UNIVERSAL
LASER SYSTEMS INC.

OPERATION MANUAL

ULS-25PS / ULS-25PSR
ULS-50PS / ULS-50PSR

Universal Laser Systems, Inc.
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Notice

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Introduction

The ULS Performance Series are designed to combine flexibility and full featured performance with simplicity and ease of use. Using advanced engineering and design, these laser systems offer finer control, higher precision, more versatility, better resolution, faster speed, and overall greater quality than any other laser system in its class. It combines the performance of high speed engraving and cutting capabilities with the ease of a user friendly, specially designed, Windows or Macintosh printer driver interface. Actually, the Performance Series is such a breakthrough in technology that it is more than just a laser system, it is a precision engraving and cutting device used as a tool for the imagination.

To begin with, we highly recommend that this entire manual be read before attempting to use the laser system. The manual includes important information about the safety, assembly, use, and maintenance of the laser system. **We cannot overemphasize the importance of reading the owner's manual completely.**

Where to get HELP:

If it is necessary to call for technical assistance, please call our **TECHNICAL SUPPORT** at (**602)483-1214**. Please be prepared to answer our questions by following the procedures below, as this will allow us to provide assistance in a prompt and efficient manner:

- ❍ Take a moment to write down all of the pertinent information about the computer being used with the laser cutting and engraving system such as software, operating system and computer type.

- ❍ Our technical support staff will ask you for your company name and the laser systems serial number. The serial number tag is located on the back of the machine in the lower right corner.

- ❍ Try to recreate the problem and write down the circumstances in which the problem occurred. This will help our technical staff tremendously.

- ❍ If possible call from a phone that is close to the laser engraving system so that the system can be operated while talking with our technical support staff.

Section 1 - Safety

1.1   Laser Safety

The laser system contains a sealed carbon dioxide laser that produces intense and **invisible** laser radiation (at a wavelength of 10.6 microns in the infrared spectrum). The laser system is designed as a CLASS I device, meaning that the system is equipped with a protective housing and safety devices to completely contain the laser under normal use. Do not at any time attempt to modify or disassemble any part of the system and do not attempt to operate a system that has been modified or disassembled. Improper use of controls and adjustments or performance of procedures other than those specified in this manual may invalidate the Class I rating and result in exposure to the laser beam.

Please remember the following safety precautions when operating the laser system:

1.   Exposure to laser radiation may produce physical burns and can cause severe eye damage. Proper use and care of this system is very important to the safety of all people in the surrounding area.

2.   **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. A properly maintained fire extinguisher should be kept on hand at all times.

3.   Operation and care of the laser system must be performed in accordance with this manual.

4.   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 **UNPLUG THE MACHINE FIRST**.

5.   Never operate the laser system without properly exhausting the fumes generated by the cutting and engraving process.

6.   Please contact Universal Laser Systems Inc. with any questions concerning laser safety before operating this system.

Note: The laser system is specifically designed to comply with CDRH performance requirements under 21CFR 1040.10 and 1040.11. No guarantees of suitability or safety are provided for any use other than those specified by Universal Laser Systems Inc.

1.2   Safety Labels

According to CDRH standards, all interlocked and non-interlocked covers that allow access to a laser beam **MUST** have appropriate laser safety labels attached to them. These labels must be visible to personnel prior to the removal of the covers. Additional labels must be installed inside the machine and be visible if the covers are removed from the machine. Labels that provide the manufacturer's name, date of manufacture, description of product, model number, serial number and compliance statement must also be visible on the outside of the machine.

All CDRH required labels are properly affixed to the machine in the appropriate locations at the time of manufacture. These labels are not to be removed. If they become damaged or removed for any reason, please request additional labels from Universal Laser Systems (they will be provided free of charge). Below is a list of all the labels and their locations on the system.

Laser Processing System Manufactured By:

UNIVERSAL
LASER SYSTEMS INC.

Scottsdale, Arizona

Model No: ULS-25PS
Manufactured: XXXX $C \in$
Serial No: XXXX   Made in USA

Manufacturer's Label
Location: On the back of the machine in the lower right corner.

This equipment conforms
to provisions of
US 21 CFR 1040.10
and 1040.11
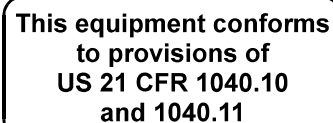
CDRH Compliance Label
Location: On the back of the machine above the Manufacturer's Label.

DANGER
INVISIBLE LASER RADIATION WHEN OPEN
AND INTERLOCK FAILED OR DEFEATED.
AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED RADIATION.
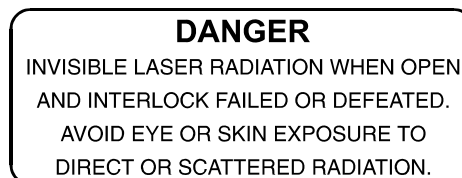
Warning Label for Interlocked Panels and Doors
Location: On the outside of the top door, on the inside of the top door (visible when door is open), on the outside of the front door, on the inside of the front door (visible when door is open) and to the left of the interlock defeat tool receptacle.

```
┌─────────────────────────────────┐
│           AVOID EXPOSURE          │
│     INVISIBLE LASER RADIATION     │
│    EMITTED FROM THIS APERTURE     │
└─────────────────────────────────┘
```

Exposure Warning Label
Location: To the right of the beam window inside the system where the laser beam enters the work area. On the laser mounting bracket before the first mirror and next to the aperture where the beam exits the laser tube.

```
┌─────────────────────────────────┐
│             DANGER                │
│  INVISIBLE LASER RADIATION WHEN OPEN │
│     AVOID EYE OR SKIN EXPOSURE TO    │
│    DIRECT OR SCATTERED RADIATION.    │
└─────────────────────────────────┘
```

Warning Label for Non-interlocked Panels
Location: 25 Watt - On the inside and outside of the first mirror cover (visible when the fan cover is removed). 50 Watt - On the inside and outside of the laser cover and inside the laser cover on the laser backplate where the laser tube attaches to the system.

1.3   The Safety Interlock System

The laser cutting and engraving system incorporates a safety interlock circuit that automatically shuts off the power supplied to the laser whenever the front or top door is opened. This interlock system is connected in series with a switch and a red indicator light on the control panel of the system. The switch allows the power to the laser to be manually turned on and off. The red indicator light will light up when power is being supplied to the laser. If at any time the red indicator light remains **ON** when the front or top door is open, **IMMEDIATELY** unplug the system and call Universal Laser Systems Inc. for service instructions.

The laser system comes equipped with a safety interlock defeat tool. Do not use this tool unless you have been properly trained by Universal Laser Systems Inc. This tool is only to be used for maintenance and repair procedures and should only be used when instructed to do so by Universal Laser Systems Inc. and all safety precautions have been followed.

WARNING:
Do not attempt to modify or defeat the safety interlock system for any reason as this could result in exposure to hazardous laser radiation. When using the interlock defeat tool, wear appropriate laser safety goggles. Failure to wear appropriate goggles can result in severe eye damage.

1.4 EMI Compliance

This ULS laser system has been tested and found to comply with both Federal Communication Commission (FCC) and European Union (EU) 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 insure compliance with FCC regulations.

EU Declaration of Conformity

Universal Laser Systems, Inc. hereby declares that the equipment specified below is in conformity with Directive 89/336/EEC based on test results using the harmonized standards listed.
Product Identification: ULS-25 or 50 PS laser cutting and engraving system
Manufacturer: Universal Laser Systems, Inc. 16008 N. 81st St. Scottsdale, AZ 85260 USA
Standards Used: EN 50081-1, EN 50082-1, EN55022

Section 2 - Installation

2.1 Unpacking and Assembling the Laser System

The laser system is shipped in one crate and is fully assembled. Remove the top and four sides of the wooden crate. With the help of an assistant, roll the laser system off the base of the crate and onto the floor. Store the flattened crate in a dry place. Save the shipping crate in case the machine needs to be shipped. Remove all packing materials such as Rubber bands, foam, and tie straps.

2.2 Operating Environment

Before the system is installed, choose a suitable location. Follow these guidelines:

❍ Avoid places where the system may be exposed to high temperatures, dust, or high humidity (humidity exceeding 70% or where the temperature is near the dewpoint). The laser system should be installed in an office type environment.

❍ Avoid places where the system may be exposed to high levels of vibration or electrical noise. We recommend using a high quality surge protector to protect the laser engraving system's electronics.

❍ Avoid small enclosed areas where ventilation is poor.

❍ Choose a place where the ambient operating temperature will remain between 60 and 80 degrees Fahrenheit(15 to 25 degrees Celsius).

❍ Choose a place which provides a short and direct path to the exhaust duct work (not provided).

❍ If planning to connect the laser engraving system to a computer through the parallel port, choose a location where the computer can be placed within 10 feet(3 meters) of the machine since this is the maximum recommended parallel cable length.

❍ If planning to have another laser system or other type of printer connected to the same computer, we recommend installing an additional parallel port into the computer system. **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's electronics.

❍   Try to have a work table or storage area next to or nearby. This prevents the operator from using this precision machine as a table or storage facility.

❍   Make sure that the floor where the laser system will be located is flat within 1/8" (3 mm). It is not necessary that the floor be level, it simply should not dip or rise in the areas where the casters will rest.

2.3   Exhaust System Requirements

To properly exhaust fumes and smoke from the laser system during operation, it is necessary to provide an exhaust unit moving a minimum of 235 CFM at 6 inches of static pressure. Many industrial supply companies carry blowers that should meet these requirements.

THROUGH OUR RESEARCH WE HAVE ESTABLISHED GUIDELINES ON THE PROPER CFM RATINGS REQUIRED FOR THE EXHAUST SYSTEM. THESE RATINGS ARE BASED ON THE MEASURED DISTANCE BETWEEN THE EXHAUST OUTLET ON THE LASER SYSTEM AND THE INLET OF THE EXHAUST BLOWER. WE HAVE FOUND A SUITABLE SUPPLIER FOR THIS TYPE OF EQUIPMENT   IF YOU CHOOSE NOT TO USE THIS SUPPLIER, PLEASE ENSURE THAT THE BLOWER THAT YOU PURCHASE MEETS OR EXCEEDS THE FOLLOWING SPECIFICATIONS.

DISTANCE BETWEEN BLOWER AND LASER	CFM RATING AT 6 INCHES STATIC PRESSURE
UP TO 10 FEET	235 @ 6 INCHES STATIC PRESSURE
11 - 20 FEET	410 @ 6 INCHES STATIC PRESSURE
21 - 30 FEET	535 @ 6 INCHES STATIC PRESSURE
31 - 40 FEET	625 @ 6 INCHES STATIC PRESSURE

The blower must be mounted on the **OUTSIDE** of the building either on the roof or on a cement pad next to the building. Rigid duct work should be used between the blower unit and the laser system. The exhaust tubing should be smooth walled and have as few bends as possible. Use duct work with a diameter that matches the blower unit and reduce the duct work to four inches just before the point where it attaches to the laser system. Also consider installing a gate to control air flow 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 is not good to have cold air coming into the laser from the outside. Do not connect the rigid duct work directly to the laser system. Use a short piece of industrial grade, wire reinforced rubber tubing to connect the end of the gate, or tubing, to the laser system. This will provide mobility and will dampen blower vibrations. Do not use a very long piece because it's spiral construction reduces air flow. Install a hose clamp on both ends of the hose to prevent leaks and to prevent the hose from slipping off.

We recommend installation of the exhaust system by a licensed contractor to meet safety and local code requirements. Please contact a local air quality control specialist. Having the blower wired to a wall switch, by a licensed electrician, in the same room will make it easy to turn it off and on.

WARNING
Do not attempt to 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.

TYPICAL ROOF MOUNT INSTALLATION

SHIELD BLOWER
FROM THE WEATHER
WITH PROTECTIVE ENCLOSURE

EXHAUST

ROOF

EXHAUST BLOWER

WIRE BLOWER TO
A WALL SWITCH

USE SMOOTH WALL TUBING SUCH AS SHEET METAL OR PVC THAT IS THE SAME DIAMETER AS THE BLOWER INLET. SEAL ALL JOINTS TO PREVENT FUME LEAKS. KEEP TUBING AS STRAIGHT AS POSSIBLE. BENDS REDUCE AIR FLOW.

SHUT OFF
GATE

REDUCE TO 4 INCHES WITH
A REDUCING COUPLER

4 INCH DIAMETER FLEXIBLE RUBBER HOSE

TYPICAL OUTSIDE MOUNT INSTALLATION

INSIDE | OUTSIDE

WIRE BLOWER TO
A WALL SWITCH

USE SMOOTH WALL TUBING SUCH AS SHEET METAL OR PVC THAT IS THE SAME DIAMETER AS THE BLOWER INLET. SEAL ALL JOINTS TO PREVENT FUME LEAKS. KEEP TUBING AS STRAIGHT AS POSSIBLE. BENDS REDUCE AIR FLOW.

REDUCE TO 4 INCHES WITH
A REDUCING COUPLER

EXHAUST

SHUT OFF
GATE

SHIELD BLOWER
FROM THE WEATHER
WITH PROTECTIVE ENCLOSURE

4 INCH DIAMETER FLEXIBLE RUBBER HOSE

EXHAUST BLOWER

Sample Exhaust System Layouts

2.4   Water Chiller Installation (50 Watt CO2 Only)

Set up the chiller next to the laser system and connect the tubes between the chiller and the laser system. Press the tubes into the connectors and twist the tubes slightly to seat them. Gently tug on the tubes to make sure that they do not come out.
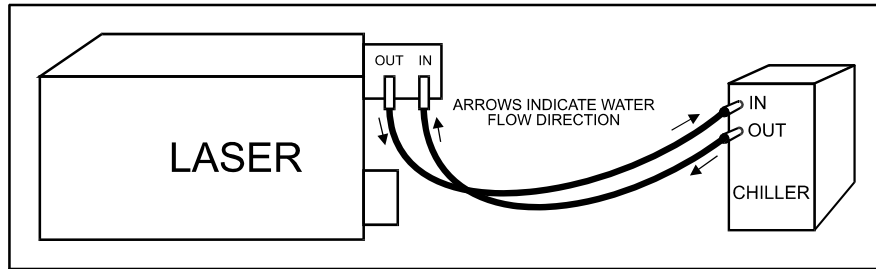
Chiller Connections

Fluids will have to be added to the chiller. Please follow the chiller's instruction manual on it's installation and use. Turn the chiller on and allow it to run for a few minutes to purge the air that is trapped in the lines. Set the chiller's temperature between 20 - 22 degrees Celsius. The laser system will not fire the laser beam unless the chiller has been turned on.

2.5   Computer Recommendations and Setup

The following computer configuration is the **minimum** requirement necessary to operate in the Windows environment. Using a computer with more speed, memory and storage capacity will enable the graphic images to be produced faster. A faster computer will perform calculations quicker and will shorten download time to the laser.

- ❍ 486-33 Mhz or higher PC compatible computer
- ❍ 8 MB of RAM
- ❍ 250 MB hard drive
- ❍ One floppy disk drive
- ❍ Color VGA monitor
- ❍ Mouse
- ❍ Microsoft Windows version 3.1
- ❍ Windows compatible graphics program

The following is our **recommended** computer configuration:

- ❍ Pentium 90 or higher(Pentium 120 Mhz system if doing rubber stamps or full field engraving)
- ❍ 32 MB of RAM
- ❍ 1 Gigabyte hard drive or bigger
- ❍ 17 inch color VGA monitor
- ❍ One floppy disk drive
- ❍ CD-ROM Drive
- ❍ Mouse
- ❍ Microsoft Windows 3.11 for Workgroups or Windows 95

❍ CorelDraw 3.0, 4.0, 5.0 (see appendices for anomalies)
❍ 600 DPI Optical Resolution Scanner
❍ Adobe Photoshop 2.5LE or 3.0
❍ Adobe Streamline (for raster to vector conversion)

CAD users do not necessarily need Windows or Windows compatible programs. The laser system is compatible with any program that can output HPGL commands whether it is Windows based or not. Check with your salesperson for specific details on DOS based CAD programs compatibility and recommendations.

The following is our **recommended** Macintosh computer configuration:

❍ Any system capable of running System 7.0 or higher.
❍ 32 MB of RAM or higher
❍ 1 Gigabyte hard drive or bigger
❍ 17 inch color monitor
❍ 600 DPI Optical Resolution Scanner
❍ Adobe Photoshop
❍ Aldus Freehand

2.6   Laser System Installation

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

1. Connect the laser system power cord to a good quality surge suppresser and then the surge suppresser to a grounded outlet. Do the same for the computer system.

2. Make sure both the computer and laser system are plugged in and turned **OFF**, then connect the laser system to the computer using either a serial or parallel connection.
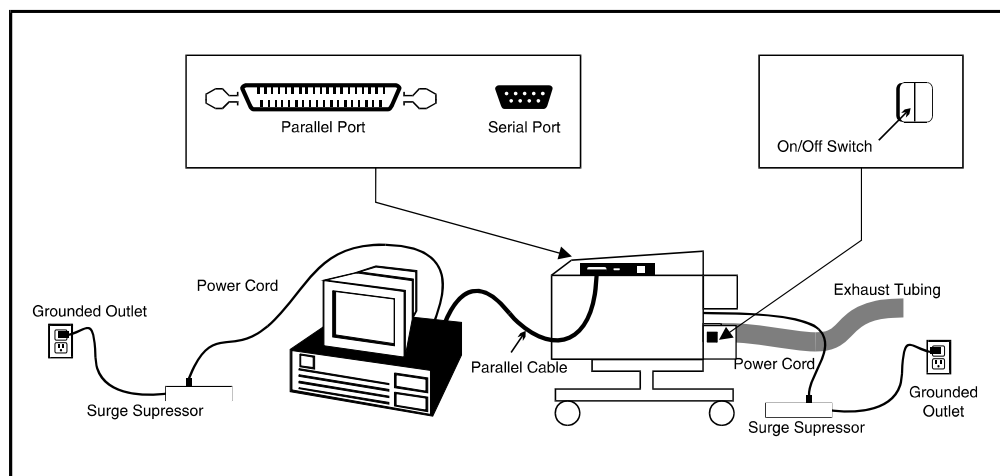
Cabling Connections

2.7 Installing the ULS Printer Driver for Windows 3.1 or 3.11

Installation of the ULS Printer Driver will allow Windows to interface with the laser system. This driver is installed the same way as most other Windows 3.1 or 3.11 printer drivers and a simple step-by-step installation procedure is outlined below. Complete understanding of how Windows works is essential to the operation of the laser system. Please consult the Windows owner's manual on its installation, use, and operation before continuing.

1. Start Windows, double click on "Main" in "Program Manager" and double click on "Control Panel".

2. Double click on "Printers" from inside "Control Panel". The "Printers" dialog box will now appear.
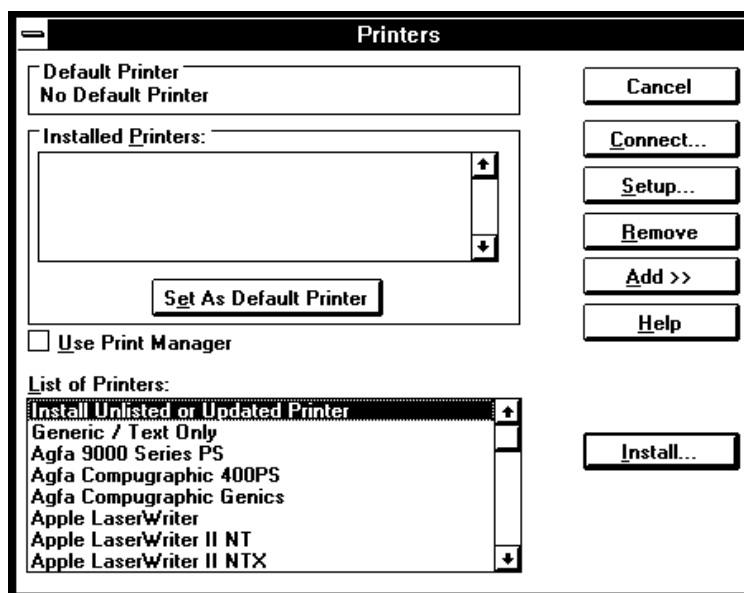
Printers Dialog Box

3. Click on the "Add" button if other drivers are present in the "Installed Printers" dialog box.

4. Click on "Install Unlisted or Updated Printer" and click on "Install".

Add Unlisted Printers Dialog Box

5. The "Install Driver" dialog box will appear asking for the location of the new driver.

6. Insert the floppy disk containing the ULS Printer Driver into the appropriate disk drive and type in the correct drive letter.

7. Click on "OK" and a new dialog box called "Add Unlisted or Updated Printer" will appear.
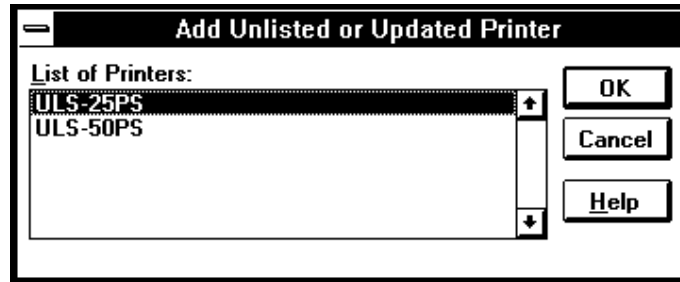
Add Unlisted or Updated Printer Dialog Box

8. Select the appropriate laser system from the list (or the "R" version if you purchased the Rubber Stamp Option) and click on the "OK" button. The driver will now install itself to your Windows System directory and the laser system will appear in the "Installed Printers" section of the "Printers" Dialog Box.
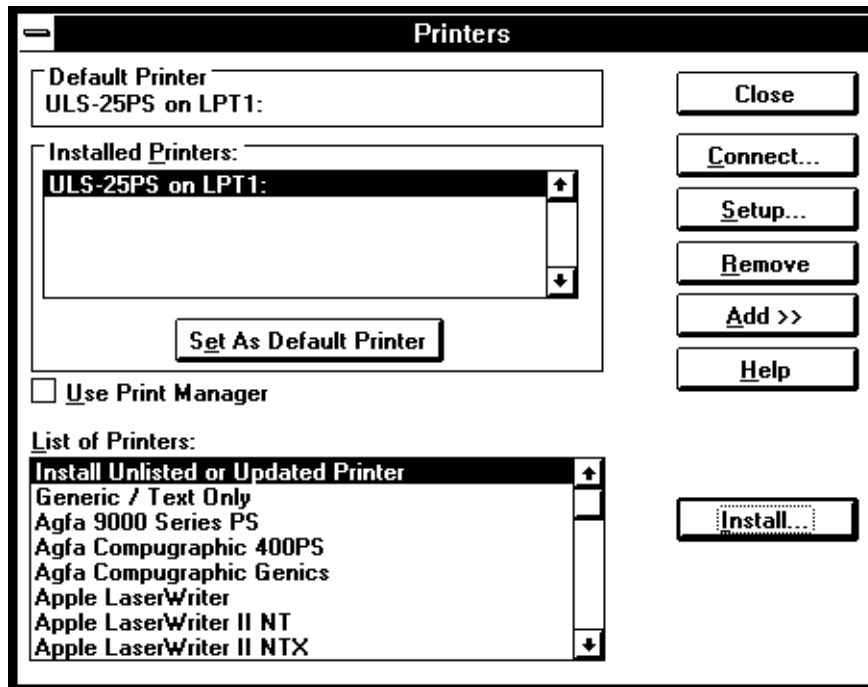
Printers Dialog Box

9. Select the laser system and click on "Connect" if connecting to a port other than LPT1. Now select the appropriate port.

