

# Plasma CNC Manual



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MCNC Plasma 48 x 48  
MCNC Plasma 48 x 96  
MCNC Plasma 60 x 120

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## **Safety Rules.**

**As with all machinery, there are certain hazards involved with the operation and use. Using it with caution will considerably lessen the possibility of personal injury. However, if normal safety precautions are overlooked or ignored, personal injury to the operator may result. If you have any questions relative to the installation and operation, do not use the equipment until you have contacted your supplying distributor.**

**Read carefully before operating the machine.**

- 1. Keep the working area clean and be sure adequate lighting is available.**
- 2. Do not wear loose clothing, gloves, bracelets, necklaces or ornaments. Wear face, eye, respiratory and body protection devices as indicated for the operation or environment.**
- 3. Be sure that the power is disconnected from the machine before tools are serviced or an attachment is to be fitted or removed.**
- 4. Never leave the machine with the power on.**
- 5. Do not use dull, gummy or cracked cutting tools.**
- 6. Be sure that the keys and adjusting wrenches have been removed and all the nuts and bolts are secured.**

# Limited Warranty

New machines and accessories sold by Laguna Tools carry a one-year warranty effective from the date of shipping. Machines sold through dealers must be registered with Laguna Tools within 30 days of purchase to be covered by this warranty. Laguna Tools guarantees all new machines and accessories sold to be free of manufacturers' defective workmanship, parts and materials. We will repair or replace, without charge, any parts determined by Laguna Tools, Inc. to be a manufacturer's defect. We require that the defective item/part be returned to Laguna Tools with the complaint. Any machines returned to Laguna Tools must be returned with packaging in the same manner in which it was received. If a part or blade is being returned it must have adequate packaging to ensure no damage is received during shipping. In the event the item/part is determined to be damaged due to lack of maintenance, cleaning or misuse/abuse, the customer will be responsible for the cost to replace the item/part, plus all related shipping charges. This limited warranty does not apply to natural disasters, acts of terrorism, normal wear and tear, product failure due to lack of maintenance or cleaning, damage caused by accident, neglect, lack of or inadequate dust collection, misuse/abuse or damage caused where repair or alterations have been made or attempted by others.

Laguna Tools, Inc. is not responsible for additional tools or modifications sold or performed (other than from/by Laguna Tools, Inc.) on any Laguna Tools, Inc. machine. Warranty maybe voided upon the addition of such described tools and/or modifications, determined on a case-by-case basis.

Software purchased through Laguna Tools Inc. is not covered under this warranty and all technical support must be managed through the software provider. Software is non-refundable.

Normal user alignment, adjustment, tuning and machine settings are not covered by this warranty. It is the responsibility of the user to understand basic machinery operation, settings and procedures and to properly maintain the equipment in accordance with the standards provided by the manufacturer.

Parts, under warranty, are shipped at Laguna Tools, Inc.'s cost either by common carrier, FEDEX ground service or a similar method. Technical support to install replacement parts is primarily provided by phone, fax, e-mail or Laguna Tools Customer Support Website. The labor required to install replacement parts is the responsibility of the user.

Laguna Tools is not responsible for damage or loss caused by a freight company or other circumstances not in our control. All claims for loss or damaged goods must be notified to Laguna Tools within twenty-four hours of delivery. Please contact our Customer Service Department for more information.

Only **new** machines sold to the original owner are covered by this warranty. For warranty repair information, **call 1-800-332-4094**.



## Noise Emissions.

Notes concerning noise emission:

Given that there exists a relationship between noise level and exposure times, it is not precise enough to determine the need for supplementary precautions. The factors affecting the true level of exposure to operators are clearly the amount of time exposed, the characteristics of working environment other sources of dust and noise etc. For example, adjacent machines in other words the level of ambient noise. It is possible that exposure level limits will vary from country to country.

## Specification Sheet.

**Note:** The specification will depend on the machine that is ordered. Most machines are made to order, and therefore, the specification will vary depending on the machine you require.

**Note:** This manual is designed to cover the general use of CNC Plasma machines. CNC machines and some pitchers may be different to the machine that you receive. The general principles apply to the CNC plasma machine.

## Receiving your machine.

**Note.** It is probable that your machine will be delivered by a third party. Before you unpack your new machine, you will need to first inspect the packing, invoice, and shipping documents, supplied by the driver. Ensure that there is no visible damage to the packing, or the machine. You need to do this prior to the driver leaving. All damage must be noted on the delivery documents and signed by you and the delivery driver. You must then contact the seller, Laguna Tools, within 24 hours.

## Introduction to CNC Plasma machines.

The CNC Plasma is designed to give you years of safe service. Read this owner's manual in its entirety before assembly or use.

The advantage of the CNC Plasma machine is that it can, in most cases, fully machine the complete job without it being removed from the table so that you have finished parts of high accuracy that are totally repeatable.

Nesting is also a valuable feature of CNC Plasma machining that saves on waste and costs.

### **What is Plasma?**

Plasma is a gas heated to an extremely high temperature and ionized so that it becomes electrically conductive. Plasma arc cutting uses the plasma as an electrode to transfer a electrical arc to the work piece. The heat of the arc melts the work piece and the force of the plasma and shield gases blow away the molten metal to cut the work piece.

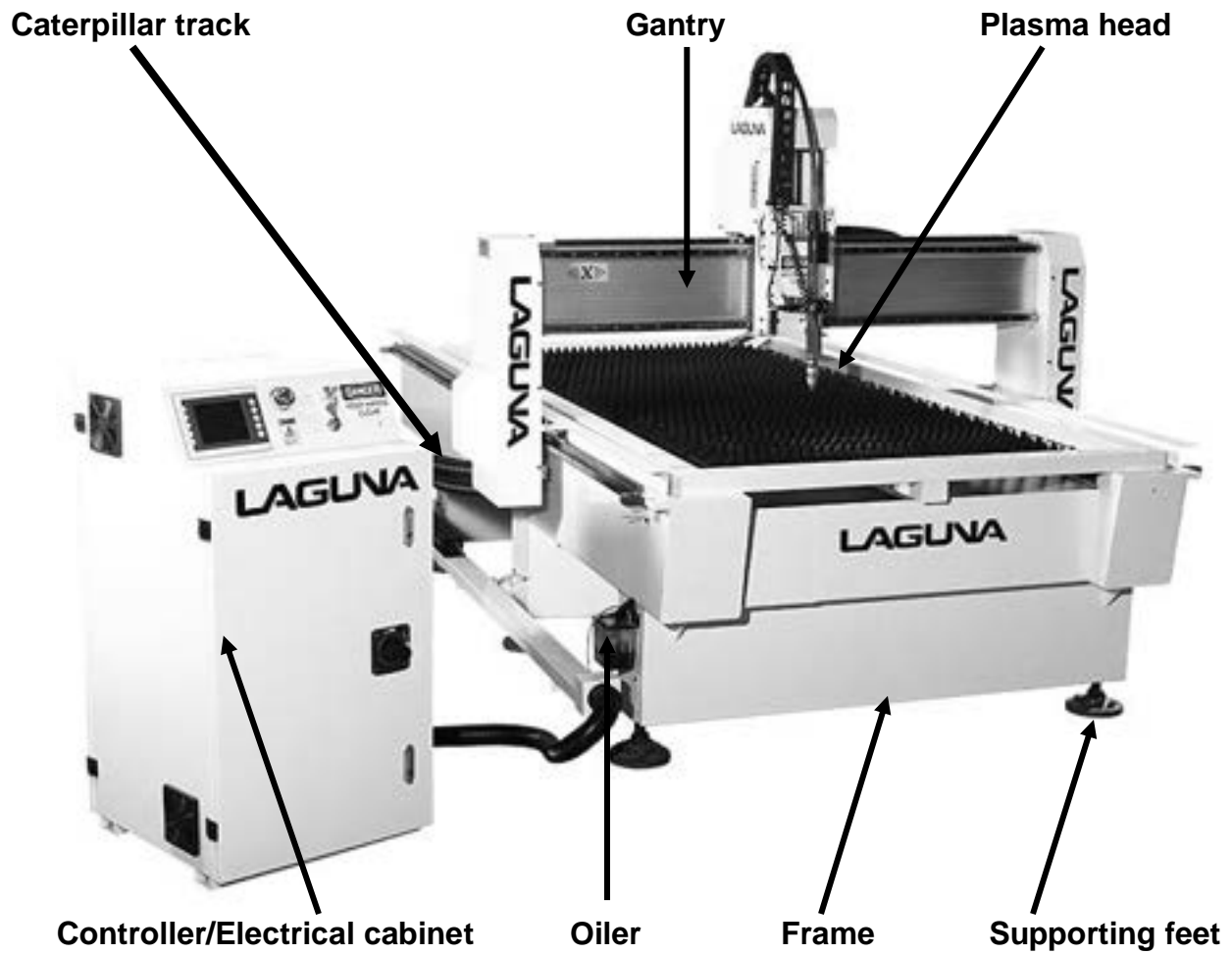
Different metals react differently to plasma cutting. Carbon steel can be oxidized, and is usually cut with a plasma containing oxygen to take advantage of the exothermic process. Higher levels of oxygen in the plasma result in higher heat and higher rates of oxidation. The result is a faster and cleaner cut. Stainless steel and aluminum are not subject to rapid oxidation and depend entirely on the plasma's heat for the cutting process. Because plasma produces much higher heat than the oxygen-fuel cutting process, plasma can cut stainless steel and aluminum quickly and cleanly.

### **History of plasma:**

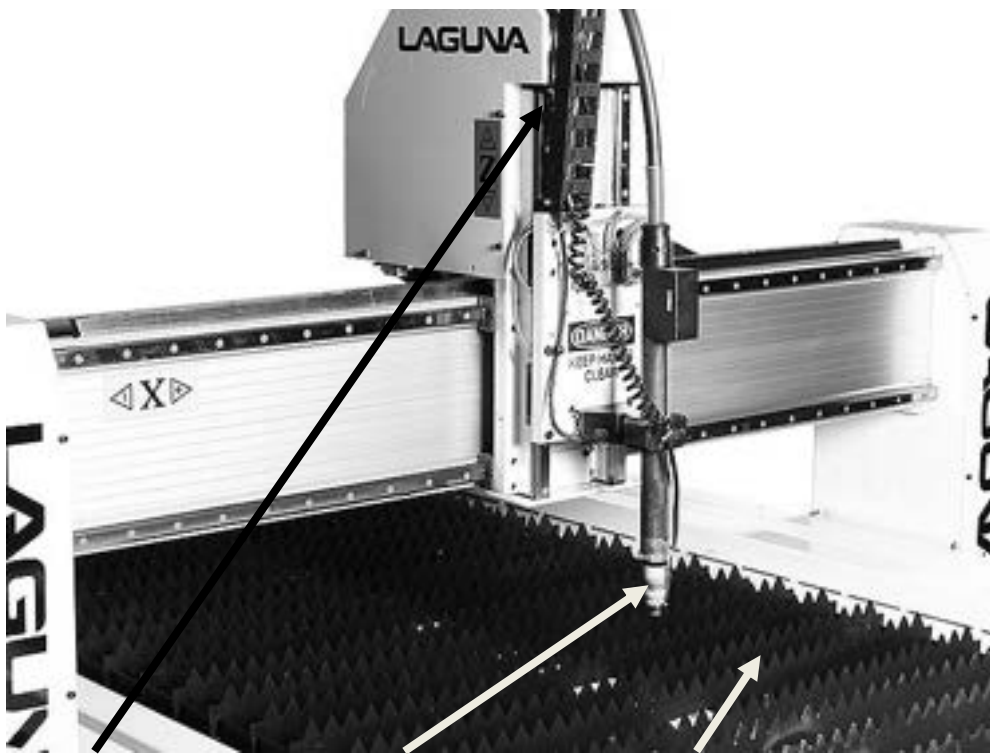
Half a century ago Thayer Professor James Browning '44 was nicknamed Hanover's firebug for his study of flame stability and combustion at Dartmouth college.

Browning will be remembered best for inventions that fired up the N.H. Upper Valley economy. In the 1950s he created a plasma torch that produced flames twice as hot as the sun's surface. Passing nitrogen or hydrogen through a high-intensity electric arc, the torch cut metal like butter. Browning and Thayer colleague Merle Thorpe founded Thermal Dynamics Corp. to manufacture the device. Within three years the start-up had sales of \$1 million. A decade later, Thayer Professor Robert Dean and Richard Couch '64, Th'65 formed Hypertherm Inc.

## Parts of the CNC Plasma







**Caterpillar track**

**Plasma head**

**Bed**

#### **1. Bed.**

The bed of the machine consists of a heavy steel frame with a steel supporting plates. The supporting plates are designed to give point contact with the job and are consumable as they will be cut by the plasma cutting head.

#### **2. Gantry.**

The gantry straddles the bed and carries the Plasma cutting head motion system. It is moved along the length of the bed by a precision rack-and-pinion system that is controlled by the machine controller.

#### **3. Plasma cutting head.**

The plasma cutting head is moved along the gantry by a precision rack-and-pinion system that is controlled by the machine controller. The plasma cutting head is moved vertically by a precision ball screw system that is controlled by the machine controller.

#### **4. Frame.**

The frame is a heavy welded construction that supports all the other parts of the machine.

#### **5. Controller/Electrical cabinet.**

The Controller/Electrical cabinet is located on the side of the machine. The enclosure houses all the electrical components for controlling and powering the machine.

#### **6. Caterpillar track.**

The caterpillar track runs along the side of the machine and across the gantry in a trough and carries all the electrical cables and gas pipes.

#### **7. Oiler.**

The oiler connects to all the relevant slides on the machine and when pumped by hand will lubricate all the relevant slides.

#### **8. Supporting feet.**

There are supporting feet that are used to level the machine.

### **Additional instructions for the use of the CNC Plasma**

Like all machines, there is danger associated with the machine. Injury is frequently caused by lack of knowledge or familiarity. Use this machine with respect. If normal safety precautions are overlooked or ignored, serious personal injury may occur. As the CNC is under the control of the onboard machine controller, it is important that you are clear when operating the machine.

