories
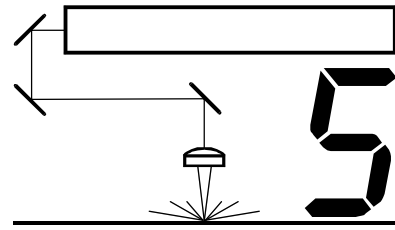
There are several options and accessories available for this laser system.  The new 3D Effects option is now available as a standard feature.  The Rotary Fixture, Cutting Table, Air Assist System, Air Assist Compressor, various Focus Lens Kits, and the Dual Head option are available at additional cost.

## 3D Effects

The 3D Effects option can be used to create rubber stamps or produce a three-dimensional engraving appearance on other materials.  As an example of how this option works, we will describe how to make rubber stamps with the laser system.

**Rubber Stamps**
There are two methods used to create a rubber stamp, the single stamp method and the full sheet method.  In the following examples will show you the step by step method of creating both a single rubber stamp and a full sheet of stamps.

**Single Stamp Method**
To create the artwork and engrave only one or a few stamps, set the page size in the graphics program to something smaller than the full field.  Just as an example, we will use a page size that is 8.5 x 11 inches (215.9 x 292.1 mm) in the Landscape mode.  In this way we can output to a paper printer, before engraving, for proofreading.  Make sure that this page size is set up the same in the printer driver.  Create a negative style stamp by drawing a black box slightly larger than the size of the stamp desired.  Type in or add graphics within that area and color them with a fill of white.  If you want the laser to cut out your stamp, draw a red outline box that is the smallest possible line thickness as your program allows.  **Make sure that the red outline is inside the black box by at least .050 inches, otherwise there will be a little rubber strip of rubber sticking up around the border that will unintentionally appear when using the stamp.**



WHITE FILLED TEXT                WHITE FILLED GRAPHIC
MIRRORED IMAGE
BLACK FILLED BOX                RED CUT LINE .001" THICK (MAXIMUM)

COMPUTER GRAPHICS SCREEN

PLACE STAMP IN AN
UNUSED AREA

PREVIOUSLY
COMPLETED
STAMPS

GRAPHICS SOFTWARE
PAGE LAYOUT
11 INCHES ( 292.1 mm) WIDE
8.5 INCHES ( 215.9 mm) TALL
LANDSCAPE MODE

Action Sports Equipment
100 Easy Street #117
Plainville, KS 99924
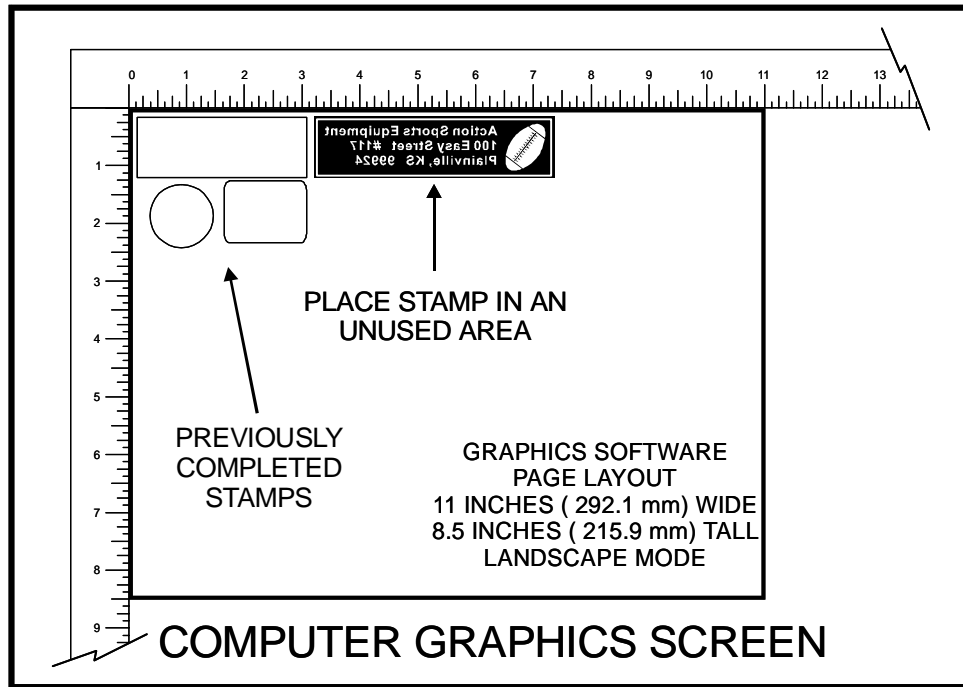
Place the stamp (on screen) where you want it to engrave in laser system. Avoid the spots where you have already engraved and cut out other stamps.



LASER ENGRAVING TABLE

AREA WHERE NEW
STAMP WILL ENGRAVE

PREVIOUSLY
COMPLETED
STAMPS

SHEET OF RUBBER
STAMP MATERIAL
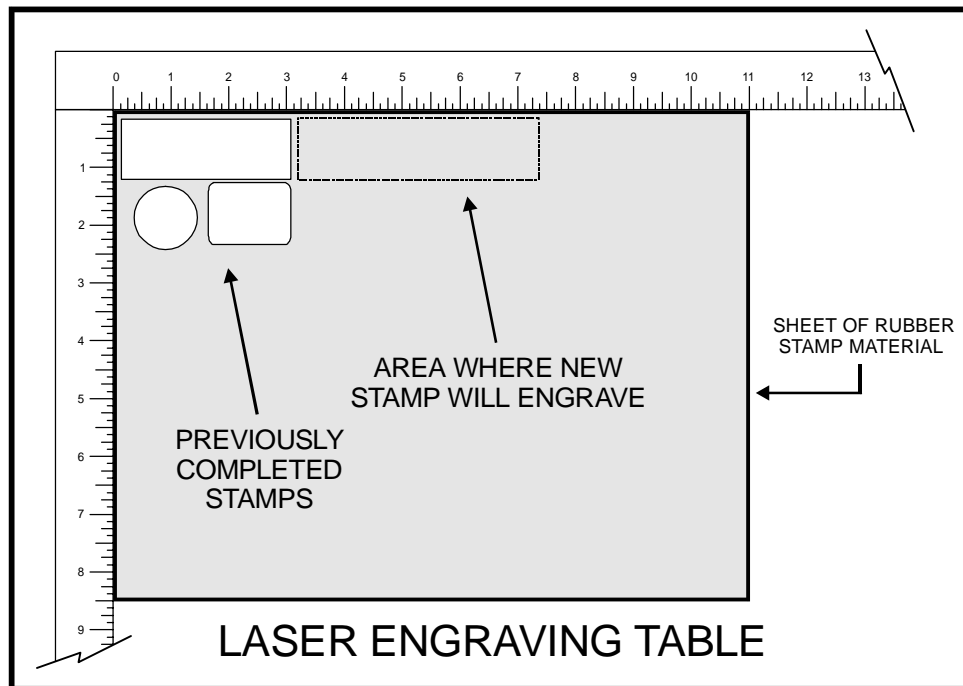
Place a sheet of rubber stamp material into the **UPPER LEFT CORNER** against the rulers, as the following diagram illustrates, and be sure to properly focus on the material. Now, set the printer driver settings as shown on the following page.

**Laser Settings tab**

| | Pen Mode | Color | % Power | % Speed | PPI |
|---|---|---|---|---|---|
| 1 | RAST/VECT | Black | 100.0 | 16 | 500 |
| 2 | RAST/VECT | Red | 60.0 | 1.6 | 90 |
| 3 | RAST/VECT | Green | 50.0 | 100 | 500 |
| 4 | RAST/VECT | Yellow | 50.0 | 100 | 500 |
| 5 | RAST/VECT | Blue | 50.0 | 100 | 500 |
| 6 | RAST/VECT | Magenta | 50.0 | 100 | 500 |
| 7 | RAST/VECT | Cyan | 50.0 | 100 | 500 |
| 8 | RAST/VECT | Orange | 50.0 | 100 | 500 |

Power: 100. %
Speed: 16 %
PPI: 500 PPI
Set

☐ Use Default PPI (500)   ☐ Coated Metal Mode
☐ Clipart Mode   ☐ Curve Enhancement
Resolution: 500 DPI

Settings: Load   Save

OK   Cancel   Apply

**Engraving Field tab**

ENGLISH ▼   Version   ?

Start Options: ○ Auto Start   ● Manual Start

Engraving Field:
○ Metric   ● Inches
Width: 11.000 (Inches)   Height: 8.500 (Inches)

Orientation: ○ Portrait   ● Landscape
Note: arrow indicates raster direction.

Rotary Fixture: ☐ Rotary Installed   Diameter (Inches)

OK   Cancel   Apply

**3D Effects tab**

Shoulder Steps / Step Width (inches) .001 .002 .003 .004 / % Power

(Foreground is always 0%)

| Step | .001 | .002 | .003 | .004 | % Power |
|---|---|---|---|---|---|
| 1 | ○ | ● | ○ | ○ | 8 |
| 2 | ○ | ● | ○ | ○ | 20 |
| 3 | ○ | ● | ○ | ○ | 31 |
| 4 | ○ | ● | ○ | ○ | 39 |
| 5 | ○ | ● | ○ | ○ | 49 |
| 6 | ○ | ● | ○ | ○ | 59 |
| 7 | ○ | ○ | ○ | ○ | |
| 8 | ○ | ○ | ○ | ○ | |
| 9 | ○ | ○ | ○ | ○ | |
| 10 | ○ | ○ | ○ | ○ | |
| 11 | ○ | ○ | ○ | ○ | |
| 12 | ○ | ○ | ○ | ○ | |
| 13 | ○ | ○ | ○ | ○ | |
| 14 | ○ | ○ | ○ | ○ | |

(Background is always 100%)

Special:
☑ Add Shoulder
☐ Print as a Negative Image
☐ Print as a Mirror Image

Shoulder:
Shoulder Type: Normal Rubber Stamp ▼
Add Custom Shoulder
Delete Custom Shoulder

OK   Cancel   Apply

# Settings for a 30 Watt System

There is a considerable difference between rubber blends, thickness, and hardness between different manufacturers.  Use these setting as a starting point for a 30 Watt system.  You might need to experiment with different settings to obtain the desired results.

As you can see, we set the page size in the driver equal to the graphics programs page size.  We also selected "Add Shoulder" and "Normal Rubber Stamp".  We did not choose "Print as Negative Image" or "Print as Mirror Image" because these switches are only used when printing a full sheet of stamps.

After making all driver selections, print the graphic to the laser system.  Start engraving and watch the stamp engrave and cut in the correct position on the rubber sheet.  The background area, since it is colored black is being engraved and the letters remain standing up.  When the engraving part is done, the stamp gets cut out along the red cut line due to the stronger settings that were assigned in the driver for the color red.

**Full Sheet Method**
The second method is to create a full sheet of rubber stamps and engrave them all at the same time. First create a stamp as a positive image as shown below.

BLACK FILLED GRAPHIC                                    BLACK FILLED TEXT

**Action Sports Equipment**
**100 Easy Street   #117**
**Plainville, KS   99924**

RED CUT LINE .001" THICK

Create more stamps to fill the entire page.  They can be the same stamp or different ones.

COMPUTER GRAPHICS SCREEN
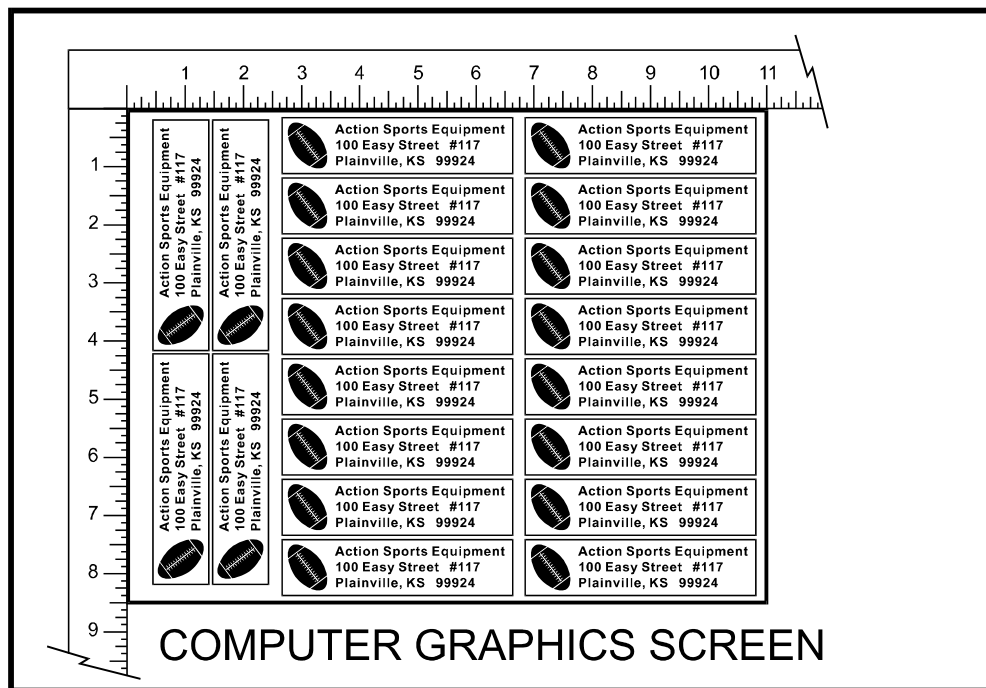
If desired, output the page to a paper printer for proofreading.  Printing out a positive image to a printer is easier to read and uses less toner or ink than a negative print.

In the laser systems printer driver, use the same settings as the previous example but with only minor modifications.  In the "3D Effects" tab, select all three "Special" options; "Add Shoulder", "Print as Negative Image" and "Print as Mirror Image" as the diagram below illustrates.
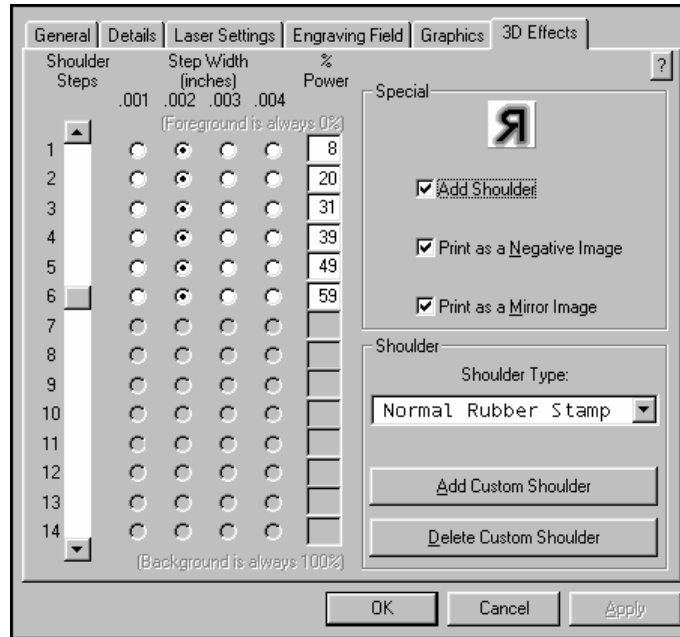


Print to the laser system.  Position the full sheet of rubber stamp material in the same upper left location on the engraving table and begin engraving.  The driver automatically adds the shoulder, mirrors the entire page, and creates a negative image for engraving, and cuts out the stamps.