NOTE: A check box named "Fast Printing Direct to Port" located on the bottom of the Dialog Box should **NOT** be checked, otherwise file transmission errors can occur.
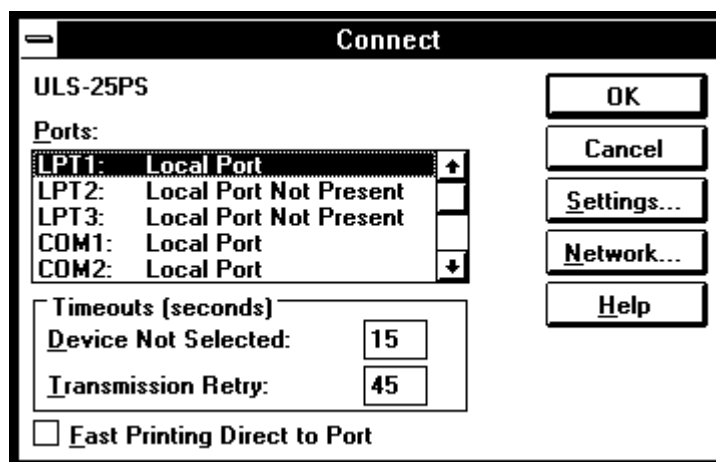
Connect Dialog Box

10. Click on "OK" and the "Printers" Dialog Box will re-appear.
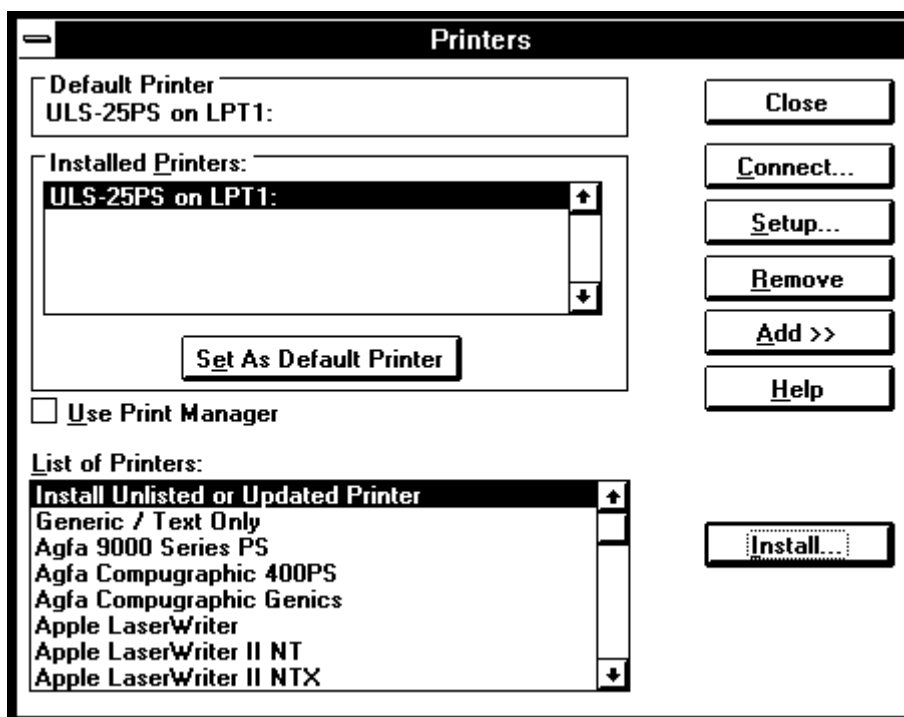
Printers Dialog Box

11. Selecting "Set As Default Printer" and "Use Print Manager" are of personal preference. Refer to the Windows manual on how to use Print Manager, if desired. We recommend that you do not use Print Manager because it serves no use to the laser system and it can become a nuisance.

12. Now you **MUST** click on "Setup" to initiate the installation of the driver. If you do not, the driver will not store your power settings correctly. The driver settings dialog box will now appear.

```
┌─┐                     ULS-25PS on LPT1: *
File   Help
┌─System──────────┐  Color    Power Speed  PPI  ┌─Laser Control──────┐
│ ┌─────────────┐ │  1 Black    50   100  │auto│   Power  Speed  PPI
│ │ ULS-25PS    │ │  2 Red      50   100  │auto│    [↑]    [↑]    [↑]
│ └─────────────┘ │  3 Green    50   100  │auto│
│                 │  4 Yellow   50   100  │auto│
│ ☐ Corel Bitmaps │  5 Blue     50   100  │auto│
│ ☐ B/W Raster    │  6 Magenta  50   100  │auto│
│                 │  7 Cyan     50   100  │auto│    [↓]    [↓]    [↓]
│                 │  8 Orange   50   100  │auto│
│                 │        ┌─Resolution─────┐    [   ]  [   ]  [   ]
│ ┌Page Setup┐ ☐ Metric │                  │     %      %     PPI
│ ○ Portrait            │ │ 500 DPI    [↓] │    ┌──────────────┐
│ ◉ Landscape           │ └────────────────┘    │     Set      │
│ Width    Height       │                        └──────────────┘
│ [24.000] [18.000]     │ ☐ Rotary Fixture       ☐ Advanced
│                       │   Diameter
│ inches   inches       │   [      ]  inches   ┌──────┐ ┌────────┐
│                       │                      │  OK  │ │ Cancel │
└───────────────────────┘                      └──────┘ └────────┘
```

Driver Settings Dialog Box

13. How to adjust the settings will be covered in a later chapter. Now you **MUST** click on "OK" in order for the driver to create a file called "Laser.ini" which the driver will install to your c:\windows directory. This file stores all of the driver settings as you change them. If you do not perform this procedure, any settings that get changed later on will not be stored in when the computer gets shut down. Upon reboot, the default settings like the ones shown above will appear instead of the settings you used before computer shut down. To prevent this, make sure that the "OK" button is clicked and **NOT** the "Cancel" button.

14. At this point, exit the "Printers" dialog box and the "Control Panel" window. Printer driver installation is now complete. Store the driver disk in a safe place.

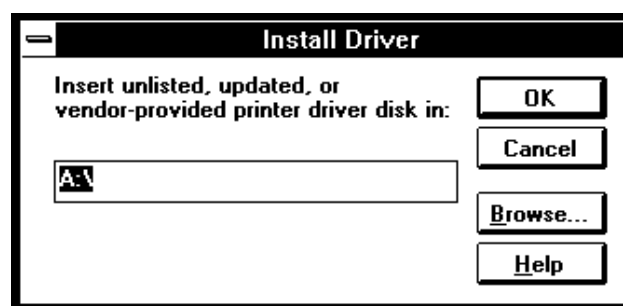## 2.8   Installing the ULS Printer Driver for Windows 95

Installation of the ULS Printer Driver will allow Windows 95 to interface with the laser system. This driver is installed the same way as most other Windows 95 printer drivers and a simple step-by-step installation procedure is outlined below. Complete understanding of how Windows 95 works is essential to the operation of the laser system. Please consult the Windows 95 owner's manual on its installation, use, and operation before continuing.

1. Power **ON** your PC.

2. From the Task Bar click "Start".

3. Point the mouse to the "Settings" icon, and then click the "Printers" icon.

4. Double-click on the "Add Printer" icon.

5. When the "Add Printer Wizard" appears click "Next".

6. Select "Local Printer" and click "Next".

7. When the "Manufacturer" and "Printers" menu list appears click "Have Disk" (Do not look for the printer in the menu)

8. Insert the driver disk.

9. Make sure the dialog box matches the floppy drive you are using: "A:\" or "B:\".

10. Click on "OK".

11. When the list of "Printers" appears choose the appropriate laser system (or the "R" version if you purchased the Rubber Stamp Option).

12. Click on "Next".

13. Choose the port your laser system is connected to and click on "Next".

14. If you would like to name the laser system a different name then rename it now.

15. Choose if you would like to set it as your default printer and click on "Next".

16. Select "No" when it asks to print a test page, and then click on "Finish".

17. Click on the laser system, then click on "File" and drag the mouse to "Properties".

18. Click on "Details" and then click on "Setup".

19. The driver settings screen will appear. Click on "OK" and then "OK" once again. This step is important because it will allow the driver to write the Laser.ini file to your c:\windows subdirectory. This file is essential for proper driver operation.

20. Driver installation is now complete. Store your driver disk in a safe place.

2.9   Installing the ULS Printer Driver for Macintosh

Installation of the ULS Printer Driver for Macintosh will allow Macintosh computers running system 7.0 or higher to interface with the laser engraving system. This driver is installed in the same way most other Macintosh printer drivers are, and a simple step-by-step installation procedure is outlined below. A complete understanding of how the Macintosh operating system works is essential to the operation of the laser system. Please consult your Macintosh owner's manual for answers to any question you might have on operating your Macintosh computer.

1. Turn on your Macintosh computer and insert the ULS Macintosh driver disk in the computer's disk drive.

2. Copy the appropriate laser system driver (or the "R" version if you purchased the Rubber Stamp Option) and Engrave Monitor onto your Macintosh computer by dragging these items from the floppy disk folder into the "Extensions" folder located inside the "System" folder on your computers hard drive.

3. Copy the "Preferences" file (if present) from the floppy disk onto your Macintosh computer by dragging this item from the floppy disk folder into the "Preferences" folder also located inside the "System" folder on your computers hard drive.

4. Click on the "Apple" menu and drag the mouse pointer to "Chooser". Click on the appropriate laser system as your output device by clicking on it with the mouse.

5. Click on the "Modem Port" in the "Connect To" dialog box and close the "Chooser" dialog box.
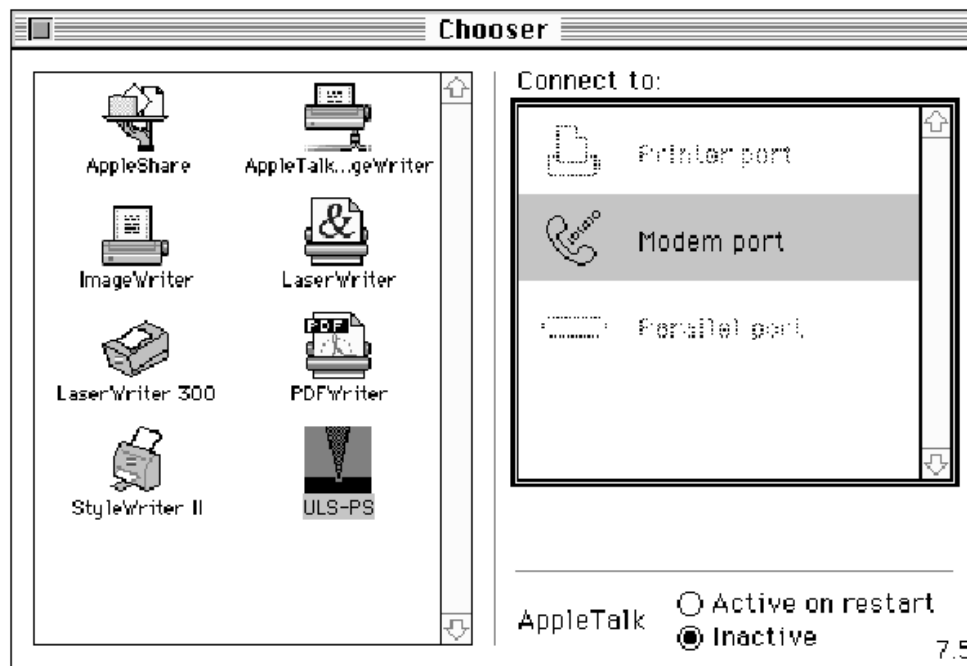
Chooser Dialog Box

6. Make sure that AppleTalk is set to "Inactive".

7. Driver installation is now complete. Store the driver disk in a safe place.

Section 3 - Software Setup and Operation

3.1   Using Graphics Software

Page Setup

To properly generate and position artwork, most graphics software will permit the customization of the page size and orientation. Set the page orientation, in the graphics software to Landscape, and the page size to a horizontal length of 24 inches(609.6 mm) and vertical height of 18inches(457.2 mm). The ULS Printer Driver's orientation and page size **MUST** then be set to match these specifications **EXACTLY**, otherwise the artwork may not print correctly. When setting page orientation and driver orientation to Landscape mode, the laser system will operate in the horizontal direction, left to right. If page orientation and driver orientation is set to Portrait mode, the laser system will operate in the vertical direction, front to back. The laser system is designed to operate best in the Landscape mode and this orientation is highly recommended. The page size may also be reduced to match the size of the engraving material, but remember to adjust the page size in the ULS Printer Driver to correspond to the graphics software's page size.   Note that in production situations it is often more efficient to leave the page size at its maximum page size and engrave or cut more than one object at a time. This is accomplished by duplicating the image on screen as many times as necessary to fill up the entire page.

Ruler Setup

Usually the graphics software will provide on-screen rulers which can be configured to match the rulers in the laser system. Using rulers in the software and matching them with the ones provided in the laser system gives the ability to correctly align the graphic on the screen with the material in the laser system. The laser system's origin is fixed in the upper left corner of the engraving area and cannot be altered. It is necessary to change the ruler position on screen to match the laser system with the origin (0,0) in the upper left corner.

It is also possible to use a page size smaller than the maximum engraving area. For example, if an 8 inch(203.2 mm) x 10 inch(254 mm) page size is desired, set this page size in the graphics software as well as the ULS Printer Driver. The laser system will automatically move the engraving area to the origin so place the object all the way up into the left hand corner against the rulers in the laser system.

Power Control Through Color Selection

The laser system allows the use of 8 different colors to access 8 different power settings when cutting and engraving. This feature is controlled by the ULS Printer Driver. When using this power change feature with the ULS Printer driver, the colors that are used **MUST** exactly match the colors listed in the driver. The colors are black,

red, green, yellow, blue, magenta, cyan, and orange. Some programs will provide these basic colors pre-defined and other programs may require the creation of each of the colors by defining them in CMYK percentages. If the eight driver colors are not automatically provided in the software, use the chart below to create the eight driver colors by specifying the appropriate CMYK values:

COLOR	CYAN	MAGENTA	YELLOW	BLACK
BLACK	0 %	0 %	0 %	100 %
RED	0 %	100 %	100 %	0 %
GREEN	100 %	0 %	100 %	0 %
YELLOW	0 %	0 %	100 %	0 %
BLUE	100 %	100 %	0 %	0 %
MAGENTA	0 %	100 %	0 %	0 %
CYAN	100 %	0 %	0 %	0 %
ORANGE	0 %	60 %	100 %	0 %

If using a color other than the exact colors listed above, the driver will attempt to match it to a color in the driver that it most closely resembles. The driver will then use that color's power setting and apply a halftone pattern to represent the original color's shade. For example, if using a color like pink to fill a rectangle, the driver takes a reading of the percentage of different colors used to create that color and will use the power setting assigned to one of the eight colors of the driver that it most closely resembles. It might be expected that the driver will use the power setting assigned to the color red but instead the driver may choose the magenta setting and halftone the rectangle as a representation of the pink color's lighter shade. To prevent the incorrect assignment of laser power, be sure to use the right colors. If using graphics with colors other than the eight listed above or to simplify the assignment of power settings, try using the B/W Raster feature in the driver. This feature will cause the system to only use the power setting assigned to the color black and halftone all of the other colors.

Outlines and Fills

The ULS Printer Driver distinguishes between raster mode (engraving) and vector mode (cutting) by the type of graphic artwork being used. Basically all graphics other than outlines of very thin line widths will be interpreted as engraved images and the raster mode will be used for output. If laser cutting is desired, set the line thickness of the lines that are drawn in the graphics software to .001 inches (.1 mm) or the smallest possible line thickness that is available. The printer driver will interpret these objects as vectors and will cut them out. The use of color fills or bitmaps will cause the laser system to engrave. The combination of engraving and cutting is available in most graphics software. We suggest that when combining engraving and cutting objects, use different colors for the fills and outlines since engraving requires different power settings than cutting objects. One thing to keep in mind when creating cutting objects is that if the outline thickness is set too thick, the driver might interpret the outline as a filled object and will engrave the outline instead of cutting. This might be desirable if engraving thick outlines is necessary. The outline thickness at which the driver will

interpret cut lines as filled objects is dependent on the software used. Usually, any line thickness .008 inches (.2 mm) or greater will engrave. The only way to determine the cross over point for line thickness is to experiment with different line widths. Software programs that do not have outline capabilities will not have the ability to cut.

Image Processing Order

When cutting or engraving a graphic image, the laser system will perform all engraving first, then proceed to cutting. Engraving will proceed in the exact order of the colors listed in the driver. For example, all black filled objects will engrave first, then all red filled objects, then all green filled objects and so on. When all engraved objects have been completed, the laser system will proceed to cut any outlines present in the artwork. Unlike engraving, cutting will proceed in the order from which the outlines are drawn regardless of color. There are several different ways to control the order in which the outlines are cut. One way is to draw them in the exact order in which they need to be cut, but this is not always practical. Another way is to select the outline in the graphics software and "send it to the back", behind the other objects, to cause the outline to be cut first. Bringing the outline "to the front" will cause that outline to cut last. A final way is to cut and paste each outline in the cutting order desired. This effectively works the same way as the two previous suggestions.

Overlapping Fills

If the artwork created has overlapping filled areas, the driver will automatically filter these fills to prevent the overlapped area from being engraved twice. This is similar to color separation in the printing industry. The entire filled area of the object on top will be engraved and only the visible part of the underlying filled area will be engraved. The final result is a what-you-see-is-what-you-get output. In this way the color white can be used as an effective drawing tool. Since the laser system will not engrave the color white (this is the background color), it can be used to block out the undesired engraving areas of filled regions and/or bitmaps.

Overlapping Outlines

The ULS Printer Driver does not filter outlines that overlap each other. If placing one outline one on top of another, both outlines will be cut by the laser system. This is a useful feature that will allow deeper cutting by passing the laser over a single outline path twice or more. To take advantage of this feature, duplicate the outline on top of itself.

Hidden Vector Lines in Artwork

The ULS Printer Driver does not automatically filter out outlines that are overlapped by engraved objects such as fills. If there are filled objects with some hidden outlines

underneath, the laser system will then engrave out the fill and cut the hidden outline on top of the fill. This is a common occurrence when using pre-drawn ClipArt designed for laser printers. To prevent this from happening, turn on the B/W Raster feature in the driver. This feature disables the cutting mode and converts all visible outlines to engraved objects and ignores all hidden outlines.

Optimizing Speed

It is advantageous to engrave an object in its longest direction because total engraving time will be reduced when the motion system has to make fewer stops and starts. If the engraving object is longer than it is tall, a greater engraving speed can be achieved by rotating the graphic 90 degrees and placing the material in the laser system sideways. Be aware that some graphics programs do not allow the rotation of bitmaps. In this case, it may be necessary to use bitmap image processing software to first rotate the bitmap before importing the bitmap into the graphics program. If the artwork contains engraved objects of the same color with a great deal of space between them in the engraving direction, processing time can be longer since the laser must make long strokes to engrave both objects at the same time. To reduce engraving time in cases like these, use different colors for each of the objects but assign the same power setting to both colors. This will cause the laser to engrave one object at a time, skipping over all blank space, which in many cases will reduce engraving time.

Bitmaps

There are three types of bitmaps available. They are monochrome, grayscale, and color. Bitmaps are patterns of dots blended to form pictures. Most bitmaps are created by scanning artwork into a computer through a scanner. Others are created by drawing them in a bitmap image processing program. Only monochrome or grayscale bitmaps are used by the laser system. The driver handles color bitmaps the same as grayscale bitmaps. Since color bitmaps use more memory, they are unnecessary and are therefore **NOT** recommended. Monochrome bitmaps are used when scanning and engraving line art or camera ready black and white images. Grayscale bitmaps are used for scanning and engraving photographs even if they are color.

When scanning black and white images, scan at least 600 DPI. The higher the DPI, the smoother the image will be. Scanning in at 300 DPI is the minimum resolution for scanning line art (monochrome bitmaps), but 600 DPI provides a significant improvement in the image quality. Grayscale bitmaps (photographs) usually should be scanned at no more than 300 DPI. Scanning at a higher DPI for photographs does not effectively improve image quality but consumes more memory. As a rule of thumb, scan photographs at 300 DPI and line art images at 600 DPI.

There are several different bitmap formats available: TIF, BMP, PCX, and others. The format makes no difference to the laser system. The difference in formats involves how they are stored on the computer's hard disk. Bitmaps cannot be edited in most

graphics software. Some basic functions such as cropping, scaling, or mirroring might be possible but it is usually necessary to use an image processing software to perform a dot by dot editing or rotation of the bitmap.

Monochrome bitmaps are engraved in the same manner as black filled text. The black area will turn the laser on and the white area turns the laser off. In order to engrave a photograph however, a halftone pattern must be created. A halftone is a series of dots arranged in a specific pattern. By varying the size and intensity of these dots, shading can be simulated in a process that is similar to that used to generate newspaper photographs. Sometimes this is referred to as setting the screen for printing. Usually, imaging software gives the choice of using different halftone patterns including frequency of lines per inch and pattern angles. 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 or graphic software, the ULS Printer Driver will automatically default to a predetermined pattern based on the Resolution setting in the driver.