### **What you will receive with the machine.**

**What is supplied with your machine will depend on the specification of the machine and extras that you order.**

### **Where to locate your machine.**

Before you unpack your machine, select the area where you will use your machine. There are no hard-and-fast rules for its location, but below are a few guidelines.

1. There should be an area around the machine suitable for the length of job that you will be cutting.
2. Adequate lighting. The better the lighting, the more accurate and safely you will be able to work
3. Solid floor. You should select a solid flat floor, preferably concrete or something similar.
4. Close to power source.

## Unpacking your machine.

To unpack your machine, you will need tin snips, knife and a wrench.

1. Using the tin snips, cut the banding that is securing the machine to the pallet (if fitted).

**WARNING: EXTREME CAUTION MUST BE USED BECAUSE THE BANDING WILL SPRING AND COULD CAUSE INJURY.**

2. Remove the box from the CNC machine if fitted and any other packaging material. The parts ordered with the machine will be packed on or inside the machine.

**Note:** The machine is heavy, and if you have any doubt about the described procedure, seek professional assistance. Do not attempt any procedure that you feel is unsafe, or that you do not have the physical capability of achieving.

3. Use a forklift with sufficient lifting capacity and forks that are long enough to reach the complete width of the machine.

4. Remove the securing bolts that attach the machine to the pallet (if fitted).

5. Approaching the machine from the side and lift the machine on the frame, taking care that there are no cables or pipes in the area of the forks.

6. Move the machine to the required position and lower gently to the floor.

7. Level the machine so that all the supporting feet are taking the weight of the machine and no rocking is taking place.

**Lock nut**



**Supporting foot**



**Supporting foot**

## Assembly and set up.

## Cleaning the machine.

The machine is shipped with the non-painted surfaces protected from rust by a film of grease. The grease must be removed with WD40 or similar, as it attracts dirt. The surfaces should then be coated with a 30W oil or wax and any excess removed.

## Electrical connections for the machine.

The main power cable and has no plug fitted, as it will be dependent on your installation. Ensure that when installing the electrical supply to the machine that 220v three-phase is supplied. It is not possible to recommend a breaker size, as this will be dependent on the specification of the machine that you purchase.

**Note:** When wiring the machine to your electrical system, keep your cable as short as possible, and the cable should not be allowed to run along the floor, as this will cause a trip hazard.

**Note:** A qualified electrician must carry out the electrical installation.

## Shielding and Grounding.

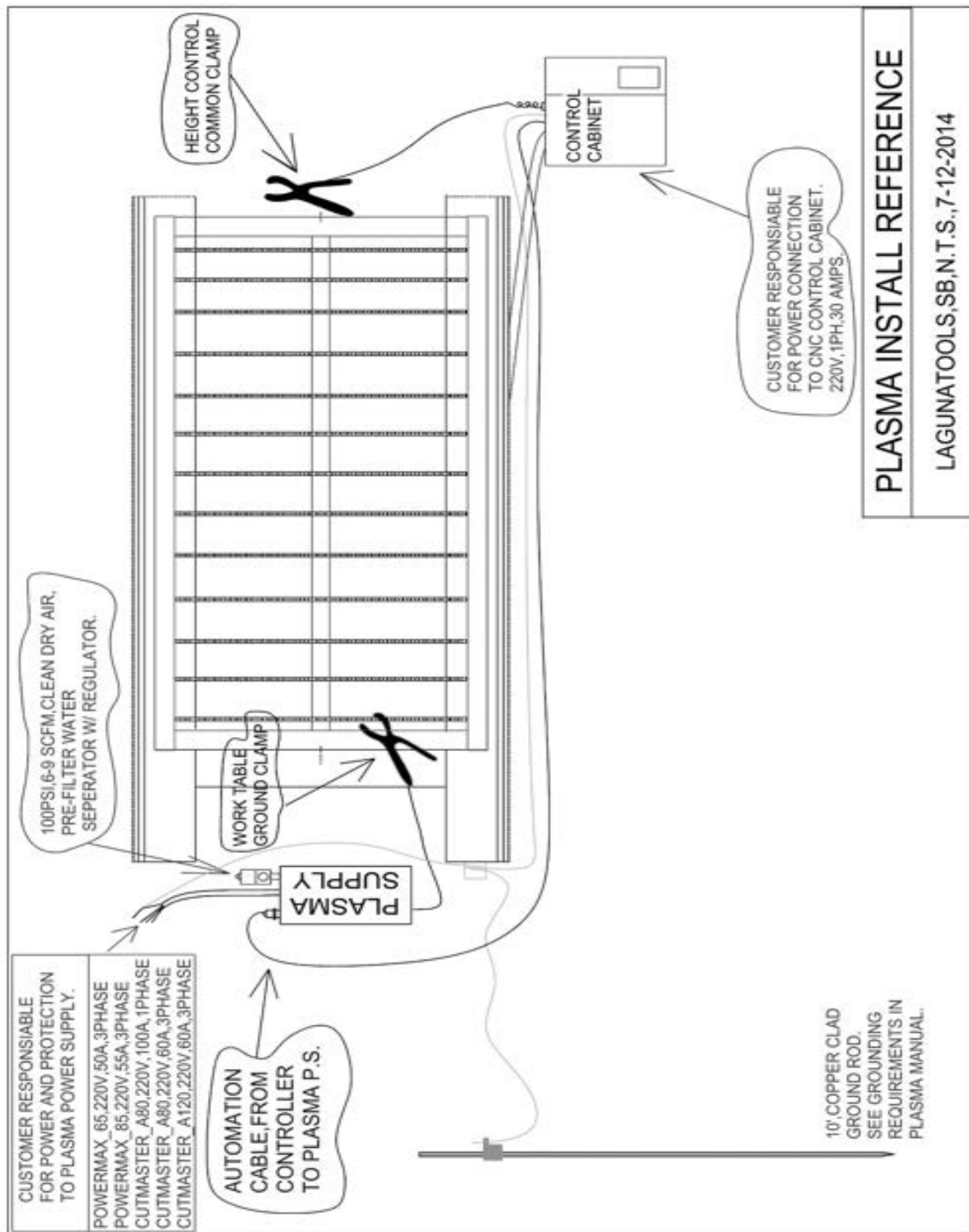
This section is preliminary and offers only typical shielding and grounding techniques to reduce RF noise. As with all electrical devices it is important to always follow all local electrical codes including but not limited to the National Electrical Code.

## **Motor controller and other controls.**

Keep the motor controller and other controls as far from the plasma power supply as possible.

## **Plasma Power Supply.**

Place the plasma power supply and/or remote arc starter at the rear of the frame. Keep the CNC computer controller as far from the power supply and/or remote arc starter as possible. Follow the power supply grounding diagram found in the system manual.



## PLASMA INSTALL REFERENCE

LAGUNATOOLS, SB, N.T.S., 7-12-2014

## Grounding Connections.

Pilot arc starting generates a certain amount of electromagnetic interference (Called EMI). This is commonly called RF noise. This RF noise may interfere with other electronic equipment such as the CNC controller and other equipment in the vicinity. To minimize the RF interference the following grounding procedures should be followed when installation of the machine is undertaken.

Drive 5/8" diameter X 10 feet long copper clad steel earth rod as close to the table as possible. It may be necessary to weld a second rod to reach the moisture layer to achieve a proper ground. Follow the attached instructions for proper earth ground rod testing. If multiple ground rods are required to achieve proper grounding keep a minimum distance of 1.1 times the driven length between driven rods.

**Note: Keep ground wires as short as possible. Remove any paint, rust or oxide from the connection point. Always use star washers and electrical anti corrosion paste on all connections.**

Create a main star ground on one of the table legs. The main star ground will be the only point where all grounding wires will terminate before the earth ground rod. The point should have good metal to metal contact and provide a sufficient number of ground lead attachment points to eliminate the need to stack lead terminals, see figure 2 below. Connect a minimum 1/0 AWG cable (4/0 is best) from the star to the earth ground rod. Do not connect any other grounds directly to the ground rod.

Create an auxiliary star ground point as needed to connect ground leads from moving points of the table to the main ground. The point should have good metal to metal contact. Connect this star to the main star using #4 AWG minimum.

Connect the power supply safety ground directly to the main star ground with a minimum 1/0 cable.

Connect the remote arc starter directly to the main star ground with a minimum 1/0 cable.



**Fig. 2 Avoid stacking terminal lugs**

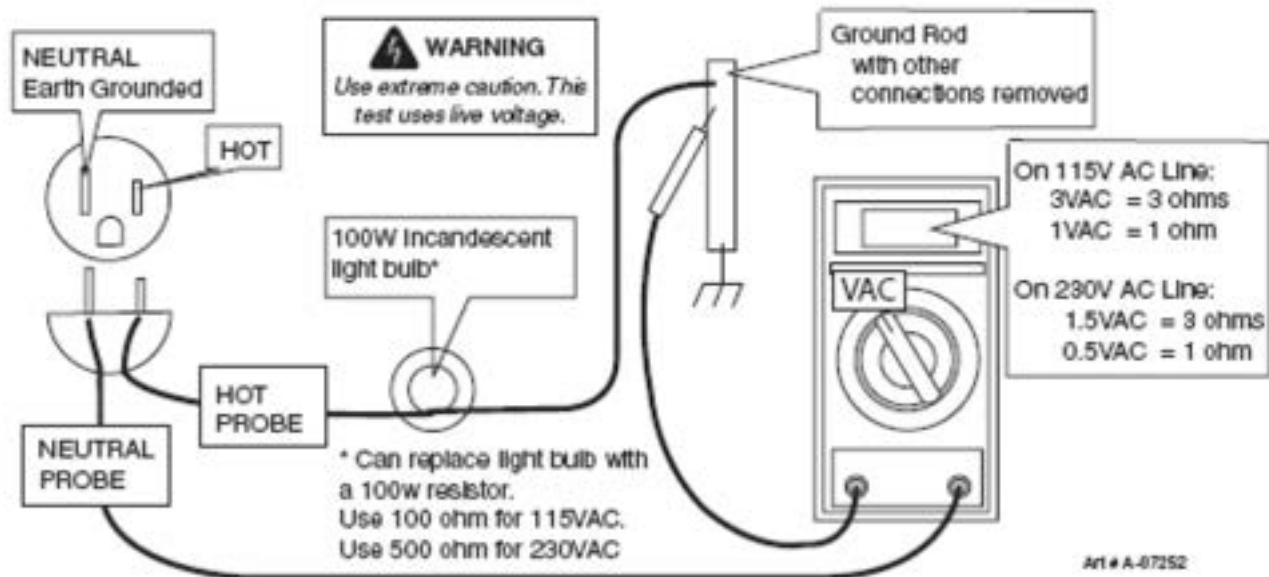
## Testing for proper Grounding.

To Test for a proper earth ground refer to the following diagram. Ideally, the reading on the multimeter should be 3 VAC for 115VAC or 1.5VAC for 230 VAC line.

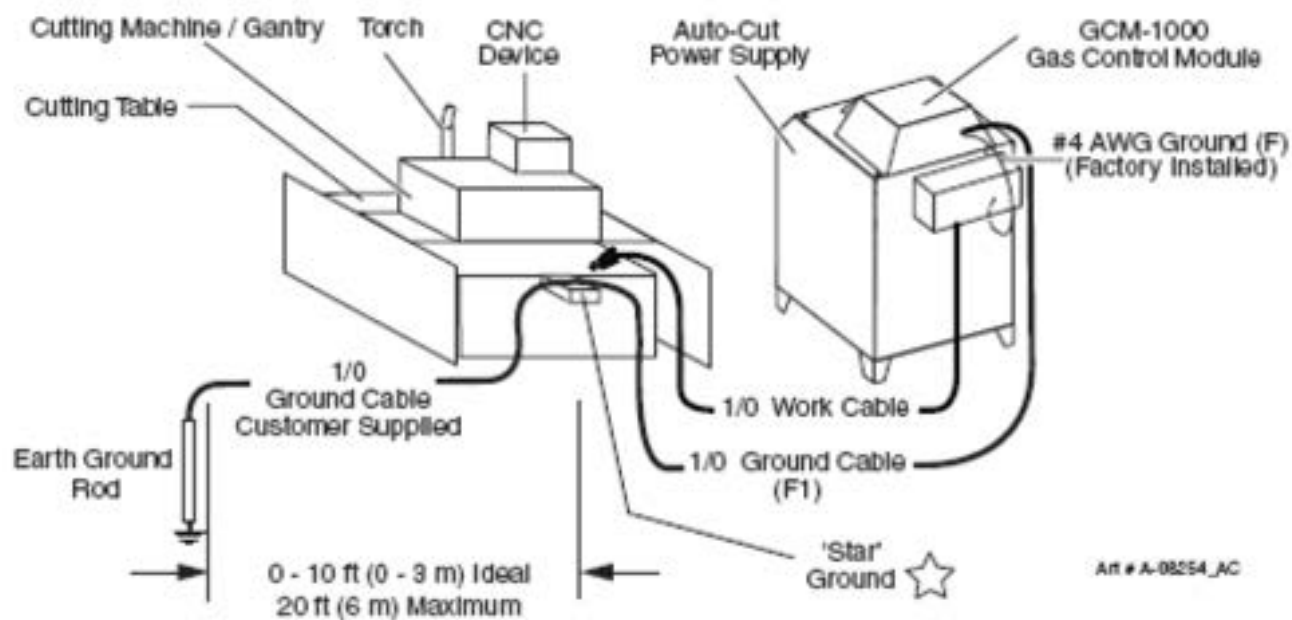
**Note:** Increasing the ground rod length beyond 20-30ft (6.1- 9.1m) does not generally increase the effectiveness of the ground rod. A larger diameter rod which has more surface area may help. Sometimes keeping the soil around the ground rod moist by continuously running a small amount of water into it will work. Adding salt to the soil by soaking it in salt water may also help to reduce its resistance. When you use these methods periodic checking of the ground resistance is required to ensure that the ground is still good.

**Note:** Keep the torch leads clean . Dirt and metal particles bleed off energy, which causes difficult starting and increases chances of RF interference.





Ground Testing



## Shielding.

### Single Shield Method (Good):

Connect the shield/drain of a shielded cable to ground at the sensitive equipment end and leave the other end of the shield disconnected.