# Rotary Fixture

The Rotary Fixture has been designed to engrave cylindrical objects.  Two attachments come with the fixture, a cone shaped disk attached to the motorized end of the fixture and an inverted cone shaped disk attached to the adjustable end of the fixture.  These attachments are used to hold wineglasses, mugs, cups, etc.
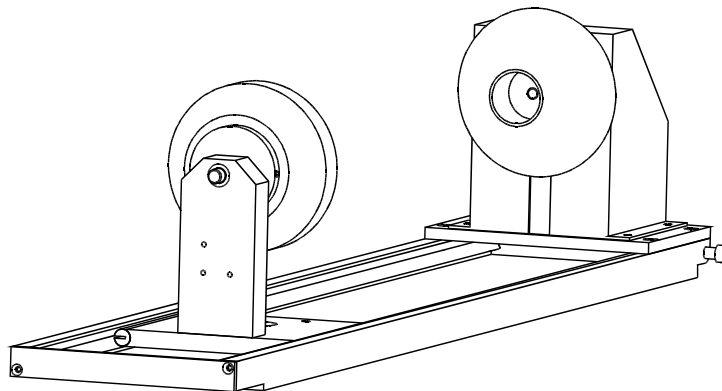
The Rotary Fixture is placed on the engraving table as the following diagram illustrates.



TOP VIEW
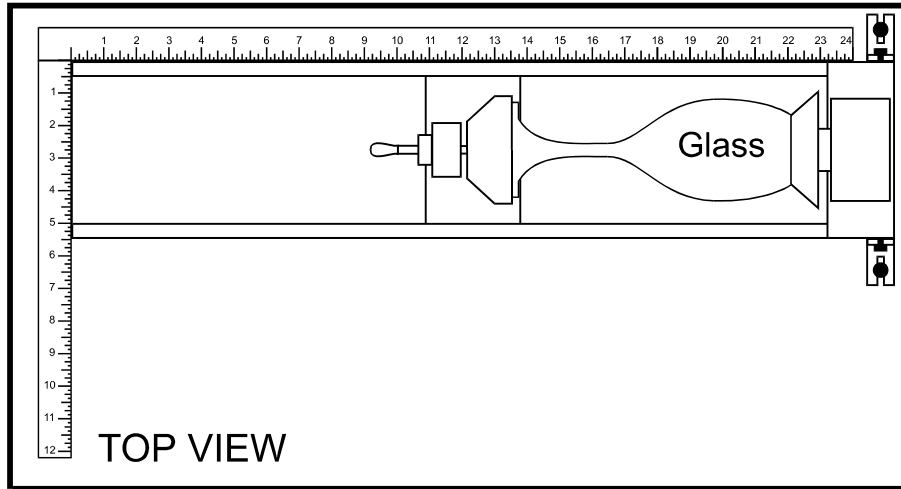
Please refer to the instructions supplied with the Rotary Fixture on how to properly install and use this option.

# Cutting Table

The purpose of the Cutting Table is to support the material that you are cutting off of the engraving table's surface to minimize surface contact area.  It also redirects exhaust airflow below and above the material for better smoke removal.  The Cutting Table is installed directly on top of the engraving table.  It is composed of a sheet metal box, alignment rulers, and a replaceable honeycomb style bed.  The honeycomb material is reflective only in the area that contacts your material to minimize laser beam reflection.
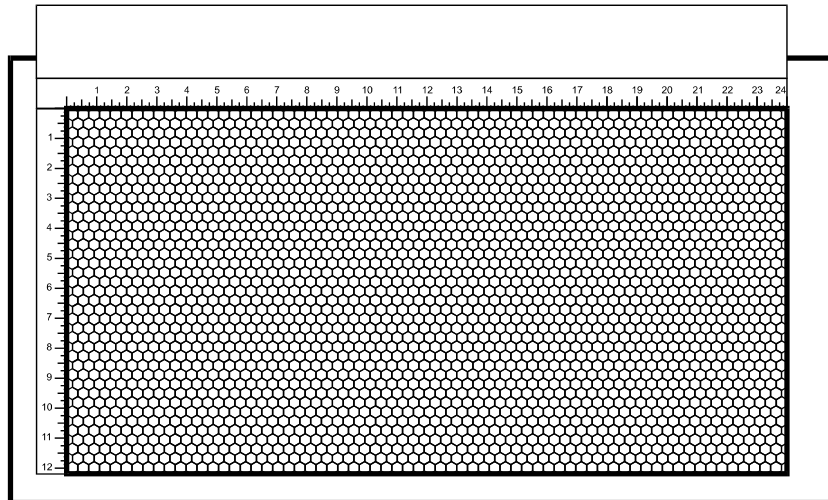


Please refer to the instructions supplied with the Cutting Table on how to properly install and use this option.

# Air Assist System

The Air Assist System consists of a nozzle that attaches to the focus carriage, Optics protection adapters, tubing, mounting brackets, needle valve, and pressure gauge.  The purpose of this system is to force air or other types of gases directly onto the surface of your material to reduce the burning effects of the laser beam and helps disperse the smoke and gases created when cutting or engraving materials.  The optics protection parts assist in helping keep the optics cleaner from flying debris created from the pressurized nozzle.  Use of this system requires a minimum compressed air source capable of 50 PSI @ 2.5 cfm.  This supply **MUST** be free from oil, water, and particulate matter.   Another option called the "Air Assist Compressor", can supply this source. The Air Assist System is truly a unique option that is a must for serious laser system production.

Please refer to the instructions supplied with the Air Assist System on how to properly install and use this option.
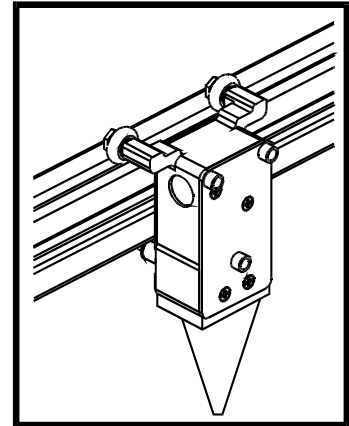
# Air Assist Compressor

The Air Assist Compressor option is a 50 PSI @ 2.5 cfm source for oil-free, water-free, and particulate matter-free compressed air.  It contains a sound insulated air compressor, water dryer (desiccant), and coalescent particulate filter.  This compact and custom designed unit is a great compliment to the Air Assist System option.

WATER DRYER
(desiccant)

ON  OFF  AUTO

COILED AIR HOSE
(with quick disconnect fittings)

PARTICULATE
FILTER

SOUND INSULATED
COMPRESSOR ENCLOSURE
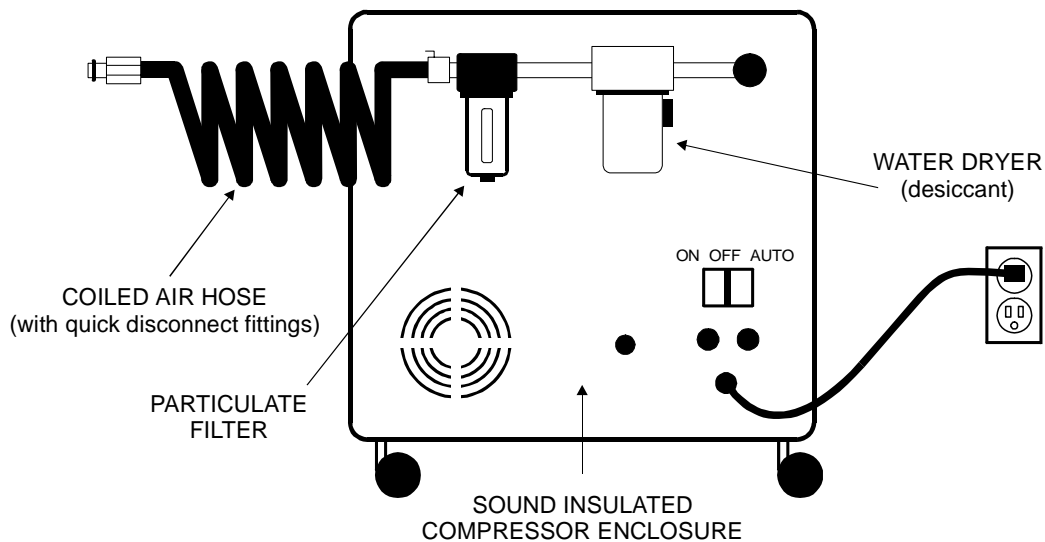
Please refer to the instructions supplied with the Air Assist Compressor on how to properly install and use this option.

# Focus Lens Kits

There are three optional Focus Lens Kits available other than the standard 2.0", they are the 1.5", 2.5", and the 4.0" kits.  Included in these kits are the focus lens,  #3 mirror, front plate, thumbscrews, and a focus tool.

THUMBSCREWS

#3
MIRROR

FRONT COVER

FOCUS LENS

FOCUS TOOL
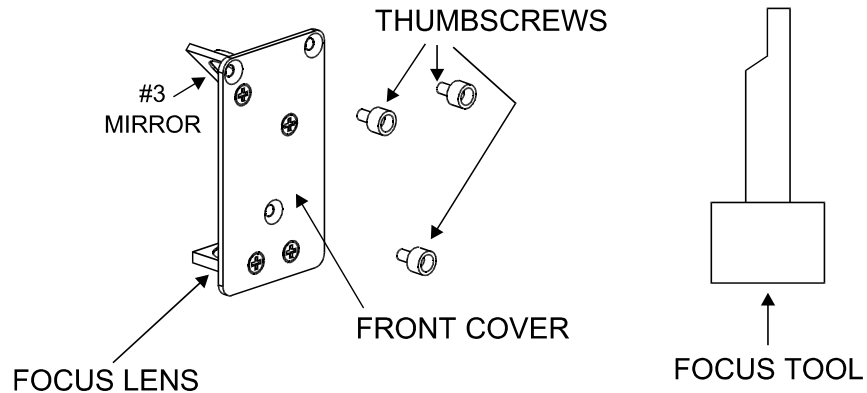
Different lenses produce different spot sizes and have different focal ranges.  For example, the 1.5" lens produces a spot size of .003" and has an effective focal range of +/- .075".  This lens can engrave very fine detail but can only be used on very flat materials.  On the opposite end, the 4.0" lens has a spot size of .013" but has an effective focal range of +/- .2".  Although this lens cannot engrave very fine detail, its focal range allows you to engrave on slightly rounded or curved objects without the need for rotation. Using a baseball as an example, focus the beam halfway between the highest point and the lowest point of engraving.  Since a 4.0" lens has a greater focal range than a shorter lens, you can engrave a considerable distance around the ball without having to rotate it.  Attempting to engrave further around the ball will result in a loss of engraving power and a distorted image.

EFFECT ENGRAVING
AREA

HIGH POINT

FOCUS HERE        .2"

.2"

LOW POINT
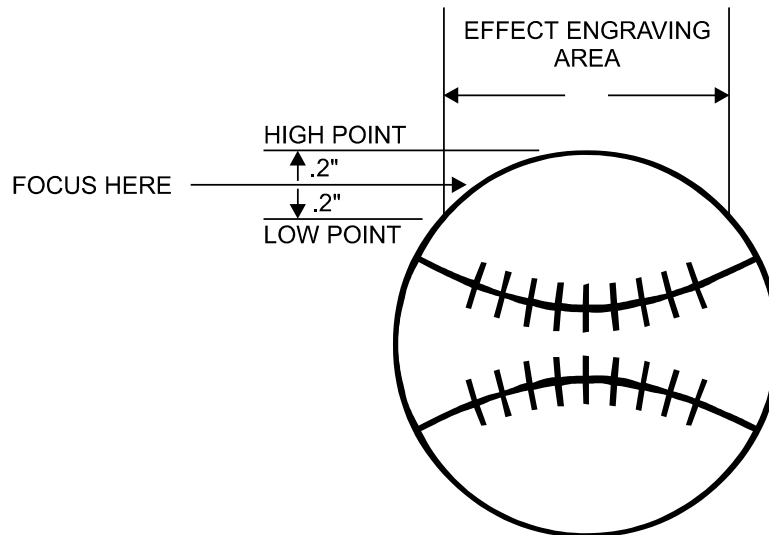
Refer to the following chart for spot sizes and focal ranges of the lenses available.

| FOCAL LENGTH | SPOT SIZE | FOCAL RANGE |
|:---:|:---:|:---:|
| 1.5 " | .003 " | + / - .075 " |
| 2.0 " | .005 " | + / - .100 " |
| 2.5 " | .007 " | + / - .125 " |
| 4.0 " | .013 " | + / - .200 " |

If you would like to order any of the accessories described in this section, please speak with your salesperson or call us directly to place an order or to get current pricing.  Most of these items are in stock and are available for immediate shipment.

**SECTION 6**

# Sample Materials
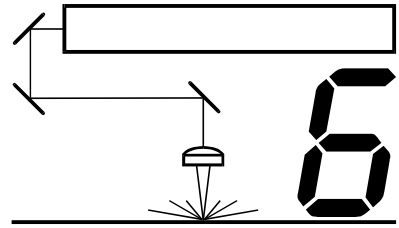
This section provides sample driver settings and helpful hints to get started engraving and/or cutting the materials listed.

# Safety



**WARNING**

**NEVER LEAVE THE LASER SYSTEM RUNNING UNATTENDED FOR ANY REASON.** Exposure to the laser beam can cause ignition of combustible materials. All laser cutting and engraving should be constantly supervised.

**NEVER OPERATE THE LASER SYSTEM WITHOUT A PROPERLY INSTALLED AND OPERATING EXHAUST SYSTEM.** Some materials when cut or engraved can produce fumes that are hazardous in concentrated amounts. Also make sure that your room is adequately ventilated as some materials will continue to produce fumes for several minutes to possibly hours after the cutting or engraving process has been completed. Since many materials can produce toxic and possibly caustic fumes or residue, it is advisable to obtain the Material Safety Data Sheet (MSDS) from the materials manufacturer. The MSDS discloses all of the hazards when handling or processing that material. The law requires all manufacturers to provide this information to anyone who requests it.

**DO NOT ENGRAVE OR CUT PVC (Polyvinylchloride) BASED MATERIALS.** The fumes are extremely toxic if you inhale them. The fumes are so caustic that it can chemically destroy the metal parts of the laser system. Damage to the laser system from this type of abuse **WILL NOT** be covered under warranty.

**DO NOT ENGRAVE OR CUT UNCOATED METALS OR REFLECTIVE SURFACES.** The laser beam can reflect off of these materials causing damage to the laser system as well as being a safety hazard. Damage to the laser system from this type of abuse **WILL NOT** be covered under warranty.

# NOTICE

Laser engraving or cutting materials other than those described in this manual can be a safety hazard and can damage the laser system.

The laser system operator is liable for any damages caused, in whole or in part, for any economic loss, physical injury, lost revenue, lost profits, lost savings or other indirect, incidental, special or consequential damages incurred.

Damages to the laser system due to neglect, misuse, or operator error WILL NOT be covered under warranty.