RESOLUTION	ANGLE	SHAPE	LINES PER INCH
1000	45 DEGREES	ROUND	180
500	45 DEGREES	ROUND	90
333	45 DEGREES	ROUND	60
250	45 DEGREES	ROUND	45
200	45 DEGREES	ROUND	36

Bitmap images cannot be cut by the laser system only engraved. The only way to have the laser system cut out a bitmap is to first convert it to a vector file format such as an EPS. Raster to vector conversion programs are available that trace the bitmap (this only works well with monochrome bitmaps) and creates a separate EPS vector file. These EPS files can then be imported into the graphics program and printed out from there. Since tracing programs have many adjustments, some practice with them is necessary to produce desirable results.

Postscript Files

The laser system does not support Encapsulated Post Script (EPS) printing directly. EPS files can only be edited and printed if they are first imported into a graphics program. However, since EPS files do support engraving and cutting objects, they are therefore useful for transferring artwork from one graphics program to another. Once an EPS file has been imported into a graphics program, the objects can be outlined, stretched, rotated, mirrored, filled with different colors, or anything else desired. Be careful when using EPS files in layout software as opposed to true graphics software. Layout software may allow the placement of EPS files in the artwork but may not actually import and convert the EPS file to a useful format for the ULS Printer Driver. The laser system is not a postscript device. This means that postscript fills, postscript textures, and postscript fonts will not be able to print to the laser system.

Working with Fonts in the Windows Environment

We recommend the use of True Type fonts with the laser system. 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. Other types of fonts might not print correctly to the laser system.

Post Script fonts will not print correctly on the laser system unless you have the Adobe Type Manager (ATM) installed. Even with ATM installed, a Postscript font will print but the quality will usually be slightly lower than that of a comparable TrueType font. Some ATM fonts will not print correctly at all to the laser system especially if they are rotated 90 degrees. If you are having trouble printing a particular ATM font, we recommend that you use it's True Type equivalent.

Bitmap 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.

3.2   The ULS Printer Driver for Windows
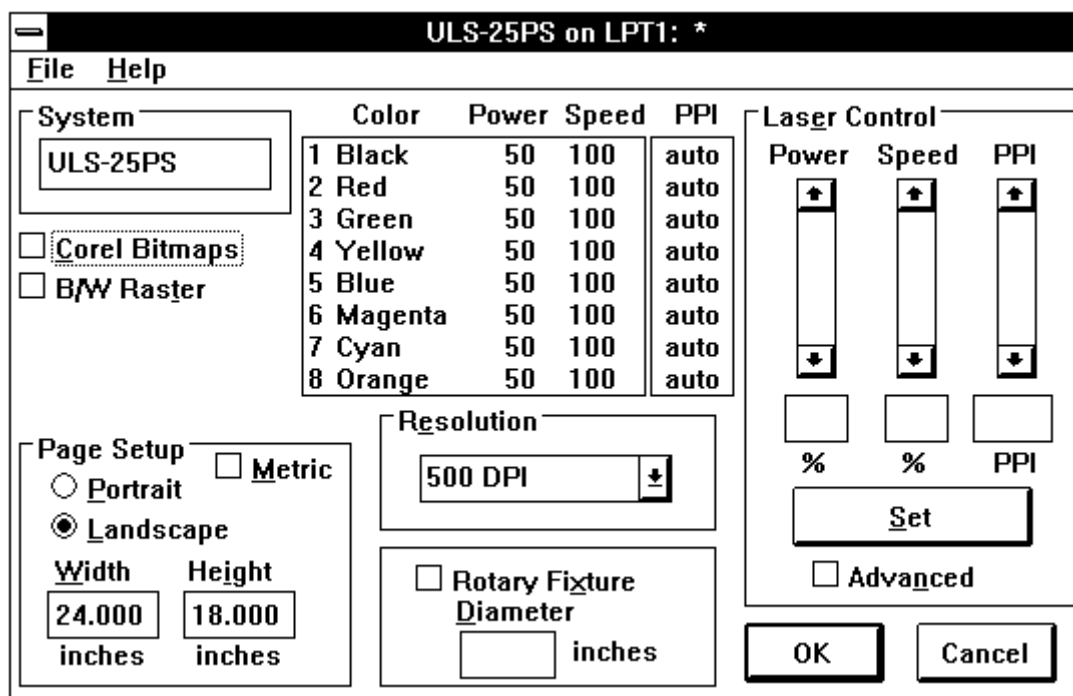
The ULS Printer Driver for Windows

NOTE: When the following sections refer to turning a switch ON, this means putting an "X" in the box next to the driver selection desired. Turning a switch OFF signifies removing the "X" from the box. To change the Power, Speed, and PPI of a color, position the mouse arrow on the color and click once with the left mouse button. This

will highlight the color and allow changing of the settings by using the scroll bars or highlighting out and typing in each setting. It is possible to set one color at a time or click on additional colors to set more than one at a time.

Power Setting

Laser power is controlled by assigning the percentage of power from 0 - 100% to each color used in the graphic drawing. Since the laser is proportionally pulsed, this percentage represents how long the laser remains on for each laser pulse fired. Basically, the power setting is directly related to how deep the engraving will be.

Speed Setting

This setting controls how fast the motion system moves in a percentage of the maximum speed of the system. For example, 100% Speed is equivalent to 25 inches per second straight line velocity. Therefore, 10% Speed is equal to 2.5 inches per second. When engraving, this is the rate in which the motion system moves back and forth. When cutting, this is the speed of the straight lines. If cutting curves or circles, the motion system automatically slows down. For example, there is no speed difference when cutting a circle at 50% or 100% Speed because curves will run slower than straight lines even if it is set to 100%. Proportional pulsing of the laser will ensure that there is no difference in the depth of cut from straight lines to curves. Power and speed work together in determining how deep the engraving will be. Higher power settings and slower speeds will produce deeper engraving.

PPI

PPI stands for laser pulses per inch. This setting determines how many laser pulses, per linear inch, the laser system will fire. Again, since the laser system is proportionally pulsed, all pulses will fire equally spaced from one to the next regardless of changes in Speed, Power, acceleration, deceleration, or the cutting of curves. For example, when setting the PPI to 500 and using a standard lens that has a laser spot size of seven thousandths of an inch, significant pulse overlap will occur. The laser system fires a laser pulse and moves over two thousandths of an inch (that is 1 inch divided by 500). It then fires the next pulse and so on, overlapping the pulses significantly. Lines are formed by pulsing the laser pulses so close together and slightly overlapping each other that it appears to be a continuous line. Dot matrix printers work the same way except the laser system uses laser pulses instead of ink dots. When engraving, it is advisable to use a PPI setting of 500 or higher. If using less, the image resolution of the engraving is reduced. For cutting, a PPI of 150 and above can be used. Using less than 150 will result in the pulses being spread so far apart that they will not touch one another. This is a good example on how to perforate paper. Increasing or decreasing the PPI setting has absolutely no effect on engraving speed. The laser must either fire more quickly or slowly. Experiment with using different PPI settings on some scrap material when cutting or engraving and note the results.

Set

This button must be pressed after adjusting the Power, Speed, and PPI settings in order for these changes to take effect. If forgetting to click on "Set", and clicking on the "OK" button instead, the settings will go back to the previous ones and will engrave the object with the incorrect settings.

Advanced

Turning this switch ON will permit the changing of the PPI settings. If the switch is turned OFF, the word "Auto" will appear in the PPI column and will be colored gray. Since 500 PPI is the setting that is used most often, "Auto" sets the PPI to 500 automatically and does not allow change unless the "Advanced" switch is turned back ON.

Resolution

This setting is the image resolution of the engraving in DPI or dots per inch. There are six DPI settings to choose from: 1000, 500, 333, 250, 200 and DRAFT. The resolution can also be referred to as horizontal lines per inch or fill spacing. This is how many raster strokes per vertical inch of travel that the motion system steps down to produce an engraving. Higher resolutions will produce cleaner and deeper engraving but take longer to engrave. Lower resolutions produce a coarser and shallower image but are quicker to engrave. Experiment with the different settings and note the results.

Corel Bitmaps

This switch is for CorelDraw! users **ONLY**. Turn this switch ON only when there is an imported monochrome or grayscale bitmap in CorelDraw!. If printing any drawing that has a bitmap in it and forgetting to turn this switch ON, everything else except the bitmap will print. If the bitmap does not engrave, go back and turn the switch ON, select the bitmap only, and print Selected Objects Only in the software. Make sure to leave this switch OFF if there is no bitmap present. This switch should remain **OFF** if using software other than CorelDraw!.

B/W Raster

This switch simulates laser printer output and is very useful if using a drawing with many colors, shades of gray, or many outlines. It is recommended to turn this switch ON when using ClipArt because there may be some underlying cutting lines hiding behind some filled areas. Having this switch ON gives a what-you-see-is-what-you-get output very similar to laser printer output. The entire drawing will be engraved, including all outlines, and only one power level will be used which is black. The color change ability of the driver is essentially turned off and all colors are engraved as

different shades of gray. The laser system represents different shades of gray by producing a halftone pattern when engraving. The halftone pattern is based upon the Resolution setting of the driver the same way grayscale bitmaps are interpreted. Since ClipArt images use a wide variety of colors, shades, and outlines, the only effective way of engraving these images is to have this switch turned ON. B/W RASTER mode also provides greater compatibility with Windows software that do not work well with vector devices such as the ULS laser system. Call our technical support if there seems to be a compatibility problem with a particular software program.

Page Setup and Orientation

Input here lets the ULS Windows Printer Driver know what page size and orientation is being used in the graphics software. These settings **MUST** match the graphics software settings **EXACTLY** otherwise no output, partial output, or misalignment of the graphic will occur. It is up to the operator to enter in the correct settings. Not only must the page size be **EXACT**, but the orientation must be the same also. Remember, the maximum page size is horizontal length of 24 inches(609.6 mm) and vertical length of 18 inches(457.2 mm) in the Landscape mode. Select the "Metric" box if metric units are desired.

Rotary Fixture

It is only necessary to use this selection if the optional Rotary Fixture has been purchased.   For full details on how to use this option, please refer to Section 4.5. Do not skip over to that section until the rest of this manual, up to that section, has been read. There is important information about the operation of the laser system that must be read before being able to fully understand how to operate the Rotary Fixture.

Rubber Stamp and Invert Fill

These two selections will only appear in the driver if the Rubber Stamp option has been purchased.   For a full explanation on how to use this option, refer to Section 4.6. Again, please read the rest of this manual up to that point before attempting to use this option.   A full understanding of how the laser system works is essential to producing correct results.

File

A unique feature of the driver is being able to store the power settings that are currently on screen. By selecting "File" and then "Save Setup File", all settings will be stored in a file that can be named as desired. The file extension, however, must remain as .LAS for the driver to recognize this file as a setup file. These files can be stored in any directory and may be retrieved by selecting "File" and then "Load Setup File".

The Laser.ini file can be thought of as being a file that stores the current power settings when the "OK" button is pressed. This gives the driver the ability to restore these settings every time the driver is accessed. Without this file, the power settings would have to be entered in every time the graphic is sent to print. Selecting "File" then "Load Laser.ini" will restore the settings that were saved the last time the "OK" button in the driver was pressed. Once the "OK" button is selected, the current power settings will be stored in the "Laser.ini" file and the original ones will be erased.

Help

Select this option to access Help on the use of the ULS Printer Driver. Selecting "Help" and then "About" will display the current driver version number and our copyright notice.

3.3   Using DOS Based Programs

When using DOS based programs, there are a few things to keep in mind. DOS software is not standardized and each application will work differently. When using DOS applications, it is not possible to print through the ULS 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 which the laser system has been designed to accept. When configuring the DOS based program, select the HP7475 plotter as the printing device. Set the maximum paper size to 24 inches(609.6 mm) wide by 18 inches(457.2 mm) tall (refer to the DOS software manual for how to configure the printing device). Once configured properly, the laser system should interface with the program very nicely and act just like a plotter. The following are a few points to remember when printing from DOS based programs:

1. Some DOS programs will not allow the page size to be set at 24 inch(609.6 mm) x 18 inches(457.2 mm) in the Landscape mode. 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 to see where the laser system will output.

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 "Power Settings" display.

4. Some DOS programs may allow the setting of pen speed for the different plotter pens. These speeds will be ignored by the laser system so do not be concerned with making those settings in the software. The only place that the settings can be made is in the "Power Settings" display section of the laser systems control panel.

5. Make sure that you set all of your line widths to .001 inches(.1 mm) otherwise the laser system may go into raster mode instead of the desired vector mode.

6. After every file download, an "End of File" marker must be inserted at the laser system so that the buffer control will work properly.

7. Power setting for plotter pens can only be done at the laser system itself through the main control panel display. Section 4.2 of this manual will explain how to set the Power, Speed, and PPI settings for plotter pens. It will also describe how to insert an "End of File" marker and why it is necessary after every file download. Please refer to that section for more explicit details. If having trouble with using DOS based programs, please contact our technical support.

3.4   The ULS Printer Driver for Macintosh

The ULS Printer Driver for Macintosh consists of three parts: the Printer Driver, the Engrave Monitor, and the Page Setup. Many features of this driver function the same as they do for the Windows based Printer Driver.

The Printer Driver
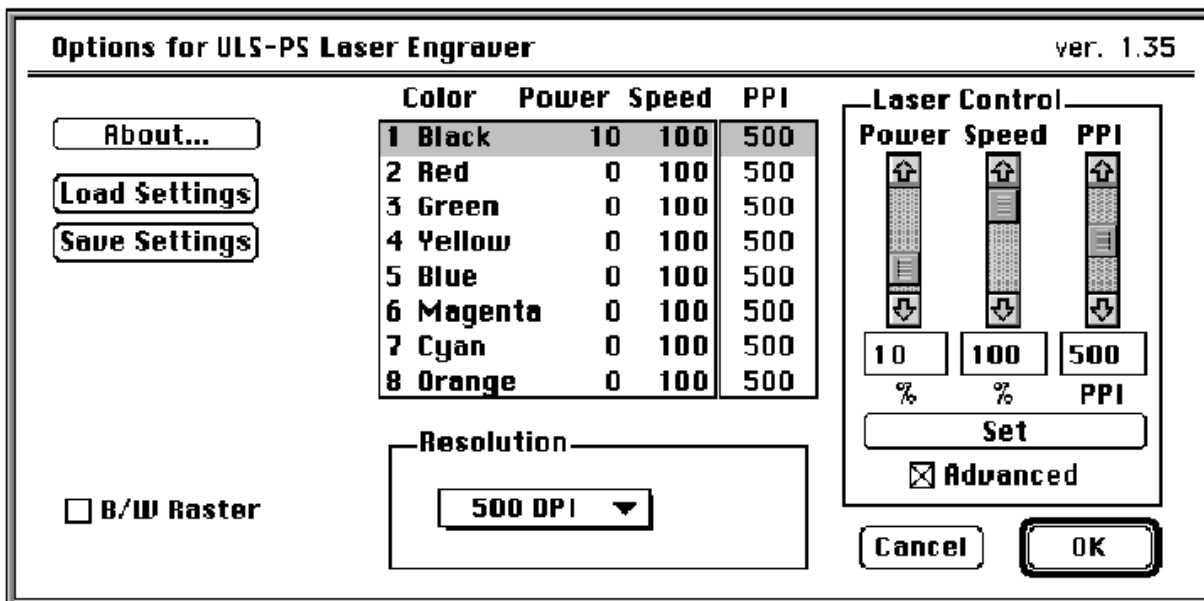
The ULS Printer Driver for Macintosh

In the ULS Printer Driver for Macintosh there is only one switch, the "Corel Bitmaps" switch, that is not present in this driver because it is not necessary to have this switch for the Macintosh computer system. Please refer to the section on "The ULS Windows Printer Driver" to understand the function and selection of the different settings the driver has to offer.

The Engrave Monitor
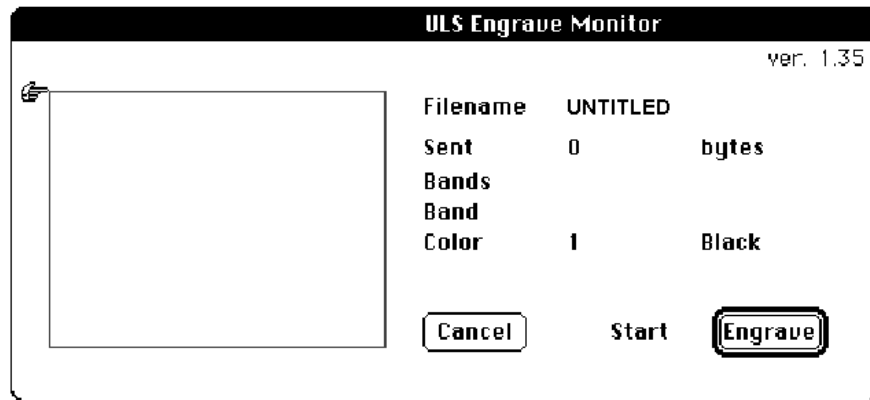
Engrave Monitor

The Engrave Monitor provides a graphical preview of the printed image and allows you to send the image to the printer or cancel printing at any time during the process by selecting the cancel button.

While the image is being printed a pointer travels down the length of the page indicating printing progress and a counter indicates how many bytes of information have been sent. You can also pause printing by selecting the pause button and then resume printing at any time.

The Page Setup

Page setup for the printer driver is specified in the Page Setup dialog box which can be accessed through the file menu of the graphic software you are using. The page setup you specify in this dialog box only applies to the printed output and won't effect the graphic. For proper printing you **MUST** match the settings of the graphic page on your computer screen **EXACTLY** with the printed page settings otherwise no output, partial output, or misalignment of the graphic will occur. It is up to the operator to enter in the correct settings. Not only must the page size be **EXACT**, but the orientation must be the same also.
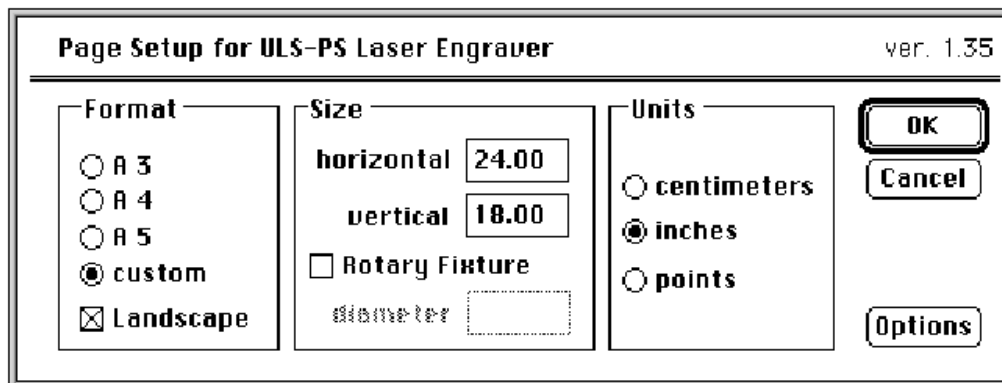
Page Setup

Working with Fonts in the Macintosh Environment

We recommend the use of True Type Fonts. 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.

Post Script fonts will not print correctly on the laser system unless your Macintosh has the Adobe Type Manager (ATM) extension loaded. Even with the ATM extension loaded, a Postscript font will print but the quality will usually be slightly lower than that of a comparable TrueType font. Some ATM fonts will not print correctly to the laser system especially if they are rotated 90 degrees.

Bitmap 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.

Font types can only be identified by looking in the Fonts folder which is found in the System folder. Each font has its own icon in the Fonts folder and the font type can be identified by the icon. Refer to the Macintosh System 7 Reference Manual for an explanation of the font icons and their meanings.