Cover all **non-shielded** cables with a tightly woven braided shield. Slide the shield over the cable leaving enough to slide back over the electrical connectors and terminate only the one end to the sensitive equipment side ground. Use a metal cable clamp to attach the shield to the ground. **See Figure 3.**

### Double Shield Method (Better):

Cover all **shielded** cables with a tightly woven braided shield. Slide the shield over the cable leaving enough to slide back over the electrical connectors. Use a metal cable clamp to attach the shield to the nearest ground at both ends of the cable. **See Below Figure.**



### Clamp On Ferrite Cores:

Use a clamp type ferrite core on the following cables:

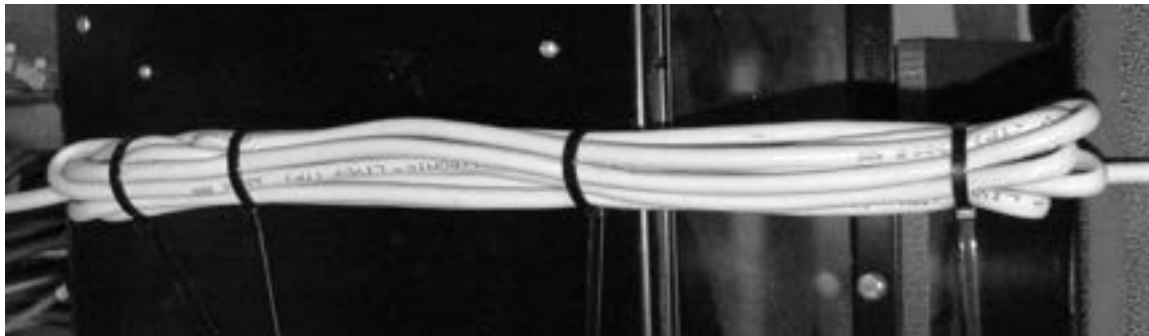
- Wall Mount Transformers
- RS232 Cables (as an alternative, fiber optic converters will offer the best noise immunity)
- Computer and Motor Controller AC power cord
- Control cables and encoder cables

- I/O cables

Open the ferrites clamp and pass 4 to 10 turns around one half of the core then close and snap the clamp shut. Ferrite cores are not recommended for use with braided shielding.

#### Other:

- If cables must cross ground wires or at worse case torch leads do so at 90 degree angles.
- Select a power outlet rated to support the devices that will be connected.
- Avoid connecting the cutting table to multiple AC power outlets. Use one outlet with a good surge suppression device and multiple power outlets.
- The Plasma Power Supply may be connected to a different power outlet however it is best if the outlet is common to the same panel as the cutting table.
- Do not coil wires and cables. If you need to clean up the install do so by wire tying the loops of extra cable so the major length of the cable is touching. Remove as much air gap as possible from the cable bunch. **See Below Figure.**



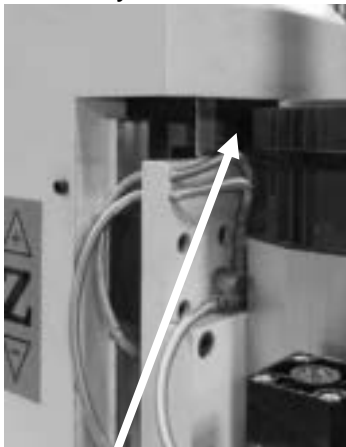
This does not apply to Ground cables, always cut ground wires & cables to minimum required length.

- Route ground cables as far apart from control cables as is possible. Keep cables that run in parallel (i.e. in the same power track) with the ground separated by as much air space or other gas hoses as possible.
- HF (High Frequency) travels on the outside of a wire. Increasing the diameter of the ground wire or using flat braid for ground wire will improve the ability to carry the HF to ground.

## Machine Operation.

### Home switches.

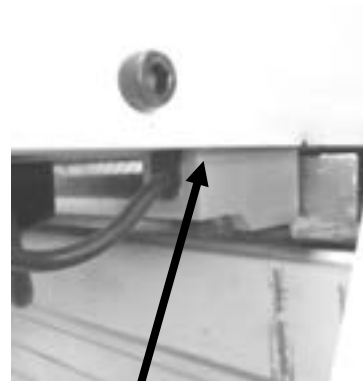
There are three switches that determine the home position of the cutting head. The switches are factory set, and no adjustment should be required. If adjustment is required, contact your service technician prior to conducting any adjustment.



Z axis home switch



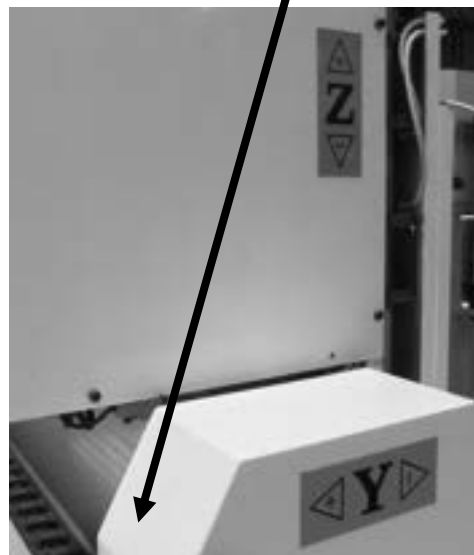
Y axis home switch



X axis home switch

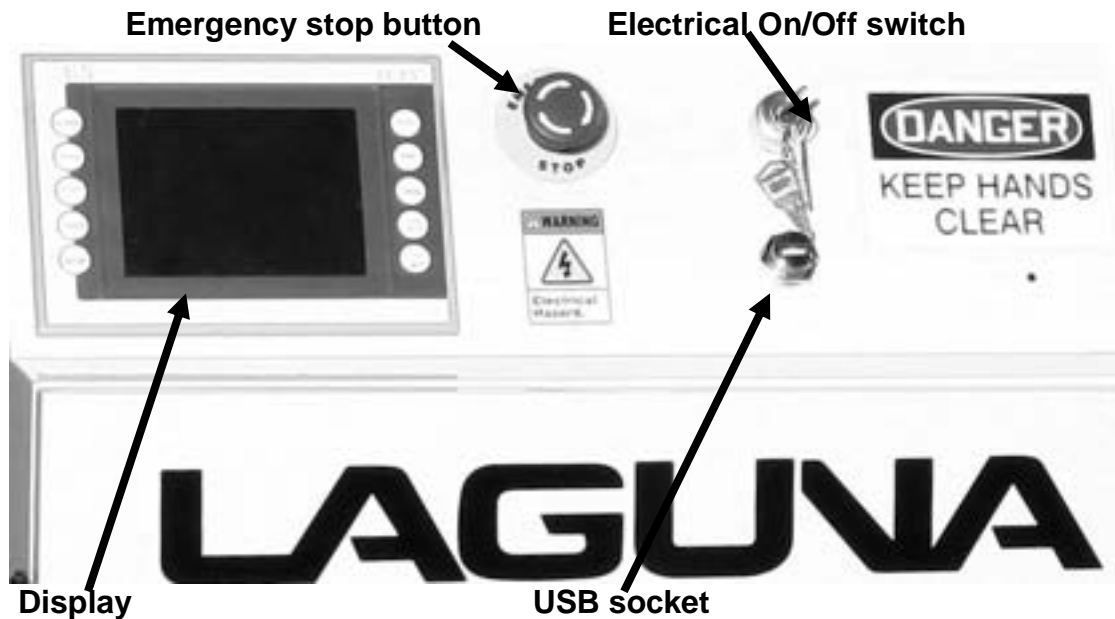


Y axis home switch



X axis home switch

## Control Panel.



The control panel houses the main interface to the machine.

1. Display.
2. USB socket. This is used to input programs into the controller.
3. Emergency stop button.

To reset the emergency stop, twist clockwise and it will pop out.

4. Electrical On/Off switch. The electrical On/Off switch connects the controller to the electrical supply and starts the processor.

## Loading a program into the machine.

1. Load your program into your USB drive.
2. Fit the USB into the USB slot.
3. Press the PROG. button. This will take you to the program page.
4. Press ACCESS USB button. The "active program" box will display the name of the first program on your USB.
5. Use the arrow keys to select a file.
6. Press the copy button to copy the file.
7. Press Access Card button.

8. Use arrow keys to select a file.
9. Press RUN button to go to the run screen
10. **Ensure that you are cleared of the machine. Wear Proper flash protection for your eyes.**
11. Press START button. The machine will start running the G code

## Turning on the Machine.

**Note:** Before you turn on the machine, remove all tools and other objects from the machine table.

**Release the emergency stop by twisting clockwise, and it will pop out.**

Turn the On/Off switch to turn the power on. The display will light up.

Press HOME MACHINE button

**Make sure that the table surface is clear of obstructions.**

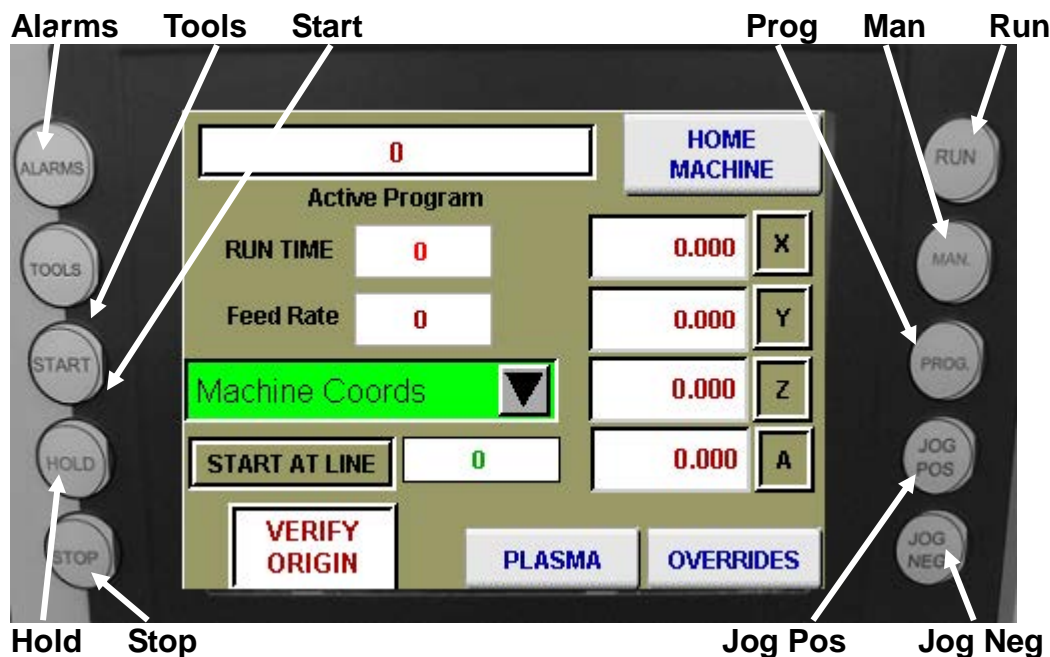
The head will move to the home position on the table.

## Do's and Don'ts.

1. **DO** lubricate all ball screws every 8 hours of run. Use 30w oil or lithium white grease lubricant or equivalent to lubricate the ball screws and wipe off any excess to reduce dirt and dust acumination.
2. **DO NOT** ever under any circumstances reach over the table or obstruct the movement of the gantry while the machine is powered or running a program.
3. **ALWAYS** press in the E-STOP button on the control box and turn off main power prior conducting any maintenance. Remember to clear alarms caused by the E-STOP button on the alarm pages after the E-STOP has been removed.
4. The E-STOP button **MUST** be out before turning on the main power (twist and it will pop out).

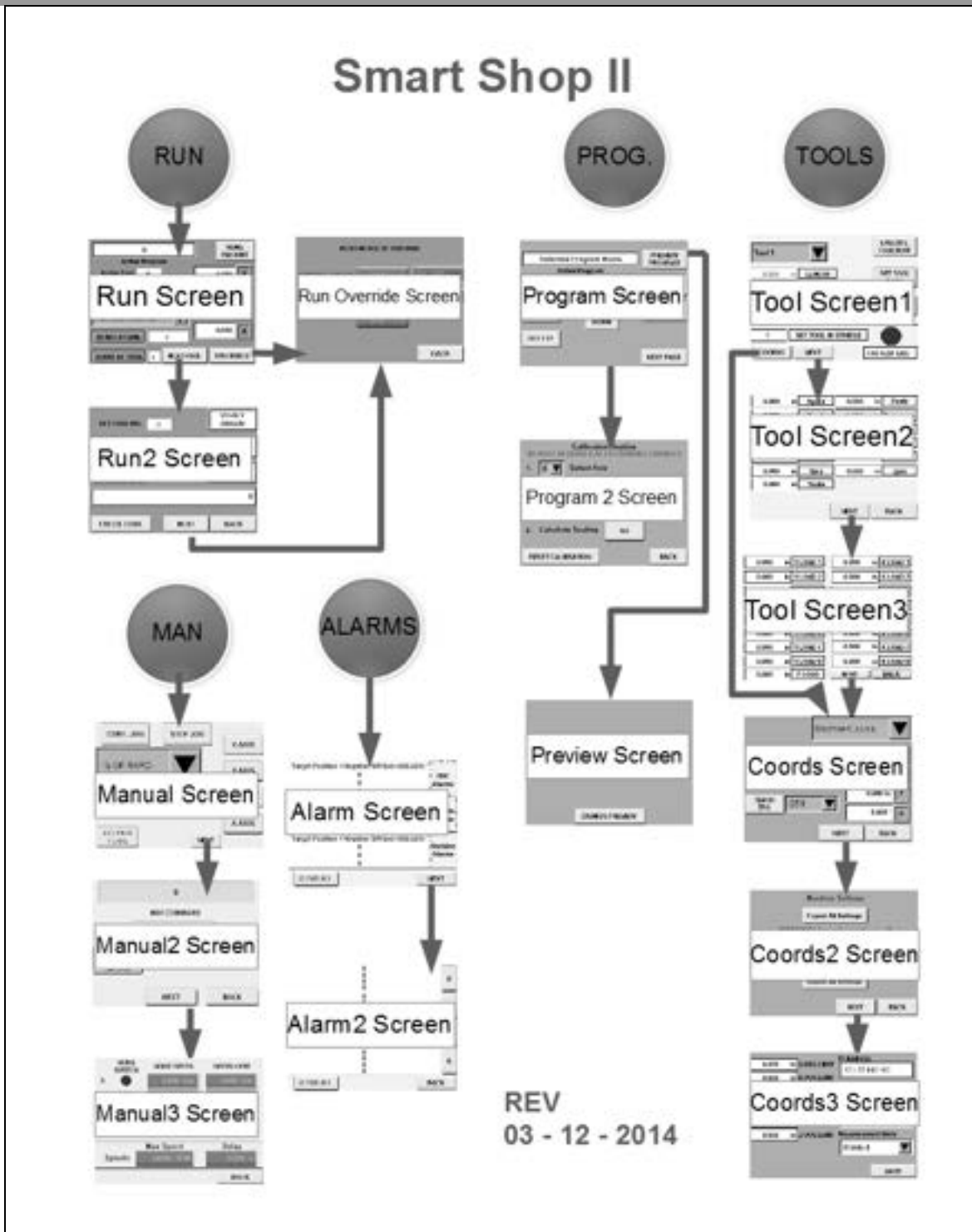
## Membrane Button Descriptions.