## Materials

There are many variables that can affect the cutting and engraving process such as differences in the thickness of the material, density of the material, composition of the material, and the manufacturing processes used to make the material.

**Please use these settings as a guideline or starting point, in most cases these settings should work out well, but sometimes may have to be adjusted to produce desirable results.**

## *PRINTER DRIVER SETTING TIPS*

### Power Setting
- Higher burns deeper.  Too much power sacrifices detail.  Has no effect on running time.
- Lower burns shallower.  Too little power sacrifices detail.  Has no effect on running time.

### Speed Setting
- Higher saves time.  Burns shallower and reduces detail.
- Lower increases time.  Burns deeper but too deep may reduce detail.

### PPI Setting
- Higher increases the burning or melting effect.  Produces finer detail if Speed is not too fast.  Has no effect on running time and very little effect on depth.
- Lower decreases the burning or melting effect.  Reduces image detail if set too low.  Has no effect on running time and very little effect on depth.  Very low settings are used to perforate the material.

### Rule of Thumb
- Doubling the Power doubles the depth and halving the Power halves the depth.
- Halving the Speed doubles the depth and doubling the Speed halves the depth.

NOTE

When engraving very small objects, top speed cannot be achieved because acceleration and deceleration of the motion system requires time and distance.  The laser system will automatically adjust itself to a maximum engraving speed that it can achieve due to the size and position of the graphic.  This is why you might notice that there might be no difference in engraving time on certain graphics whether you choose 100% speed or less.

The following materials were tested with the laser system set at 500 DPI except where noted otherwise.  The following pages will fully describe the results of these tests and will offer helpful hints when choosing materials, setting parameters, and using different techniques to provide the best laser cutting and engraving results.

**Please use these settings as a guideline or starting point, in most cases these settings should work out well, but sometimes may have to be adjusted to produce desirable results.**

<div align="center">

ACRYLIC - CAST AND EXTRUDED

ACRYLIC – MIRRORED

ALUMINUM – ANODIZED

**BRASS – PAINTED**

CORK

CORIAN / AVONITE / FOUNTAINHEAD

DELRIN (SEAL PRESS)

GLASS / CRYSTAL

LEATHER

MARBLE

MAT BOARD

MELAMINE

PLASTIC – MICROSURFACED

RUBBER STAMPS

VINYL – SIGN (3 MIL)

WOOD / WOOD INLAY

</div>

## ACRYLIC - CAST AND EXTRUDED

*LIGHT RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 70 | 80 | 500 | 1 | .001" |
| 20 | 50 | 80 | 500 | 1 | .001" |
| 25 | 40 | 80 | 500 | 1 | .001" |
| 30 | 35 | 80 | 500 | 1 | .001" |
| 35 | 30 | 80 | 500 | 1 | .001" |
| 40 | 26 | 80 | 500 | 1 | .001" |
| 45 | 22 | 80 | 500 | 1 | .001" |
| 50 | 20 | 80 | 500 | 1 | .001" |

*DEEP RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 20 | 500 | 1 | .010" |
| 20 | 100 | 27 | 500 | 1 | .010" |
| 25 | 100 | 33 | 500 | 1 | .010" |
| 30 | 100 | 40 | 500 | 1 | .010" |
| 35 | 100 | 47 | 500 | 1 | .010" |
| 40 | 100 | 54 | 500 | 1 | .010" |
| 45 | 100 | 60 | 500 | 1 | .010" |
| 50 | 100 | 67 | 500 | 1 | .010" |

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 10 | 4.0 | 1000 | 1 | .010" |
| 20 | 8 | 4.0 | 1000 | 1 | .010" |
| 25 | 6 | 4.0 | 1000 | 1 | .010" |
| 30 | 5 | 4.0 | 1000 | 1 | .010" |
| 35 | 4 | 4.0 | 1000 | 1 | .010" |
| 40 | 3 | 4.6 | 1000 | 1 | .010" |
| 45 | 3 | 5.2 | 1000 | 1 | .010" |
| 50 | 3 | 5.8 | 1000 | 1 | .010" |

*VECTOR CUTTING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 80 | .2 | 1000 | 1 | .2" |
| 20 | 100 | .4 | 1000 | 1 | .2" |
| 25 | 90 | .4 | 1000 | 1 | .2" |
| 30 | 75 | .4 | 1000 | 1 | .2" |
| 35 | 65 | .4 | 1000 | 1 | .2" |
| 40 | 55 | .4 | 1000 | 1 | .2" |
| 45 | 50 | .4 | 1000 | 1 | .2" |
| 50 | 45 | .4 | 1000 | 1 | .2" |

**COMMENTS**

There are two types of acrylic available, cast and extruded.  Cast turns white or frosted and extruded remains clear when engraved.  Use extruded acrylic for paint filled engraving and cast for regular engraving.  Cast engraves better without masking.  Lightly engrave the surface to frost it with a low power setting such as the first setting listed above.  If deep engraving is desired, it is necessary to mask the acrylic with transfer tape to prevent the smoke from damaging the clear surface of the acrylic.  However, another problem with deep acrylic engraving is that the intense heat creates a white, crusty, deposit that accumulates along the edges of the area that was just engraved and is impossible to remove without causing damage.  Engraving lightly and without masking seems to be the better all around alternative.

If only cutting acrylic, extruded works better and is less expensive than cast.  The cut edges of extruded acrylic will appear to be more highly polished and clearer than cast acrylic when laser cut.  When cutting acrylic, it might be necessary to remove both sides of the original masking and re-mask with transfer tape if cutting through the original masking produces flaming.  The original masking is coated with wax and will not absorb water.  If cutting through very thick acrylic, re-mask both sides with transfer tape and dampen the masking on both sides of the acrylic with water from a spray bottle.  Elevate the acrylic off the table at least 1/2 inch, re-focus, and then proceed to cut.  Elevating the acrylic will allow the beam to completely pass through the material which allows the smoke and heat to escape from underneath.  If cutting directly on the engraving table, the trapped heat might cause the bottom edge of the cut to pit and distort.  Re-masking and dampening with water will act as a heat sink to pull the laser heat away from the cutting area resulting in less distortion or heat effected zones (HAZ).  When dampening, be sure not to leave puddles of water.  Puddles of water will reduce cutting depth significantly.  For the best results when combining engraving and cutting on the same piece, first engrave lightly and unmasked.  Then mask with transfer tape, dampen, elevate, re-focus, and cut as a second step.

Paint filling the engraved area is possible by first masking the acrylic or leave on the original masking then engraving through the masking.  Before removing the masking, brush or spray on some acrylic based or water based paint right on to the masking.  When the paint is dry, remove the masking and the paint will remain in the recessed area of the engraving.  Remember to use extruded acrylic when paint filling and cast acrylic when simply engraving.



WARNING
NEVER OPERATE THE LASER SYSTEM
WITHOUT CONSTANT SUPERVISION

EXPOSURE TO THE LASER BEAM MAY
CAUSE IGNITION OF COMBUSTIBLE
MATERIALS WHICH CAN CAUSE SEVERE
DAMAGE TO THE EQUIPMENT

**Acrylic is extremely flammable.  Do not leave the laser system unattended when cutting or engraving.**

**ACRYLIC - MIRRORED**

*LIGHT RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 75 | 80 | 500 | 1 | .003" |
| 20 | 55 | 80 | 500 | 1 | 003" |
| 25 | 45 | 80 | 500 | 1 | 003" |
| 30 | 40 | 80 | 500 | 1 | 003" |
| 35 | 35 | 80 | 500 | 1 | 003" |
| 40 | 31 | 80 | 500 | 1 | 003" |
| 45 | 27 | 80 | 500 | 1 | 003" |
| 50 | 25 | 80 | 500 | 1 | 003" |

*DEEP RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 20 | 500 | 1 | .010" |
| 20 | 100 | 27 | 500 | 1 | .010" |
| 25 | 100 | 33 | 500 | 1 | .010" |
| 30 | 100 | 40 | 500 | 1 | .010" |
| 35 | 100 | 47 | 500 | 1 | .010" |
| 40 | 100 | 54 | 500 | 1 | .010" |
| 45 | 100 | 60 | 500 | 1 | .010" |
| 50 | 100 | 67 | 500 | 1 | .010" |

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 12 | 4.0 | 1000 | 1 | .010" |
| 20 | 10 | 4.0 | 1000 | 1 | .010" |
| 25 | 8 | 4.0 | 1000 | 1 | .010" |
| 30 | 7 | 4.0 | 1000 | 1 | .010" |
| 35 | 6 | 4.0 | 1000 | 1 | .010" |
| 40 | 5 | 4.6 | 1000 | 1 | .010" |
| 45 | 5 | 5.2 | 1000 | 1 | .010" |
| 50 | 5 | 5.8 | 1000 | 1 | .010" |

*VECTOR CUTTING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 80 | .2 | 1000 | 1 | .2" |
| 20 | 100 | .4 | 1000 | 1 | .2" |
| 25 | 90 | .4 | 1000 | 1 | .2" |
| 30 | 75 | .4 | 1000 | 1 | .2" |
| 35 | 65 | .4 | 1000 | 1 | .2" |
| 40 | 55 | .4 | 1000 | 1 | .2" |
| 45 | 50 | .4 | 1000 | 1 | .2" |
| 50 | 45 | .4 | 1000 | 1 | .2" |

**COMMENTS**

Engraving mirrored acrylic is similar to engraving regular acrylic.  The idea is to engrave through the mirrored backing enough to begin to penetrate into the acrylic.  Engraving deeply will cause a crusty residue to form just like with non-mirrored acrylic.  A double image will appear if engraving on the front side of the mirror.  It is not necessary to mask the backside when engraving because the mirrored backing shields the acrylic from smoke damage.  To cut mirrored acrylic, it might be necessary to remove all original masking, re-mask with transfer tape, and dampen the tape with water from a spray bottle.  Next, place the acrylic in the laser with the mirrored surface facing upwards and elevate at least 1/2 inch above the table.  The laser beam will not reflect off of the mirrored surface because it is absorbed by the acrylic first.  Sometimes cutting the acrylic from the backside will cause the mirrored backing to distort and crack from the intense heat required to cut.  If the combination of engraving and cutting is desired, our suggestion is to engrave the backing, unmasked, remove the acrylic, mask both sides with transfer tape, flip the acrylic over, dampen, elevate, re-focus, and cut from the front side.  When paint filling the engraved area, make sure to use an acrylic-based paint or paint that does not contain acetone or alcohol, as these chemicals will crack the acrylic.  Water based paints also work very well.  Since the mirrored backing serves as a masking, it is not necessary to mask the backside before engraving.

WARNING
NEVER OPERATE THE LASER SYSTEM
WITHOUT CONSTANT SUPERVISION

EXPOSURE TO THE LASER BEAM MAY
CAUSE IGNITION OF COMBUSTIBLE
MATERIALS WHICH CAN CAUSE SEVERE
DAMAGE TO THE EQUIPMENT

**Acrylic is extremely flammable.  Do not leave the laser system unattended when cutting or engraving.**

**ANODIZED ALUMINUM**

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 90 | 80 | 500 | 1 | .001" |
| 20 | 68 | 80 | 500 | 1 | .001" |
| 25 | 54 | 80 | 500 | 1 | .001" |
| 30 | 45 | 80 | 500 | 1 | .001" |
| 35 | 38 | 80 | 500 | 1 | .001" |
| 40 | 34 | 80 | 500 | 1 | .001" |
| 45 | 30 | 80 | 500 | 1 | .001" |
| 50 | 27 | 80 | 500 | 1 | .001" |

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 20 | 4.0 | 1000 | 1 | .001" |
| 20 | 15 | 4.0 | 1000 | 1 | .001" |
| 25 | 12 | 4.0 | 1000 | 1 | .001" |
| 30 | 10 | 4.0 | 1000 | 1 | .001" |
| 35 | 9 | 4.0 | 1000 | 1 | .001" |
| 40 | 8 | 4.0 | 1000 | 1 | .001" |
| 45 | 7 | 4.0 | 1000 | 1 | .001" |
| 50 | 6 | 4.0 | 1000 | 1 | .001" |

**COMMENTS**

There is a process called Laser Color Marking which enables the color filling of anodized aluminum.  First, coat or spray the aluminum with a clear acrylic finish.  After the finish has thoroughly dried, laser engrave the graphic onto the aluminum.  Then take a water based marker, such as those found in an art supply store, and swab on the ink into the engraved area.  You can actually see the ink get absorbed into the engraved area but not the unengraved area.  The ink will appear lighter in color because the white engraved area tends to lighten the shade.  Use a darker tint marker to compensate for the lighter effect. Wipe off the excess with a soft, lint free cloth.  Finish the piece by applying another coat of clear acrylic finish and let dry.

**DO NOT ATTEMPT TO ENGRAVE DEEPLY OR CUT THIS MATERIAL WITH THE LASER SYSTEM**.  High Power and low Speed settings can cause the laser beam to reflect off of this material which can damage the laser system and can be a safety hazard.  Damage caused by this type of abuse **WILL NOT** be covered under warranty.

**WARNING**

**ENGRAVING THIS MATERIAL PRODUCES ABRASIVE PARTICLES**. Clean the laser system more frequently to reduce wear and tear on the motion system components and optics.  Damage to the laser system from inadequate or insufficient maintenance **WILL NOT** be covered under warranty.

**WARNING**

**BRASS - PAINTED**

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 90 | 80 | 500 | 1 | .001" |
| 20 | 68 | 80 | 500 | 1 | .001" |
| 25 | 54 | 80 | 500 | 1 | .001" |
| 30 | 45 | 80 | 500 | 1 | .001" |
| 35 | 38 | 80 | 500 | 1 | .001" |
| 40 | 34 | 80 | 500 | 1 | .001" |
| 45 | 30 | 80 | 500 | 1 | .001" |
| 50 | 27 | 80 | 500 | 1 | .001" |

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 20 | 4.0 | 1000 | 1 | .001" |
| 20 | 15 | 4.0 | 1000 | 1 | .001" |
| 25 | 12 | 4.0 | 1000 | 1 | .001" |
| 30 | 10 | 4.0 | 1000 | 1 | .001" |
| 35 | 9 | 4.0 | 1000 | 1 | .001" |
| 40 | 8 | 4.0 | 1000 | 1 | .001" |
| 45 | 7 | 4.0 | 1000 | 1 | .001" |
| 50 | 6 | 4.0 | 1000 | 1 | .001" |

**COMMENTS**

The manufacturing processes for coated brass varies from one vendor to another.  Some manufacturers do not polish the brass before coating it.  Since $CO_2$ lasers at this power level do not engrave into metals when the coating is removed, the tarnished brass underneath will have a dull appearance that will need to be polished with a brass polishing compound.  This type of brass is designed for mechanical engravers that actually remove the metal when engraving which gives the brass a shine without polishing.  Brass that is produced for the laser engraving industry is polished, then clear coated, and finally coated with paint.  When laser engraving this type of material, adjust the power so that the laser beam removes the painted coating but not the clear coating.  This will expose the polished, clear-coated brass without penetrating all the way down to the metal.  Since the brass is already clear coated and polished, it will not require any cleanup after engraving nor will it ever oxidize.  If too much laser power is used, the brass the clear coat will be removed and the brass underneath will be exposed to the heat of the laser beam causing instant tarnish.  If polishing the brass, use a soft, non-abrasive cloth or tissue (not paper towels) and good quality brass polish.  Do not rub too hard, as this will scratch the painted coating.