Section 4 - Laser System Operation

4.1 General System Overview

1. Top Door
2. Top Door Window
3. Top Door Counterbalances
4. Exhaust
5. Focus Lens Holder Assembly
6. Motion System X-Axis Arm
7. Front Door
8. Interlock Defeat Tool Socket
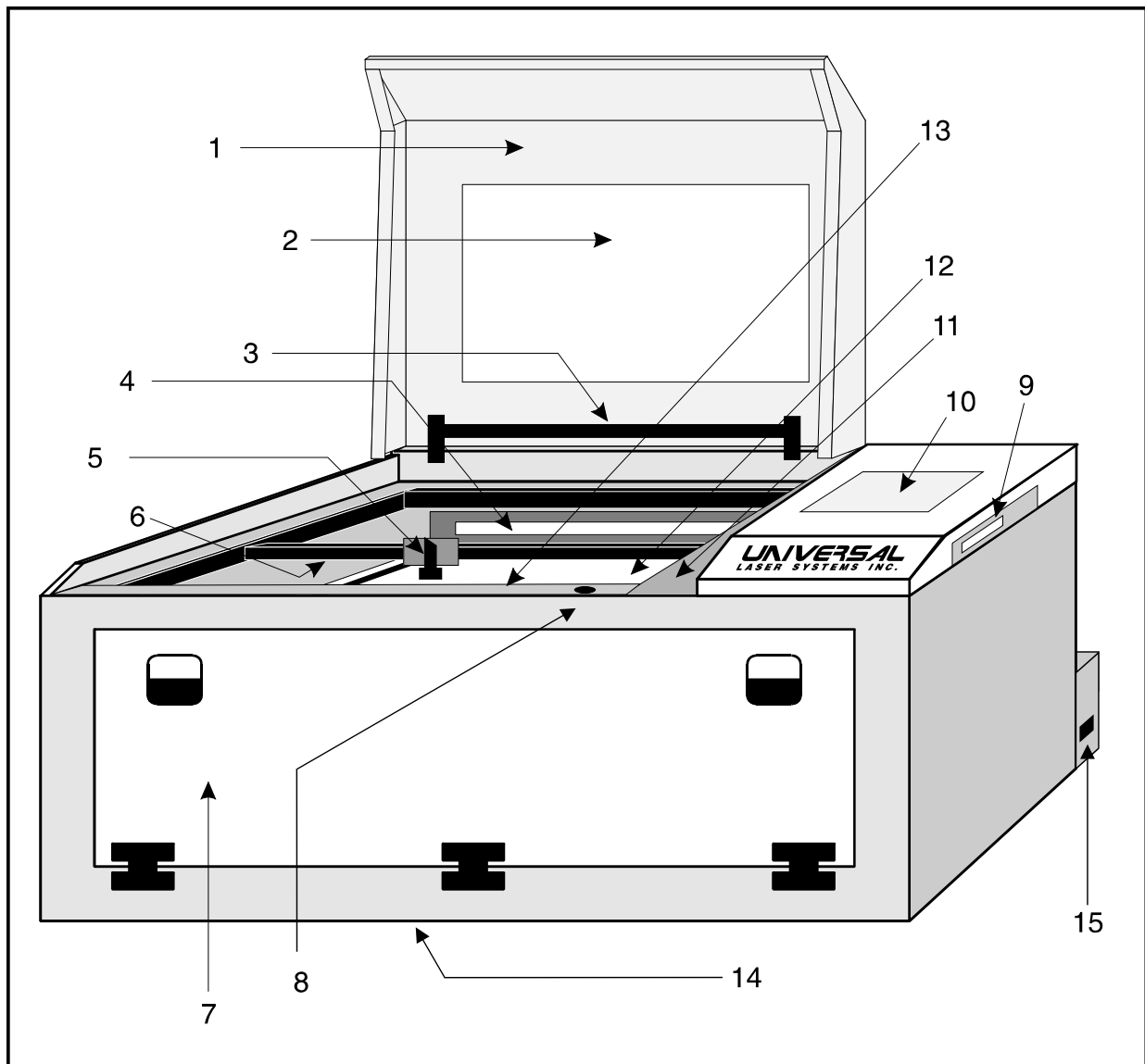
9. Parallel and Serial Connectors,
10. Control Panel
11. Motion System Protective Overhang
12. Engraving Table
13. Rotary Fixture Receptacle
14. Air Intake Filter
15. On/Off Switch

4.2   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, buttons, and a laser ON/OFF switch. The control panel is divided into four sections: the Menu Control, Process Control, Laser ON/OFF Control, and Motion Control Systems.
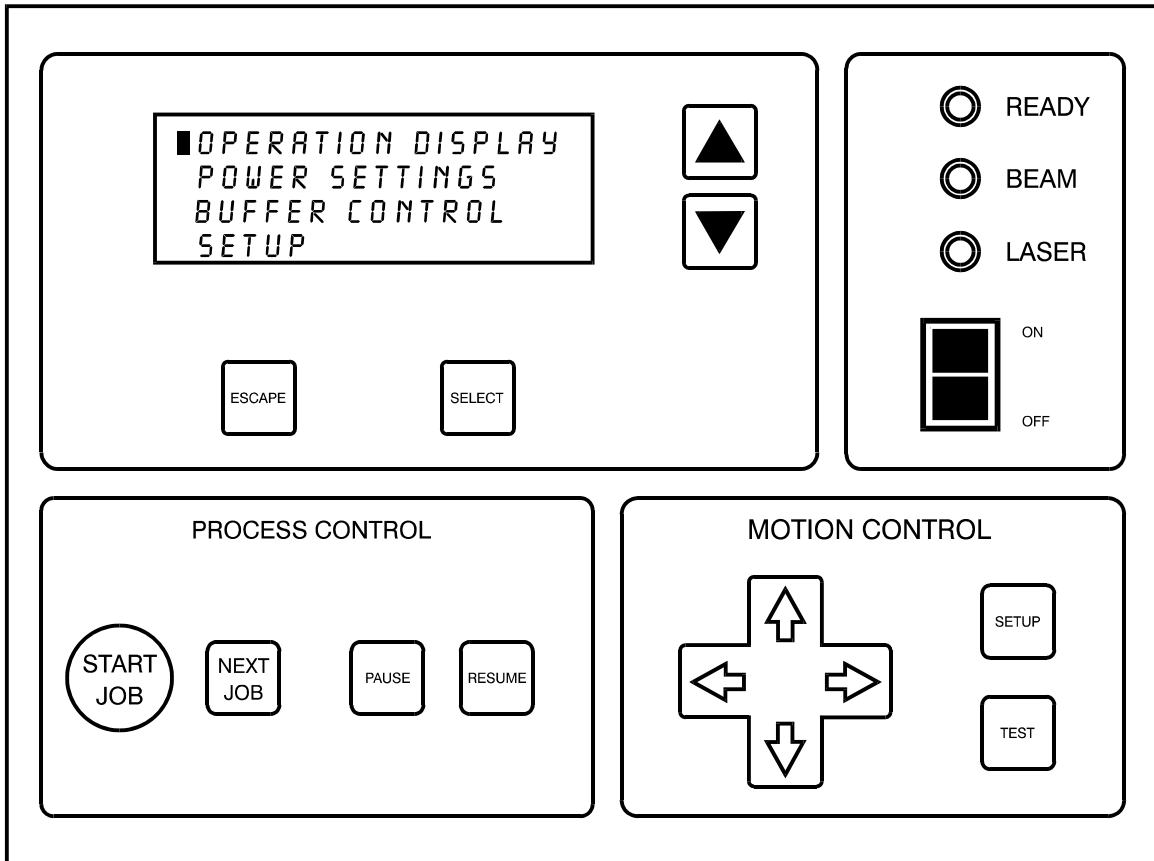
The Control Panel

The four keys surrounding the liquid crystal display give complete access to the Menu Control System. The up and down arrow keys are used to scroll up or down through the displayed menu. Pressing the "SELECT" button allows access to other submenus. Some items in the submenus can be adjusted and others are for display only. The "ESCAPE" key allows backing up through the Menu Control System to the main menu.

The "ESCAPE" and "SELECT" buttons also function for changing a setting. The "SELECT" key accepts and stores the change and the "ESCAPE" key exits without changing the setting.

POWER ON

MAIN MENU

■OPERATION DISPLAY
 POWER SETTINGS
 BUFFER CONTROL
 SETUP

MAIN MENU

■OPERATION DISPLAY
 POWER SETTINGS
 BUFFER CONTROL
 SETUP

 OPERATION DISPLAY
■POWER SETTINGS
 BUFFER CONTROL
 SETUP

 OPERATION DISPLAY
 POWER SETTINGS
■BUFFER CONTROL
 SETUP

 OPERATION DISPLAY
 POWER SETTINGS
 BUFFER CONTROL
■SETUP

■1) BUFFER EMPTY
 #COPIES   0 0:00:00
 BLACK   100%SPEED
 100%POWER   500PPI

■POWER SETTING □WIN
 SPEED   100%
 POWER   100%
 RESOLUTION   500PPI

■1) FILENAME.XXX
 INSERT END-OF-FILE
 DELETE THE FILE
 BUFFER SPACE 15.9MB

■TICKLE
 CONFIGURATION
 DIAGNOSTICS
 RETAIN SETTINGS

 1) FILENAME.XXX
■INSERT END-OF-FILE
 DELETE THE FILE
 BUFFER SPACE 15.9MB

 1) FILENAME.XXX
 INSERT END-OF-FILE
■DELETE THE FILE
 BUFFER SPACE 15.9MB

 1) FILENAME.XXX
 INSERT END-OF-FILE
 DELETE THE FILE
■BUFFER SPACE 15.9MB

 INSERT EOF
 --- ARE YOU SURE ---
■CANCEL
 YES INSERT EOF

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

 DELETE ALL FILES
 --- ARE YOU SURE ---
■CANCEL
 YES CLEAR THE BUFFER

■TICKLE
 CONFIGURATION
 DIAGNOSTICS
 RETAIN SETTINGS

 TICKLE
■CONFIGURATION
 DIAGNOSTICS
 RETAIN SETTINGS

 TICKLE
 CONFIGURATION
■DIAGNOSTICS
 RETAIN SETTINGS

 TICKLE
 CONFIGURATION
 DIAGNOSTICS
■RETAIN SETTINGS

■TICKLE RATE   5KHZ
 TICKLE WIDTH   1 uS

■AUTO POWER   ON
 BUZZER   ON
 PORTS
 LOAD DEFAULTS

■TEST MEMORY
 PLACE 24000X 18000Y
 UNIVERSAL LASER SYS.
 COPYRIGHT 1994 04-10

 RETAIN SETTINGS
 --- ARE YOU SURE ---
■CANCEL
 YES ACCEPT

 MEMORY TEST
 PAGE   63   FAILS 0
■CANCEL
 YES (CLEARS BUFFER)

■AUTO POWER   ON
 BUZZER   ON
 PORTS
 LOAD DEFAULTS

 AUTO POWER   ON
■BUZZER   ON
 PORTS
 LOAD DEFAULTS

 AUTO POWER   ON
 BUZZER   ON
■PORTS
 LOAD DEFAULTS

 AUTO POWER   ON
 BUZZER   ON
 PORTS
■LOAD DEFAULTS

 PARALLEL

 CHANGE ALL SETTINGS
 --- ARE YOU SURE ---
■CANCEL
 YES LOAD DEFAULTS

 SERIAL
 BAUD RATE   9600
 STOP BITS   1
 PARITY   ODD

Menu Control System Flow Chart

The "MAIN MENU"

```
┌─────────────────────────┐
│ OPERATION DISPLAY       │
│ POWER SETTINGS          │
│ BUFFER CONTROL          │
│ SETUP                   │
└─────────────────────────┘
```

The Main Menu will display when the system is first turned on. To access the submenus of the Main Menu System, move the cursor with the arrow keys to the desired submenu and press "SELECT".

The "OPERATION DISPLAY" submenu

```
┌─────────────────────────┐
│■OPERATION DISPLAY       │
│ POWER SETTINGS          │
│ BUFFER CONTROL          │
│ SETUP                   │
└─────────────────────────┘
```

Then

```
┌─────────────────────────┐
│■1) BUFFER EMPTY         │
│ #COPIES   0   0:00:00   │
│ BLACK      100%SPEED    │
│ 100%POWER     500PPI    │
└─────────────────────────┘
```

This is the "OPERATIONS DISPLAY" submenu which will probably remain on most of the time during normal operation. 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 that the laser system's print buffer is empty, but when the buffer is loaded with files (or jobs), this line will display the currently selected job. To move to the next job in the buffer press the "NEXT JOB" button. The "NEXT JOB" button only scrolls upwards through the buffer. It is also possible to scroll forwards and backwards through the buffer by pressing the "SELECT" button which moves the cursor to the right side of the display. The up and down arrow keys can then be used to move through the list of jobs in the buffer. When the desired job is found, simply press the "SELECT" key to make that job the current job. This will move the cursor back to the left hand side of the display. To run the currently selected job simply press the "START JOB" button. Changing the current job is not possible while running the laser system. No other items in this submenu can be selected or changed.

The "# OF COPIES" feature on the second line indicates the number of times the current job has been used since it was loaded into the buffer (the system keeps a running count of the number of times each job in the buffer has been completely processed). The second line also contains a timer to time jobs as they are run (this is useful for costing jobs). The timer will pause when the "PAUSE" key is pressed and starts up again when the "RESUME" button is pressed. If the same job is run again, the timer will count backwards displaying how much remaining time is left.

The last two lines show the power setting last used by the laser system. "BLACK" indicates the current power setting color used for all of the portions of the computer artwork which are colored black, "SPEED" indicates the speed of the motion system, "POWER" indicates the power output percentage of the laser and the PPI setting indicates the laser's pulse rate (in this case 500 laser pulses per inch). The "OPERATIONS DISPLAY" mode is the part of the menu system that is used most often. In this mode, the job name will be displayed as well as the current power setting that the laser system is processing. When the laser system is first powered on and this submenu is selected, there will be an initial power setting displayed. Even after the first job is downloaded and the name of the job appears on the display, the power setting will still be unchanged. Please ignore these settings. Only until the job is run will the display show the correct power setting that was entered in the ULS Printer Driver when the job was sent to print.

The "POWER SETTINGS" submenu

```
 OPERATION DISPLAY
■POWER SETTINGS
 BUFFER CONTROL
 SETUP
```

Then

```
■POWER SETTING  #WIN
 SPEED           100%
 POWER           100%
 RESOLUTION   500PPI
```

This submenu serves several purposes. The first purpose is to display the current power settings the laser system is using while it is running a job. This is very similar to the "OPERATIONS DISPLAY" submenu except that the name of the job running is not shown. Secondly, it is possible to change these settings while the laser system is running which is very useful for testing purposes. To adjust these settings, press the up or down arrow key until the cursor is on the desired selection. Press the "SELECT" key which moves the cursor to the right and then use the arrow keys to increase or decrease the values. Pressing the "SELECT" key again will accept the change and pressing the "ESCAPE" key will 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 ULS Printer Driver, and re-send the job to the laser system for the final run. Lastly, the laser system allows eight different power settings to be saved in memory and used when processing a DOS based file. Since a DOS based printer driver is not available, the 8 power settings must be set manually on the laser system. Think of it as being able to assign laser "POWER", "SPEED", and "PPI" to the pens on a flatbed plotter. This is not necessary when using Windows since all settings can be set in the driver.

To access the power settings, press the "SELECT" key when the cursor is on "POWER SETTINGS", then use the up and down arrow keys to scroll through settings 1 through 8. When the desired power setting number is found, press the "SELECT" key again to bring the cursor over to the left hand side of the display, and proceed to make the adjustments as previously described. Do not use power setting "#WIN" because this power setting is used by the ULS Printer Driver to temporarily store information during operation, and any settings stored there will be lost

CAUTION:
If setting the "PPI" higher than "1000", the laser system will display the word "CONTINUOUS". This mode is used for maintenance procedures **ONLY** and is **NOT** to be used under normal operation

The "BUFFER CONTROL" submenu

```
 OPERATION DISPLAY
 POWER SETTINGS
■BUFFER CONTROL
 SETUP
```

Then

```
■1) FILENAME.XXX
 INSERT END-OF-FILE
 DELETE THE FILE
 BUFFER SPACE 15.9MB
```

The laser engraving system comes equipped with a built in 16 megabyte memory buffer which is expandable to 64 megabytes. The buffer has built in file handling intelligence enabling each individual job in the buffer to be run in any order. The jobs are stored sequentially based on the order in which they were transferred from the computer and each one is assigned a number to help for tracking. A running total of the free space left in the buffer is provided at the bottom of the display. A small amount of memory is used by the system so there will never be a full 16 megabytes free. The file name displayed on the screen is always the currently active job and there are two methods for looking through the list of jobs and choosing another job. The first method is to press the "NEXT JOB" button on the control panel. Each time the "NEXT JOB" button is pressed, the next job in the buffer becomes the current job. The second method is to bring the cursor up to the line with the job name displayed and press the "SELECT" key which will move the cursor to the right, then use the up and down arrow keys to move forward or backward through the list until the desired job is displayed. Now press the "SELECT" key again to bring the cursor back to the left side of the display.

The "INSERT END-OF-FILE" submenu

```
1) FILENAME.XXX
■INSERT END-OF-FILE
 DELETE THE FILE
 BUFFER SPACE 15.9MB
```

Then

```
INSERT EOF
--- ARE YOU SURE ---
■CANCEL
YES INSERT EOF
```

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 ULS Printer Driver, an end-of-file(EOF) marker is automatically sent to the laser system after each job is downloaded. An end-of-file marker is needed by the buffer in order for it to recognize the end of one job, the beginning of the next job, and to calculate the remaining free buffer space. Without an EOF, the buffer will not operate properly.

There are two ways that a downloaded job will have a missing EOF. The first is if printing through the ULS Printer Driver and printing is canceled, interrupted, or file size exceeds the remaining free buffer space. When this occurs, chances are that the EOF never made it to the buffer and the buffer will show that it is empty or that the job does not exist. If this happens, part of the job might still remain in the buffer and that part might become mixed up with other jobs. This is when having an "INSERT-END-OF-FILE" option becomes important. In order to delete that partial file, the buffer must either be cleared entirely or an EOF must be manually inserted into the buffer by simply bringing the cursor down to the appropriate menu choice and pressing "SELECT". This provides an alternative to clearing out the entire buffer by inserting the EOF marker at the end of the unwanted file fragment. Next, press the "NEXT JOB" button and this fragment will then show up on the display as "NONAME" and will allow its solitary deletion without having to delete the other jobs in the buffer.

Secondly, when using DOS based programs, a printer driver other than the ULS Printer Driver must be used. That particular driver does not know to send down to the laser system the required EOF marker at the end of file downloading. Again, the buffer will not recognize that the job exists because it does not see the end of it. In this case, an EOF must be manually entered into the buffer after each and every file download from a DOS based program. Since the job name is not sent to the laser system by a DOS based printer driver, every job will be called "NONAME". To distinguish one "NONAME" job from the next, the display will number the jobs in the order from which they were downloaded.

The "DELETE THE FILE" submenu

```
┌─────────────────────────┐
│ 1) FILENAME.XXX          │
│ INSERT END-OF-FILE       │
│ ■DELETE THE FILE         │
│ BUFFER SPACE 15.9MB      │
└─────────────────────────┘
```

Then

```
┌─────────────────────────┐
│ 1) FILENAME.XXX          │
│ --- ARE YOU SURE ---     │
│ ■CANCEL                  │
│ YES DELETE THE FILE      │
└─────────────────────────┘
```

Eventually the buffer will fill up with jobs that will need to be removed from memory. It is possible to select each individual job and delete them one at a time. To accomplish this, make the desired job for deletion the current job in the same manner as previously described, then select the "DELETE THE FILE" option from the menu. To do this, use the up or down arrow keys until the cursor is pointing to that menu choice and then press the "SELECT" key. The display will then ask if you are sure and will expect a "CANCEL" or a "YES" response.

The "BUFFER SPACE" submenu

```
┌─────────────────────────┐
│ 1) FILENAME.XXX          │
│ INSERT END-OF-FILE       │
│ DELETE THE FILE          │
│ ■BUFFER SPACE 15.9MB     │
└─────────────────────────┘
```

Then

```
┌─────────────────────────┐
│ DELETE ALL FILES         │
│ --- ARE YOU SURE ---     │
│ ■CANCEL                  │
│ YES CLEAR THE BUFFER     │
└─────────────────────────┘
```

To completely clear out the entire buffer all at once without having to turn the laser system off, bring the cursor down to the "BUFFER SPACE" option and press "SELECT". The display will then ask if you are sure and will expect a "CANCEL" or a "YES" response.

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The "SETUP" submenu

```
┌─────────────────────────┐
│  OPERATION DISPLAY      │
│  POWER SETTINGS         │
│  BUFFER CONTROL         │
│ ■SETUP                  │
└─────────────────────────┘
```

Then

```
┌─────────────────────────┐
│ ■TICKLE                 │
│  CONFIGURATION          │
│  DIAGNOSTICS            │
│  RETAIN SETTINGS        │
└─────────────────────────┘
```

The "SETUP" submenu allows laser system reconfiguration. Selecting this option will lead to other submenu choices.

The "TICKLE" submenu

```
┌─────────────────────────┐
│ ■TICKLE                 │
│  CONFIGURATION          │
│  DIAGNOSTICS            │
│  RETAIN SETTINGS        │
└─────────────────────────┘
```

Then

```
┌─────────────────────────┐
│ ■TICKLE RATE    5KHZ    │
│  TICKLE WIDTH    1 uS   │
│                         │
│                         │
└─────────────────────────┘
```

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. As the laser tube ages it may become necessary to change these settings to maintain peak performance.

Tickle keeps the laser "warmed up" at times when the laser system is powered ON but not firing and the top and front doors are closed. We suggest keeping the doors closed at all times when the laser system is powered ON as this keeps the laser warmed up. If the door(s) are open, the power to the laser tube itself is turned OFF and the tube will cool down.   The laser runs best after being warmed up for a couple of minutes. Optimally,   we can adjust the Tickle to maintain the plasma excitation level at a threshold so that upon demand, the laser will fire instantaneously upon request from the computer, and at greater average power levels. Having Tickle can actually extend the life of the laser tube between gas re-charges.

Since every laser has its own personality, Tickle is adjustable through the control panel on the laser system. Tickle is set for each individual laser at the factory, but from time to time, the Tickle setting may need to be adjusted as the internal characteristics of the
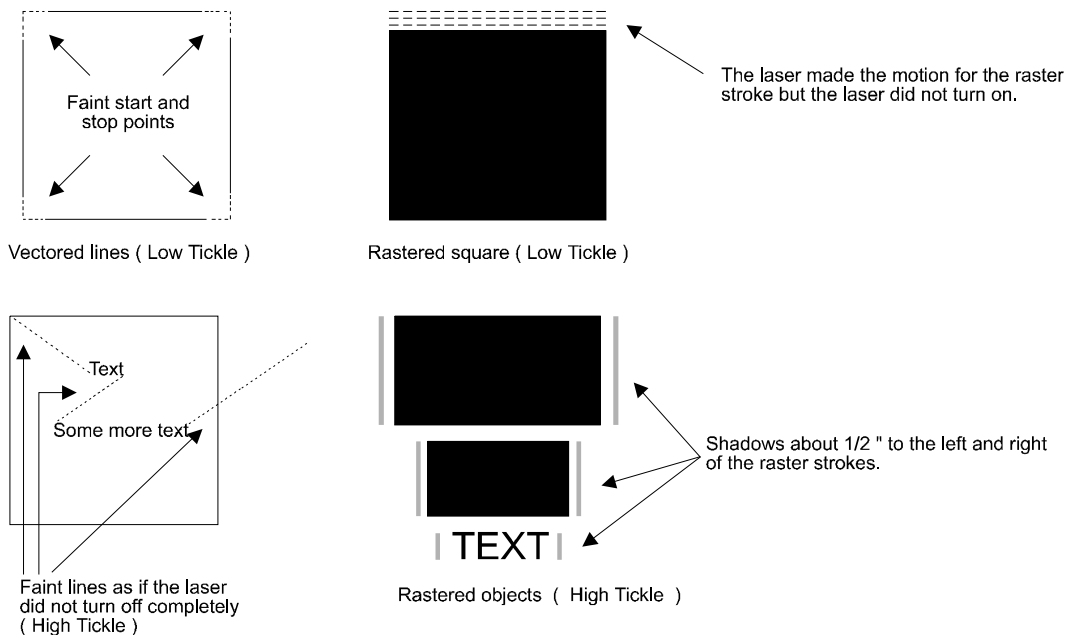
laser change over several months or several years of operation. Adjustments need only to be done if necessary. There are two main symptoms of a laser that needs Tickle adjustment.

Tickle Setting-Low
If the Tickle setting is too low, the laser will appear to hesitate before firing. Vectored lines may appear to start off weak at the beginning of the line, get stronger in the middle of the line, then get weak again at the end of the line. If the setting is really off, parts of the line may be missing entirely. If you are rastering, the laser may make some raster strokes without firing and then start to fire a couple of strokes later.