<b><u>Alarms.</u></b>	This is a page jump to the first Alarm Screen.
<b><u>Tools.</u></b>	This is a page jump to the first Tool Screen.
<b><u>Start.</u></b>	This button is for starting the program shown in the active Program screen.
<b><u>Hold.</u></b>	This button is used to pause a running program. To release Hold, press the start button, and the program will continue.
<b><u>Stop.</u></b>	This button Stops the active program.
<b><u>Run.</u></b>	This button is a page jump to the first Run (home) screen.
<b><u>Man.</u></b>	This button is a page jump to the first Manual screen
<b><u>Prog.</u></b>	This button is a page jump to the first Program screen
<b><u>Jog Pos.</u></b>	This button jogs the selected Axis in the positive direction.
<b><u>Jog Neg.</u></b>	This button jogs the selected Axis in the negative direction.





## Screen overview





## Run Screen.

The Run Screen interface displays the following elements:

- Top Bar:** A large white box with the number **0** in red, and a **HOME MACHINE** button to its right.
- Active Program:** A label above a field containing **0**.
- RUN TIME:** A label above a field containing **0**.
- Feed Rate:** A label above a field containing **0.00 in/m**.
- Machine Coords:** A green highlighted label next to a drop-down menu showing a downward arrow.
- START AT LINE:** A label above a field containing **0**.
- Axis DROs:** Four fields showing **0.000 in** for X, Y, Z, and **0.000°** for A, each with a small button to its right.
- Buttons:** **VERIFY ORIGIN** (red text), **PLASMA**, and **OVERRIDES** (blue text).

- 1) Homing the machine is the first step every time power is applied. No functions or actions can occur until homing is complete and successful.
- 2) (Active Program) field shows the current program loaded for run.
- 3) (Feed Rate) and (Spindle RPM) indicate the programmed rate and speed during a program run..
- 4) (Start at Tool) allows the operator to start a program from a specific tool in a multiple tool program.
- 5) (Machine Coords) is a drop-down menu to select which dimension set is shown in the X, Y, Z, and A axis DROs. The displayed references are for Machine Coordinates, Zero Point Offset (G54), and relative coordinates.
- 6) (OVERRIDES) button is for a page jump to the overrides available while the program is in run.
- 7) (PLASMA) button is for a page jump to the second Run screen where the operating parameters for Plasma cutting are set.

## Run 2 Screen.{PLASMA SET-UP,1}

PLASMA SET-UP			
PIERCE HEIGHT	0.000	PLASMA FEEDRATE	0.000
CUT HEIGHT	0.000	PIERCE DWELL	0.00
EXECUTE TOUCHOFF	PID Scan (x 4ms)		0
	ARC Sample Delay		0
CHECK CODE	NEXT	BACK	

The following fields are propagated from the cut chart provided by your Plasma power supply manufacturer.

**NOTE:** The settings are a starting point only. Metals vary greatly and so adjustments for total performance are generally required.

- 1) {PIERCE HEIGHT}: This is the distance the torch will ignite from the metal plate as detected by plate touch off that can occur before every ignition.
- 2) {CUT HEIGHT}: This is the distance from the plate that the torch will move to for the material during the cutting process.
- 3) {PLASMA FEEDRATE}: This is the cutting federate from the cut chart based on material thickness and Amperage setting of the power supply.
- 4) {PIERCE DWELL}: This is the time delay the torch stay's at the pierce height to pierce through the plate based on the chart.
- 5) {PID SCAN}: This is the scan time adjustment for fine tuning the height control system. Unless you're a very high end user there is no reason to adjust this parameter.
- 6) {ARC SAMPLE DELAY}: This is the delay from the movement to cut height until the system takes a sample of the arc feedback for the height control. For instance if you're starting on an incline you want the sample to be taken sooner so the torch stays above the material correctly. Most cases this does not need to be adjusted providing you have cammed the vectors with an intelligent starting point.

**7) {EXECUTE TOUCH OFF}:** Pressing this button will make the machine find the top of the plate. Execution of touch off will slowly lower the torch until there is continuity between the Ohmic clip on the torch and the grounded plate on the machines table.

Make certain the torch tip is clean and there is no scale or filth layer to inhibit continuity.

**8) {CHECK CODE}** Press this button prior to starting your program and the controller will pre-run the code looking for errors prior to starting the program.

## Run Overrides Screen.(Plasma Setting's,2)

PERCENTAGE OF OVERRIDE

P	0.00	Max O	0
I	0.00	Min O	0
D	0.00		

ARC PRESENT ●

FEED RATE 000.00 000.00

RAPID 000.00 BACK

The green numbers are fields that can be used for entering a percentage above and below the programmed rates of feed and speed.

The red numbered fields show the current rates of feed and speed.

The field (RAPID) is used to restrict the machines feed rate by a percentage when a G0 (Rapid Move) is called in a program.

**P, I, AND D FIELDS:** These are a very high end user function's.

For 98% of your cutting the default settings are perfect.

These are the height controllers PID loop control settings and should only be adjusted by competent personnel.

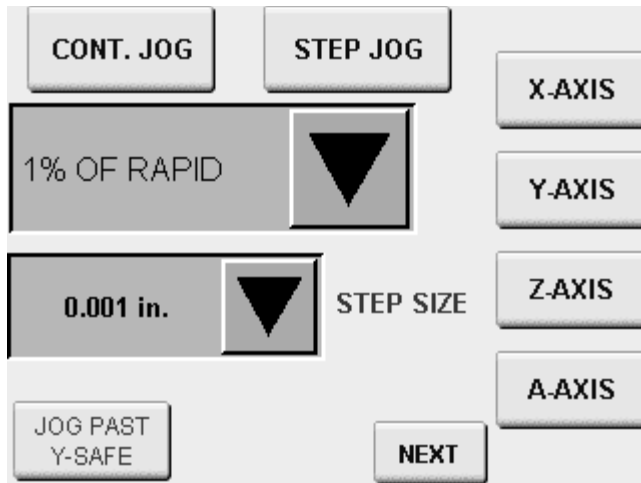
**MAXO AND MIN O:** These are the max velocities of Z during the use of the height control system. These too should only be adjusted by qualified personnel.

**FEEDRATE FIELD:** This is an Override for the feed rate during a program run, If you have set feed rate wrong this allows for adjustment during the cutting process. The adjustments are in percentage of the original feedrate that was set on the plasma set-up page.

The green is the percentage of change and the red field is the real time feed rate feedback after adjustment.

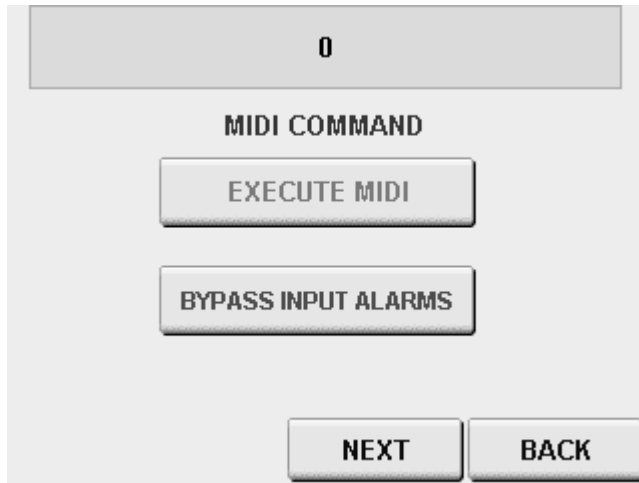
**RAPID Field:** This an override for the G0 rapids that are moves between cuts. There are times an operator would like to have more time between torch ignitions.

## Manual Screen 1 (Jog control).



- 1) (CONT. JOG) When pressed, selects a continuous jog mode based on the percentage of full speed chosen under (JOG SPEED).
- 2) (STEP JOG) When pressed, selects a step jog mode based on the resolution chosen under (STEP SIZE).
- 3) (X-AXIS, Y-AXIS, Z-AXIS, AND A-AXIS) Buttons are used to select the axis you wish to jog.
- 4) (JOG PAST Y-SAFE) Button allows the operator to jog past the Y-safe dimension, i.e., just before the tool rack.
- 5) The (NEXT) button is used to jump to the second manual screen for MIDI functions.

## Manual 2 Screen.



- 1) This screen is used for MIDI functions; this is when an operator needs to run a single line of G code at a time. This can do manual tool changes and move any axis to a specific location in the table.

Press on the pink command window, and an alpha-numeric pad will pop up for MIDI string entry.

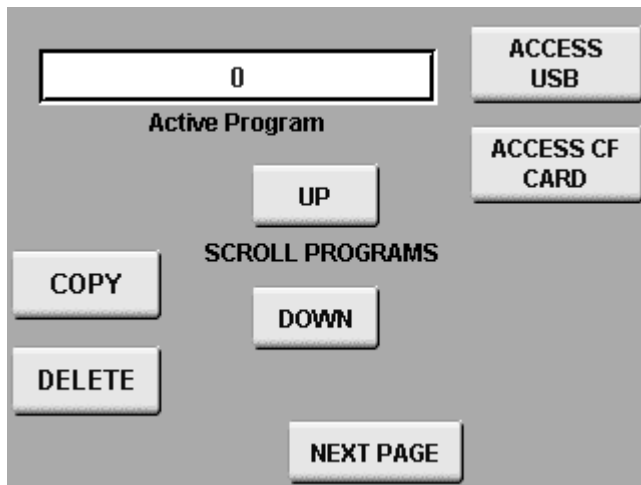
With the string entered, press (EXECUTE MIDI) to run.

## Manual 3 Screen.

0.000	HOME SPEED	0.000	0.000
0.000	SPINDLE DELAY		
0.000	X,Y SPEED LIMIT		
0.000	Z,A SPEED LIMIT		
<input type="checkbox"/>	X HOME SWITCH	<input type="checkbox"/>	Z HOME SWITCH
<input type="checkbox"/>	Y HOME SWITCH		BACK

- 1) The top three fields are for setting the Home speeds, from left to right is X, Y, and Z.
- 2) (SPINDLE DELAY) is the time the program waits for the spindle to become at speed before cutting begins.
- 3) (X, Y SPEED LIMIT) is the top speed the controller will rapid at when 100% of feed rate is required.
- 4) (Z, A SPEED LIMIT) is the top speed the controller will rapid at when 100% of feed rate is required.
- 5) The lower indicators are used to verify the individual home switches are functioning correctly, you can flag the home switches with something ferrous and activation will show on the corresponding light on the screen.

## Program Screen.



- 1) (Active Program) field displays the current program selection.
- 2) (ACCESS USB) Opens the inserted USB with stored programs.
- 3) (ACCESS CF CARD) Opens the list of stored programs on the controllers CF card.
- 4) (COPY) Button moves a program from either the network or the USB to the CF card on the controller.
- 5) (DELETE) Button is used for deleting programs from SD card.
- 6) (UP)/(DOWN) Buttons are used for scrolling through the stored programs in the location selected.



## Coord's Screen.

The screenshot shows a control interface for coordinate settings. At the top, there is a 'Machine Coords' label next to a downward-pointing triangle icon. Below this, on the left, are two buttons: 'RESET RELATIVE' and 'TEACH ZPO'. To the right of the 'TEACH ZPO' button is a dropdown menu currently displaying 'G54' with a downward-pointing triangle icon. To the right of the dropdown menu is a vertical stack of four input fields, each displaying '0.000' and a corresponding axis label in a small box to its right: 'X', 'Y', 'Z', and 'A'. At the bottom of the interface are two buttons: 'NEXT' and 'BACK'.

- 1) (Machine Coords) is a drop-down menu to select which dimension set is shown in the X, Y, Z, and A axis DROs. The displayed references are for Machine Coordinates, Zero Point Offset (G54), and relative coordinates.
- 2) (RESET RELATIVE) is a built-in tape measure. By pressing the RESET RELATIVE button, you will zero the X- and Y-axis DRO under relative coordinates display. You can then jog from there to get precise measurement when needed. This function does not affect machine or zero point offset locations.
- 3) (TEACH ZPO) Teach Zero Point Offset is used to set the work offsets the program will reference during run (G54 is generally the front left corner of the spoil board). Jog to the front left corner in X and Y and press the (TEACH ZPO) button.
- 4) The next button will jump to the Export and Import settings screen.

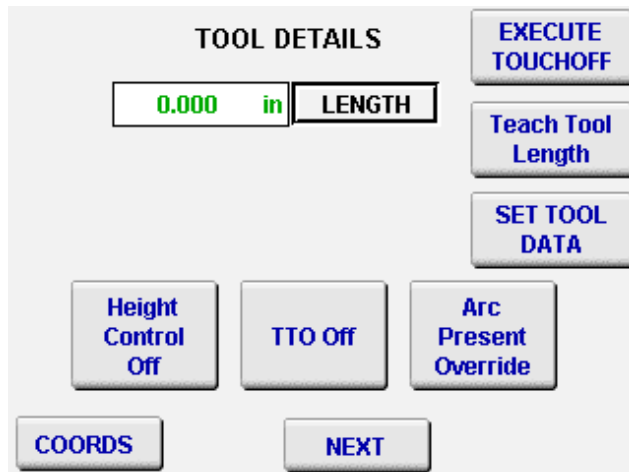
## Coord's 2 Screen.