⚠ **WARNING**

**DO NOT ATTEMPT TO ENGRAVE DEEPLY OR CUT THIS MATERIAL WITH THE LASER SYSTEM**.  High Power and low Speed settings can cause the laser beam to reflect off of this material which can damage the laser system and can be a safety hazard.  Damage caused by this type of abuse **WILL NOT** be covered under warranty.

## CORIAN / AVONITE / FOUNTAINHEAD

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 20 | 500 | 1 | .005" |
| 20 | 100 | 27 | 500 | 1 | .005" |
| 25 | 100 | 33 | 500 | 1 | .005" |
| 30 | 100 | 40 | 500 | 1 | .005" |
| 35 | 100 | 47 | 500 | 1 | .005" |
| 40 | 100 | 53 | 500 | 1 | .005" |
| 45 | 100 | 60 | 500 | 1 | .005" |
| 50 | 100 | 67 | 500 | 1 | .005" |

*DEEP RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 10 | 1000 | 1 | .015" |
| 20 | 100 | 13 | 1000 | 1 | .015" |
| 25 | 100 | 17 | 1000 | 1 | .015" |
| 30 | 100 | 20 | 1000 | 1 | .015" |
| 35 | 100 | 23 | 1000 | 1 | .015" |
| 40 | 100 | 27 | 1000 | 1 | .015" |
| 45 | 100 | 30 | 1000 | 1 | .015" |
| 50 | 100 | 33 | 1000 | 1 | .015" |

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 4.0 | 1000 | 1 | .010" |
| 20 | 75 | 4.0 | 1000 | 1 | .010" |
| 25 | 60 | 4.0 | 1000 | 1 | .010" |
| 30 | 50 | 4.0 | 1000 | 1 | .010" |
| 35 | 43 | 4.0 | 1000 | 1 | .010" |
| 40 | 38 | 4.0 | 1000 | 1 | .010" |
| 45 | 33 | 4.0 | 1000 | 1 | .010" |
| 50 | 30 | 4.0 | 1000 | 1 | .010" |

## COMMENTS

If paint filling, mask the material first, then engrave through the masking. In this way, when ready to paint fill, the material is already masked. Spray painting seems to be the easiest. Use the paint sparingly. Excess paint can accumulate on the edges of the engraving, which will make mask removal difficult and leave unsightly ridges. It is best to apply several lighter coats than one heavy coat of paint. Remove the masking after the paint has dried.



**ENGRAVING THIS MATERIAL PRODUCES ABRASIVE PARTICLES**. Clean the laser system more frequently to reduce wear and tear on the motion system components and optics. Damage to the laser system from inadequate or insufficient maintenance **WILL NOT** be covered under warranty.

**WARNING**

**CORK**

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 80 | 30 | 500 | 1 | .010" |
| 20 | 80 | 40 | 500 | 1 | .010" |
| 25 | 80 | 50 | 500 | 1 | .010" |
| 30 | 80 | 60 | 500 | 1 | .010" |
| 35 | 80 | 70 | 500 | 1 | .010" |
| 40 | 80 | 80 | 500 | 1 | .010" |
| 45 | 80 | 90 | 500 | 1 | .010" |
| 50 | 80 | 100 | 500 | 1 | .010" |

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 20 | 4.0 | 500 | 1 | .010" |
| 20 | 15 | 4.0 | 500 | 1 | .010" |
| 25 | 12 | 4.0 | 500 | 1 | .010" |
| 30 | 10 | 4.0 | 500 | 1 | .010" |
| 35 | 9 | 4.0 | 500 | 1 | .010" |
| 40 | 8 | 4.0 | 500 | 1 | .010" |
| 45 | 7 | 4.0 | 500 | 1 | .010" |
| 50 | 6 | 4.0 | 500 | 1 | .010" |

*VECTOR CUTTING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 1.6 | 100 | 1 | .060" |
| 20 | 75 | 1.6 | 100 | 1 | .060" |
| 25 | 60 | 1.6 | 100 | 1 | .060" |
| 30 | 50 | 1.6 | 100 | 1 | .060" |
| 35 | 43 | 1.6 | 100 | 1 | .060" |
| 40 | 38 | 1.6 | 100 | 1 | .060" |
| 45 | 33 | 1.6 | 100 | 1 | .060" |
| 50 | 30 | 1.6 | 100 | 1 | .060" |

**COMMENTS**

Cork is not very popular for engraving but it does engrave and cut nicely. Cork is mainly used for making gaskets by vector cutting the gasket patterns.

**LASER CUTTING THIS MATERIAL CAN CAUSE FLAMING AND SPARKING.** Use caution when attempting to cut this material. It would be better to use a longer focal length lens to prevent the lens from being damaged during processing. **NEVER** leave the machine unattended while processing any material. Damages caused by processing any material **WILL NOT** be covered under warranty.

**WARNING**

## DELRIN (SEAL PRESS)

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 18 | 500 | 1 | .015" |
| 20 | 100 | 23 | 500 | 1 | .015" |
| 25 | 100 | 29 | 500 | 1 | .015" |
| 30 | 100 | 35 | 500 | 1 | .015" |
| 35 | 100 | 41 | 500 | 1 | .015" |
| 40 | 100 | 47 | 500 | 1 | .015" |
| 45 | 100 | 53 | 500 | 1 | .015" |
| 50 | 100 | 58 | 500 | 1 | .015" |

*VECTOR CUTTING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 75 | 1.2 | 200 | 1 | .060" |
| 20 | 75 | 1.6 | 200 | 1 | .060" |
| 25 | 75 | 2.0 | 200 | 1 | .060" |
| 30 | 75 | 2.4 | 200 | 1 | .060" |
| 35 | 75 | 2.8 | 200 | 1 | .060" |
| 40 | 75 | 3.2 | 200 | 1 | .060" |
| 45 | 75 | 3.6 | 200 | 1 | .060" |
| 50 | 75 | 4.0 | 200 | 1 | .060" |

## COMMENTS
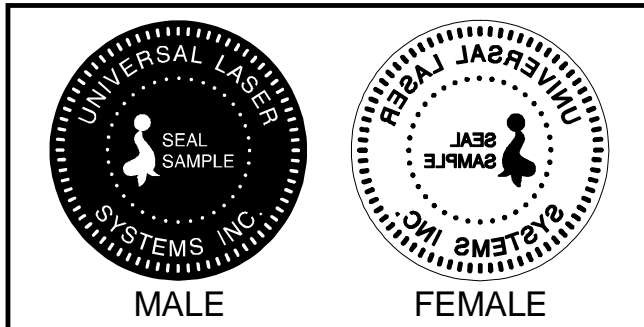
The laser system can be used to make dies for seal presses.  It can engrave and cut out a typical Notary Seal in less than 5 minutes. Create the male with a white graphic and a black background.  Mirror the image and invert it by making the background white and the graphic black.   Add a .010 inch black outline to the graphic portion of the female side.  This will give the greater clearance to the female side to prevent the paper from piercing through when the male side of the seal presses into the female side.  Once the seal is made and fastened to the press, make several impressions onto 400 grit sandpaper to smoothen out the edges of the plastic.  Make sure you turn the sandpaper over to get both sides of the seal.



MALE            FEMALE

**LASER CUTTING THIS MATERIAL CAN CAUSE FLAMING.**  Use caution when attempting to cut this material.  Make sure that the flame does not come in contact with any part of the laser system.  **NEVER** leave the machine unattended while processing any material.  Damages caused by processing any material **WILL NOT** be covered under warranty.

**WARNING**

**GLASS / CRYSTAL**

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 10 | 300 | 1 | .001 |
| 20 | 100 | 13 | 300 | 1 | .001 |
| 25 | 100 | 17 | 300 | 1 | .001 |
| 30 | 100 | 20 | 300 | 1 | .001 |
| 35 | 100 | 23 | 300 | 1 | .001 |
| 40 | 100 | 27 | 300 | 1 | .001 |
| 45 | 100 | 30 | 300 | 1 | .001 |
| 50 | 100 | 33 | 300 | 1 | .001 |

**COMMENTS:** Engrave at 333 DPI

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 10 | 2.0 | 300 | 1 | .001 |
| 20 | 10 | 2.7 | 300 | 1 | .001 |
| 25 | 10 | 3.3 | 300 | 1 | .001 |
| 30 | 10 | 4.0 | 300 | 1 | .001 |
| 35 | 10 | 4.7 | 300 | 1 | .001 |
| 40 | 10 | 5.3 | 300 | 1 | .001 |
| 45 | 10 | 6.0 | 300 | 1 | .001 |
| 50 | 10 | 6.7 | 300 | 1 | .001 |

**COMMENTS**

Glass engraving is different from other types of engraving.  A $CO_2$ laser cannot engrave into the glass nor can it cut glass.  Instead, laser interaction with glass causes the surface of the glass to appear frosted. Sometimes, placing a piece of newspaper on the glass and dampening is with water will improve the appearance of the engraving.  Another method is to apply transfer tape to the glass, wet it with water from a spray bottle, and laser engrave it.  The transfer tape and water will act as a heat sink and pull the heat away from the glass as the laser system engraves it.  This helps reduce chipping or flaking of the glass.

Be especially careful when engraving leaded crystal.  The lead in crystal conduct heat, which can cause much more flaking or even the cracking of the crystal.  Use a lower power setting to try to reduce the chance of damage.  It is always good to have at least one extra piece to use as a test piece to get the right settings especially if you have never tried to engrave that material before.



**ENGRAVING THIS MATERIAL PRODUCES ABRASIVE PARTICLES**.  Clean the laser system more frequently to reduce wear and tear on the motion system components and optics.  Damage to the laser system from inadequate or insufficient maintenance **WILL NOT** be covered under warranty.

**WARNING**

# LEATHER

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 56 | 80 | 500 | 1 | .001" |
| 20 | 42 | 80 | 500 | 1 | .001" |
| 25 | 34 | 80 | 500 | 1 | .001" |
| 30 | 28 | 80 | 500 | 1 | .001" |
| 35 | 24 | 80 | 500 | 1 | .001" |
| 40 | 21 | 80 | 500 | 1 | .001" |
| 45 | 19 | 80 | 500 | 1 | .001" |
| 50 | 17 | 80 | 500 | 1 | .001" |

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 10 | 4.0 | 500 | 1 | .001" |
| 20 | 8 | 4.0 | 500 | 1 | .001" |
| 25 | 6 | 4.0 | 500 | 1 | .001" |
| 30 | 5 | 4.0 | 500 | 1 | .001" |
| 35 | 4 | 4.0 | 500 | 1 | .001" |
| 40 | 4 | 4.0 | 500 | 1 | .001" |
| 45 | 3 | 4.0 | 500 | 1 | .001" |
| 50 | 3 | 4.0 | 500 | 1 | .001" |

*VECTOR CUTTING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 50 | 1.0 | 200 | 1 | .1" |
| 20 | 50 | 1.3 | 200 | 1 | .1" |
| 25 | 50 | 1.7 | 200 | 1 | .1" |
| 30 | 50 | 2.0 | 200 | 1 | .1" |
| 35 | 50 | 2.3 | 200 | 1 | .1" |
| 40 | 50 | 2.7 | 200 | 1 | .1" |
| 45 | 50 | 3.0 | 200 | 1 | .1" |
| 50 | 50 | 3.3 | 200 | 1 | .1" |

## COMMENTS

Leather is a very simple material to engrave and most types of leather engrave very well with the laser system.  Simulated leather engraves well also, but the results are not as nice as with the real thing. Engraving lightly will turn the surface of the leather dark brown giving it a high contrast in appearance. Try engraving at a light power setting first.  If the result is not deep enough the job can be run again over the same spot.  Experiment with different depths of engraving and note the results.

### MARBLE

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 28 | 500 | 1 | .003" |
| 20 | 100 | 37 | 500 | 1 | .003" |
| 25 | 100 | 46 | 500 | 1 | .003" |
| 30 | 100 | 55 | 500 | 1 | .003" |
| 35 | 100 | 64 | 500 | 1 | .003" |
| 40 | 100 | 73 | 500 | 1 | .003" |
| 45 | 100 | 83 | 500 | 1 | .003" |
| 50 | 100 | 92 | 500 | 1 | .003" |

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 40 | 4.0 | 500 | 1 | .003" |
| 20 | 30 | 4.0 | 500 | 1 | .003" |
| 25 | 24 | 4.0 | 500 | 1 | .003" |
| 30 | 20 | 4.0 | 500 | 1 | .003" |
| 35 | 17 | 4.0 | 500 | 1 | .003" |
| 40 | 15 | 4.0 | 500 | 1 | .003" |
| 45 | 13 | 4.0 | 500 | 1 | .003" |
| 50 | 12 | 4.0 | 500 | 1 | .003" |

### COMMENTS

Most marble and polished stones will turn white when engraved.  Masking is not necessary and light engraving works out better than heavy and deep engraving.  Engraving deeply will cause a highly detailed image to appear washed out.  The objective is to engrave deep enough to turn the marble white and provide a good contrast.  Too much power can also cause the material to discolor and turn brown as if it were burned.  Photographs look great when engraved on marble, especially darker marbles where the whiteness of the engraving really stands out.  Avoid using marble that is very textured looking.  The texture washes out the details of the engraving.  Try to use uniformly colored marble and related stones.  Marble can also be paint filled by using a wax based paint.  Rub the paint on with a fingertip, let dry and then buff with a soft cloth.  The paint will only adhere to the engraved surface and not the surrounding areas.

⚠ **WARNING**

**ENGRAVING THIS MATERIAL PRODUCES ABRASIVE PARTICLES**.  Clean the laser system more frequently to reduce wear and tear on the motion system components and optics.  Damage to the laser system from inadequate or insufficient maintenance **WILL NOT** be covered under warranty.

## MAT BOARD

### *RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 90 | 80 | 250 | 1 | .005" |
| 20 | 68 | 80 | 250 | 1 | .005" |
| 25 | 54 | 80 | 250 | 1 | .005" |
| 30 | 45 | 80 | 250 | 1 | .005" |
| 35 | 39 | 80 | 250 | 1 | .005" |
| 40 | 34 | 80 | 250 | 1 | .005" |
| 45 | 30 | 80 | 250 | 1 | .005" |
| 50 | 27 | 80 | 250 | 1 | .005" |

### *VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 40 | 4.0 | 250 | 1 | .005" |
| 20 | 30 | 4.0 | 250 | 1 | .005" |
| 25 | 24 | 4.0 | 250 | 1 | .005" |
| 30 | 20 | 4.0 | 250 | 1 | .005" |
| 35 | 17 | 4.0 | 250 | 1 | .005" |
| 40 | 15 | 4.0 | 250 | 1 | .005" |
| 45 | 13 | 4.0 | 250 | 1 | .005" |
| 50 | 12 | 4.0 | 250 | 1 | .005" |

### *VECTOR CUTTING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 3.2 | 200 | 1 | .050" |
| 20 | 75 | 3.2 | 200 | 1 | .050" |
| 25 | 60 | 3.2 | 200 | 1 | .050" |
| 30 | 50 | 3.2 | 200 | 1 | .050" |
| 35 | 43 | 3.2 | 200 | 1 | .050" |
| 40 | 38 | 3.2 | 200 | 1 | .050" |
| 45 | 33 | 3.2 | 200 | 1 | .050" |
| 50 | 30 | 3.2 | 200 | 1 | .050" |

## COMMENTS

Mat board (thick cardboard) is an excellent material to use for architectural modeling and for picture framing.  It cuts and engraves very neatly and cleanly.  It comes in a variety of shades and colors. Patterns can be engraved on the surface with a power setting for light engraving which just breaks through the very thin top layer and exposes the lighter colored underlying substrate.  When engraving, a low PPI setting is used to prevent overexposure of the underlying substrate material, which causes excessive dark discoloration.  Masking is not necessary on the top surface when engraving.  When cutting, both sides might need to be masked and the material elevated above the engraving table.  This will produce an extremely clean edge on both sides of the material.