Tickle Setting-High
If the Tickle setting is too high, shadows and extra faint lines will appear in blank areas. Vectored text, for example, will appear to be connected by very light lines from one letter to the next as if the laser was supposed to turn off but stayed on slightly. Rastered images will appear to have a shadow to the left and right of the raster stroke about 1/2" from the edge of the rastered area.

Faint start and
stop points

The laser made the motion for the raster
stroke but the laser did not turn on.

Vectored lines (Low Tickle)   Rastered square (Low Tickle)

Text

Some more text

Shadows about 1/2 " to the left and right
of the raster strokes.

ǀTEXTǀ

Faint lines as if the laser
did not turn off completely
(High Tickle)

Rastered objects (High Tickle)

To set the Tickle, go to the Preferences menu in the Control Panel of the laser system, then select "Tickle". There are two numbers, the Tickle Rate in khz(or kilohertz) and the other is Tickle Width in us(or microseconds).   The Tickle Rate is a fine adjustment and the Width is a more coarse adjustment. To set the Tickle, warm up the laser by running a graphic at full power and full speed on some scrap material for about 15 minutes. Then draw a rectangle and raster engrave that rectangle on a very sensitive material that will show the shadows of Tickle if it is set too high. If the Tickle setting is too high, reduce the Rate setting, while observing the file as it is running,   until the shadows disappear. If the Rate setting gets down to zero and the shadows are still present, then put the Rate back to its original number and reduce the Width by one. If

the shadows still appear, keep reducing the Rate again until it does disappear. If the setting is too low, increase the Rate setting until the shadows appear, then back it off one or two numbers. Once the Tickle is set properly, escape out of the menu and "Retain Settings" which will make the changes permanent.

WARNING:
Do not attempt to adjust the "TICKLE" setting. Consult the ULS technical staff first to determine whether it is necessary.

The "CONFIGURATION" submenu

```
 TICKLE
■CONFIGURATION
 DIAGNOSTICS
 RETAIN SETTINGS
```

Then

```
■AUTO POWER      ON
 BUZZER          ON
 PORTS
 LOAD DEFAULTS
```

The "CONFIGURATION" selection allows the reconfiguration of certain features of the engraving system. Selecting this option will lead to other submenu choices.

The "AUTO POWER" option can be toggled either "ON" or "OFF" by placing the cursor on the appropriate menu choice and pressing "SELECT". The "AUTO POWER" feature allows the laser system to change power settings while it is cutting and engraving a job. If this feature is "ON" (the default setting), the power settings will change in response to different colors used in the artwork (or in the case of DOS applications different pen numbers assigned to the artwork) as described earlier in the section on the "POWER SETTINGS" submenu. If this feature is turned "OFF", the system will use the current power setting selected in the "POWER SETTINGS" submenu and no power changes will take place.

```
 AUTO POWER      ON
■BUZZER          ON
 PORTS
 LOAD DEFAULTS
```

The "BUZZER" option can be toggled either "ON" or "OFF" by placing the cursor on the appropriate menu choice and pressing "SELECT". This submenu option emits a sound to indicate when a job has finished.

The "PORTS" submenu

```
┌─────────────────────────────┐
│ AUTO POWER        ON         │
│ BUZZER            ON         │
│ ■PORTS                       │
│ LOAD DEFAULTS                │
└─────────────────────────────┘
```

Two ports are provided on the right side 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, select "PORTS" from this menu and one of the following sub menus will appear:

```
┌─────────────────────────────┐
│ PARALLEL                     │
│                              │
│                              │
│                              │
└─────────────────────────────┘
```

<div align="center">Or</div>

```
┌─────────────────────────────┐
│ SERIAL                       │
│ BAUD RATE         9600       │
│ STOP BITS            1       │
│ PARITY             ODD       │
└─────────────────────────────┘
```

The menu that appears indicates the currently active port on the laser system. To switch to the other port press the "SELECT" key. 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 engraving machine. For example if the number of "STOP BITS" on the laser engraving 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" key while the cursor is on "PARITY" will toggle through these choices.

The "LOAD DEFAULTS" submenu

```
┌─────────────────────────────┐
│ AUTO POWER        ON        │
│ BUZZER            ON        │
│ PORTS                       │
│ ■LOAD DEFAULTS              │
└─────────────────────────────┘
```

Then

```
┌─────────────────────────────┐
│ CHANGE ALL SETTINGS         │
│ --- ARE YOU SURE ---        │
│ ■CANCEL                     │
│ YES  LOAD DEFAULTS          │
└─────────────────────────────┘
```

The "LOAD DEFAULTS" submenu on the last line returns the system to its factory default settings.

WARNING:
Do not select the "LOAD DEFAULTS" menu selection without first consulting a ULS technical support representative.

The "DIAGNOSTICS" submenu

```
┌─────────────────────────────┐
│ TICKLE                      │
│ CONFIGURATION               │
│ ■DIAGNOSTICS                │
│ RETAIN SETTINGS             │
└─────────────────────────────┘
```

The "DIAGNOSTICS" submenu allows the testing of certain features of the engraving system. Selecting this option will lead to other submenus.

```
┌─────────────────────────────┐
│ ■TEST MEMORY                │
│ PLACE 24000X 18000Y         │
│ UNIVERSAL LASER SYS.        │
│ COPYRIGHT 1994 04-10        │
└─────────────────────────────┘
```

Then

```
┌─────────────────────────────┐
│ MEMORY TEST                 │
│ PAGE  63   FAILS  0         │
│ ■CANCEL                     │
│ YES (CLEARS BUFFER)         │
└─────────────────────────────┘
```

It may be necessary to use the diagnostic tests if instructed to do so by a member of the ULS technical support staff. The first line on the menu display is a buffer memory test but in the process of testing memory all jobs in the buffer will be erased. Once the memory test is started it will continue to run until it is canceled. The second line

displays the current position of the motion system in motion system units. Each unit represents a single step of the motion system motors. Each step is equal to .001 inches. The final two lines are a copyright notice.

The "RETAIN SETTINGS" submenu

```
TICKLE
CONFIGURATION
DIAGNOSTICS
■RETAIN SETTINGS
```

Then

```
RETAIN SETTINGS
--- ARE YOU SURE ---
■CANCEL
YES ACCEPT
```

By selecting "RETAIN SETTINGS", and then "YES", any and all changes made to the display settings will be permanently stored even if power is turned off to the laser system. Those settings will be retained in the laser system until they are changed and "RETAIN SETTINGS" is selected again.

The Process Controls

```
                PROCESS CONTROL


    ( START )  [ NEXT ]    [ PAUSE ]   [ RESUME ]
    ( JOB   )  [ JOB  ]
```
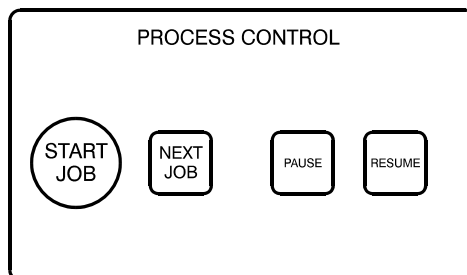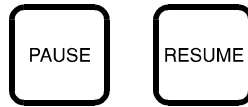
START JOB   (START JOB)

Press the "START JOB" button to start cutting or engraving the current job in the system buffer. De pressing the "START JOB" button while the system is cutting or engraving a job has no effect.

PAUSE AND RESUME
[PAUSE] [RESUME]

The "PAUSE" button can be pressed while the system is cutting or engraving a job to pause all operations. When paused, the motion system arm will move to its home position in the upper right corner. When ready to resume operation, press the "RESUME" key and the system will begin cutting or engraving again where it left off. The "READY" indicator light will blink when the system is paused.

NEXT JOB
[NEXT JOB]

Pressing the "NEXT JOB" button brings up the next job in the system buffer and makes it the current job. Pressing the "START JOB" button starts cutting or engraving of the job. Pressing the "NEXT JOB" button while the system is cutting or engraving a job has no effect.

The Laser Controls

◎ READY
◎ BEAM
◎ LASER
ON
OFF
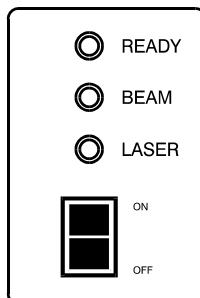
The Laser ON/OFF switch allows the laser's power to be turned on and off manually for emergencies. The red "LASER" indicator light will illuminate when power is being supplied to the laser. The indicator light is also tied in with the safety interlock system, so the light will go on and off as the doors to the system are opened and closed.

The green "READY" indicator light serves two purposes. It will illuminate to indicate when a job is completed and the system is ready to begin a new job, and if the "PAUSE" key is pressed, it will blink to indicate that the system is paused. When the laser is first powered on, the green light will blink until a job is run for the first time.

The yellow "BEAM" indicator light will illuminate when the laser is being pulsed. This provides a visual cue that the laser is firing. This indicator light actually signals that the laser control board is signaling the laser to fire, so the light will continue to blink even if the power to the laser is turned off.

The Motion Controls

```
┌─────────────────────────────────────┐
│          MOTION CONTROL              │
│                                      │
│              ⬆                       │
│                          ┌───────┐   │
│          ⬅     ➡         │ SETUP │   │
│                          └───────┘   │
│              ⬇                       │
│                          ┌───────┐   │
│                          │ TEST  │   │
│                          └───────┘   │
│                                      │
└─────────────────────────────────────┘
```
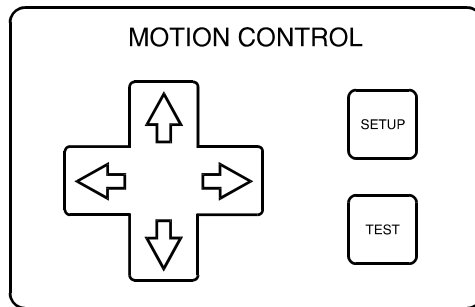
The "MOTION CONTROL" section of the control panel enables the user to manually control motion system movement. Pressing and holding down an arrow key will cause the focus lens holder assembly to move in the respective direction. Pressing two adjacent arrow keys will move the assembly in a diagonal direction. This part of the control panel is primarily used for focusing the laser beam on the engraving material using the focus tool. Refer to the next section on focusing for a thorough explanation of these controls.

4.3   Loading and Focusing the Laser System

The first step to laser engraving is loading the material and focusing the laser beam on the top surface. Let's use a wooden plaque as an example. Open the top door and place the wood on the engraving table. Rotate the wood so that the longest direction is in the horizontal direction. Slide the wood into the upper left hand corner of the engraving table against the horizontal and vertical rulers.

Materials larger than maximum engraving area can be processed provided they can be fit into the machine and allow all the doors to be closed properly. If you have an application of this type, load the material through the front door of the system. However, all the doors must be able to close before cutting and engraving.

WARNING:
Do not attempt to defeat the interlock system in order to process materials too large to fit into the system as this could result in exposure to laser radiation.

To process more than one piece of material at a time, such as in a production application, a template can be easily made to help in loading the system. To make a template draw a slightly oversized outline of the material to be processed and duplicate it as many times as will fit into the engraving area. Place a large piece paper, cardboard, or acrylic on the engraving table and cut the outlines into the material. Position the engraving objects within the template outlines. Now position the graphics on screen so that they are aligned within the template outlines. Finally, print only the graphics and not the outlines to the laser system. A convenient template has now been made for quickly loading the system.

In order to cut and engrave with precision the laser beam in the laser engraving system is focused to a small spot by the focus lens. There are two ways in which to focus the laser beam. The first is to use the focus tool and the other is to measure the thickness of the engraving material and enter in that thickness into the control panel on the laser system.

To access the motorized Z-axis control (engraving table adjustment), first turn on the laser system. After the laser system has completed its homing routine, press the "SETUP" key on the MOTION CONTROL panel. The following display will appear:

```
■ Z AXIS HOMING     ON
  OBJ. HEIGHT    0.000
  SD-RES LENS
  SET ROTARY AXIS
```

NOTE: The Z-axis controls are only accessible when the display is showing the Main Menu. If the Main Menu is not displayed, repeatedly press the "ESCAPE" key until it does.

To use the focus tool method of adjustment, first move the motion system using the arrow keys on the MOTION CONTROL panel until the focus lens holder assembly is positioned over the plaque.

Position the cursor next to the line that reads "OBJ. HEIGHT" by using the up or down arrow keys located to the right of the LCD display. Press the "SELECT" key to move the cursor over to the right. This positions the cursor over the tenths digit and allows Z-axis movement in those increments in either an up or down direction by using the arrow keys. Pressing "SELECT" again will move the cursor over to the hundredths and then again to the thousandths level of adjustment.

Position the engraving table up or down until the base of the focusing tool can be placed on the top surface of the material to be processed and the flat of the focusing tool can be placed flat against the lens holder as in the diagram below:

FOCUS LENS

FOCUS TOOL
(TILT EXAGGERATED)

ENGRAVING
MATERIAL
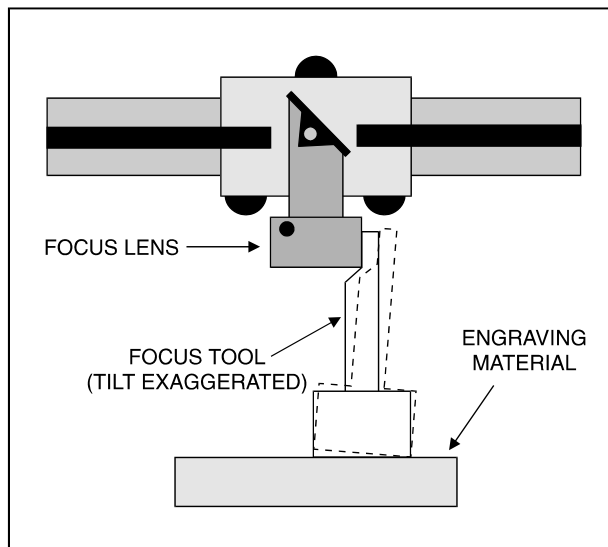
Observe the top of the focusing tool. Now raise the engraving table until the focusing tool just starts to tilt away from the lens holder as shown in the diagram below. Back the engraving table down again slightly so the focusing tool again sets flat against the side of the lens holder.

Press the "ESCAPE" key twice to bring up the main menu. Focus is now complete.

The second method to adjust focus does not incorporate the use of the focus tool. Remove the material from the laser system and measure the thickness of the material in the location where the engraving will appear. Load the material back into the laser system and go over to the control panel. While the main menu is displayed, press the "SETUP" key. Again bring the cursor down to "OBJ. HEIGHT" and press "SELECT". Use the up and down arrow keys to manually insert the thickness of the material all the way out to the thousandths digit. When the data has been entered, press the "SELECT" key. If a different lens is being used, bring the cursor down to the "SD RES LENS" selection and press "SELECT" to toggle the choice among the three lenses available("HIGH RES" and "LOW RES" are optional lenses). When the correct lens is displayed, move the cursor back up to set the new "OBJ. HEIGHT" adjustment. Once all adjustments have been made, pressing "ESCAPE" twice will bring back the main menu display.

There are other options in the Z-axis control menu system. To prevent the Z-axis table from homing every time the laser is powered up, go to the main menu, press the "SETUP" key, and while the cursor is on the line the reads "Z AXIS HOMING", press the "SELECT" key to display the next submenu as shown below.

```
┌─────────────────────────────┐
│ ■Z AXIS HOMING    ON         │
│  CHANGE Z HOMING             │
│  CANCEL                      │
│  YES. ACCEPT                 │
└─────────────────────────────┘
```

To set the homing OFF, move the cursor down to "CHANGE Z HOMING" and press "SELECT". This will toggle the choice between "ON" and "OFF". Next, bring the cursor down to either "CANCEL" or "YES" and make the appropriate selection.

If "YES" is selected, the focus tool method **MUST** now be used when focusing. The following display will appear:

```
┌─────────────────────────────┐
│ ■Z AXIS HOMING   OFF         │
│  OBJ. HEIGHT    0.000        │
│  MANUAL                      │
│  SET ROTARY AXIS             │
└─────────────────────────────┘
```

Since the "Z AXIS HOMING" has now been turned OFF, disregard the numerical data that is being displayed. This number is set to zero every time the laser is powered up regardless of the height of the Z-axis table. This "OBJ. HEIGHT" data will only be correct when the homing is set back ON.

The final choice on this menu system is "SET ROTARY AXIS". 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 pre-drilled screw holes on the engraving table.

To change this 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 focal lens carriage directly over the Rotary Fixture's centerline of rotation as the following diagram demonstrates:

TOP VIEW
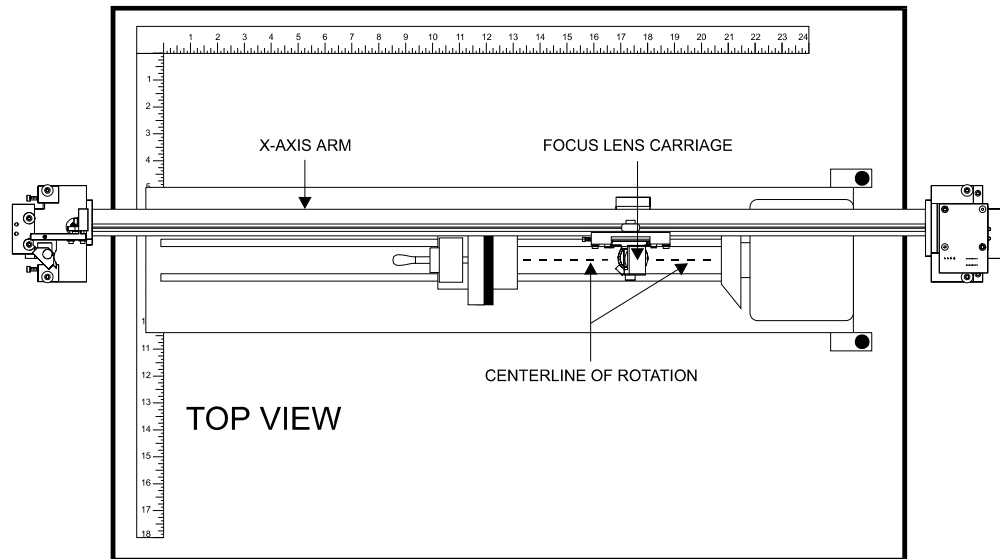
The left and right position (X-position) of the focus carriage is irrelevant in this setting. It's position is determined by where the graphic is placed in the graphics program, therefore, it's position is ignored by the laser system and cannot be set in this procedure. Now, select the "YES SAVE Y AXIS" 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.

```
 SET ROTARY AXIS
 PLACE 17257X 6125Y
■CANCEL
 YES SAVE Y AXIS
```

NOTE: To save this setting in the laser systems memory configuration, "RETAIN SETTINGS" must be performed. This procedure is defined later in this section. If you do not "RETAIN SETTINGS", all changes that you made, even after selecting "YES SAVE Y AXIS", will be lost and the previous settings will remain. To restore the Rotary Fixture back into it's original factory condition, locate the Rotary Fixture in it's normal position and repeat this entire procedure.

4.4   Running a Sample

The following outline is a step by step procedure used to produce a laser engraved object.   Please follow this procedure to understand the steps necessary for laser engraving.

Step 1   Turn on the computer and then the laser system.   Be sure to turn the equipment on in this order.

Step 2   Load the object that will be engraved into the laser system and position it in the desired location in the engraving area.   Usually, the object is placed up against the rulers in the upper left hand corner of the engraving area.   Use the rulers to determine the size of the engraving object.   Use either the top door or the front door for loading.

Step 3   By using the motion system control keys, position the focus lens assembly over the engraving material.   Adjust focus by using the focusing tool and adjusting the height of the engraving table or entering in the thickness in the control panel.

Step 4   Create a graphic using the graphics software program and position the graphic on screen so that it matches the placement of the object in the laser system.

Step 5   Before printing, go to the ULS Printer Driver and assign the power settings. If using DOS based programs, go to the laser system and enter in the power settings on the control panel.

Step 6   Now send the job down to the laser system.

Step 7   Turn on the exhaust blower.

Step 8   Supervise the engraving or cutting function.   **DO NOT** leave the job unattended.

Step 9   Finally, when the job is in the laser system's buffer, press the "START JOB" button to start engraving.

4.5   Using the Optional Rotary Fixture

The Rotary Fixture controls in the ULS Printer Driver are used along with the optional Rotary Fixture to engrave onto round or cylindrical objects. In order to compensate for different diameter objects, the image must be adjusted. This is done automatically by the ULS Printer Driver when selecting Rotary Fixture and entering in the diameter of the object being engraved.

Two attachments come with the fixture, a cone shaped disk attached to the motorized end of the fixture and a flat disk with foam padding attached to the adjustable end of the fixture. These attachments are designed to hold wine glasses, mugs, cups, etc. The following is a step by step procedure in the installation and operation of the Rotary Fixture. We are going to use a glass as an example.

Installation of the Rotary Fixture

1. Turn the laser system ON and lower the table all the way down to the bottom. Next, turn the laser system OFF. Open the top door of the laser engraving system and place the Rotary Fixture on the engraving table with the black box on the Rotary Fixture to the right.

2. Attach the Rotary Fixture to the engraving table by aligning it with the screw holes on the table. Before tightening the thumbscrews, position the fixture so that it is squarely aligned with the rulers. Being square to the rulers will ensure that the fixture is square to the engraving area. The rulers also provide a visual guide as to where to locate the graphic in the graphics software. Tighten the thumbscrews.