- 1) This screen is used for exporting all user and factory machine settings in a machine settings .xml file for backup. This is needed if the flash card (operating system) is replaced or upgraded.

Simply insert a USB memory stick and press export. A file called "machine settings" will be generated. It is suggested you save this file securely so a rebuild or upgrade can be done quickly without resetting up the machine and its saved locations. Tool touch-off data is the only information not backed up, but once the tool touch-off is automated, it is easily repeated.

## Tools Screen.



The tools screen is where the operator can turn on and off the various plasma functions built into the B+R controller.

- 1) (EXECUTE TOUCHOFF) Button starts a torch touch-off routine to measure the Torch to Plate {Z zero distance}. Pressing this button starts to lower the Z axis down until continuity between the torch tip and the Plate to be cut.  
The distance the Z travels in Rapid before slowing is set in the {Z Pre field}.
- 2) To manually set the torch distance for Z Zero. Jog the Z axis until it contacts the plate. Press (Teach Tool Length), then press (SET TOOL DATA) to set.

**NOTE:** THE TOUCHOFF DOES NOT MOVE TO A LOCATION FOR THIS FUNCTION, IT LOWERS WHERE EVER THE OPERATOR HAS JOGGED THE TORCH OVER.

### 3) HEIGHT CONTROL OFF BUTTON:

This feature cancels the Height control system when it is not required. This is very helpful on flat plates where you want to go very fast. The height control has issues over 70- 80 IPM depending on the metal.

**4)TTO OFF BUTTON:** This button cancels the automatic torch touch off system that finds the top of the plate before every ignition. When you're doing thick flat material cancelling this feature will quicken your program considerably. When your material is not flat or is changing with heat it is best to use the TTO so the torch is always at the exact distance from the plate for the best cut quality and consumable life.

**5)ARC PRESENT OVERRIDE:** This button cancels the controllers need for Arc verification from the plasma power supply. This is useful when cutting expanded metal or cutting very

small parts free with many separate ignitions. If Arc present is enabled the control system waits for arc present and if there is no signal the program faults out. This is also needed to be canceled if cutting with a torch or a system without the feedback signal.

## Tools 2 Screen.



- 1) (ZSPOIL) is used when there is a spindle present for standard routing. This is used to offset the tool length when required.
- 2) (ZHOME) This is a Negative dimension for the Torch distance from the Home switch. This is the Height the Torch will travel at between Moves within a program.
- 3) (Zmeasure) Is used with a spindle and TTO touch off switch set-up only.
- 4) (Z Puck) This is used for a spindle application where a puck is used for measuring tool length.
- 5) (Zpre) is used with the Torch Touch off function and the TTO for spindle cutting. This is the dimension the Z axis will rapid to before slowing when looking for the Plate Z zero distance. Pierce height and Cut height both are measured from the top of the plate when discovered during TTO.

## Coord,s 3 Screen (coord,s set-up)

0.000	X-NEG LIMIT	IP ADDRESS	
0.000	X-POS LIMIT	192.192.192.192	
0.000	Y-NEG LIMIT	SS	AR
0.000	Y-POS LIMIT	1.0	V3.91
0.000	Z-NEG LIMIT	ACP10	
0.000	Z-POS LIMIT	1.0	
0.000	A-NEG LIMIT	ARNCO	
0.000	A-POS LIMIT	1.0	
		BACK	

- 1) The left side fields are for setting the positive and negative limits of each axis's travel.
- 2) The right side of the screen is used to set up a home network for file transfers and remote control via VNC from another computer on the network.

## Alarm Screen 1 & 2.

'Target Position < Negative SW End (G00,G01) '		CNC Alarms
0		
0		
0		
0		System Alarms
0		
0		
0		
'Target Position < Negative SW End (G00,G01) '		Machine Alarms
0		
0		
0		
<div>CLEAR ALL</div> <div>NEXT</div>		
0		X AXIS
0		
0		
0		
0		Y AXIS
0		
0		
0		
0		Z AXIS
0		
0		
0		
0		Y' AXIS
0		
0		
0		
<div>CLEAR ALL</div> <div>BACK</div>		

**Note:** Whenever something is wrong with the machine or the Operator has tried to operate outside the machine's parameters there will be a message on one of these alarm screens. The first screen represents CNC, System, and Machine faults. The second screen represents Axis errors.

If the error cannot be reset with the (CLEAR ALL) button, then contact Laguna Tools Customer Service department for assistance.

## Getting Started.

### Ethernet connection.



1. Control panel



2. Network hub



3. Ethernet cable



4. Ethernet cable connected to screen

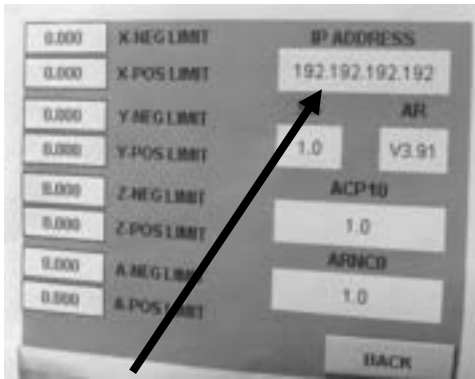


5. Screen seen from inside of control cabinet



6. Ethernet cable connected to network hub





### **Store IP address in safe place**

You need FILE ZILLA software to be able to transfer files.

Real VNC viewer 4 to view machines on your computer

## **Control Panel Back up Battery..**



**Control panel battery compartment**



**Battery cover removed**

To replace the control panel has a backup battery.

1. Remover the control panel from the electrical control cabinet.
2. Release the battery cover and remove.
3. Pull the tab and remove the battery. Note the +\_ position of the battery.
4. Replace the battery, ensuring that it is inserted in the correct orientation.
5. Replace the battery cover and refit the control cabinet.

## M Code.

M-Function	Sync / Async	In Use	Description
0	Sync	Yes	Predefined: Programmed Stop
1	Sync	Yes	Predefined: Optional Stop
2	Sync	Yes	Predefined: End of Main Program / Subprogram
3	Sync	Yes	Spindle On
4	Sync	No	
5	Sync	Yes	Spindle Off
6	Sync	Yes	Tool Changer - executes subprogram brtc.cnc
7	Sync	No	
8	Sync	Yes	Dust Hood Up On
9	Sync	Yes	Dust Hood Up Off
10	Sync	Yes	Open Grip On
11	Sync	Yes	Open Grip Off with check for tool in spindle
12	Sync	Yes	Open Grip Off with no check for tool in spindle
20	Sync	No	Turns on mister output
21	Sync	No	Turns off mister output
29	Sync	Yes	Predefined: End of Main Program / Subprogram
30	Sync	Yes	Predefined: End of Main Program / Subprogram, turns off Digital Outputs
31	Sync	Yes	DO_SPINDLE_RET = 1, DO_DRILL_MOTOR_EN = 1
M-Function	Sync / Async	In Use	Description
32	Sync	Yes	DO_DRILL_MOTOR_EN = 0, DO_DRILL[1-10]_EXT = 0, DO_SPINDLE_RET = 0, DO_SPINDLE_EXT = 1
33	Sync	Yes	DO_DRILL_[1-10]_EXT = 1 (based on TFunctionValue)
34	Sync	Yes	DO_SPINDLE_RET=1, DO_SPINDLE_EXT=0
35	Sync	Yes	DO_DRILL_[1-10]_EXT = 0
50	Sync	Yes	Engages the Tangential Tool for Tangential Machines,

51	Sync	Yes	Engages Slide Drills on SS2_MT_3SLIDES Machine with Z-Offset
52	Sync	No	Disable Z-Safe Position Offset and Disengage Slide Drills
100	Sync	Yes	Rotates rack to empty position (tool in spindle)
101	Sync	Yes	Extends tool rack
102	Sync	Yes	Rotates rack to new tool position
103	Sync	Yes	Retracts rack
200	Sync	Yes	A Axis free run - MoveVelocity command
201	Sync	Yes	Stop A Axis
202	Sync	No	
203	Sync	Yes	Plasma - DO_START_ARC = 1
400	Sync	Yes	Tangent Axis - move Z-Axis Offset to TanSafe position for tool
401	Sync	Yes	Disable Z-Safe Position (return Z-offset to 0)
500	Sync	Yes	HMI_IF.Input.Command.RequestDisabledMode = 1
550	Async	Yes	Invalid Tool Alarm
600	Async	Yes	ARC_SAMPLE delay
700	Async	Yes	Vision System

# G Code.

## Overview

G-Function	M	S	Group	Description
G00	x		1	Rapid interpolation
G01	x		1	Linear interpolation
G02	x		1	Circular interpolation - clockwise
G03	x		1	Circular interpolation - counter clockwise
G04		x		Dwell time in seconds
G05	x		1	Direct programming of the polar axes in the clockwise direction (starting with V0.207)
G06	x		1	Direct programming of the polar axes in the counter-clockwise direction (starting with V0.207)
G10	x		14	Programmed path speed on the tool center point
G11	x		14	Programmed path speed on the workpiece contour
G12	x			Path speed at transition arcs
G16	x		19	Orientation of the tool axis (starting with V0.270)
G17	x		2	XY plane selection
G18	x		2	ZX plane selection
G19	x		2	YZ plane selection
G17 Q	x		2	CAM wrapping
G18 Q	x		2	
G19 Q	x		2	
G20	x		3	Deactivate mirroring
G21	x		3	Y axis mirroring
G22	x		3	X axis mirroring
G23	x		3	X and Y axis mirroring
G25	x		11	Tangential transition arcs
G36	x		17	CDC: Replace arc with straight line - DEACTIVATE
G37	x		17	CDC: Replace arc with straight line - ACTIVATE
G38	x		18	CDC: Allow contour violations at small path sections - DEACTIVATE
G39	x		18	CDC: Allow contour violations at small path sections - ACTIVATE
G40	x		5	Deactivate the CDC
G41	x		5	CDC left
G42	x		5	CDC right
G53	x		6	Deactivate the zero point offset
G54	x		6	Zero point offset 1
G55	x		6	Zero point offset 2
G56	x		6	Zero point offset 3
G57	x		6	Zero point offset 4
G58	x		6	Zero point offset 5
G59	x		6	Zero point offset 6
G60		x		Accuracy hold
G70	x			Units switch (Programming in Inch)
G71	x			Units switch (Programming in mm)
G90	x		8	Absolute position coordinates
G91	x		8	Relative position coordinates
G92	x			Programmed zero point offset with coordinate system rotation
G93	x			Feed Rate Definition (inverse time feed rate definition)
G94	x			Feed Rate Definition (feed per minute)
G100	x			Full transformation
G101	x			
G102	x		1	Circle Interpolation in General Orientation

G103	x		CDC: Radius-dependent feed adjustment at convex path sections (starting with V0.201)
G104	x		CDC: Radius-dependent feed adjustment at concave path sections (starting with V0.201)
G105	x		Setting the "v_jump" Parameter (starting with V0.198)
G106	x		Setting the "a_jump" Parameter (starting with V0.198)
G107	x		Axis limit switch (starting with V0.190)
G108	x	12	Set Path Acceleration
G109	x	13	Set Path Deceleration
G110	x	12,13	Set Path Acceleration and Path Deceleration
G111	x		Block transition with speed dip (starting with V0.240)
G112	x		Block transition without speed dip (starting with V0.240)
G113		x	Reduction of path speed at tangential path section transitions
G114	x		Optimized circular acceleration ratio
G115	x		Standard acceleration ratio
G126	x	11	Rounding edges
G130	x	20	Compensation in the direction of the machine coordinate system (starting with V0.270)
G131	x	20	Compensation in the direction of the programmed system (starting with V0.270)
G132	x	4	CDC with linear transitions (starting with V0.200)
G133	x	4	CDC with arc transitions (starting with V0.200)
G134	x	4	Intersection path calculation - DEACTIVATE (starting with V0.194)
G135	x	4	Intersection path calculation - ACTIVATE (starting with V0.194)
G137	x	9	Activate/deactivate CDC indirectly with transition block
G138	x	9	Activate/deactivate CDC directly
G139	x	9	Activate/deactivate CDC indirectly
G140	x	15	Deactivate tangential axis automatically (starting with V0.130)
G141	x	15	Activate tangential axis automatically (starting with V0.130)
G144	x		Continuous alignment of automatic tangential axes
G145	x		Standard alignment of automatic tangential axes
G153		x	Position coordinates in the machine coordinate system
G159=0-199	x	6	Expanded zero point offset
G161	x	10	Absolute coordinates for center of circle
G162	x	10	Relative coordinates for center of circle
G170		x	Decoder synchronization
G171		x	Immediate processing of NC blocks
G172		x	Decoder/Path Synchronization
G180		x	Connecting path elements
G192	x		Rotate/Shift Coordinate System (Mounting correction)
G193	x		Activate mode "Linear Feed Characteristic"
G194	x		Deactivate mode "Linear Feed Characteristic"
G195	x		Switch On RTCP
G196	x		Switch Off RTCP
G200		x	Position latch
G201		x	Position latch with following halt
G211	x		Activate "blended move mode"
G217		x	Mapping
G218		x	
G219		x	
G220		x	Output signal before the end of the path section
G221		x	Activate prediction for G220
G222		x	Signal function with specification of the remaining path distance

G234	x			Activation Change without transition lines
G235	x			Activation Change with transition lines
G240	x		16	Non-periodic tangential axis (starting with V0.151)
G241	x		16	Periodic tangential axis (starting with V0.151)
G292	x			Rotate/Shift Coordinate System
G300	x			Chord error monitoring (starting with V0.201)
G300	x			Chord Error Monitoring: Variations for polar coordinate motor (starting with V0.201)
G320	x			Workspace Boundaries Definition and Monitoring Activation
G320.1	x			Workspace Boundaries Monitoring Deactivation
G320.2	x			Switch on workspace monitoring and self-collision detection
G320.3	x			Switch off workspace monitoring and self-collision detection
G320.4	x			Diameter of the Robot Arms
G320.5	x			Protected Block Definition
G320.6	x			Protected Block Activation
G320.7	x			Protected Block Deactivation
G320.8	x			Protected Half-Space Definition
G320.9	x			Protected Half-Space Activation
G321	x			Protected Half-Space Deactivation
G395	x			TCP frame
G396	x			TCP axes orientation by frame on
G397	x			TCP axes orientation by frame off
G398	x			Calculation method of TCP axes orientation closer to actual TCP orientation
G399	x			Calculation method of TCP axes orientation closer to programmed TCP orientation
G701	x			Resume MP logging
G702	x			Pause MP logging
G801	x			Start of a C2 Spline
G802	x			End of a C2 Spline

**M ... Modal valid**

Valid until the G-function is deactivated by another from the same group

**S ... Block valid**

Only valid in the block in which the G-function is programmed

## Maintenance.

As with any machine, to ensure optimal performance, you must conduct regular maintenance.