**MELAMINE - STANDARD ENGRAVING**

*LIGHT RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---------------|-------|-------|-----|------|-------|
| 15 | 100 | 20 | 500 | 1 | .015" |
| 20 | 100 | 27 | 500 | 1 | .015" |
| 25 | 100 | 33 | 500 | 1 | .015" |
| 30 | 100 | 40 | 500 | 1 | .015" |
| 35 | 100 | 47 | 500 | 1 | .015" |
| 40 | 100 | 53 | 500 | 1 | .015" |
| 45 | 100 | 60 | 500 | 1 | .015" |
| 50 | 100 | 67 | 500 | 1 | .015" |

*DEEP RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---------------|-------|-------|-----|------|-------|
| 15 | 100 | 14 | 500 | 1 | .020" |
| 20 | 100 | 19 | 500 | 1 | .020" |
| 25 | 100 | 23 | 500 | 1 | .020" |
| 30 | 100 | 28 | 500 | 1 | .020" |
| 35 | 100 | 33 | 500 | 1 | .020" |
| 40 | 100 | 37 | 500 | 1 | .020" |
| 45 | 100 | 42 | 500 | 1 | .020" |
| 50 | 100 | 47 | 500 | 1 | .020" |

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---------------|-------|-------|-----|------|-------|
| 15 | 40 | 4.0 | 500 | 1 | .010" |
| 20 | 30 | 4.0 | 500 | 1 | .010" |
| 25 | 24 | 4.0 | 500 | 1 | .010" |
| 30 | 20 | 4.0 | 500 | 1 | .010" |
| 35 | 17 | 4.0 | 500 | 1 | .010" |
| 40 | 15 | 4.0 | 500 | 1 | .010" |
| 45 | 13 | 4.0 | 500 | 1 | .010" |
| 50 | 12 | 4.0 | 500 | 1 | .010" |

**COMMENTS**

Engraving melamine is very similar to engraving regular wood with the added benefit of a consistent surface finish and uniform base material composition. Unlike regular wood that has grain patterns and density variations, melamine, when laser engraved, produces a flat and even engraved area. This characteristic gives this material superior engraving and paint filling qualities. Masking can be used if desired but it is just as easy to spray the engraved area with water and wipe down with a chamois cloth to remove the smoke residue. Since the top surface material is consistent in texture and color, engraving photographs or highly detailed images produces exceptional results. Refer to the next example on engraving photographs and/or ClipArt.

## MELAMINE - PHOTO/CLIPART ENGRAVING

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 80 | 30 | 500 | 1 | .008" |
| 20 | 80 | 40 | 500 | 1 | .008" |
| 25 | 80 | 50 | 500 | 1 | .008" |
| 30 | 80 | 60 | 500 | 1 | .008" |
| 35 | 80 | 70 | 500 | 1 | .008" |
| 40 | 80 | 80 | 500 | 1 | .008" |
| 45 | 80 | 90 | 500 | 1 | .008" |
| 50 | 80 | 100 | 500 | 1 | .008" |

**COMMENTS:** Engrave unmasked.  Use a resolution of 500 DPI.

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 80 | 15 | 500 | 1 | .008" |
| 20 | 80 | 20 | 500 | 1 | .008" |
| 25 | 80 | 25 | 500 | 1 | .008" |
| 30 | 80 | 30 | 500 | 1 | .008" |
| 35 | 80 | 35 | 500 | 1 | .008" |
| 40 | 80 | 40 | 500 | 1 | .008" |
| 45 | 80 | 45 | 500 | 1 | .008" |
| 50 | 80 | 50 | 500 | 1 | .008" |

**COMMENTS:** Engrave unmasked.  Use a resolution of 250 DPI.

## COMMENTS

Engraving photographs can be challenging at first but becomes easier once there is an understanding of what to look for and how to achieve the desired results.  In an image processing software, scan the image in at 300 DPI.  Adjust the brightness and the contrasts to brighten the light colors and darken the dark colors.  The photo might look better by using a sharpening filter to sharpen up the image slightly.  The next step is to select a halftone pattern.  Usually, imaging software gives the choice of using different halftone patterns including frequency of lines per inch and pattern angles.  Use a line frequency above 20 and below 100.  The size of the dots decreases as the line frequency increases.  Experiment to see which pattern looks the best.  Big dots look good on some materials and small dots look better on others.  If it is not possible to assign a halftone pattern in the imaging software, the printer driver will automatically default to a predetermined pattern based on **RESOLUTION**. When using the Clipart mode switch, which prints all Clipart or drawings as grayscale bitmaps, use the same parameters and techniques as for engraving photographs.  Please refer to Section 3 about using predefined halftone screens in the driver or creating custom ones.

**PLASTIC - ENGRAVERS MICROSURFACED**

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 70 | 80 | 500 | 1 | .003" |
| 20 | 50 | 80 | 500 | 1 | .003" |
| 25 | 40 | 80 | 500 | 1 | .003" |
| 30 | 35 | 80 | 500 | 1 | .003" |
| 35 | 30 | 80 | 500 | 1 | .003" |
| 40 | 26 | 80 | 500 | 1 | .003" |
| 45 | 22 | 80 | 500 | 1 | .003" |
| 50 | 20 | 80 | 500 | 1 | .003" |

*VECTOR CUTTING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 1.2 | 150 | 1 | .060" |
| 20 | 75 | 1.2 | 150 | 1 | .060" |
| 25 | 60 | 1.2 | 150 | 1 | .060" |
| 30 | 50 | 1.2 | 150 | 1 | .060" |
| 35 | 43 | 1.2 | 150 | 1 | .060" |
| 40 | 38 | 1.2 | 150 | 1 | .060" |
| 45 | 33 | 1.2 | 150 | 1 | .060" |
| 50 | 30 | 1.2 | 150 | 1 | .060" |

**COMMENTS**

Laser engraveable plastic comes in many different colors, thickness, coatings, and surface textures. Most engravers plastic will engrave and cut well with the laser system as long as it is microsurfaced and formulated for laser engraving. Removal of large amounts of material will warp the plastic. You might need to tape it down or hold it down flat somehow to prevent it from curling as you engrave. Since these plastics have low melting point, a low PPI setting is used when cutting to reduce the possibility of melting. Masking and dampening with water also helps to reduce melting and keeps the plastic clear of smoke residue. Always remove the original clear masking from the plastic because it does not react well with the laser. Since there are so many types of engravers plastics, the only true way to find out if a particular brand and type will work well with the laser is to experiment. Use these power settings as a guideline for experimentation and adjust as necessary. Thicker top coated plastics are not recommended because it requires too much power to remove the material and the large amount of smoke created usually stains the substrate.

WARNING
NEVER OPERATE THE LASER SYSTEM
WITHOUT CONSTANT SUPERVISION

EXPOSURE TO THE LASER BEAM MAY
CAUSE IGNITION OF COMBUSTIBLE
MATERIALS WHICH CAN CAUSE SEVERE
DAMAGE TO THE EQUIPMENT

LASER ENGRAVING OR CUTTING PLASTIC CAN IGNITE THE MATERIAL. **Never leave the laser system running unattended for any reason.**

**RUBBER STAMPS**

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 (Not recommended) | N/A | N/A | N/A | N/A | N/A |
| 20 (Not recommended) | N/A | N/A | N/A | N/A | N/A |
| 25 | 100 | 13 | 500 | 1 | .030" |
| 30 | 100 | 16 | 500 | 1 | .030" |
| 35 | 100 | 19 | 500 | 1 | .030" |
| 40 | 100 | 21 | 500 | 1 | .030" |
| 45 | 100 | 24 | 500 | 1 | .030" |
| 50 | 100 | 27 | 500 | 1 | .030" |

*PERFORATED VECTOR CUTTING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 (Not recommended) | N/A | N/A | N/A | N/A | N/A |
| 20 (Not recommended) | N/A | N/A | N/A | N/A | N/A |
| 25 | 60 | 1.3 | 90 | 1 | .040" |
| 30 | 60 | 1.6 | 90 | 1 | .040" |
| 35 | 60 | 1.9 | 90 | 1 | .040" |
| 40 | 60 | 2.1 | 90 | 1 | .040" |
| 45 | 60 | 2.4 | 90 | 1 | .040" |
| 50 | 60 | 2.7 | 90 | 1 | .040" |

**COMMENTS**

To create a rubber stamp, use the "3D Effects" tab in the driver (Section 3).  In the above example, only one pass is necessary to achieve a deeply engraved rubber stamp.  When cutting out the rubber stamp, we recommend using a very low PPI setting.  This setting spreads the laser pulses far enough apart that they just touch at the edges.  The result is a perforated cut that allows the rubber stamp to remain attached to the entire sheet but easily removed by simply tearing it off.  The advantage to this is that the possibility of distortion or melting while cutting is virtually eliminated and the entire sheet of rubber stamps can be removed from the machine at one time instead of having to pick them up one by one.

⚠️ **WARNING**

- LASER ENGRAVING OR CUTTING RUBBER CAN IGNITE THE MATERIAL. **Never leave the laser system running unattended for any reason.**
- **LASER ENGRAVING OR CUTTING RUBBER CAN PRODUCE FOUL ODORS.** You might need to particulate filter and/or odor filter your exhaust depending on your environment, installation location, and/or your local air quality control laws.
- **LASER ENGRAVING OR CUTTING RUBBER PRODUCES ABRASIVE DUST.** Clean the laser system more frequently to reduce wear and tear on the motion system components and optics.  Damage to the laser system from inadequate or insufficient maintenance **WILL NOT** be covered under warranty.

**SIGN VINYL**

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|:---:|:---:|:---:|:---:|:---:|:---:|
| 15 | 100 | 15 | 500 | 1 | .015" |
| 20 | 100 | 20 | 500 | 1 | .015" |
| 25 | 100 | 25 | 500 | 1 | .015" |
| 30 | 100 | 30 | 500 | 1 | .015" |
| 35 | 100 | 35 | 500 | 1 | .015" |
| 40 | 100 | 40 | 500 | 1 | .015" |
| 45 | 100 | 45 | 500 | 1 | .015" |
| 50 | 100 | 50 | 500 | 1 | .015" |

*VECTOR CUTTING (KISS CUT)*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|:---:|:---:|:---:|:---:|:---:|:---:|
| 15 | 5 | 2.0 | 500 | 1 | .003" |
| 20 | 5 | 2.7 | 500 | 1 | .003" |
| 25 | 5 | 3.3 | 500 | 1 | .003" |
| 30 | 5 | 4.0 | 500 | 1 | .003" |
| 35 | 5 | 4.7 | 500 | 1 | .003" |
| 40 | 5 | 5.3 | 500 | 1 | .003" |
| 45 | 5 | 6.0 | 500 | 1 | .003" |
| 50 | 5 | 6.7 | 500 | 1 | .003" |

**COMMENTS**

Sign vinyl comes in a wide variety of colors, patterns, thickness, finishes, and reflectivity. There are a few methods for using sign vinyl with the laser system. One method is to vector cut (unmasked) through the vinyl but not through the backing. This technique provides results equivalent to a vinyl cutter machine. Once the vinyl has been cut, remove the excess vinyl, apply transfer tape and use a squeegee to remove trapped air bubbles. The transfer tape can then be lifted off and the vinyl lettering or objects that were vector cut will stick to the transfer tape and maintain their correct spacing with respect to each other. Now apply the tape to the desired surface and squeegee, peel off the transfer tape, and the lettering will remain adhered to the surface. The other method is to apply a piece of vinyl to the desired surface (unmasked) and adjust the laser power so as to cut through the vinyl without engraving into the material below. Another example is to cover the entire surface of a wooden plaque with vinyl, use a squeegee to remove all air bubbles, and then mask the entire surface with transfer tape to protect the vinyl from smoke damage. In the graphics software, color the background black and place white filled text on top of the colored background. Since the laser system does not engrave white filled objects, the background will be engraved and the lettering will be untouched. Peel off the excess vinyl and transfer tape to reveal the final product.

⚠ **WARNING**
**MOST SIGN VINYL IS MADE FROM PVC (Polyvinylchloride). DO NOT USE PVC BASED VINYL.** The fumes are extremely toxic if you inhale them. The fumes are also caustic and can chemically destroy the metal parts of the laser system. Damage to the laser system from this type of abuse **WILL NOT** be covered under warranty.

**WOOD**

*RASTER ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 100 | 20 | 500 | 1 | .020" |
| 20 | 100 | 27 | 500 | 1 | .020" |
| 25 | 100 | 33 | 500 | 1 | .020" |
| 30 | 100 | 40 | 500 | 1 | .020" |
| 35 | 100 | 47 | 500 | 1 | .020" |
| 40 | 100 | 53 | 500 | 1 | .020" |
| 45 | 100 | 60 | 500 | 1 | .020" |
| 50 | 100 | 67 | 500 | 1 | .020" |

*VECTOR ENGRAVING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 80 | 2.5 | 500 | 1 | .030" |
| 20 | 80 | 3.3 | 500 | 1 | .030" |
| 25 | 80 | 4.2 | 500 | 1 | .030" |
| 30 | 80 | 5.0 | 500 | 1 | .030" |
| 35 | 80 | 5.8 | 500 | 1 | .030" |
| 40 | 80 | 6.7 | 500 | 1 | .030" |
| 45 | 80 | 7.5 | 500 | 1 | .030" |
| 50 | 80 | 8.3 | 500 | 1 | .030" |

*VECTOR CUTTING*

| LASER WATTAGE | POWER | SPEED | PPI | PASS | DEPTH |
|---|---|---|---|---|---|
| 15 | 50 | 0.8 | 250 | 1 | .125" |
| 20 | 50 | 1.1 | 250 | 1 | .125" |
| 25 | 50 | 1.3 | 250 | 1 | .125" |
| 30 | 50 | 1.6 | 250 | 1 | .125" |
| 35 | 50 | 1.9 | 250 | 1 | .125" |
| 40 | 50 | 2.1 | 250 | 1 | .125" |
| 45 | 50 | 2.4 | 250 | 1 | .125" |
| 50 | 50 | 2.7 | 250 | 1 | .125" |

**COMMENTS**

When engraving wood with a laser, a brown, maple syrup like residue will deposit on the surface of the wood.  This is normal and impossible to eliminate by **POWER**, **SPEED**, or **PPI** changes.  More residue will be present when engraving deeper and/or slower.  This residue washes off with water and a sponge. We recommend using a kitchen sponge with a nylon string mesh wrapped around it.  Dampen the sponge and wipe off the residue.  A damp chamois cloth works well also.  Do not use paper towels or a regular sponge because these materials will get lodged in the engraved area when wiping and are extremely difficult to remove.  A method to avoid cleanup is to mask the wood with transfer tape and peel off the tape after engraving.  If desired, after engraving and before peeling off the tape, spray paint can be applied to color fill the engraved areas.  After the paint dries, peel off the tape.  If an intricate drawing has been    engraved    and    there    are    many    small    pieces    of    tape    to    remove,    it    may

be easier to flood the masking, after engraving, with water.  This will loosen the tape and it can be easily removed by rubbing it off by hand.  In the vector cutting example, the wood was elevated from the table to let smoke and heat escape from underneath.  If elevating the wood, mask and/or dampen the bottom side of the wood very lightly and the water acts as a heat sink to prevent the underside from flaming and charring.  Elevating the wood also helps to determine whether the laser has passed completely through since the cut pieces will fall through to the table when cutting is finished.  If raising the wood, set up the drawing so that the inner pieces of the drawing are cut first, otherwise pieces may fall through at the wrong time.