SIDE VIEW

RULER

ENGRAVING TABLE

THUMB
SCREW

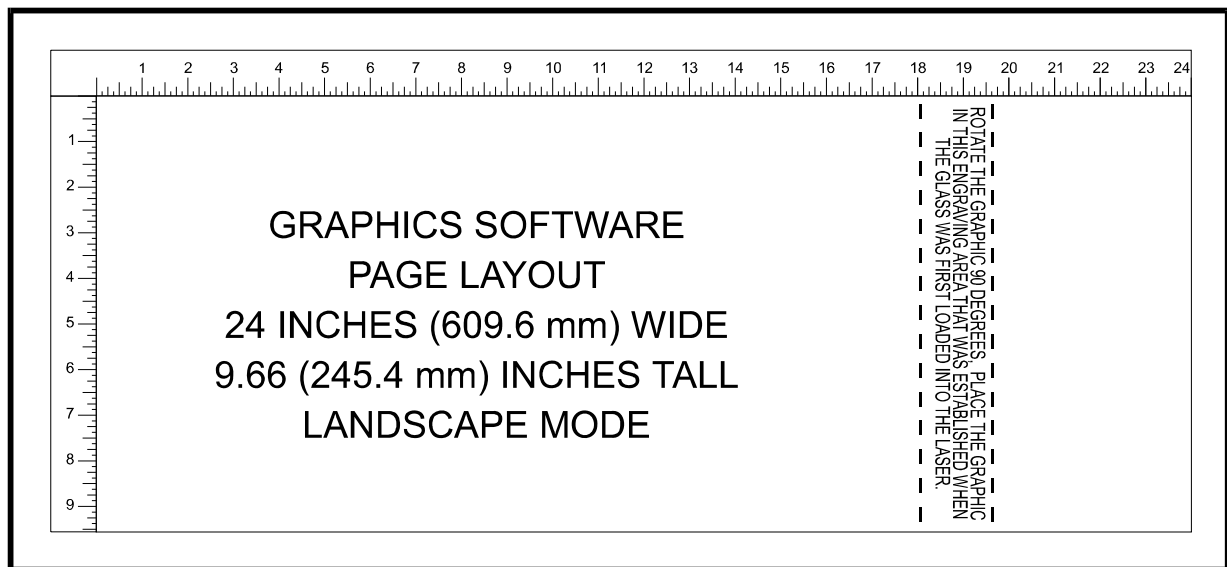TOP VIEW
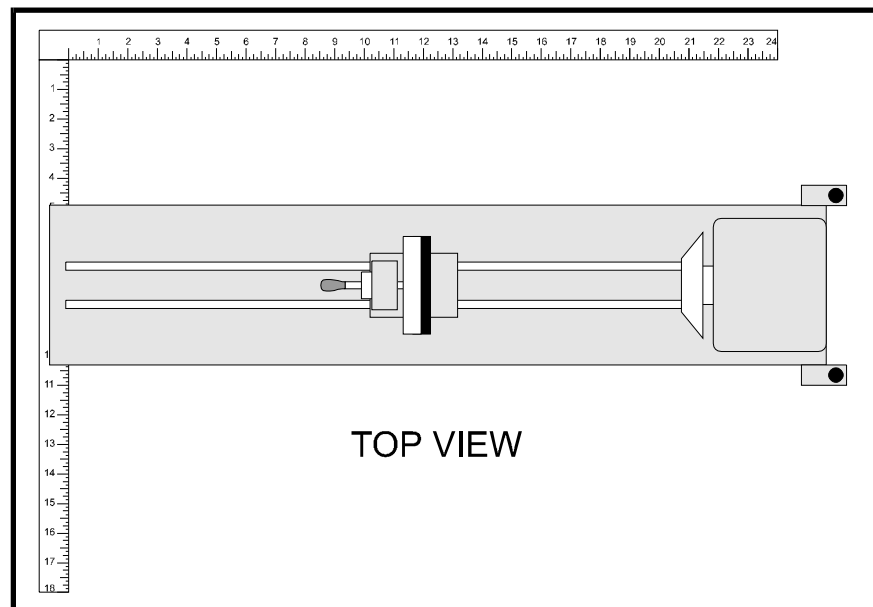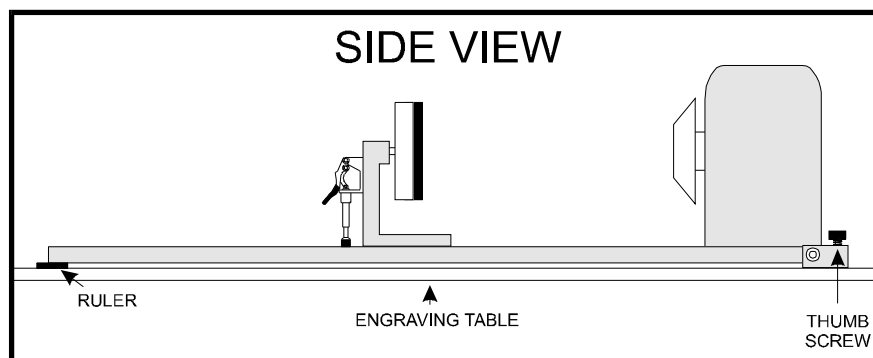
Installed Rotary Fixture

3. Next, connect the Rotary Fixture control cable to the receptacle on the laser engraving system. If necessary, refer to the diagram at the beginning of this chapter for the receptacle's location.

4. Before loading the glass into the fixture, measure the diameter of the glass in the area where the engraving is to be located by using a caliper or similar measuring device. Remember this number or write it down.

5. Place the open end of the glass on the right side of the Rotary Fixture. Lift the lever on the adjustable end of the fixture and slide it up against the other end of the glass so the glass rests firmly against the padded foam disk. Do not to apply too much pressure, especially with glass. Lower the lever on the adjustable end of the fixture to secure it in place.

6. Turn on the laser system and wait for it to home. Press one of the directional arrow keys on the Motion Control panel and notice that the motion system will align to the centerline of the Rotary Fixture automatically. Now focus on the glass by using the focus tool and adjusting the table up or down. If the glass slopes too much in the engraving area, the Rotary Fixture can be tilted upwards to make the surface of the glass parallel with the motion system. To do this, lift up the left end of the fixture and place some sort of spacer underneath the fixture to prop it up. Be careful not to raise the Rotary Fixture too high, otherwise it might interfere with the motion system. Press the "PAUSE" key to move the arm out of the way.

Focusing Hint: To focus without using the focus tool, turn the Z-Axis homing feature ON. Then add 5.5 inches to 1/2 the diameter of the object. Now take the result and enter it into the "OBJECT HEIGHT" adjustment in the Control Panel of the laser system.

Operation of the Rotary Fixture in the Landscape mode
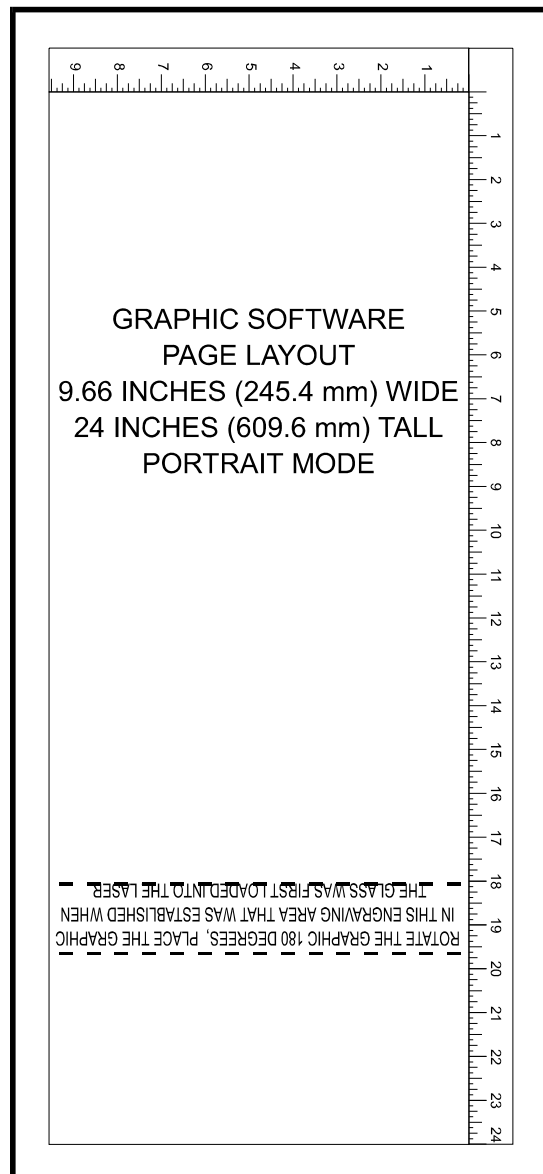

TOP VIEW

ENGRAVING AREA

56
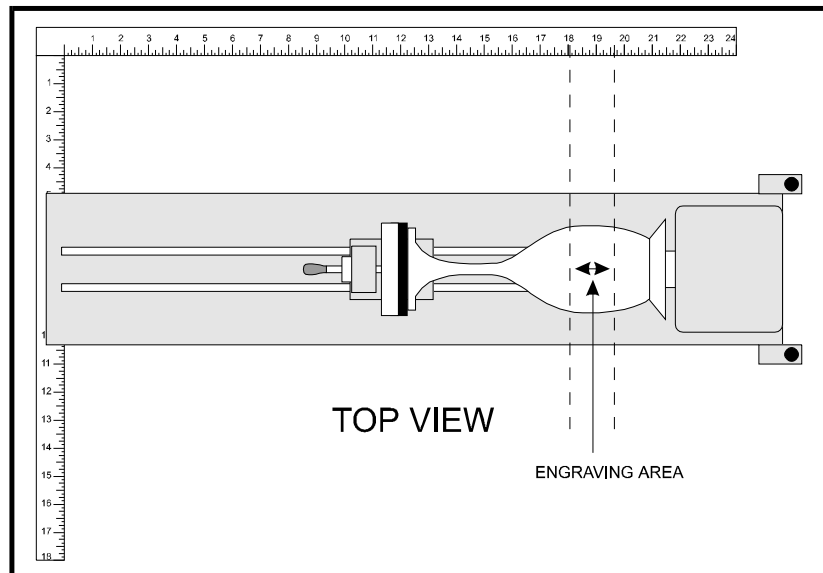
1. Use the top ruler as a visual aid in referencing the engraving area of the glass. Sometimes using a ruler placed up against the glass and at a right angle to the table rulers will help with determining the engraving area. Note this area because is will be used in designating where to place the graphic on the computer screen.

2. In the driver, make sure that the Page Setup is set to Landscape and the size set to a width equal to 24 x 18 inches (609.6 mm x 457.2 mm). Then click on the "Rotary Fixture" selection box and type in the diameter that was measured. Notice that while typing in the diameter, the size of the height dimension changes automatically. Remember or write down this new page size. Click on "OK" and go back to the graphics software's page setup and change it to **EXACTLY** match the new page size that the ULS Printer Driver established when the diameter of the object was typed in.

3. This new vertical page size is now the actual circumference of the object that is going to be engraved. From the top of the engraving area (on screen) to the bottom represents one complete revolution of the Rotary Fixture. For example, if engraving a glass that has a diameter of 3.075 inches (78.1mm), the driver calculates that the circumference (and vertical page size) is 9.66 inches (245.4 mm).

GRAPHICS SOFTWARE
PAGE LAYOUT
24 INCHES (609.6 mm) WIDE
9.66 (245.4 mm) INCHES TALL
LANDSCAPE MODE

ROTATE THE GRAPHIC 90 DEGREES. PLACE THE GRAPHIC IN THIS ENGRAVING AREA THAT WAS ESTABLISHED WHEN THE GLASS WAS FIRST LOADED INTO THE LASER.

4. Position the graphic, on screen, so that it will fit vertically within the new page height and horizontally within the engraving area of the glass. If the graphic does not fit within the vertical page size limits, the portion that is outside the page limit will not engrave. Remember, the new page size that the driver calculates from the diameter of the glass is it's actual circumference. From the top of the page down to the bottom is one complete revolution of the glass. Since the Rotary Fixture will not turn more than 360 degrees, make sure that the graphic lies between the page limits.

5. Set the driver parameters, send the file to print, and begin engraving.

Operation of the Rotary Fixture in the Portrait mode

1. The Rotary Fixture can also operate in the Portrait mode providing that the engraving object is not too heavy. The Portrait mode will cause the Rotary Fixture to spin the object back and forth very quickly. The normal Landscape mode will rotate the object very slowly and raster the X-axis arm from left to right very rapidly. Landscape mode usually takes longer to engrave than Portrait mode. If using Portrait mode, make sure to engrave or cut at speeds lower than 50% otherwise the object might slip as the Rotary Fixture spins back and forth. If the object slips, it is either too heavy or the engraving speed is too fast. To use the Portrait mode, simply click on Portrait in the graphics software's page setup and then in the ULS Printer Driver.

2. The graphic on screen will now need to be adjusted. The graphic will have to be rotated another 90 degrees so that the graphic is upside down. Reposition it within the defined engraving area as the diagram illustrates.

GRAPHIC SOFTWARE
PAGE LAYOUT
9.66 INCHES (245.4 mm) WIDE
24 INCHES (609.6 mm) TALL
PORTRAIT MODE

ROTATE THE GRAPHIC 180 DEGREES. PLACE THE GRAPHIC
IN THIS ENGRAVING AREA THAT WAS ESTABLISHED WHEN
THE GLASS WAS FIRST LOADED INTO THE LASER.

3. Do nothing to the Rotary Fixture inside of the laser. The setup on it is the same as in Landscape mode. Experiment with using both the Landscape and Portrait modes and note the results.

NOTE: Remember that the new page size that was established by the driver when the objects diameter was entered in indicates the circumference or distance around the outside of the object. Be sure to go back and adjust the graphics programs page size to match these new dimensions **EXACTLY** otherwise the graphic will engrave in the wrong place, engrave only partially, or not engrave at all.

## 4.6   The Optional Rubber Stamp Feature

There are two switches in the ULS Printer Driver which manage the rubber stamp option, the "RUBBER STAMP" switch and the "INVERT FILL" switch. The "RUBBER STAMP" selection taper profiles the engraving and automatically mirrors the entire page about it's centerline. The "INVERT FILL" switch will turn the entire page into a negative while it is printing. This image inversion causes the laser system to engrave out the background and leave the characters standing up. The "INVERT FILL" selection is only used when engraving a full sheet of stamps because it creates the negative image for the entire sheet, not just an individual stamp. Selecting both features allows the user to create a full sheet of rubber stamps as a positive and unmirrored image on screen. Since there are several different methods in creating and producing rubber stamps, we will give just a few examples to follow so that the process becomes fully understandable. Experiment with the different techniques and choose the method most desired.

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 ULS Printer Driver. Draw 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. It is not necessary to mirror the image. Then draw a red outline box (.001inch or .1 mm line thickness) for the cut. An example is shown below.

WHITE FILLED GRAPHIC   WHITE FILLED TEXT

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

RED CUT LINE .001" THICK   BLACK FILLED BOX

Rubber Stamp Example

Since the driver automatically mirrors the entire page when the "RUBBER STAMP" option is selected, be aware that the stamp will engrave on the opposite side of the page. As an example, position the stamp in the upper right hand corner of the page and place a full sheet of rubber in the upper left side of the engraving area inside the laser system. We recommend installing the High Resolution lens for engraving rubber stamps. Focus on the material using the correct focusing tool and go to the ULS Printer Driver to set the power settings. There are some sample settings in section 4.7 of this manual for rubber stamps. They might have to be adjusted for different types of rubber and thicknesses. When selecting "RUBBER STAMP" in the driver, notice that the "INVERT FILL" switch automatically becomes selected. Deselect the "INVERT FILL" option because it will not be used in this example. The following diagram shows an example of setting up the graphics software's page layout and positioning the rubber engraving material inside the laser system respectively:

COMPUTER GRAPHICS SCREEN

LASER ENGRAVING TABLE
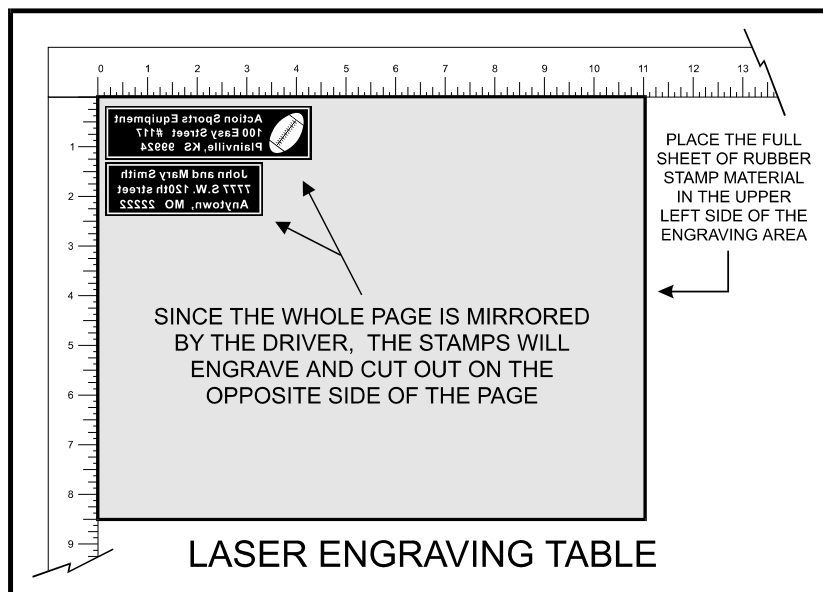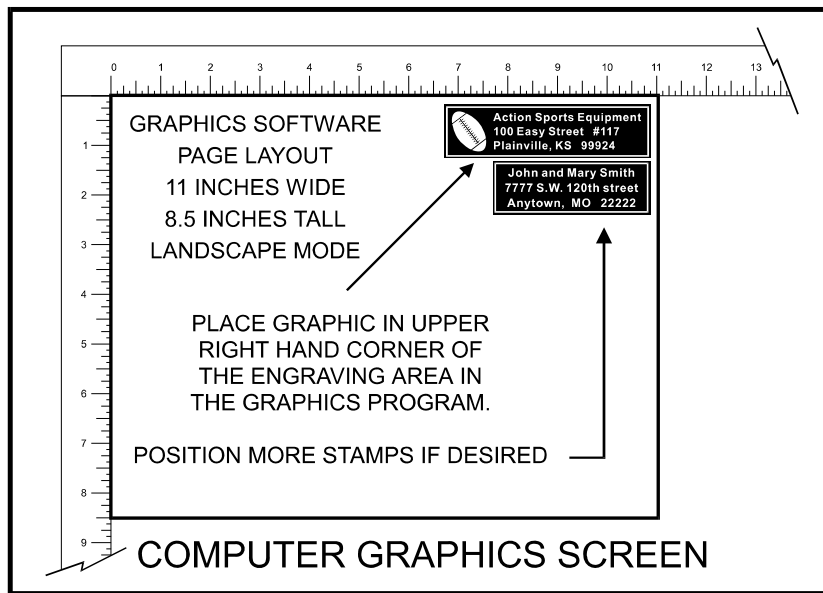
After making all driver selections, print the graphic to the laser system. Start engraving and notice that the stamps are being engraved as a mirrored image and are in the correct position on the rubber sheet. The background area, since it is colored black is being engraved and the letters remain standing up. When all engraving is done, the stamp gets cut out along the red cut line due to the higher power setting that was assigned in the driver for the color red.

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. Create more stamps to fill the entire page.
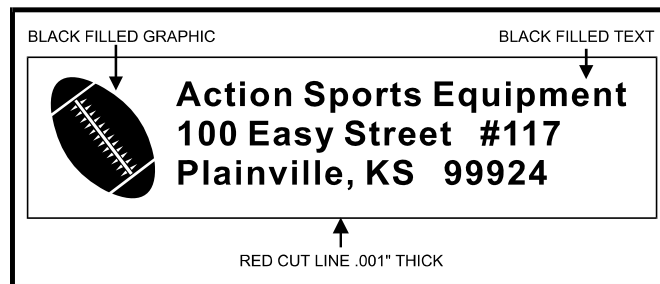
Rubber Stamp Sample

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. Go to the ULS Printer Driver and select "RUBBER STAMP" and leave the "INVERT FILL" selection ON. Set the power settings and 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 mirrors the entire page, profiles all of the characters, and creates a negative image for engraving.

Printing Speed

When printing a large number of rubber stamps on one page it can take quite a bit of time to generate the print file. This is because the calculations required to produce a profiled shape take much longer than those required for a non-profiled shape. However, there are things that can be done to control the printing time:

❍ Use as few fonts as possible. The more fonts used the longer it will take to generate a print file.

❍ Use the automatic invert fill feature whenever possible. Manually inverted images with many black backgrounds will take longer to print.

❍ Use the minimum page size necessary to produce the stamps desired. Larger pages take longer to print.

❍ If possible, upgrade the computer system. A faster computer processor will produce faster print times.

4.7   Start Up Parameters for Various Materials

This section provides driver settings and helpful hints to get started engraving and/or cutting various materials. These settings are to serve as a starting point and are not necessarily optimized for each particular application. 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, in most cases these settings should work out well, but sometimes may have to be adjusted to produce desirable results.

In compiling these settings, all samples were run with the resolution set at 500 DPI(except were otherwise noted). When using a lower resolution in order to achieve greater engraving speeds, remember that the resolution will be reduced which in turn will reduce quality and depth. In order to compensate for lower resolution settings, lower the speed and/or increase the power to achieve the same depth. The opposite applies for higher resolution settings.

Below is a list of the various materials that were tested. 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.

<div align="center">

ACRYLIC - CAST AND EXTRUDED
ACRYLIC - MIRRORED
ALUMINUM - ANODIZED
BRASS - COATED
CORIAN OR AVONITE
CORK
DELRIN (SEAL PRESS)
GLASS
LEATHER
MARBLE
MAT BOARD
MELAMINE - PHOTO/CLIPART ENGRAVING
MELAMINE - STANDARD ENGRAVING
PLASTIC - ENGRAVERS
RUBBER STAMPS
VINYL - SIGN
WOOD - FINISHED WALNUT
WOOD INLAY - VENEERS

</div>

WARNING:
Because exposure to the laser beam may cause ignition of combustible materials, all cutting and engraving should be constantly supervised.

ACRYLIC - CAST AND EXTRUDED

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
LIGHT RASTER	25 WATT	25	100	500	1	.001"
ENGRAVING	50 WATT	15	100	500	1	.001"

COMMENTS:
Remove original factory masking from the engraving surface. Leave the masking on the non-engraved surface to prevent accidental scratches.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
DEEP RASTER	25 WATT	100	70	500	1	.010"
ENGRAVING	50 WATT	70	100	500	1	.010"

COMMENTS:
This sample engraved deeper than the first sample. Engrave through original masking. Engraving too deep will lose detail.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	5	4.0	500	1	.005"
ENGRAVING	50 WATT	3	4.0	500	1	.005"

COMMENTS:
Engrave with or without masking.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	75	.8	500	1	.2"
CUTTING	50 WATT	75	1.6	500	1	.2"

COMMENTS:
For the best results, remove the original masking on both sides. Re-mask with transfer tape. Moisten both sides with water from a spray bottle. Elevate the material at least 1/8" off of the engraving table.