## Torch Maintenance.

See the torch manual that is supplied with the torch.

## Lubrication.

You must regularly (minimum every 12 hours) lubricate the bearing surfaces and the ball screws. Use a thin Lithium spray or a 30wt oil lubricant. Spray daily and wipe off the excess.

## Daily Checks.

1. Clean the machine and lubricate unpainted surfaces with a 30wt oil lubricant. Wipe off any excess and buff with a dry polishing cloth. This will reduce the likelihood of rust forming.
2. Generally inspect the machine for damage and loose or worn parts.

## Weekly checks.

1. Generally inspect the machine for damage and loose or worn parts.
2. Check that all the electrical connectors are fitted correctly and are not loose.
3. Check that all the motor couplers are connected and that the screws are tight.



## Position of Home Switches.

The home switches are activated by proximity to steel items and can be tested by placing a screwdriver or something similar on the activation face (top). When activated, an LED should light. If the LED does not come on, the switch or wiring is faulty.

## Oiling the Machine.

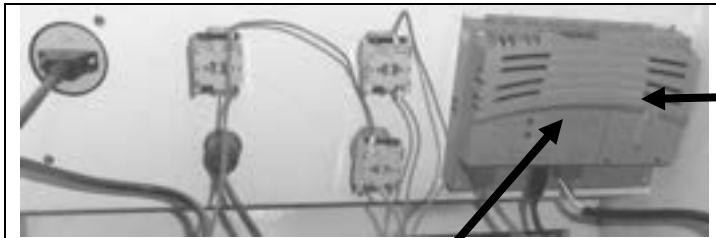
The machine is provided with a central oiler. Do not over-lubricate the machine, as the excess oil attracts dirt. It is recommended that one pump of the oiler once a month will be sufficient to keep your machine lubricated. When the oil tank needs filling, top up with a good quality SAE 30wt oil.



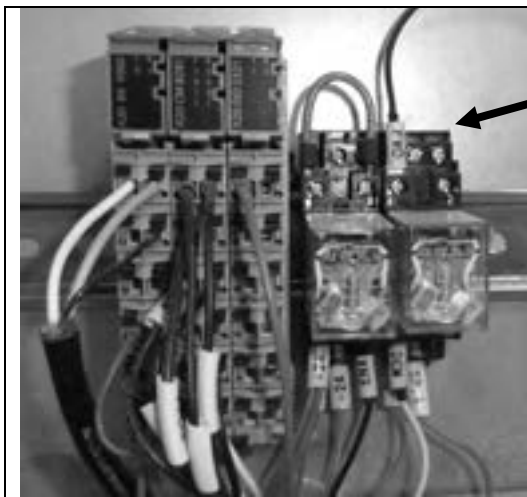
**Central oiler**



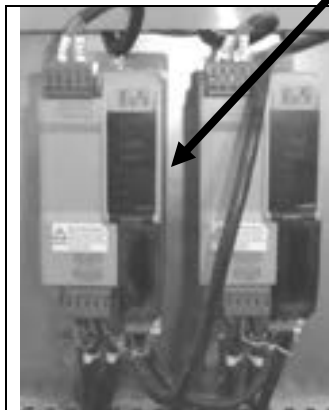
## Components inside the Electrical Control Box.



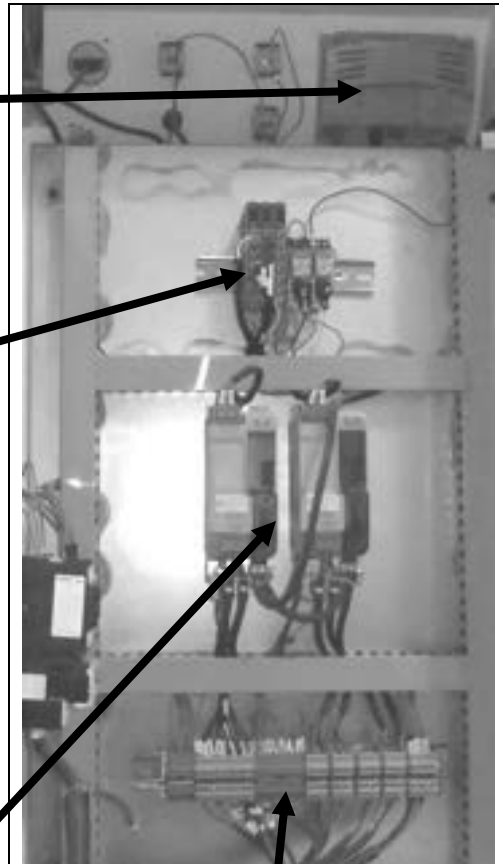
**B& R controller**



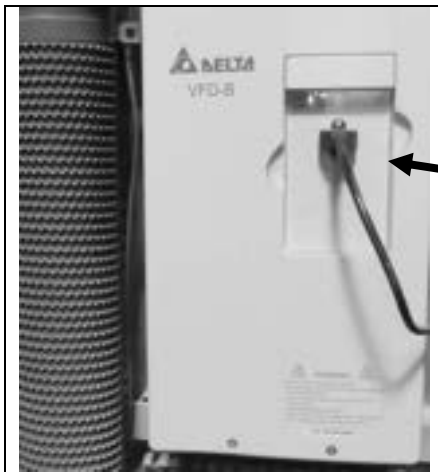
**PLC rack**



**Drivers**

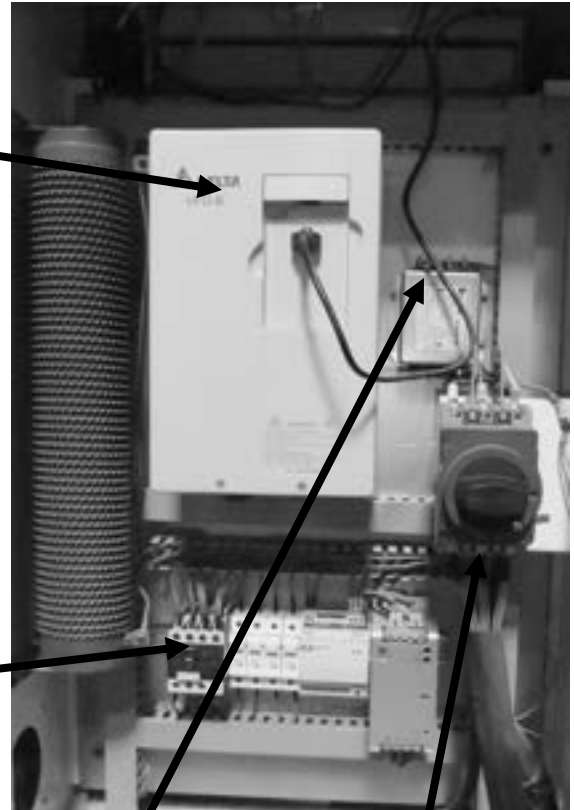


**Termination block**

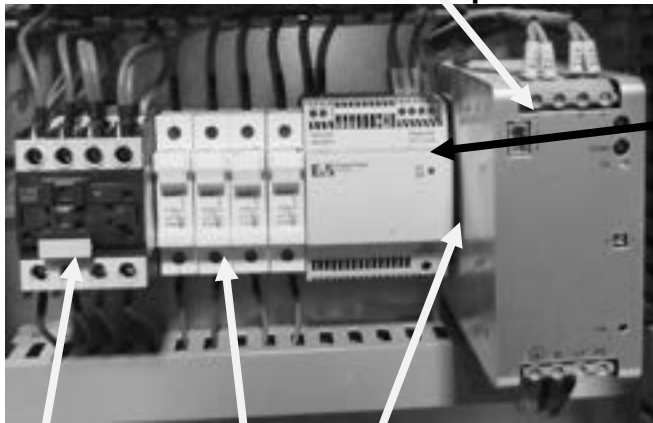


**VFD**  
**[Variable Frequency Drive]**

**Front electrical panel**



**72V p.s.**



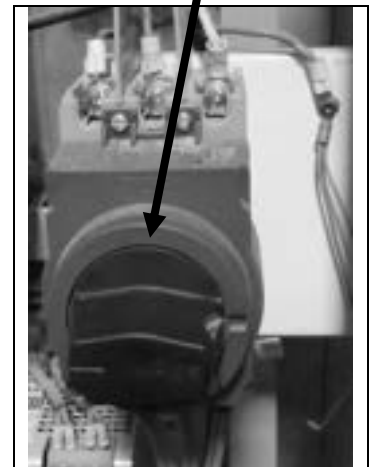
**Breaker**

**Fuses**

**24V power supply**



**EMI filter**



**Main Isolation switch**

## Troubleshooting.

### Machine will not start.

1. Check that the start switch is being pressed full in.
- 2. Check that the red emergency stop switch is fully out.**
3. Check that the electrical power cord is plugged into the power outlet.
4. Check that the electrical supply is on (reset the breaker).
5. With the power disconnected from the machine, check that the wiring to the plug is correct. Check that the rubber insulation is stripped enough and is not causing a bad connection. Check that all the screws are tight.

### Stepper motor tries to start but will not turn.

1. With the power disconnected from the machine, try to turn the relevant motor by hand. If the motor will not turn, check the reason for the jamming.
2. Motor faulty. Replace the motor.
3. Check that the voltage supplied to the machine is 220V.

### Squeaking Noise.

1. Check the bearings.
2. Check pulleys and belt for correct tension.

### Machine Vibrates.

1. Machine not level. Re-level the machine, ensuring that it has no movement.

### Machine will not home.

1. Are the home position sensors connected, damaged or out of adjustment?
2. Are the parameters in the controller correct?
3. After completing the job, press OK button and check if the cutting head returns to the home position?

### Jobs are not cut consistently.

1. Check that the motor drive belt is tight and not damaged. If damaged, replace.
2. Check if the drive couplings are tight or damaged. If loose, tighten; if damaged, replace.
3. Check if the slider bearings are fixed tight or damaged. If loose, tighten; if damaged, replace.

### Inaccurate Position of the cutting head.

1. Check that the drive screw and the bearing rails are clean and lubricated.
2. **Check** if the gantry head movement is too fast.
3. Check that all the bearings and motor fixing bolts are tight.
4. Check the input voltage is correct; it must be 220V.
5. Check that there are no obstructions on the gantry.

### The Controller Screen is Blank or Dull or Flickers.

1. Check if a fuse has blown.
2. The cable is damaged. Replace the damaged part.
3. The power supply is damaged. Replace the power supply.
4. The controller is damaged. Replace the controller.
5. The supply voltage is not within specification.

**Note:** The power must only be 24V.

**The Gantry or cutting torch will not function.**

1. Controller cable loose.
2. Drive wires loose or damaged.
3. Controller damaged.
4. E-stop is not in the out position. Re-set the E stop.

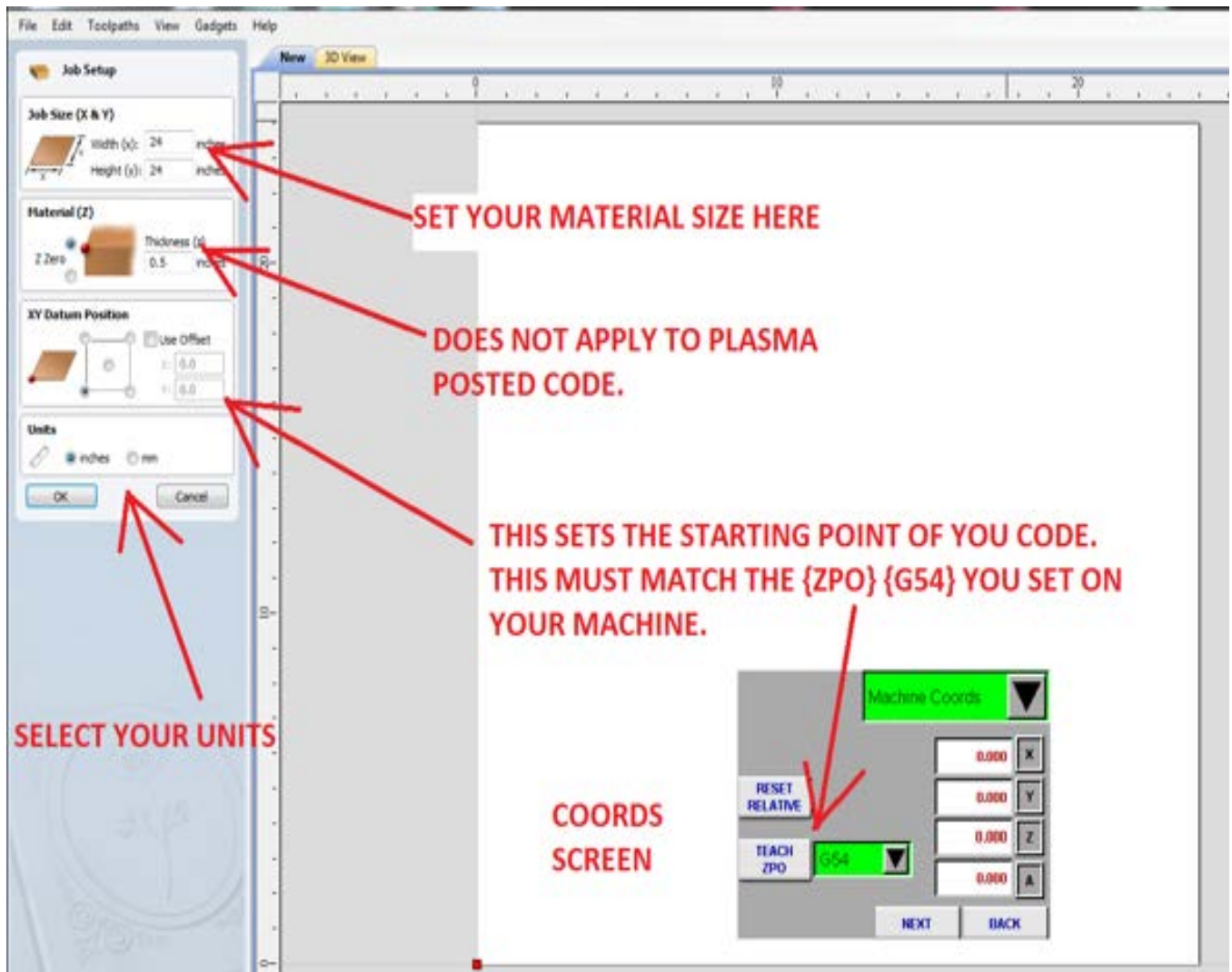
**For technical support contact Laguna Tools at  
1-800-234-1976  
or  
email Laguna Tools Customer Service at  
customerservices@lagunatools.com  
Please input machine type in subject line.**