Not all wood finishes are created equal.  When ordering wood from a supplier, be sure to specify that it is being used for laser engraving.  Some finishes cannot handle the heat from the laser and will bubble, blister, and possibly turn white.  For engraving softer woods such as pine or balsa, reduce the power settings to acquire the best depth.  Engraving too deep on soft woods will reduce quality.  Every type of wood will engrave differently.  It is better to engrave woods that are finished.  If engraving unfinished wood and it is not masked with transfer tape, the smoke residue tends to embed in the wood and is impossible to remove without sanding.  To prevent this, mask all unfinished wood with transfer tape.

### WOOD INLAYS - VENEERS

Create a drawing with no outlines, only filled areas.  Engrave the filled areas almost as deep as the thickness of the veneer (usually about .003 inches (.1 mm) or less).  With some water and a nylon brush, remove all residue from the engraved area.  When cutting veneers make sure they are lying absolutely flat.  In the drawing, give the objects an outline of .001 inches (.1 mm) and remove the fill.  Adjust the power so that there is just enough power to cut completely through the veneer.  Overpowering the cut will cause too much material removal and the fit will not be snug.  Some software programs allow outline offsetting to compensate for the thickness of the beam called contouring.  Usually, a contour to the outside of the vector line of .006 inches provides a tight fit.  Remember if using more power to cut through the veneer, compensate for the thicker width of the laser cut by contouring a little further to the outside.

Another method is to first create your graphic and fill it with the color black.  Then give it a white outline of .012 inches (.3 mm).  If you look at the graphic when you add the outline, you will see that it appears to shrink.  Now raster engrave the graphic to a depth slightly shallower than the thickness of the veneer.  When the engraving is finished, place the veneer into the laser system.  Remove the black fill and change the outline to a different color.  Cut out the veneer with the laser system, add glue to the veneer, and apply the veneer into the engraved area of the other piece of wood and let dry.  After the glue has thoroughly dried, sand the veneer until it is flush with the base wood.  A good veneer to use is one with an adhesive backing.  Once cut, place the veneer into its proper place on the engraved wood block and with a clothes iron, and iron the veneer into the engraved wood.  This melts the glue and causes the veneer to stick to the engraved area. Finish the wood as you desire and the finished product will look fantastic. The veneer can now be sanded flush with the surface and a finish coat applied.
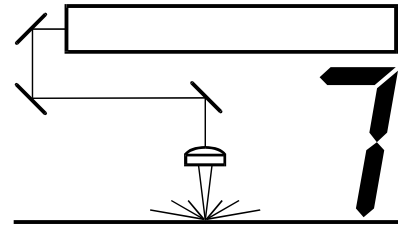
LASER ENGRAVING OR CUTTING WOOD CAN IGNITE THE MATERIAL. **Never leave the laser system running unattended for any reason.**

⚠️

**WARNING**

**SECTION 7**

# Maintenance

Keeping the laser system clean will ensure the highest quality
engraving. The frequency of cleaning will depend entirely on the type of material being engraved, the performance of your exhaust blower, the operating environment, and the amount of laser system usage over a given period of time. Dirt or debris that is allowed to build up on the motion system components will cause uneven or rough engraving, or loss of engraving position as well as premature component failure. Smoke or dirt buildup on the optics can cause damage to them, loss of laser power, or premature failure of these components. Use good judgment and keep in mind that a clean machine is the best performing machine.

**WARNING**

Always turn the laser engraving system OFF and unplug it before performing any cleaning procedures.

## Suggested Cleaning and Maintenance Supplies

- Soap solution mixture of 1 tablespoon (2 cl) liquid soap and 1 quart (liter) of water in a spray bottle
- Paper towels
- Cotton cloth
- Denatured alcohol (**NOT** to be used on any painted surface, plastic, or the Top Window)
- Acetone (can be used on the engraving table but nowhere else)

- Cotton swabs (supplied)
- Lens cleaner (supplied)
- Lens tissue (supplied)

- Vacuum cleaner
- Set of Allen wrenches sized from .050 to 3/16 inch

**\*NOTE:** When using acetone or denatured alcohol, please follow the instructions on the printed label of these materials for safe handling procedures.

Please familiarize yourself with the motion system components in the following diagram. It will help you understand which components need periodic cleaning.

NOTE: X MOTOR AND #2 MIRROR COVER PLATES WERE REMOVED FOR VISIBILITY

X MOTOR FLEX CABLE

X MOTOR

Y BEARING(2)

Y BEARING TRACK

Y SHAFT

Y SHAFT FLEX COUPLER(2)

X HOME SENSOR

Y MOTOR

Y HOME SENSOR

FOCUS CARRIAGE

#3 MIRROR (INSIDE)

FOCUS LENS

Y DRIVE GEAR(2)

Y HOME SENSOR FLAG

X BEARING TRACK(2)

X BEARING(3)

Y SHAFT

Y IDLER(2)

X BELT

X RAIL

Y RAIL

Y BELT(2)

X IDLER

#2 MIRROR AND HOLDER

Y BEARING TRACK

Y BEARING(2)

# System Cleaning

- Turn off and unplug the laser system.

- Open the Top Door and thoroughly remove all loose dirt and debris from inside the machine with a vacuum cleaner.

- Clean the Engraving Table surface with either a soap solution, alcohol, or acetone, and paper towels. **NEVER** pour or spray any solution directly into the laser system.  Always dampen your paper towel or cloth outside of the machine with the cleaning solution and then wipe down the parts you are cleaning with the dampened cloth.

- Clean X Rail and the Y Rails by using either the cotton swabs or paper towels, and alcohol or soap solution.  Pay close attention to the bearing tracks that the bearings roll in since any debris left to build up in these bearing tracks will cause the bearings to wear and the engraving quality to become rough.

- After the rails and tracks are cleaned, use a clean swab or paper towel, and alcohol to clean all of the bearings by holding the swab against each bearing and moving the motion system by hand to roll the bearings against the swab.  There are seven bearings in the system, three (3) on the Focus Carriage, two (2) on the left side of the X Rail, and two (2) on the right side of the X Rail.

- Clean the Top Window with a cotton cloth and the soap solution.  The Top Window is made out of acrylic.  **DO NOT** use paper towels because they will scratch the acrylic.  Also, **DO NOT** use window cleaner, alcohol, or acetone, as these chemicals will crack the acrylic.  Only use cleaners designed for acrylic.

- Use a soft cloth or paper towels and the soap solution to clean the enclosure.  **DO NOT** use alcohol, acetone, or any other harsh chemical as this will damage the paint.

# Optics Cleaning

A visual inspection of the #2 and #3 Mirrors, Beam Window, and Focus Lens should be performed at least once a day.

**CAUTION**

**DO NOT** clean an optic that is visually clean.  Excessive cleaning can damage the optics.  The #3 Mirror and the Focus Lens will need to be removed to clean them, the #2 Mirror and the Beam Window does not.

Before cleaning the optics, we recommend that you wash your hands thoroughly to prevent contamination.  **NEVER** touch any optic with your fingers.  The acids from your skin can destroy the coatings on the optics.

**#2 Mirror**
To gain access to the #2 Mirror, the mirror cover must be removed.  Remove the thumbscrew, slide the cover to the right slightly and lift straight up.
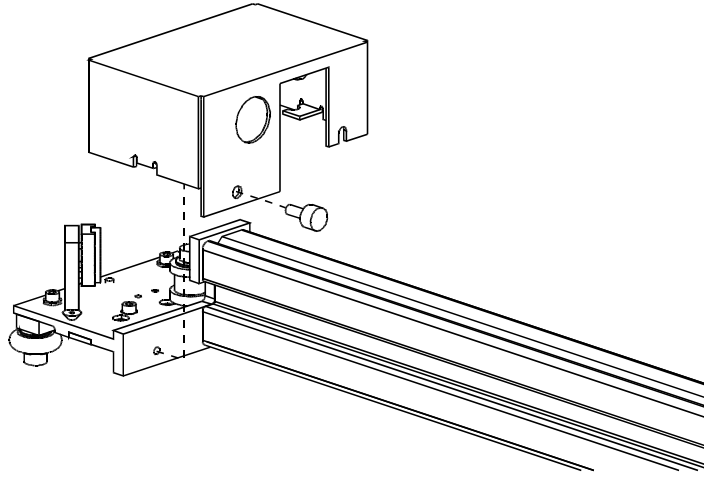


Inspect the #2 Mirror and clean it only if there is debris present.  There are two ways to clean the mirror, with a moistened cotton swab or a moistened lens tissue.



MOISTENED COTTON SWAB

MOISTENED LENS TISSUE
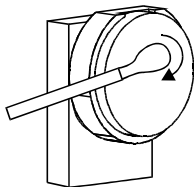
OR
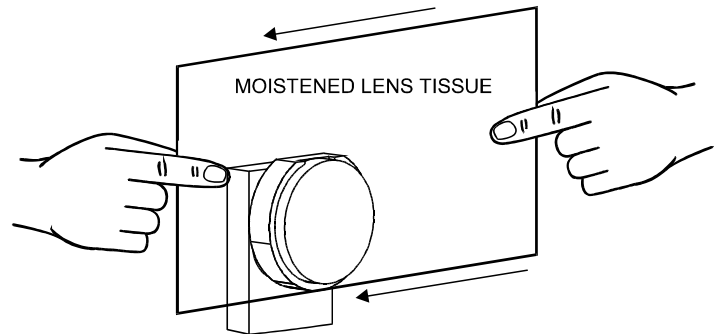
To clean the #2 Mirror with a cotton swab, moisten the cotton swab with the Lens Cleaning solution supplied with the laser system.  **DO NOT** use other types of cleaners or solutions.  Gently roll the cotton swab across the mirror once.  **DO NOT** drag the swab or roll it back and forth as this can scratch the mirror.  If the mirror did not come clean, use a fresh cotton swab and repeat the procedure.  Do not worry about small pieces of lint that come off of the cotton swab.  They will be vaporized as soon as the laser hits it.  You can cause more damage to the mirror by trying to get it off than by leaving it alone.

The other method is to use a piece of lens tissue and the Lens Cleaning solution.  Place a drop of solution onto the lens tissue.  Grasp the tissue by the edges and drag the moistened tissue across the #2 mirror in one direction.  If the #2 mirror does not come clean in the first attempt, repeat the procedure with a fresh piece of moistened lens tissue.  **DO NOT** re-use the same lens tissue twice and **DO NOT** put any finger pressure on the surface of the mirror as this can scratch it.

**#3 Mirror and Focus Lens**
You must remove the front cover to the Focus Carriage to gain access to the #3 Mirror and the Focus Lens.  To do this, hold the front cover with one hand and with the other hand, remove the three(3) thumbscrews that attach the front cover to the Focus Carriage, and pull the front cover straight out.  You will notice that the #3 Mirror and the Focus lens are both mounted to the front cover.  Refer to the diagram below.

#3
MIRROR

FRONT COVER

FOCUS CARRIAGE
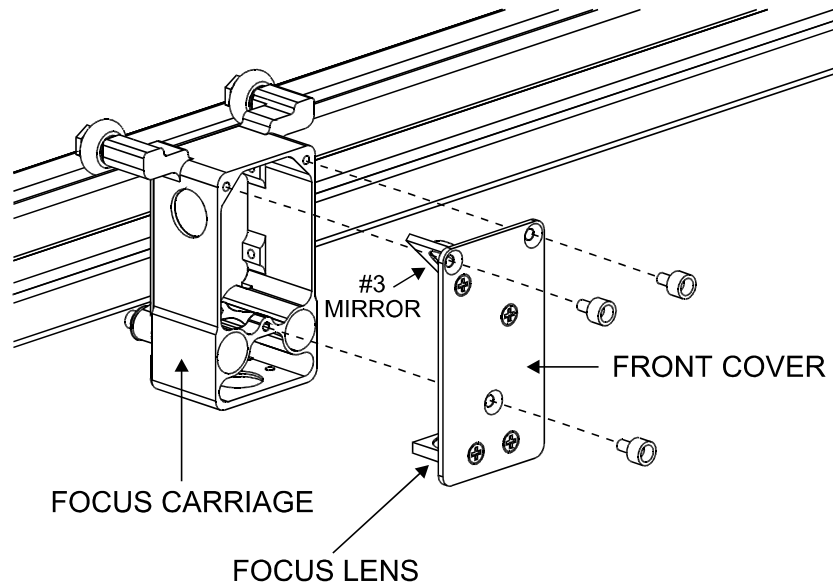
FOCUS LENS

The #3 Mirror and the Focus lens are both glued to a metal bracket and the metal bracket is attached to the front plate with Phillips head screws.  It is not necessary to detach the bracket from either optic in order to clean them.  Simply tilt the front cover at enough angle so that you can apply the Lens Cleaning solution directly to the #3 Mirror and to the Focus Lens.  Flood the surfaces with the solution.  If heavy debris is present, let the solution soak in for a minute.  Roll a fresh cotton swab across the #3 Mirror to dry it off.  Remember that it is okay if a small amount of lint from the cotton swab remains on the mirror. Repeat this procedure for the Focus lens and always use a fresh swab.