ADDITIONAL 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 1/8 inch, re-focus, 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:
Acrylic is extremely flammable. Do not leave the laser system unattended when cutting or engraving.

ACRYLIC - MIRRORED

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
LIGHT RASTER	25 WATT	30	100	500	1	.003"
ENGRAVING	50 WATT	15	100	500	1	.003"

COMMENTS: Engrave unmasked and on the backside in reverse text. Engraving on the front side of mirrored acrylic will visually produce a double image.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
DEEP RASTER	25 WATT	100	70	500	1	.010"
ENGRAVING	50 WATT	70	100	500	1	.010"

COMMENTS: Masking is not necessary because the acrylic is protected from smoke damage by the mirrored backing.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	5	4.0	500	1	.005"
ENGRAVING	50 WATT	3	4.0	500	1	.005"

COMMENTS: Again, masking is not necessary because the acrylic is protected from smoke damage by the mirrored backing.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	75	1.6	500	1	.1"
CUTTING	50 WATT	75	3.2	500	1	.1"

COMMENTS: Make sure both sides are masked. Dampen and elevate at least 1/8" above the engraving table. Two passes make a cleaner cut than one. Cut from the front side of the mirror to prevent heat distortion of the mirrored back surface.

ADDITIONAL 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 1/8 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 back side 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 back side before engraving.

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

ANODIZED ALUMINUM

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	30	100	500	1	.001"
ENGRAVING	50 WATT	15	100	500	1	.001"

COMMENTS: The power required is dependent on the thickness of the anodized coating. Do not overpower because the anodized will either be dull in appearance or the engraving lines will be too thick.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	10	4.0	500	1	.001"
ENGRAVING	50 WATT	5	4.0	500	1	.001"

COMMENTS: Different anodized coatings will require higher or lower power settings. Power must be increased if engraving at a faster speed.

ADDITIONAL 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.

BRASS - COATED

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	30	100	1000	1	.002"
ENGRAVING	50 WATT	15	100	1000	1	.002"

COMMENTS: Engrave unmasked. Use a light setting to engrave through the coating. Using 1000 PPI seems to have a cleaner removal of the coating. Some thicker coated brass will require more power. Too much power looses resolution and washes out finer detail.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	15	4.0	1000	1	.002"
ENGRAVING	50 WATT	8	4.0	1000	1	.002"

COMMENTS: Engrave unmasked. Use enough power to expose the brass. Too much power will cause thicker engraving lines.

ADDITIONAL COMMENTS

The manufacturing processes for coated brass varies from one vendor to another. Some of the 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. The same goes for enamel coated pens, some are polished and clear coated underneath, and others are tarnished which will require polishing after engraving. If polishing the brass, use a soft, non-abrasive cloth or tissue and good quality brass polish. Be careful not to rub too hard as this will scratch the painted coating. Do not use paper towels either because they will scratch also. Clear coated brass can also be engraved and the engraved area turned black with an oxidizer giving exceptional results. Test clear coated brass from different vendors as not all of them will work properly. Apply the same parameters and engraving techniques when using coated aluminum.

CORIAN or AVONITE

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	100	70	500	1	.005"
ENGRAVING	50 WATT	80	100	500	1	.005"

COMMENTS: Mask first before engraving if planning to paint fill.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
DEEP RASTER	25 WATT	100	35	500	1	.015"
ENGRAVING	50 WATT	100	70	500	1	.015"

COMMENTS: Mask first if planning to paint fill.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	50	4.0	500	1	.010"
ENGRAVING	50 WATT	25	4.0	500	1	.010"

COMMENTS: Mask first if planning to paint fill.

ADDITIONAL COMMENTS

Laser engraving this type of material produces spectacular results especially when the engraved area is paint filled. If paint filling, it is a good idea to mask first and 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. Using a paint brush is acceptable but time consuming. 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 without paint filling can work but most of the time there is very little contrast which makes the engraved area difficult to see.

CORK

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	75	100	500	1	.010"
ENGRAVING	50 WATT	35	100	500	1	.010"

COMMENTS: Engraved unmasked.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	10	4.0	500	1	.010"
ENGRAVING	50 WATT	5	4.0	500	1	.010"

COMMENTS: Engrave unmasked.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	50	1.6	100	1	.060"
CUTTING	50 WATT	50	3.2	100	1	.060"

COMMENTS: Unmasked. A low PPI setting is used to prevent flaming.

ADDITIONAL 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.

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DELRIN (SEAL PRESS)

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	100	60	500	1	.015"
ENGRAVING	50 WATT	90	100	500	1	.015"

COMMENTS: Engraved unmasked.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	75	3.2	200	1	.060"
CUTTING	50 WATT	50	3.2	100	1	.060"

COMMENTS: Unmasked. A low PPI setting is used to prevent flaming.

ADDITIONAL COMMENTS

Making a seal using plastic is revolutionizing the industry. The laser can engrave and cut out a typical Notary Seal in less than 8 minutes. A male and female die must be made as the diagram below indicates.
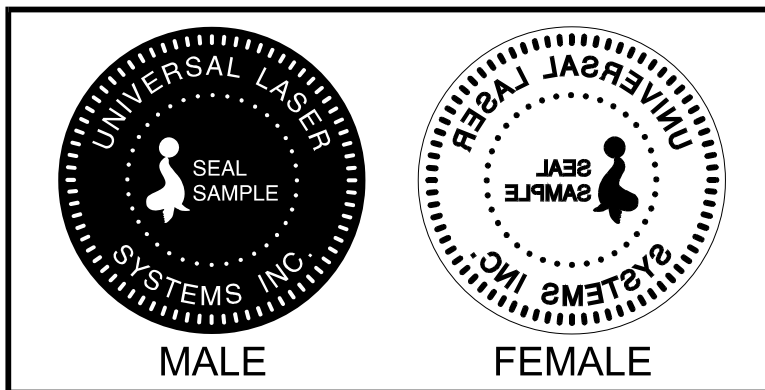
Create the male with a white graphic and a black background. Mirror the image and invert it by making the background white and the graphic black. Add a .010 inch black outline to the graphic portion of the female side. This will give the greater clearance to the female side to prevent the paper from 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.

GLASS

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	100	100	500	1	.001"
ENGRAVING	50 WATT	50	100	500	1	.001"

COMMENTS: Since glass will not vaporize when laser engraving, it does not require a lot of laser power.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	8	4.0	500	1	.001"
ENGRAVING	50 WATT	4	4.0	500	1	.001"

COMMENTS: Again, since glass will not vaporize, it does not require much laser power.

ADDITIONAL 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.

If using the optional Rotary Fixture in the Portrait Mode use the following settings to minimize the chances of the object slipping in the fixture while running at high speeds. If engraving in the landscape mode, use the settings defined at the top of this page.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	50	50	500	1	.001"
ENGRAVING	50 WATT	25	50	500	1	.001"

LEATHER

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
LIGHT RASTER	25 WATT	20	100	500	1	.001"
ENGRAVING	50 WATT	10	100	500	1	.001"

COMMENTS: Engrave unmasked.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
DEEP RASTER	25 WATT	60	100	500	1	.010"
ENGRAVING	50 WATT	30	100	500	1	.010"

COMMENTS: Engrave unmasked. Deeper engraving will require masking to prevent smoke damage.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	5	4.0	500	1	.003"
ENGRAVING	50 WATT	3	4.0	500	1	.003"

COMMENTS: Engrave unmasked.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	50	2.0	200	1	.1"
CUTTING	50 WATT	25	2.0	200	1	.1"

COMMENTS: Mask top surface and use a low PPI setting when cutting.

ADDITIONAL 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

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	100	100	500	1	.003"
ENGRAVING	50 WATT	50	100	500	1	.003"

COMMENTS: Engrave unmasked. Too much laser power by running too slowly will engrave too deep and discolor.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	20	4.0	500	1	.003"
ENGRAVING	50 WATT	10	4.0	500	1	.003"

COMMENTS: Engrave unmasked.

ADDITIONAL 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.

MAT BOARD

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	30	100	250	1	.005"
ENGRAVING	50 WATT	15	100	250	1	.005"

COMMENTS: Engrave unmasked. A low PPI setting is used to prevent discoloration.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	20	4.0	250	1	.005"
ENGRAVING	50 WATT	10	4.0	250	1	.005"

COMMENTS: Engrave unmasked and at a low PPI setting.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	55	4.0	200	1	.050"
CUTTING	50 WATT	25	4.0	200	1	.050"

COMMENTS: Mask on both sides and elevate above the table at least 1/8". Use a lower PPI setting to reduce discoloration of the cutting edge.

ADDITIONAL 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

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	100	70	500	1	.015"
ENGRAVING	50 WATT	75	100	500	1	.015"

COMMENTS: Engrave unmasked.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
DEEP RASTER	25 WATT	100	50	500	1	.020"
ENGRAVING	50 WATT	100	100	500	1	.020"

COMMENTS: Engrave unmasked.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	20	4.0	500	1	.010"
ENGRAVING	50 WATT	10	4.0	500	1	.010"

COMMENTS: Engrave unmasked.

ADDITIONAL 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 which 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

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	75	100	500	1	.008"
ENGRAVING	50 WATT	35	100	500	1	.008"

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

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	100	80	500	1	.008"
ENGRAVING	50 WATT	80	100	500	1	.008"

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

ADDITIONAL 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 contrast 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 ULS Printer Driver will automatically default to a predetermined pattern based on **RESOLUTION**. Refer to the chart below.

RESOLUTION	ANGLE	SHAPE	LINES PER INCH
1000	45 DEGREES	ROUND	180
500	45 DEGREES	ROUND	90
333	45 DEGREES	ROUND	60
250	45 DEGREES	ROUND	45
200	45 DEGREES	ROUND	36

When using the B/W Raster mode switch, which prints all ClipArt or drawings as grayscale bitmaps, use the same parameters and techniques as for engraving photographs.

PLASTIC - ENGRAVERS

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	25	100	500	1	.003"
ENGRAVING	50 WATT	15	100	500	1	.003"

COMMENTS: Remove original masking and leave unmasked. Use enough power to remove the surface material and expose the underlying substrate.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
DEEP RASTER	25 WATT	100	90	500	1	.015"
ENGRAVING	50 WATT	65	100	500	1	.015"

COMMENTS: On thicker plastics, remove the original masking and leave unmasked. Set the power high enough to assure the full removal of the top surface and to remove some of the substrate material. Sometimes it may be better to make two passes a lower power setting.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	60	1.6	150	1	.060"
CUTTING	50 WATT	60	3.2	150	1	.060"

COMMENTS: Remove original masking. Mask with transfer tape on both sides. Dampen both sides with water and elevate off the table. Make 1 to 2 more passes when cutting thicker plastics.

ADDITIONAL COMMENTS

Engravers plastic comes in many different colors, thicknesses, coatings, and surface textures. About 75 % of the available engravers plastic, including ADA signage materials, will engrave and cut well with the laser system. Microsurfaced plastics seem to work the best because there is less surface material to remove to uncover the substrate. Since most plastics have low melting points, 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. Be creative when engraving this type of material because amazing results will be produced that cannot be reproduced with a mechanical engraver.

RUBBER STAMPS

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	100	30	500	1	.030"
ENGRAVING	50 WATT	100	60	500	1	.030"

COMMENTS: Different blends and densities of rubber will engrave to different depths. Test the rubber first to determine the correct power settings.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	40	1.6	150	1	.040"
CUTTING	50 WATT	40	3.2	150	1	.040"

COMMENTS: Keep the PPI low to prevent flaming while cutting.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
PERFORATED	25 WATT	30	1.6	100	1	.020"
CUTTING	50 WATT	30	3.2	100	1	.020"

ADDITIONAL COMMENTS

Our rubber stamp option is revolutionizing the rubber stamp industry. With special electronics and a special system driver, it is possible to engrave rubber stamps with a profile and cut out the stamp in one easy step. The machine produces a taper on each character so that the base of the character is wider than the top printing surface giving greater stability when stamping. If trying to engrave stamps without this option, the letters will not have a profile, be very thin and flimsy, and will collapse while stamping them. If you do not have this option and would like to add it to your system, please contact one of our engineers in the sales department for current pricing. All laser systems can be upgraded to have this extraordinary feature.

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. Some blends of rubber produce a powdery residue when engraved. Using compressed air and blowing off the residue usually will clean the rubber effectively.

SIGN VINYL - 3 MIL

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	100	50	500	1	.015"
ENGRAVING	50 WATT	100	100	500	1	.015"

COMMENTS: These parameters are for engraving vinyl on wood. Apply the vinyl to the wood and squeegee out air bubbles. Mask with transfer tape. Engrave deep enough to go through the tape, vinyl, and into the wood. Make a second pass to go deeper. Engraving at a slower speed might cause the vinyl to melt.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	2	4.0	250	1	.003"
CUTTING	50 WATT	1	4.0	250	1	.003"

COMMENTS: Unmasked, cuts through vinyl and not the backing. Thicker vinyl requires more power and thinner ones require less. Adjust as necessary.

ADDITIONAL 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 popular example of the use of vinyl 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 due to the wood engraving involved. In the graphics software, color the background one of the eight driver colors 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. Then peel off the excess vinyl and transfer tape to reveal the final product. The lettering will be raised and vinyl coated.

WOOD - FINISHED WALNUT

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
RASTER	25 WATT	100	70	500	1	.020"
ENGRAVING	50 WATT	70	100	500	1	.020"

COMMENTS: Engrave unmasked. If masking, reduce the speed setting to 50% to get the same depth.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	40	10	500	1	.030"
ENGRAVING	50 WATT	20	10	500	1	.030"

COMMENTS: Engrave unmasked.

TYPE	MACHINE	POWER	SPEED	PPI	PASS	DEPTH
VECTOR	25 WATT	50	1.6	250	1	.125"
CUTTING	50 WATT	50	3.2	250	1	.125"

COMMENTS: Elevate at least 1/8" off of the engraving table. Lightly dampen bottom side with water. Both surfaces can also be masked and dampened with water. Elevating will let heat and smoke escape from underneath and prevent burning.

ADDITIONAL 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 of 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. Experiment with different types of wood and note the results. 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 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 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. This is called contouring and is optimal if planning to do this type of work. 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.

A good veneer to use are those with an adhesive backing. Once cut, place the veneer into its proper place on the engraved wood block and with a clothes iron, iron the veneer into the engraved wood. This melts the glue and causes the veneer to stick to the engraved area. The veneer can now be sanded flush with the surface and a finish coat applied.

Section 5 - Basic Maintenance

5.1   General Cleaning and Maintenance Supplies

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. Below is our suggested maintenance schedule.

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 will need cleaning or adjustments that will be defined in these procedures:

Y-AXIS BELT

Y-AXIS DRIVE GEAR

X-AXIS MOTOR
(WITH X-AXIS DRIVE GEAR)

Y-AXIS BEARINGS
(2 OF THEM)

Y-AXIS BEARING
TRACK

Y-AXIS LIMIT SWITCH
(HOME SENSOR)

X-AXIS BELT

Y-AXIS MOTOR

Y-AXIS IDLER PULLEY

X-AXIS LIMIT SWITCH
(HOME SENSOR)

#3 MIRROR

FOCUS LENS
(IN HOLDER)

X-AXIS BEARINGS
(3 OF THEM)

X-AXIS BEARING TRACKS

FOCUS CARRIAGE

Y-AXIS DRIVE GEAR

#2 MIRROR HOLDER

#2 MIRROR

Y-AXIS BELT

Y-AXIS IDLER PULLEY

Y-AXIS
BEARING TRACK

Y-AXIS BEARINGS
(2 OF THEM)

5.2 System Cleaning

1. Turn off and unplug the laser system.

2. Open the Top Door and the Front Door. Thoroughly remove all loose dirt and debris from inside the machine with a vacuum cleaner.

3. Clean the Engraving Table surface with either 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.

4. Remove the Cover Plate, located on the right side of the laser system below the Engraving Table Adjustment Knob, by removing the two Thumbscrews and lifting the Cover Plate straight up and out. This will allow access to the Y-axis Motion System Rail on the right side.

5. Clean all of the rails of the Motion System 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.

6. 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-axis Arm, and two(2) on the right side of the X-axis Arm.

7. 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.

8. Check the Intake Air Filter on the inside of the Front Door jamb of the laser system. To remove it, reach in with your fingers and gently pull it out. If it is dirty, clean it by submerging it in a mild soap and water solution, rinsing it clean and wringing it dry. If the Intake Filter is allowed to become too dirty it can restrict air flow making the exhaust less effective.

5.3 Optics Cleaning (as necessary)

A visual inspection of the #2 and #3 Mirrors, Beam Window, and Focus Lens should be performed at least once a day. **DO NOT** clean an optic that is visually clean. Excessive cleaning can damage the optics. The #2 and #3 Mirrors and the Focus Lens will need to be removed to clean them, the Beam Window does not.

Focus Lens Inspection and Cleaning (as necessary)

1.   Remove the Thumbscrew from the side of the Focus Lens Holder. Hold the Focus Lens Holder while removing the Thumbscrew so the Focus Lens Holder does not fall.
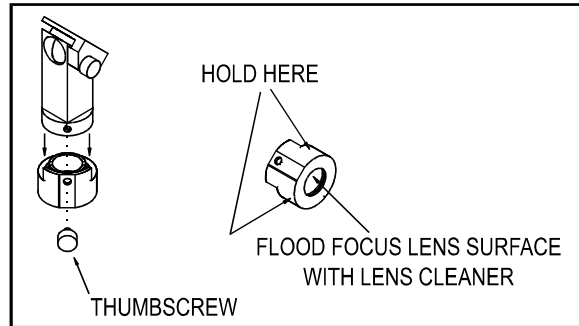
Focus Lens Holder

2.   Inspect the Focus Lens while it remains in the Focus Lens Holder by holding it up to a light and looking through it. If the Focus Lens looks visibly clean, do not clean it, simply re-install it to the Focus Carriage by proceeding to Step 8.

3.   To clean the Focus Lens while it is still in the Holder, hold it on a 45 degree angle and flood it with a few squirts from the Lens Cleaner bottle and let it drip off. With a cotton swab, gently dry off any remaining solution by rolling the cotton swab across the Focus Lens. **DO NOT** press down hard on the Focus Lens or slide the cotton swab across the Focus Lens as this may scratch it. Only roll the cotton swab across it to dry it off. If the inside of the Focus Lens is dirty, clean it the same way. If the Focus Lens does not clean easily or needs to be replaced, it will need to be removed from the Lens Holder so proceed to the next step. If the Focus Lens is clean proceed to Step 8.

4.   Place a soft cloth on a table to prevent the Focus Lens from breaking in the event that you drop it. Place a piece of Lens Tissue on top of a soft cloth. Sit down in front of a table and remove the Focus Lens from the Focus Lens Holder by holding it in one hand and a unscrewing the Retainer with the other hand. Carefully turn the Focus Lens Holder upside down onto a piece Lens Tissue so that Focus Lens and Nylon Spacers drop out onto the Lens Tissue.

5.   Inspect the Nylon Spacers and clean them if necessary with a swab or paper towel and Lens Cleaner. Re-install the bottom Nylon Spacer into the Focus Lens Holder.

6.   Flood the Focus Lens with Lens Cleaner on one side, flip it over and flood the other side. By using a fresh sheet of Lens Tissue, pick up the Focus Lens and gently dry both sides. Keep your hands close to the soft cloth in case you drop the Focus Lens. **DO NOT** touch the Focus Lens with your bare hands.
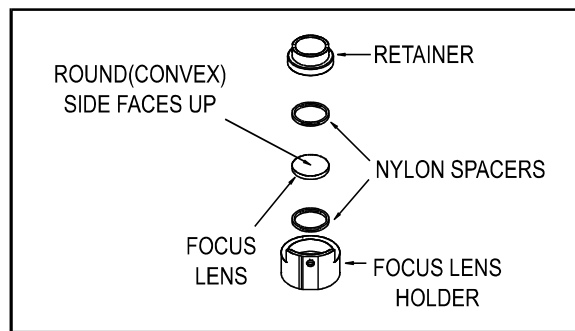
Focus Lens Holder Assembly

7.   Place the Focus Lens back into the Focus Lens Holder with the convex side facing upwards. Installing the Focus Lens upside down will result in the engraving being out of focus. Then install the other Nylon Spacer and the Retainer. Make sure that the Focus Lens and the Nylon Spacers are properly aligned as the Retainer is tightened down snugly. **DO NOT** over tighten the Retainer. To make sure the Focus Lens and Nylon Spacers are installed correctly, hold it next to your ear and shake it back and forth. If the Focus Lens rattles, check the Focus Lens and Nylon Spacer alignment and re-adjust as necessary. A loose Focus Lens in it's Holder will cause the appearance of a double image when engraving.

8.   To re-install the Focus Lens, place it back on to the Focus Carriage and tighten the Thumbscrew. There are two screw holes located on the Focus Carriage. The Thumbscrew can be installed into either hole, there is no difference except that one is for left-handed people, and the other is for right-handed people.

#2/#3 Mirror Inspection and Cleaning (as necessary)

NOTE: The following procedure refers to both the #2 and #3 Mirror. Remember, the laser system **MUST** be turned **OFF** and unplugged before performing this procedure.

Inspect the Mirrors by looking at their reflective surfaces through the hole in the Mirror Holder for signs of debris. We recommend this method of inspection because it will reduce the likelihood of accidental damage from constantly removing and replacing them. If the surface is hazy or showing signs of debris, then it must be removed for cleaning because it is not possible to clean the Mirror correctly while it is mounted to it's Holder. If the surface of the Mirror is not clearly visible, then the Mirror will need to be removed for inspection and possibly cleaning anyway.

When inspecting or cleaning the Mirrors by removal, remove them one at a time so they do not get mixed up. They appear identical, but sometimes there might be a very slight difference between them which can lead to a slight laser beam misalignment. Although this is highly unlikely, remove and replace them one at a time just as a precaution.