## Vcarve Pro software

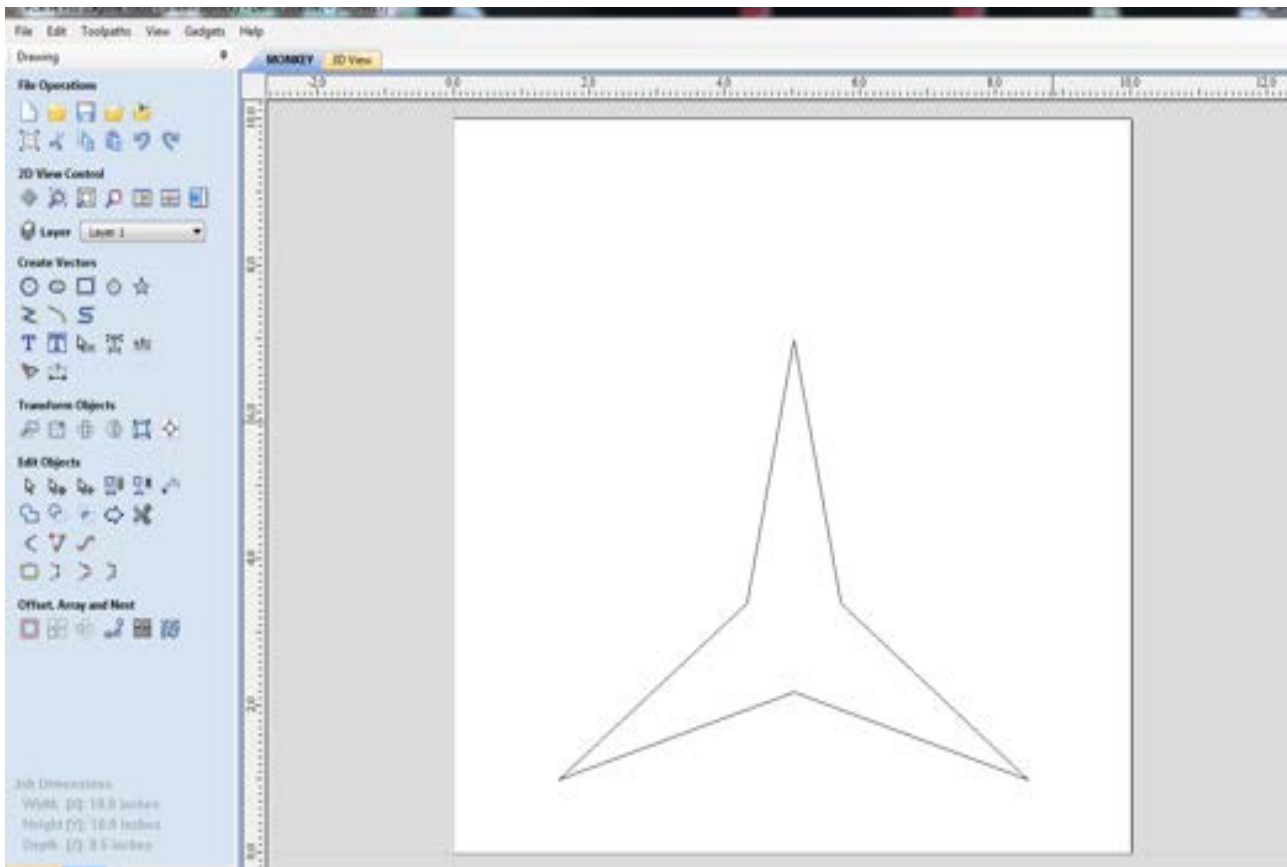
The following is a document outlining the basics of Vcarve Pro for posting code to the Laguna Plasma machine with B+R controller. There are many Vectric videos and tutorials available on your CD and online to further your skills in the software. Laguna offers several video's on their website for cutting examples as well.

To begin with we need to define the material and some parameters:

- 1) Set your material size.
- 2) The plasma post processor does not post Z axis moves. All the Z axis moves are configured in the Touch screen and based on information from the plasma cut sheets.
- 3) Set the Datum position, this is your working X and Y zero point offset. Machine zero is your home switch locations and your work zero is where the codes X and Y moves are measured from.
- 4) Select your units of measure.

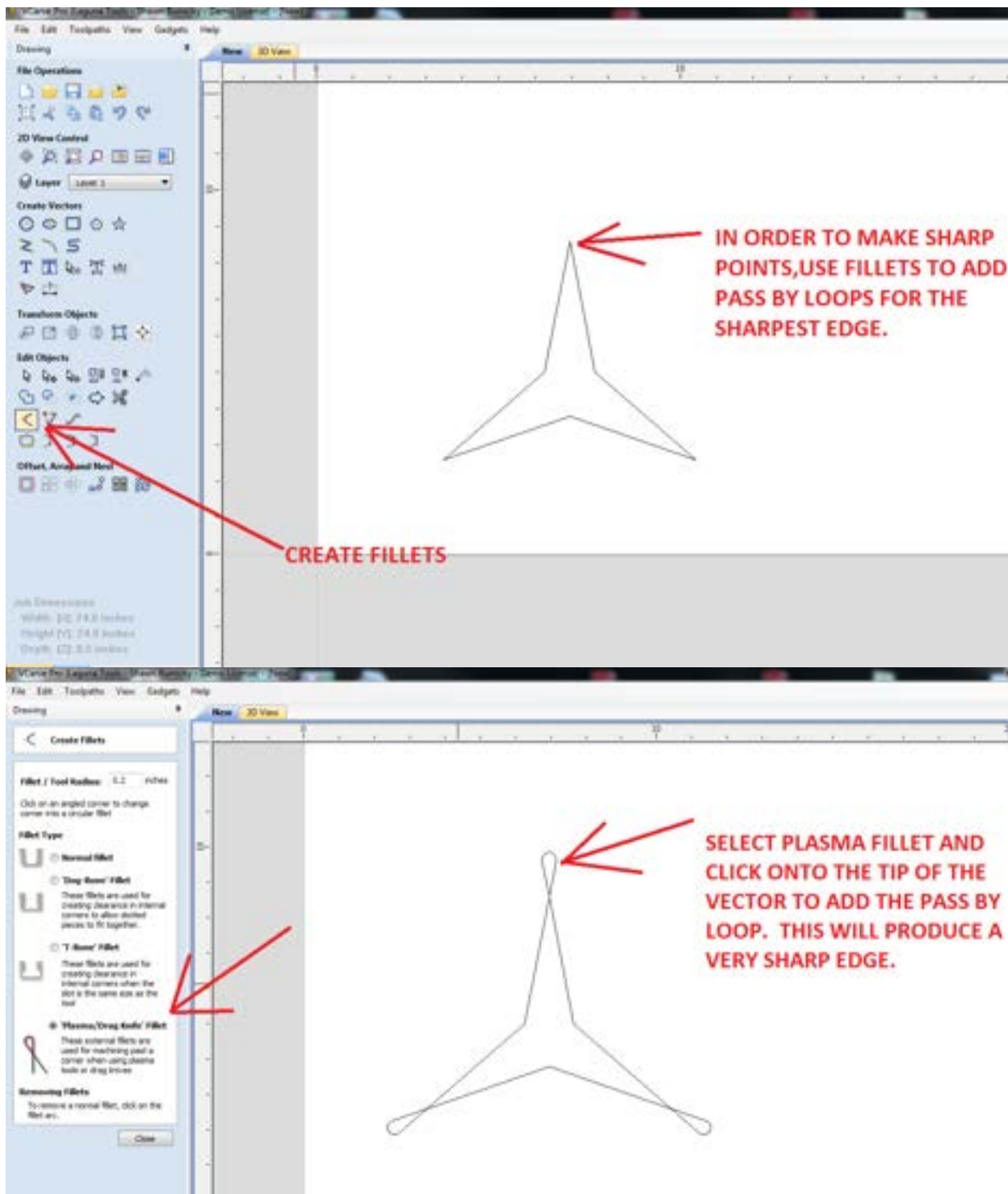


Let's add a graphic to the work area to be cut. You can either draw in Vcarve or import vectors or DXF files created in other drawing software.



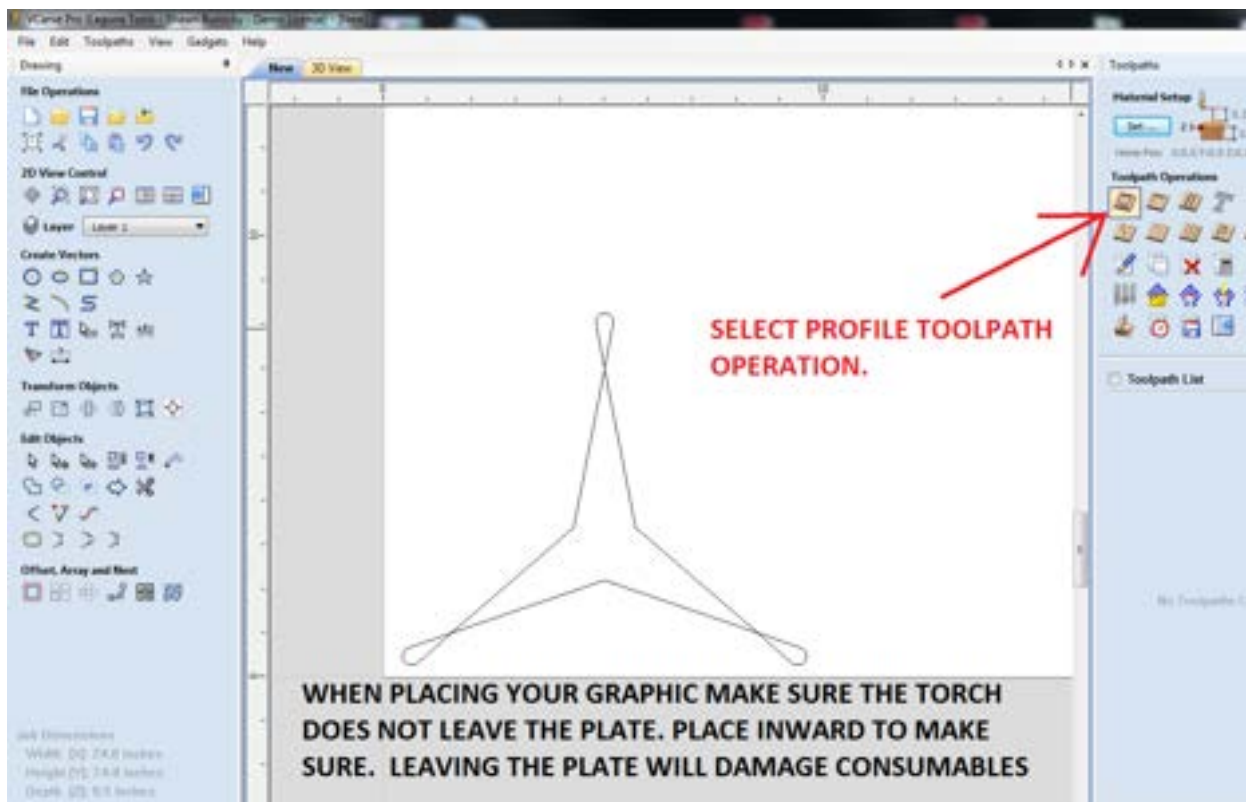
**NOTE:** In order for a plasma CNC to create a sharp point as needed in this star graphic we must add a pass by vector using the fillet command built into the software.