Lens Cleaning Solution

Lens Cleaning Solution

AND

THEN
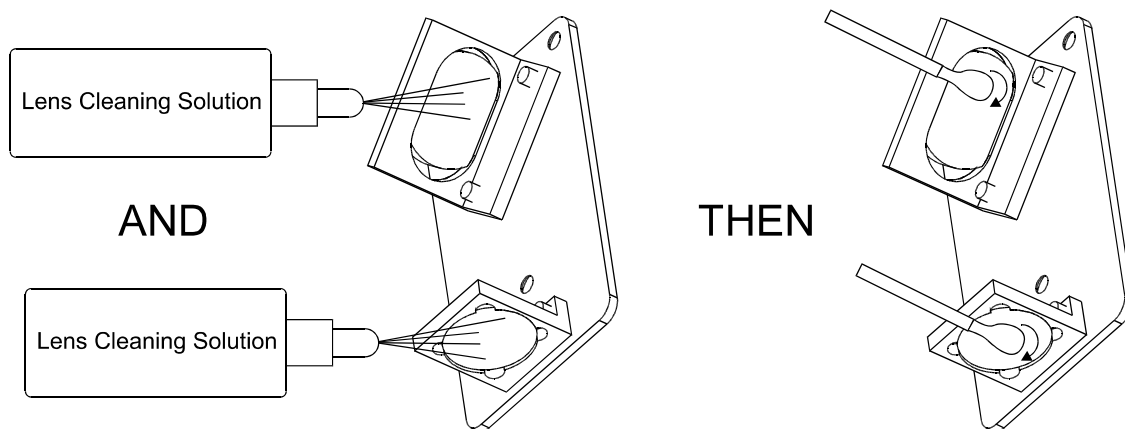
**Beam Window**
The Beam Window is where the laser beam enters into the engraving area.  It is located in the upper left hand corner of the engraving area against the back wall and is yellow in color.  It is not necessary to remove the Beam Window for cleaning since it can only get dirty on the front side.  The backside is in a sealed environment.  To clean the Beam Window, moisten a cotton swab and gently roll it across. Basically, clean it in the same manner as the #2 Mirror.

**AUTOFOCUS Sensor and Reflector (if installed)**
Engraving smoke can adhere to both the sensor and the reflector of the AUTOFOCUS system.  If this happens, you will notice that when you turn AUTOFOCUS on and press the "Z" button, the engraving table will go all the way down to the bottom and get stuck.  You will then need to call our service department so that we can assist you into getting the system back to normal operation.  To prevent this problem from occurring, you should clean the sensor and reflector periodically.  How often you clean them is dependent on the types of materials you are engraving and the quality of your exhaust system. The diagram below shows the locations of these parts.
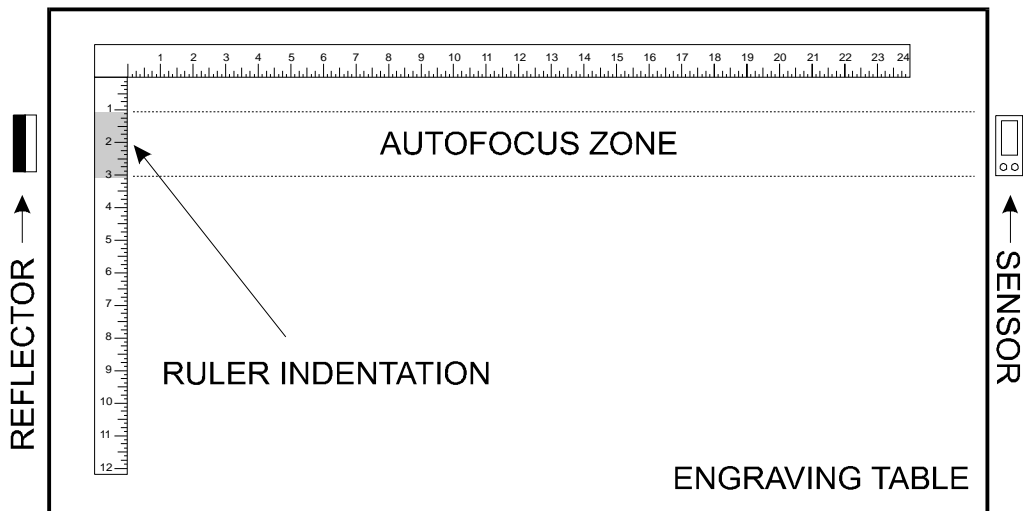


To clean these parts, dampen a soft cotton cloth with water and gently wipe across the reflective surface in one direction.  **DO NOT** rub hard or create scratches in the plastic, otherwise the AUTOFOCUS system will malfunction.  **DO NOT** use any type of cleaners, only use water or a light solution of hand soap and water on the sensor or reflector.

You can observe if the sensor is working properly by lowering the table so that you have clear sight of the sensor and the reflector.  Look at the sensor and notice that the green LED will illuminate.  Pass your hand in front of the sensor and watch the red LED turn on as your hand passes through the path, and the red LED will turn OFF when your hand clears the path.  Contact our service department if you have any other concerns about the operation or maintenance of the AUTOFOCUS system.

# Adjustments and Lubrication

There are no periodic adjustments required.  The bearings in the motion system will self adjust to take up any clearances as they begin to wear.  The belts are fiber reinforced and will not stretch under normal use so that periodic tension adjustment is not necessary. Optical alignment is not necessary because the laser and the #2 Mirror are fixed.

All bearings in the system are sealed and do not require lubrication.  **DO NOT** lubricate the tracks that the bearings ride in.  The only lubrication that may be required is the screw threads for the table lifting mechanism.  After some time, contaminants can adhere to the lubricant, which can cause the engraving table to bind up or sound squeaky.  If this is the case, wipe off the contaminated grease with a soft cloth and apply fresh white lithium grease to the screw threads.  Run the table up and down to work in the fresh grease.

# Electronic Upgrading

The laser systems onboard computer is equipped with a special "Flash" upgrade technology.  If the electronic operation of the system should ever require upgrading, it can be done electronically without the changing of any parts.  The upgrade file gets downloaded from your computer to the laser system via the parallel port.  This file is then run on the laser system and it only takes a few minutes.  Once the file has completely run, the laser system will automatically restart and the new changes will take effect.  For more specific details, please refer to the instructions that will accompany the flash disk.

# Fuse Replacement

If a fuse must be replaced, use only the following type:

**USA**
5 x 20 mm, Glass, time delay, 250V, 10A fuse, UL approved

**Europe and other countries**
5 x 20 mm, Glass, time delay, 250V, 5A fuse, designed to IEC 127-2 sheet 3, and approved by a recognized European testing agency.

# Battery Replacement

There is a danger of explosion if the battery is incorrectly replaced. Replace the battery only with the same or equivalent type recommended by the battery manufacturer. Using an incorrect battery, recharging or disassembling the battery may present a danger due to fire or explosion. Dispose of used batteries promptly according to the local regulations.

**WARNING**

# Cooling Fan Filters

This air-cooled laser system will require periodic cleaning of the cooling fan filters. Since ambient air is used to cool the laser tube, the air must be filtered before it enters the inside of the laser system otherwise dirt and dust can build up inside of the laser system and damage it. The contaminants reduce the laser system's cooling ability and will cause the laser tube to overheat. An overheated tube will lose laser power during engraving and will eventually shut down completely. The laser tube has a built in safety mechanism that will shut the beam off before it can damage itself.
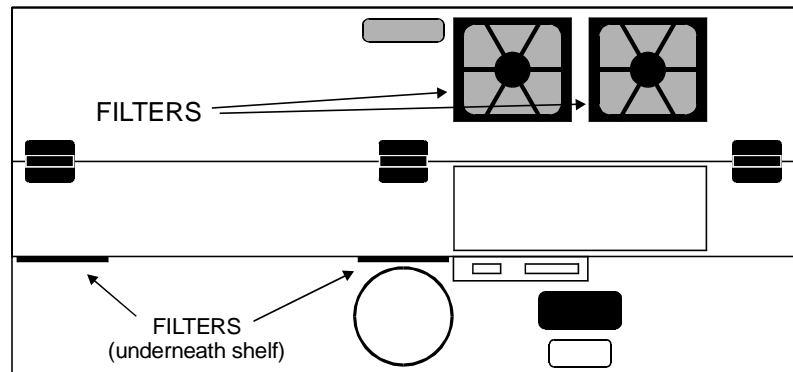
The cooling fan filters are located on the back of the laser system. Do not push the laser system all the way back against the wall because air needs to circulate behind the laser system. Since there is a variety of laser power options available for this class of laser system, **the cooling fan filters may differ in appearance compared to your system.** Regardless, you should remove and clean these filters at least once a week depending on your environmental conditions. Dirtier environments require more frequent cleanings. To remove the filter(s), simply snap off the black cover and remove the foam element. Wash the element in a soap and water solution, dry, and re-install.

**NEVER OPERATE THE LASER SYSTEM WITH THE COOLING FAN FILTERS REMOVED.** This can permanently damage the laser system. Damage from this kind of abuse WILL NOT be covered under warranty.

**WARNING**

# Maintenance Schedule

Since the maintenance requirements of the laser system is dependent on the type of material being run, the quantity of material being removed, the hours of operation, and the quality of the exhaust blower, it must be user defined. As a starting point, we recommend checking and, if necessary, cleaning the laser system after every 8 hours of engraving or cutting. Depending on your particular operation, you may need to adjust this schedule. If you are noticing a considerable buildup of debris on the optics and the motion system, clean the system at more frequent intervals. If your system has remained relatively clean, you can extend your cleaning intervals. You need to be the judge but keep in mind that a clean machine is a better performing machine and can extend the life of the parts as well as reduce the possibility of down time. Maintaining and cleaning the laser system should not take more than five (5) minutes a day. If you have any questions about maintaining the laser system, please contact our Service Department.

# Troubleshooting
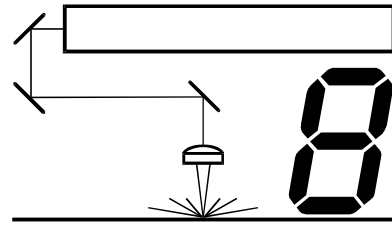
## Engraving Quality

| Problem | Possible Cause | Possible Solution |
|---|---|---|
| "Fuzzy" looking raster engraving or small text appears like a "double image" | • Dirty laser system<br>• Graphic, graphic software, graphic software setup, color palette, monitor display colors, or driver settings have changed<br><br>• Speed to fast for the material<br>• Out of focus<br>• System needs tuning<br><br>Worn X-axis belt and/or drive gear<br><br>Laser Tube is faulty | • Clean all optics, rails, bearings and belts<br>• Check to see what has changed. Use "Software Setup Guide" to properly setup the graphics software to work correctly with the laser system. Check driver settings.<br>• Slow down engraving speed<br>• Re-focus<br>• Run "Tuning" feature in printer driver version 4.17 and higher<br>• Replace belt and/or drive gear, and run "Tuning" feature<br>• Replace laser tube |
| Fine detail is missing such as the serif's of characters or thin lines of script fonts when raster engraving | • Speed too fast for the material<br>• Out of focus<br>• System needs tuning<br><br>• Laser spot size too big | • Slow down engraving speed<br>• Re-focus<br>• Run "Tuning" feature in printer driver version 4.17 and higher<br>• Use shorter focal length lens |
| Vertical or diagonal background pattern present when raster engraving large areas and/or large amounts of material | • Dirty laser system<br>• Slight pattern is normal<br><br><br><br><br>If the pattern is excessive:<br>• Loose motion system components<br>• Worn or damaged X-axis bearings<br>• Worn or damaged X-axis rail | • Clean all optics, rails, bearings and belts<br>• Don't remove so much material or try engraving shallower or deeper. Try changing PPI and or DPI<br>• Use a 50% black fill to "halftone" the background which can hide the pattern<br><br>• Check X-axis bearings, belt, optics<br>• Replace X-axis bearings<br>• Replace X-axis arm |
| Horizontal background pattern present when raster engraving large areas and/or large amounts of material | • Dirty laser system<br>• Slight pattern is normal<br><br><br><br><br>If the pattern is excessive:<br>• Laser is too cold or hot<br><br><br><br>• Laser tube is faulty | • Clean all optics, rails, bearings and belts<br>• Don't remove so much material or try engraving shallower or deeper. Try changing PPI and or DPI<br>• Use a 50% black fill to "halftone" the background which can hide the pattern<br><br>• Check and/or clean filters<br>• Make sure ambient temperature is within specifications<br>• Replace laser tube |
| Engraving disappears, becomes "lighter", or appears "choppy" when raster engraving within ½ inch of Y-axis ruler | • Normal condition. The laser system needs to accelerate and decelerate within this area | • Move graphic and/or material to the right, outside of this area<br>• Slowing the raster speed down reduces the effect |

| | | |
|---|---|---|
| Raster engraving appears sharp on both ends of the engraving but fuzzy in the middle | • Dirty laser system<br>• Something is loose<br>• System needs tuning<br><br>• Worn X-axis belt and/or drive gear<br><br><br><br>• Tickle setting too low<br>• Faulty laser tube | • Clean all optics, rails, bearings and belts<br>• Check X-axis bearings, drive gear, idler pulley, belt, and optics<br>• Run "Tuning" feature in printer driver version 4.17 and higher<br>• Replace belt and/or drive gear, and run "Tuning" feature<br>• Adjust setting higher and recheck<br>• Replace laser tube |
| Engraving does not appear as deep as it normally does | • Graphic, graphic software, graphic software setup, color palette, monitor display colors, or driver settings have changed<br><br>• Out of focus<br>• Material or material density has changed<br>• Settings have changed<br><br>• Dirty laser system<br>• Laser tube cooling fan filters are dirty<br>• Chiller not maintaining temperature(water cooled versions only)<br>• Ambient temperature not within specifications<br>• Laser beam out of alignment with the optics<br>• Air Assist cone misaligned (air assisted versions only)<br>• Faulty laser tube | • Check to see what has changed. Use "Software Setup Guide" to properly setup the graphics software to work correctly with the laser system. Check driver settings.<br>• Re-focus<br>• Check material<br>• Check power, speed, PPI, and DPI settings<br>• Clean all optics, rails, bearings and belts<br>• Check and/or clean<br>• Check, clean, or adjust chiller<br><br>• Adjust ambient temperature to within specifications<br>• Check and/or adjust laser beam alignment<br>• Check and/or adjust cone so that laser beam is in center<br>• Replace laser tube |
| Engraving is sharp, clear and at a good depth on one side of the table and fuzzy and shallow on the opposite side of the table | • Out of focus<br>• Dirty laser system<br>• Material is not level or varying in thickness<br><br><br>• Table is not level<br><br><br><br><br><br>• Laser beam out of alignment with the optics<br>• Air Assist cone misaligned (air assisted versions only)<br>• Faulty laser tube | • Re-focus<br>• Clean all optics, rails, bearings and belts<br>• Check focus point of material and different places, adjust height by shimming material or using more thickness-consistent material<br>• Using the focus tool, focus directly on the surface of the table in all four corners. Table should be within +/- .020 inches from one corner to the other. Adjust if necessary.<br>• Check and/or adjust laser beam alignment<br>• Check and/or adjust cone so that laser beam is in center<br>• Replace laser tube |

| | | |
|---|---|---|
| Engraving appears "halftoned" and not solidly filled when using colors other than black | • Graphic, graphic software, graphic software setup, color palette, monitor display colors, or driver settings have changed | • Check to see what has changed. Use "Software Setup Guide" to properly setup the graphics software to work correctly with the laser system. Check driver settings. |
| Wavy lines when vector engraving or cutting | • Running too fast<br><br>• Dirty laser system<br>• Worn or faulty bearings<br><br>• Arm is out of square<br><br><br><br>• Firmware needs to be updated | • The highest quality vectors are obtained by running less than 5% speed<br>• Clean all optics, rails, bearings and belts<br>• Check and/or replace X and/or Y axis bearings<br>• Square arm re-adjust left side Y-axis bearings so both are contacting Y-rail equally<br>• Firmware advancements have been improving vector quality |
| Angled cuts when cutting through thick materials such as ¼" acrylic | • Angled cuts are a normal condition if they are equal on all sides of the object. The front side of the object will always be slightly smaller than the backside of the object due to the material "spreading more" at the focal point.<br>• Angled cuts on only one or two sides indicates a slight beam misalignment at the #3 mirror or focus lens | • Cut a square and observe that each side is slightly tapered inward.<br><br><br><br><br><br>• Check and adjust the beam alignment at the #3 mirror position and the focus lens |
| The start and stop points of circles, when cutting, do not meet up | • Slight "notching" when cutting circles is a normal condition due to the beam starting and stopping at the same point<br><br><br><br><br><br><br><br><br><br>If the pattern is excessive:<br>• Dirty laser system<br>• Mechanical problem | • The laser beam has width and there is heat effects from starting and stopping the laser system at the same point. Try extending the circle through the end point by adding a small line segment to reduce the effect. If cutting the material when elevated off the table, make sure that the center if the circles are supported.<br>• Try rotating the circle 90 or 180 or 270 degrees. Sometimes this helps reduce the effect<br><br>• Clean all optics, rails, bearings and belts<br>• Turn machine off and check for binding in the x & y directions. Check for excessive belt tension. |
| Flat edges on curves when vector cutting | • DPI setting too low<br><br>• PPI setting too low<br><br><br>• Software limitation | • 1000 DPI produces the smoothest edges when cutting<br>• Higher PPI settings produce smoother edges but may cause excessive burning or melting<br>• The graphic software you are using has limited vector smoothness capability |