1. While holding the Mirror, remove the Thumbscrew and pull the Mirror away from it's holder. Be careful not to slide the Mirror across it's Holder as it can scratch easily.
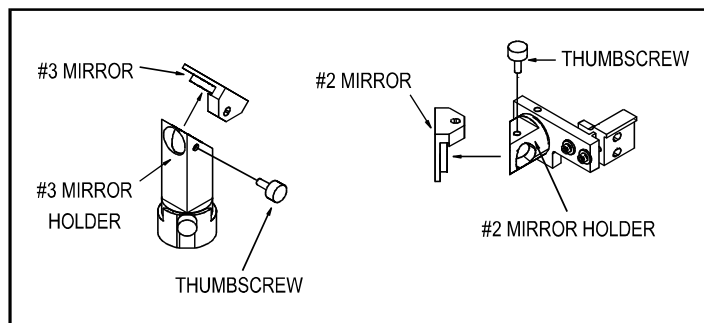
#2 and #3 Mirror Assemblies

2. Inspect the Mirror for signs of haze or debris. Since the Mirror is larger than it's Holder, you will notice scratches around the perimeter of the Mirror. This is normal and there is no need for concern. The laser beam reflects off of the middle area of the Mirror and as long as there is not dirt or scratches in the middle, the Mirror will perform correctly. If the center area of the Mirror looks visibly clean, do not clean it, simply re-install it to it's Holder by proceeding to Step 8.

3. To clean the Mirror, hold the Mirror on a 45 degree angle, flood the surface with a few squirts of Lens Cleaner, place it down on a soft cloth, and let it sit for one minute.
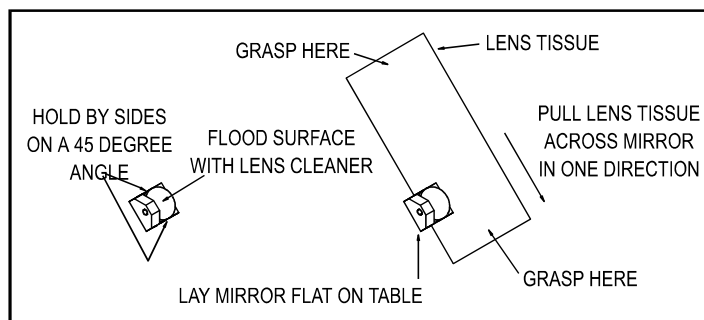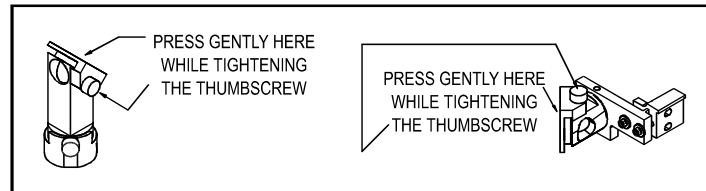

#2 and #3 Mirror Cleaning

4. Using a fresh piece of Lens Tissue, gently pull the Tissue across the Mirror in one direction to absorb the fluid. If fluid remains, use the other side of the tissue and repeat. **NEVER** use a Lens Tissue, or area of a Lens Tissue twice as dust build-up on the tissue may scratch the Mirror's surface and reduce it's life. Also remember to pull the Lens Tissue in **ONLY** one direction.

5. Repeat the cleaning procedure if the Mirror does not come clean on the first attempt. **DO NOT** use any finger pressure on the Mirror's surface as this can scratch the soft outer coating.

6. Re-install the Mirror by guiding the Mirror straight on to it's holder. Be careful not to slide the Mirror around while installing it as this can scratch the reflective surface and reduce the life of the Mirror.

CAUTION

The next step is very important. Please follow the directions otherwise a beam misalignment can occur.

7. Install the Thumbscrew, and before tightening it down all the way, gently press your finger against the back side of the Mirror so it rests flush against the Holder (refer to the next diagram). **.** Now tighten the Thumbscrew finger tight.

#2 and #3 Mirror Installation

Beam Window Inspection and Cleaning (as necessary)

The Beam Window is located inside the machine in the left hand corner. This window seals the engraving area off from the laser tube and #1 Mirror area. This prevents the need to clean the #1 Mirror or the laser tubes optics because it is in a sealed environment. Visually inspect the Beam Window for signs of dirt or debris. The Beam Window's front surface can be cleaned while remaining installed. There is no need to clean the back side of the Beam Window as it will not get dirty.

1. To clean the Beam Window, soak a cotton swab with Lens Cleaner.

2. Roll the cotton swab across the Beam Window in one direction.

3. Dry off any remaining solution by rolling a fresh, and dry, cotton swab across the Beam Window.

CAUTION

DO NOT press the cotton swab down with force, only roll it across the Window. DO NOT wipe it across as this can scratch the outer coating.

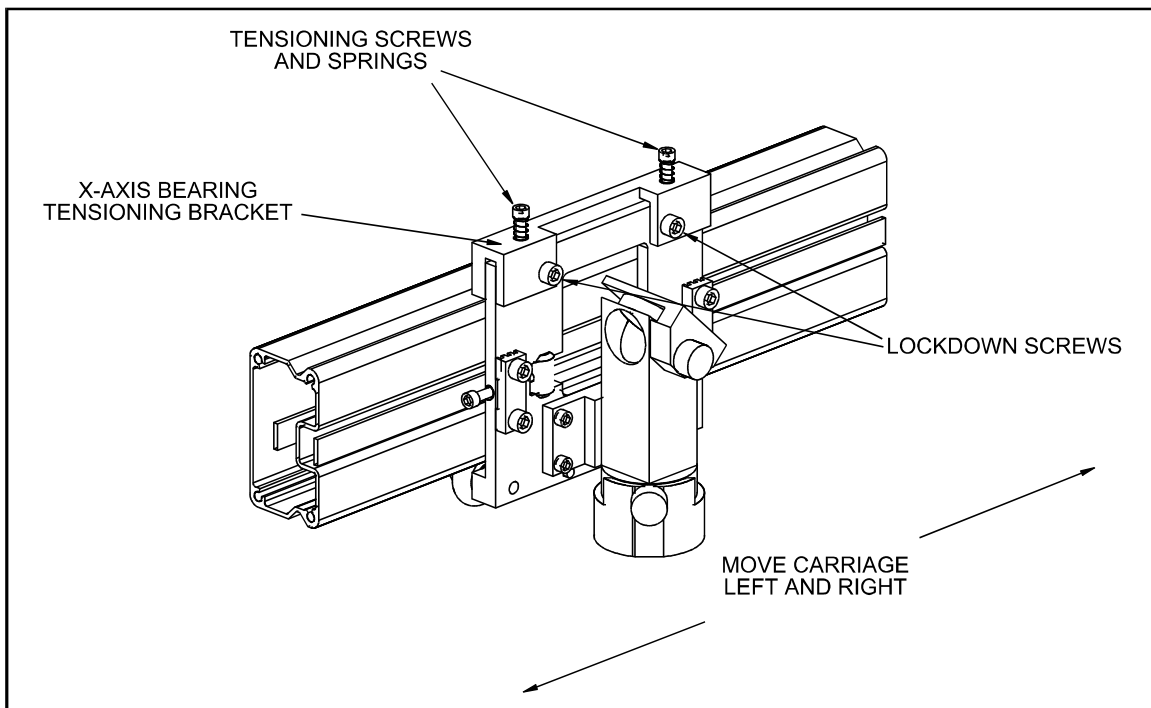## 5.4   Bearing Clearance Adjustments (as necessary)

As the motion system undergoes heavy use, the outer bearing surface will start to wear. To compensate for this wear, the Bearing Clearance between the outer bearing surface and the bearing tracks will need to be adjusted to maintain peak performance and engraving quality. Since most of the motion is in the X-axis direction, the X-axis Bearings will need adjustment more often than the Y-axis bearings. It is not necessary to adjust any bearings as a preventive maintenance step, they only need adjustment if the engraving quality becomes reduced by excessive clearances between the bearing races and the rails of the motion system.

X-axis Bearing Adjustment

As the X-axis Bearings wear, there could be a reduction in the quality of the image that the laser produces because the Focus Carriage will rock back and forth as it reverses direction.

The X-axis Bearing Clearance can be adjusted to remove the looseness and restore quality. To do this, turn the laser system off and loosen the two(2) Lockdown Screws as the diagram indicates. Loosening the Lockdown Screws will allow the Tensioning Springs at the top of the X-axis Bearing Tensioning Bracket to push the bracket downwards. This downward push actually squeezes all three(3) bearings together to remove the clearance created by bearing wear. In other words, the bearings will self adjust when the Lockdown Screws are simply loosened (about ¼ to ½ turn counterclockwise). Now re-tighten the Lockdown Screws,. Do not tighten them too tight, just snug enough to hold the X-axis Bearing Tensioning Bracket in place. If you tighten the Lockdown Screws too tight the Tensioning Bracket might twist and cause an incorrect adjustment.   The objective is to remove the clearance between the outer bearing surface and the bearing tracks, **NOT** to make the bearings tight. This is why we let the Tensioning Springs supply just a small amount of force to remove the clearance.

After making the adjustment, check to see if there is any more play in the Focus Carriage by grasping it and gently trying to rotate it in a clockwise and counterclockwise direction. If there is still clearance, repeat the procedure. It sometimes helps to move the Focus Carriage left and right a few times while the Lockdown Screws are loose to help settle the bearings in the bearing tracks.

X-axis Bearing Clearance Adjustment

Y-axis Bearing Adjustment

To adjust the Y-axis Bearing Clearance, first make sure the laser system is turned off. Then, by hand, move the arm to the center of the engraving area. Loosen (only slightly) the Lockdown Screws located on the left side of the arm and the right side of the arm as the diagram below illustrates. DO NOT loosen them too much, only enough to break the bond (about ¼ turn counterclockwise).
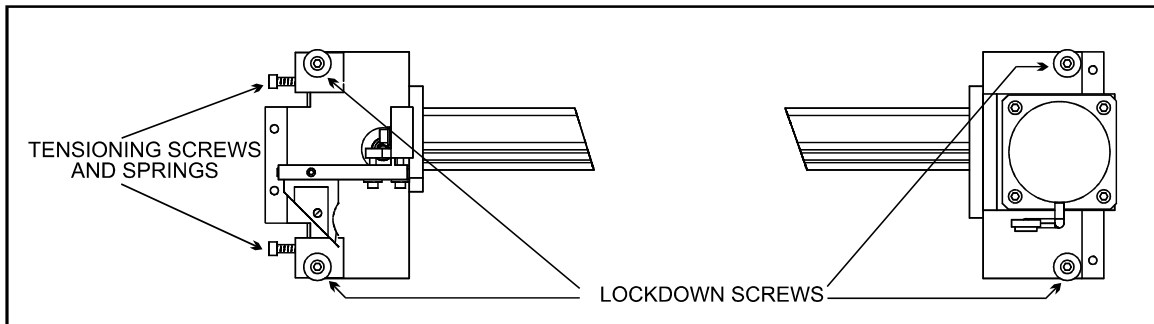
Y-axis Bearing Clearance Adjustment

After all four(4) Lockdown Screws are loose, push the arm towards the top of the field and then the bottom of the field back and forth several times to seat the bearings. The Tensioning Screws and Springs will force all four(4) bearings up against the Bearing Tracks to take up the clearance. Now tighten the two(2) Lockdown Screws on the right side first, then tighten down the two(2) on the left side.

Again, just tighten the Lockdown Screws just enough to lock them into place, if you tighten them too much, the bearing plate can twist and give you an incorrect adjustment.

To check your adjustment, slide the arm to the top of the engraving area and then to the bottom while holding a finger (with very slight finger pressure) up against one of the outer bearing surfaces. The bearing should roll in your finger while moving the arm towards you or away from you. What you are checking for is if the outer bearing surface is making contact with the Bearing Track from the top to the bottom of the engraving area and that is does not spin freely without any friction. Check this on all four bearings. If any of the outer bearing surfaces are not making contact with the Bearing Track completely, then repeat this procedure again until all four bearings are touching the Bearing Track throughout the range of the engraving area.

Remember, the objective is to remove the clearance between the outer bearing surface and the Bearing Tracks, **NOT** to make the bearings tight so this is why we let the Tensioning Screws and Springs supply the proper force.

Appendix A - Warranty

ULS warrants that all new ULS Performance Series Laser Engraving Systems will be free from defects in material and workmanship under normal and proper use and service, for a period of one year from the date of shipment from ULS. Notwithstanding the foregoing, perishable components, (lenses, mirrors, indicator lamps, batteries, fuses, belts, bearings) are warranted for only 90 days from the date of shipment from ULS. The laser is only covered by a one-year laser manufacturer's warranty.

This limited warranty extends only to the original purchasers and is not transferable. During the applicable limited warranty period, ULS will repair or replace, at its option, any defective product or part at no additional charge to the customer, provided that the defective product or part is returned to ULS. This limited warranty does not extend to any products or parts that have been damaged as a result of lack of supervision of use, accident, misuse, abuse (including, without limitation, incorrect voltages, power surges, improper or insufficient ventilation, failure to follow ULS provided operating instructions, "acts of God" or other situations beyond the control of ULS), or as the result of service or modification by anyone other than ULS. This limited warranty does not extend to parts or components that are not installed by ULS, an authorized representative of ULS, or in a manner not approved by ULS.

Universal Laser Systems reserves the right to request that a ULS Laser Engraving System be returned to the factory for repair, or to provide on-site repair. If determined by ULS that on-site repair is necessary and the nature of the repair is such that ULS believes that it can be done at the customer's facility, ULS will provide a field service technician free of charge during the applicable limited warranty period.

ULS provides no warranties whatsoever on any software used in connection with a ULS Laser Engraving System, express or implied.

Limitation of remedies and liabilities: ULS's entire liability and customer's exclusive and sole remedy for damages from any cause whatsoever (including without limitation any nonperformance, misrepresentation, or breach of warranty) shall be limited to repair or replacement of the specific products or parts that do not comply with the limited warranty given by ULS. Any products or parts repaired or replaced by ULS pursuant to this Paragraph shall be warranted as of the original date of delivery of the ULS Laser Engraving System in accordance with the terms and conditions herein for the duration of the applicable term of the limited warranty. In no event will ULS be liable for any damages caused, in whole or in part, by customer, or for any economic loss, physical injury, lost revenue, lost profits, lost savings or other indirect, incidental, special or consequential damages incurred by any person, even if ULS has been advised of the possibility of such damages or claims.

The warranties set forth herein are in lieu of all other warranties, express or implied, including without limitation, implied warranties of merchantability and fitness for a particular purpose.

Some states do not allow the exclusion of limitation of incidental or consequential damages, and some states do not allow limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you. This limited warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

NOTE: This limited warranty applies only to Universal Laser Engraving Systems installed within the United States of America.

Appendix B - ULS-Performance Series Specifications

Model Number	ULS-25PS or ULS-50PS
Maximum Engraving Area	24 x 18 inches (609.6 x 457.2 mm)
Maximum Engraving Speed	25 inches per second (635 mm/s)
Laser Source	25 Watt CO_2 or 50 Watt CO_2

Laser Beam Spot Size Diameter
- 1.5 inch Focal Length (optional)   0.003 inches (.08 mm)
- 2.0 inch Focal Length   0.005 inches (.13mm)
- 2.5 inch Focal Length (optional)   0.007 inches (.18 mm)
- 4.0 inch Focal Length (optional)   0.013 inches (.33 mm)

Repeatability	+/- 0.002 inches (+/- .06 mm)
Interfaces	Parallel = Centronics Serial = RS-232C (PC) Serial = Phone Jack (MAC)
Buffer Memory Size	16MB (upgradeable to 64MB)
System Dimensions	44" wide x 36" deep x 42" tall
System Weight	25 Watt - 205 lbs.(93 kg) 50 Watt - 255 lbs.(116 kg)
Safety Classification	Class I
Focal Plane (Z axis) Adjustment	9 inches (228.6 mm)

Facility Requirements

Electrical Power:
25 Watt - Single phase, 110 VAC, 50/60 Hz, 15 Amp (US Version)
25 Watt - Single Phase, 220 VAC, 50/60 Hz, 7.5 Amp (International Version)
50 Watt - Single phase, 110 VAC, 50/60 Hz, 20 Amp (US Version)
50 Watt - Single Phase, 220 VAC, 50/60 Hz, 10 Amp (International Version)
Chiller - Single Phase, 110VAC, 50/60 Hz, 20 Amp (US Version)
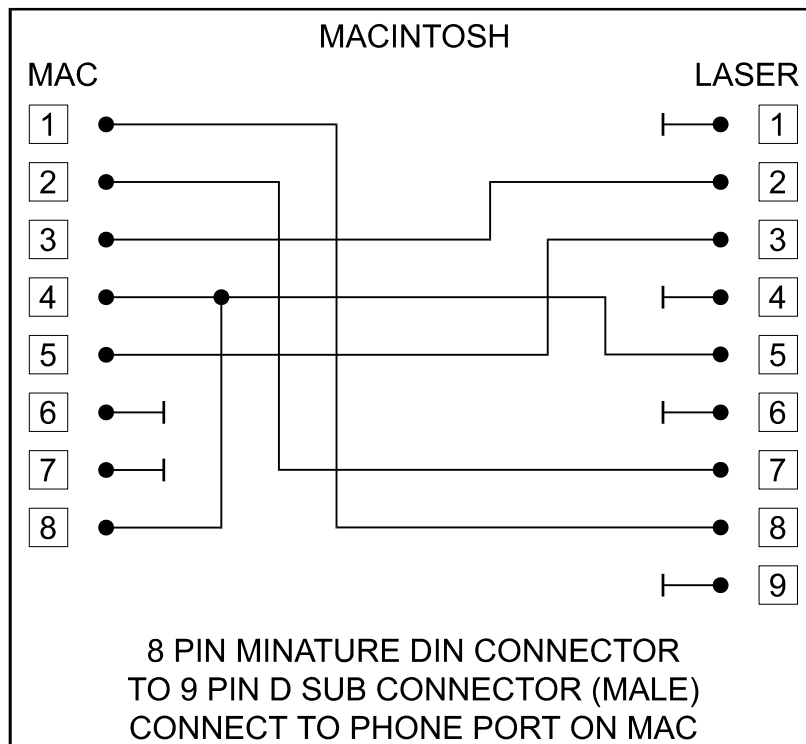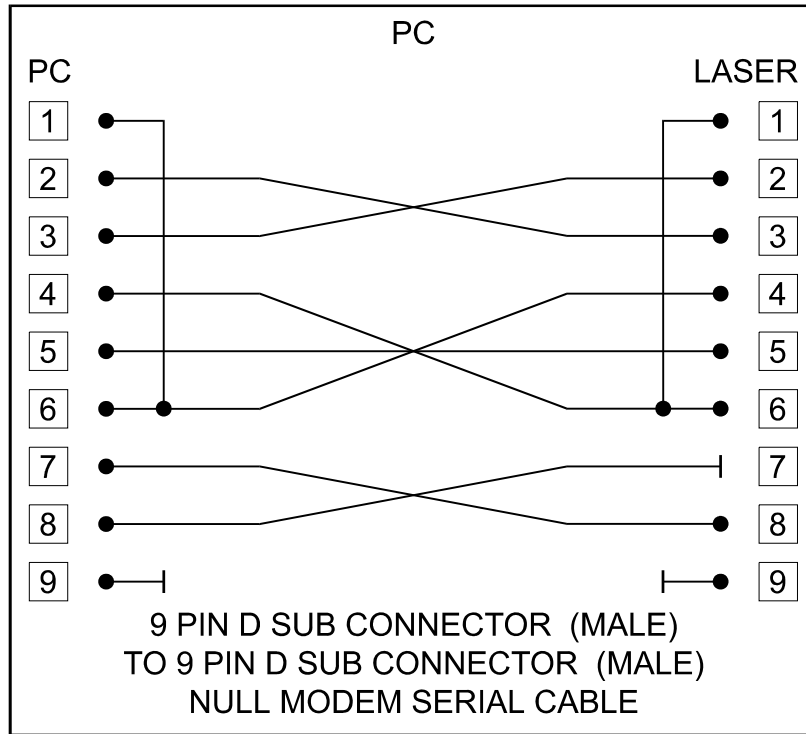Chiller - Single Phase, 220VAC, 50/60 Hz, 10 Amp (International Version)

Exhaust:
235 CFM minimum at 6 inches of static pressure

Cooling:
25 Watt - Air cooled ambient temperature less than 80 degrees F (25 degrees C)
50 Watt - Recirculating water cooled at 70 degrees F (21 degrees C)

Specifications are subject to change without notice.

Appendix C - 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

C

Appendix D - Laser.ini Modifications

Advanced Procedures

To speed up the download process to the laser system, a file modification can be made.

If the computer being used has 8 or more megabytes of RAM, open up the LASER.INI file in the Windows directory using a text editor. Scroll down to the bottom of the file and type in the following line exactly how it reads:

BandKBytes=2000

This line will allow the computer to use more of its memory for printing.

Save this file and restart Windows for the change to take effect.

Appendix E - Software Anomalies

In order for certain software to work properly with a Universal Laser System, some modifications might have to be made. If using the following software, be sure to follow these instructions. If having any difficulty making these adjustments, please contact our technical support.

CorelDraw

If experiencing problems printing text in CorelDraw!, especially mirrored text, make this modification to the files listed below:

COREL 3.0
Find the CORELDRW.INI file usually located in the c:\windows\coreldrw\draw\ subdirectory. Open this file up in a text editor such as NOTEPAD, which comes with Windows. Scroll down about 55 lines to find the line that reads:

FontRasterizer=1

and change it to read:

FontRasterizer=0

Save this file and restart CorelDraw! for the changes to take effect.

COREL 4.0
Find the CORELAPP.INI file usually located in the c:\windows\corel40\config\ subdirectory. Open this file up in a text editor such as NOTEPAD, which comes with Windows. Scroll down about 63 lines to find the line that reads:

FontRasterizer=1

and change it to read:

FontRasterizer=0

Save this file and restart CorelDraw! for the changes to take effect.

COREL 5.0
Find the CORELAPP.INI file usually located in the c:\windows\corel50\config\ subdirectory. Open this file up in a text editor such as NOTEPAD, which comes with Windows. Scroll down about 64 lines to find the line that reads:

FontRasterizer=1

and change it to read:

FontRasterizer=0

Save this file and restart CorelDraw! for the changes to take effect.

Printing photographs through CorelDraw!

Version release 3.0B and version 5.0 do not currently support our drivers halftone pattern generator. What this means is that if trying to print a grayscale photograph through these versions, it will come out as a solid black and white engraving with no halftone generation. There is no current solution available for this problem. Our suggestion is to use version 3.0A, and any of the 4.0 releases until this problem can be resolved or if it can be resolved. Please contact our technical support if there are any questions.