# Operational

| | | |
|---|---|---|
| Focus carriage looses X-axis position and slams into the left or right side of the rail during high speed raster engraving | • Mechanical interference<br><br>• Dirty laser system<br>• CPU overheating<br><br>• Focus carriage X-axis bearing tensioning arm too tight or binding<br><br><br><br>If the pattern is excessive:<br>• X-belt too tight<br>• Worn or binding X-axis bearings<br>• Worn or binding X-axis idler pulley<br>• Worn or binding X-axis motor<br>• Firmware needs updating | • Check if focus carriage makes contact with material or other objects<br>• Clean all optics, rails, bearings and belts<br>• Clean CPU filters, correct ambient temperature to be within specifications<br>• Remove carriage from rail, check for freedom of movement of tensioning arm. Lubricate if necessary. Position of tensioning arm should be no greater than 10 o'clock.<br>• Check and/or adjust<br>• Check and/or replace<br>• Check and/or replace<br>• Check and/or replace<br>• Check with Service Department |
| When homing, the arm slams repeatedly for a few seconds | • Bent Y-flag<br>• Dirty or faulty home sensor(s)<br>• Faulty flex cable<br>• Faulty lower flex cable board | • Check and/or straighten<br>• Replace upper flex board (home sensor)<br>• Replace flex cable<br>• Replace Lower flex cable board |
| When focusing, the Z-axis table only moves in one direction | • Dirty or faulty Z-axis sensor | • Try to clean sensor(s) with compressed air, otherwise replace sensor |
| When using Autofocus, the table moves all the way down to the bottom and gets stuck | • Autofocus sensor and/ or reflector is dirty<br>• Autofocus sensor is misaligned | • Clean sensor and/or reflector<br>• With the Z-axis table out of the way of the Autofocus beam, check the sensor for only an illuminated green light. A red light, both lights, or no lights indicate a misalignment or dirty condition. Clean, re-check, re-align the Autofocus sensor. |
| When printing to the laser system, the computer gives an error message "Printer out of paper" or "Printer offline and not responding" | • Laser not turned on<br>• Parallel port cable not connected or not connected properly<br>• Laser system is out of memory<br><br><br>• Single file is too large for memory installed in laser system<br>• Bad parallel port in computer system<br><br>• Damaged port in CPU | • Turn on laser system<br>• Connect cable or reseat connection at computer and/or laser system<br>• Check "Free Memory" in laser system control panel. Clear laser system memory and try again<br>• Purchase more memory<br><br>• Try printing to another printer using the same port<br>• Replace laser system's CPU |
| When running the laser system, the laser system will "freeze", the clock will keep advancing, but the operator will have no control over the system. The only way to restore the system is to power the laser off and then back on. This is a symptom of file corruption. | • Incorrect BIOS setting in computer<br>• Using a printer cable longer than 6 ft.<br><br>• Bad printer cable<br>• Usage of device in between computer and laser system<br>• Some other parallel port driver interfering with the laser system printer driver<br>• Damaged port in CPU | • Refer to manual on proper setting<br>• Use only a 6 ft., IEEE1284 compliant printer cable<br>• Replace printer cable<br>• Connect the laser system directly from computer with the printer cable<br>• Remove all other parallel port drivers and try again<br>• Replace laser system's CPU |

# APPENDIX

## Appendix A - Limited Warranty

**Please refer to the Warranty Registration Form included with your shipment.**

# Appendix B - Specifications

Model Number          M-300

Resolution            1000 x 1000 DPI, 500 x 500 DPI, 333 x 333 DPI, 250 x 250 DPI
                      200 x 200 DPI, Draft

Computer Interface    Windows 95, 98, and HPGL

Table Size            29" x 17" (736.6 mm x 431.8mm)

Work Area             24" x 12" (609.6 x 304.8 mm)

Maximum Part Size     29" (736.6mm) wide x 17" (431.8mm) deep x 9" (228.6mm) tall

Laser Source          25, 30, 35, 40, 45, 50 Quick Change Laser Cartridge

Lenses Available      Focal Length / Spot Size / (Standard or Optional)
                      1.5" (38.1mm) / 0.003 inches (.08 mm) / Optional
                      2.0" (50.8mm) / 0.005 inches (.13mm) / Standard
                      2.5" (63.5mm) / 0.007 inches (.18 mm) / Optional
                      4.0" (101.6mm) / 0.013 inches (.33 mm) / Optional

Interfaces            Centronics parallel, RS232C Serial

Memory Buffer         Multiple file / Single file / Auto Start modes, automatic data compression

Dimensions            38" high x 36" wide x 29.8" deep (965 x 914 x 757mm)

Weight                200 lbs. (90 kg)

Safety                Class IIIa interlocked safety enclosure

Available Options     Rotary Fixture, Air Assist, Honeycomb Cutting Table


## Facility Requirements

Power                 Single Phase 100/220V AC, 10/5 Amp, 50/60 Hz

Exhaust               Outside exhausting required, one 4" connection,
                      250 CFM minimum at 6 inches static pressure
                      ($425m^3$/hr at 1.5kPa)


Cooling               Air cooled (ambient temperature 50ºF (10ºC) to 95ºF (35º C)

Specifications are subject to change without notice.

# Appendix C - Using DOS Based Programs

DOS software is not standardized and each application will work differently. When using DOS applications, it is not possible to print through the Windows Printer Driver and for this situation, the system has been designed to automatically emulate a Hewlett Packard plotter. Plotters use a special language called HPGL that the laser system has been designed to accept. When configuring the DOS based program, select the HP7475 plotter (or larger) as the printing device. Set the paper size to the maximum engraving area of your Platform (refer to the DOS software manual for how to configure the printing device). Once configured properly, the laser system should interface with the program and act just like a plotter. Keep these points in mind:

1. Some DOS programs will not allow the page size to be set as large as the maximum engraving area of your Platform. If this is not possible, the full engraving field cannot be utilized. If a smaller page size is used, determine where the program will place the graphic on the engraving table by running a few tests.

2. Some DOS programs use the lower left corner of the engraving field as the origin so remember this when setting up the graphic drawing.

3. When assigning power settings to the graphic, it will be necessary to assign an HPGL plotter pen to the different colors in which the graphic was drawn. In most cases the pen numbers should match the power setting numbers in the laser systems "DOS Power Settings" display.

4. Some DOS programs may allow the setting of pen speed for the plotter pens. The laser will ignore these speeds. The laser system only recognizes the settings in the "DOS Power Settings" section of the laser systems control panel.

5. Set all of your line widths to .001 inch otherwise the laser system may go into raster mode instead of the desired vector mode.

6. If your laser system is configured to run in the multiple file memory mode, after every file download an "End of File" marker must be inserted at the laser systems control panel so that the memory control will work properly. To do this, print the file to the laser system and wait for the file to completely download. While in either the "MEMORY CONTROL" or the "FILE DISPLAY" menu, press and hold down the "NEXT FILE" button while you press the "SELECT" button once. Let go of both buttons and the word "NONAME" will appear in the display. You can now run the file. If you are in the "ONE FILE MEMORY" mode, it is unnecessary to do this because the file will run automatically as soon as the first part of the file enters into the laser systems memory.

7. Power setting for plotter pens can only be done at the laser system itself through the main control panel display. If having trouble with using DOS based programs, please contact our technical support.
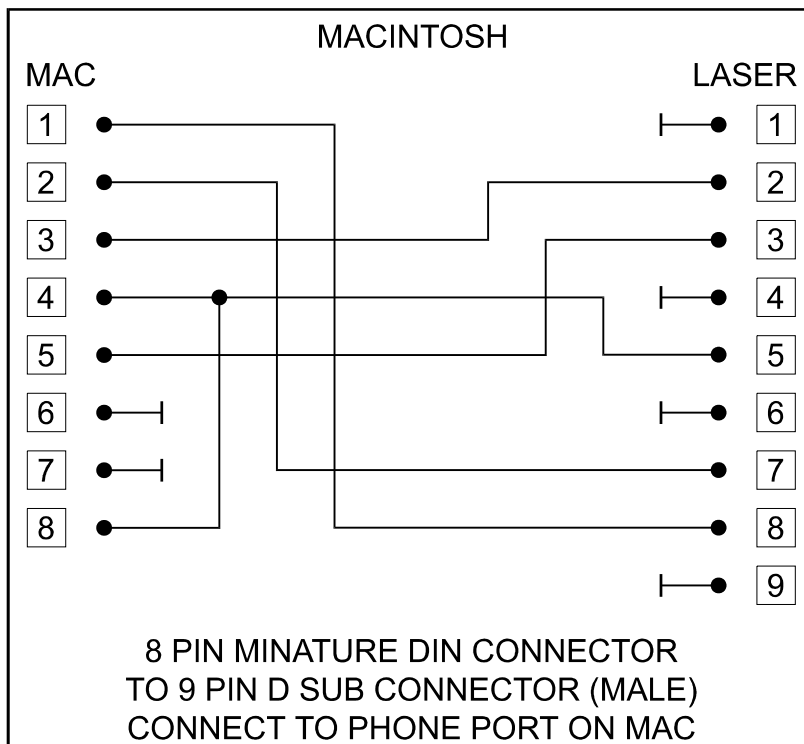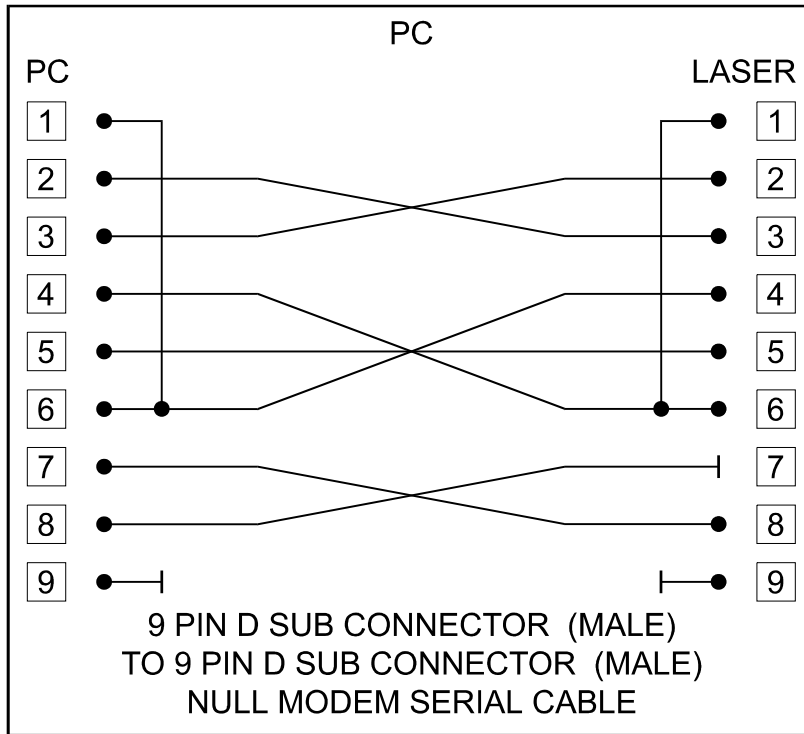
## Appendix D - Using Macintosh Computers

The laser system has primarily been designed to run under the Windows 95 or Windows 98 operating system.

There is no Macintosh Driver available for this Platform at this time, however, there may be one in the future.

Once in awhile you might want to log on to our website www.ulsinc.com to see if there are developments in this area.

# Appendix E - Serial Port Cable Requirements

### PC

PC          LASER

```
1  ●                        ●  1
2  ●  ─────────╲  ╱─────────  ●  2
3  ●  ─────────  ╳─────────  ●  3
4  ●─────╮      ╱ ╲          ●  4
5  ●     │    ╱     ╲        ●  5
6  ●─────╯  ╱         ╲──●───  6
7  ●  ──────╲  ╱──────────┤   7
8  ●  ──────  ╳──────────  ●  8
9  ●──┤                 ├──●  9
```

9 PIN D SUB CONNECTOR  (MALE)
TO 9 PIN D SUB CONNECTOR  (MALE)
NULL MODEM SERIAL CABLE

### MACINTOSH

MAC          LASER

```
1  ●──────────╮          ├──●  1
2  ●          │    ╭─────────  ●  2
3  ●          │    │        ●  3
4  ●────╮     │    │    ├──●  4
5  ●    │     │    │  ──────  ●  5
6  ●──┤ │     │    │    ├──●  6
7  ●──┤ │     │    │        ●  7
8  ●────╯     ╰──────────  ●  8
                          ├──●  9
```

8 PIN MINATURE DIN CONNECTOR
TO 9 PIN D SUB CONNECTOR (MALE)
CONNECT TO PHONE PORT ON MAC

# Appendix F - How To Get Help

**Step 1:**
Determine exactly what the problem is. Refer to "Section 8 – Troubleshooting" for a possible solution.

**Step 2:**
Try to recreate the problem and write down the circumstances in which the problem occurred. Be prepared to describe all pertinent information about the computer being used with the laser cutting and engraving system such as software, operating system and computer type.  Have the serial number of the laser system available. The serial number tag is located on the back of the machine in the lower right corner.  There is a second serial tag located behind the front door on the right side when you open it.

**Step 3:**
Contact your local Sales Representative first to assist you in diagnosing the problem. If possible, call from a phone that is close to the laser engraving system so that the system can be operated while talking to our representative.

**Step 4:**
If your local Sales Representative is unavailable, contact our Customer Service Department at:

<div align="center">

Universal Laser Systems, Inc.
Technical Support/Parts Department
16008 North 81$^{st}$ Street
Scottsdale, AZ  85260
Phone: 480-609-0297
Fax: 480-609-1203
Email: service@ulsinc.com
M-F 7am – 5pm Arizona Time

</div>