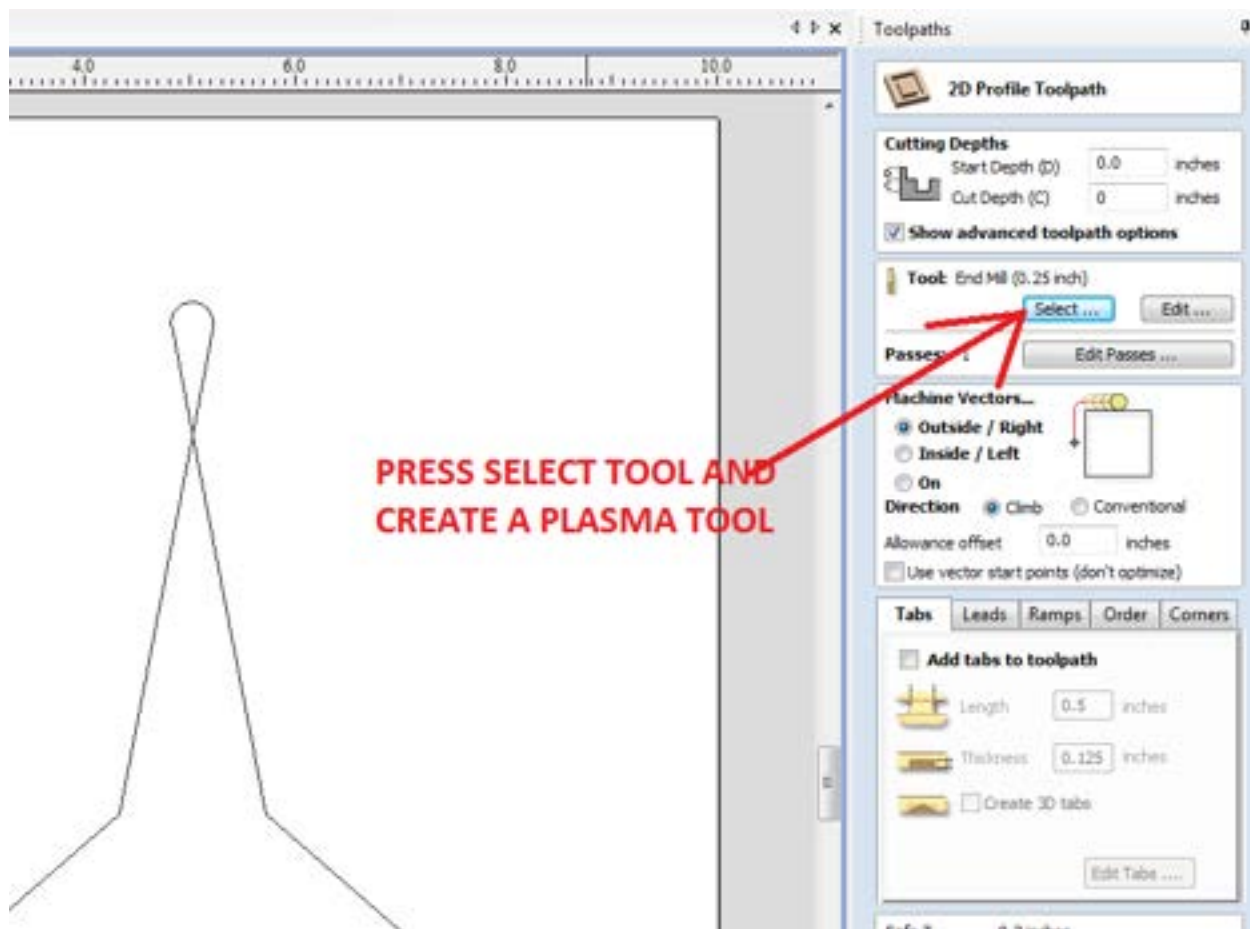


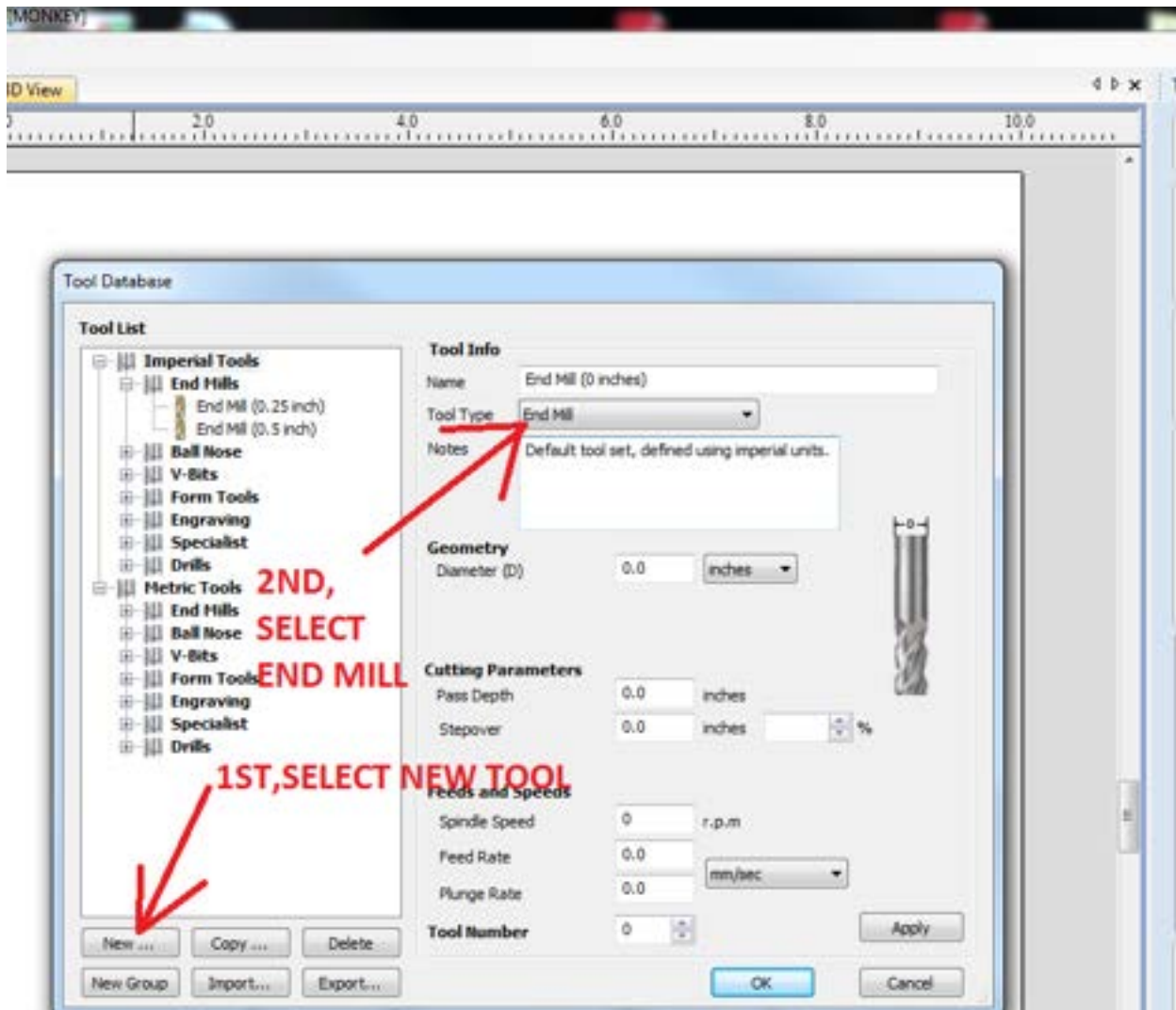


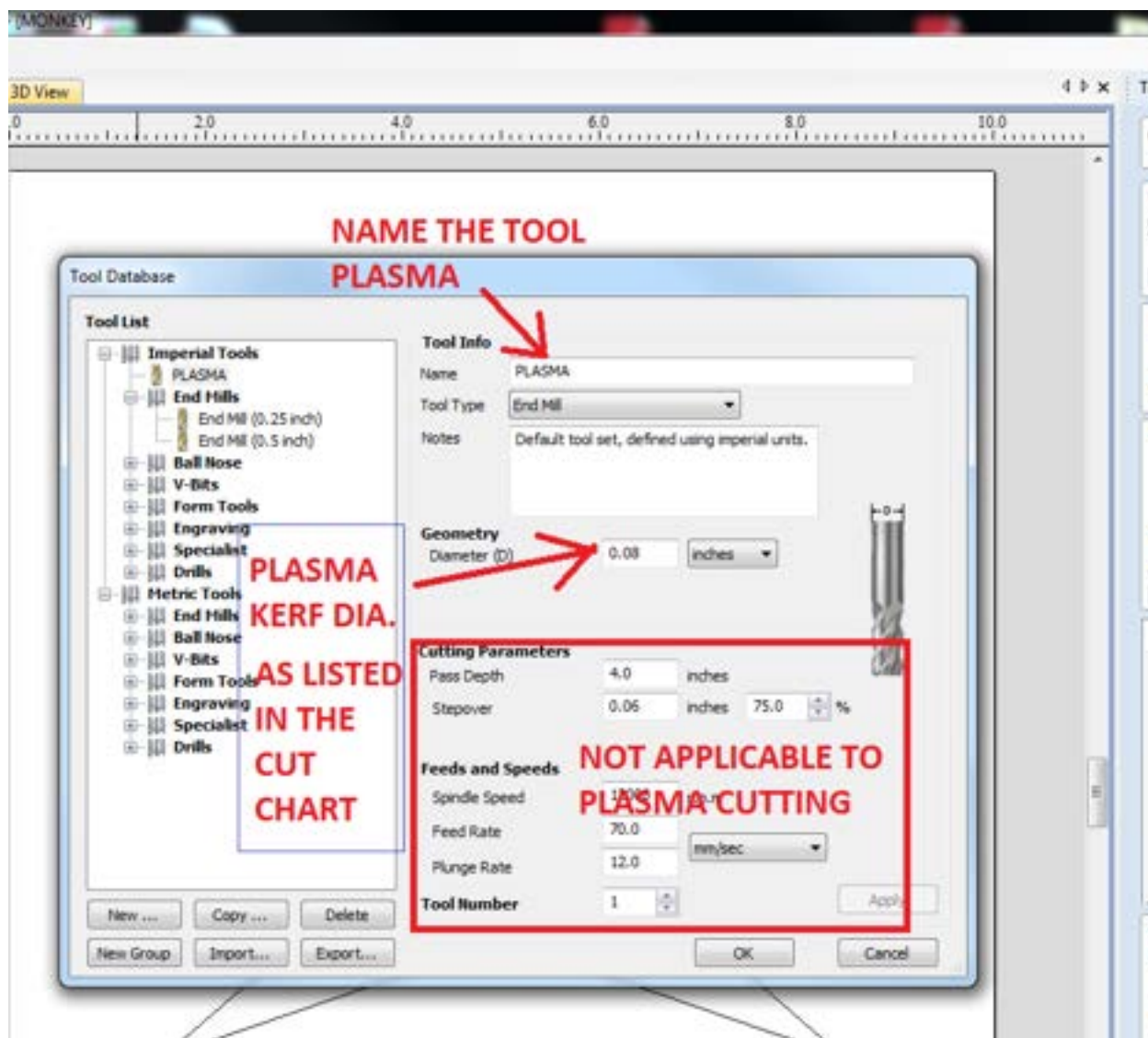
Now with the graphic adjusted we need to configure the Profile toolpath.

**NOTE:** You must cut on the line when using the Plasma fillets so it does not try to cut the pass by loops independent to the star graphic. When Cutting parts to size then cut either inside or outside the line depending on your application.





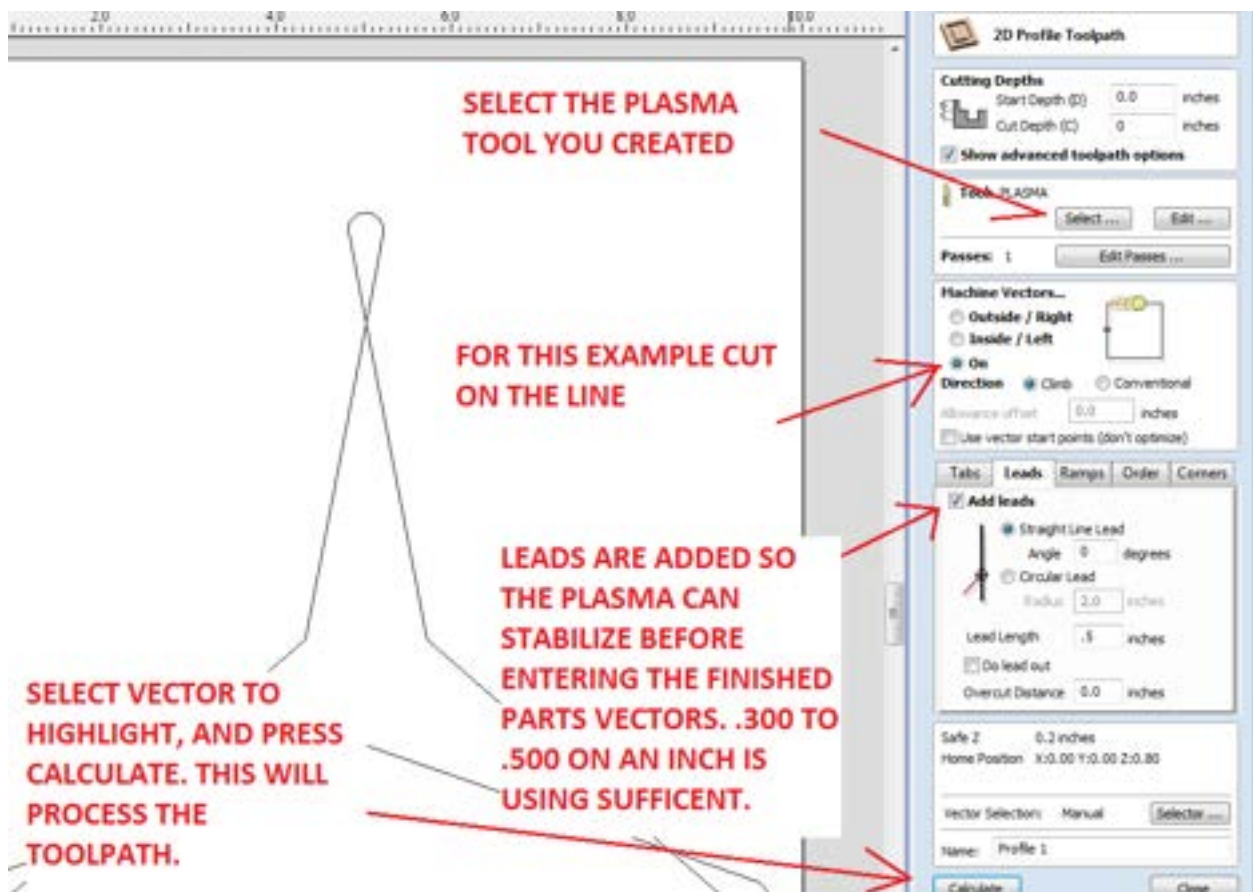




## NOTES;

- 1) Tool Diameter is defined in the Plasma Cut Charts. Look up your amperage and material thickness for the plasma flame diameter (Kerf)
- 2) Cutting parameters have no effect on Plasma cutting because the Z axis moves are handled in the machine controller. Vectric however needs these fields filled in, so use what is shown to make the field's happy.

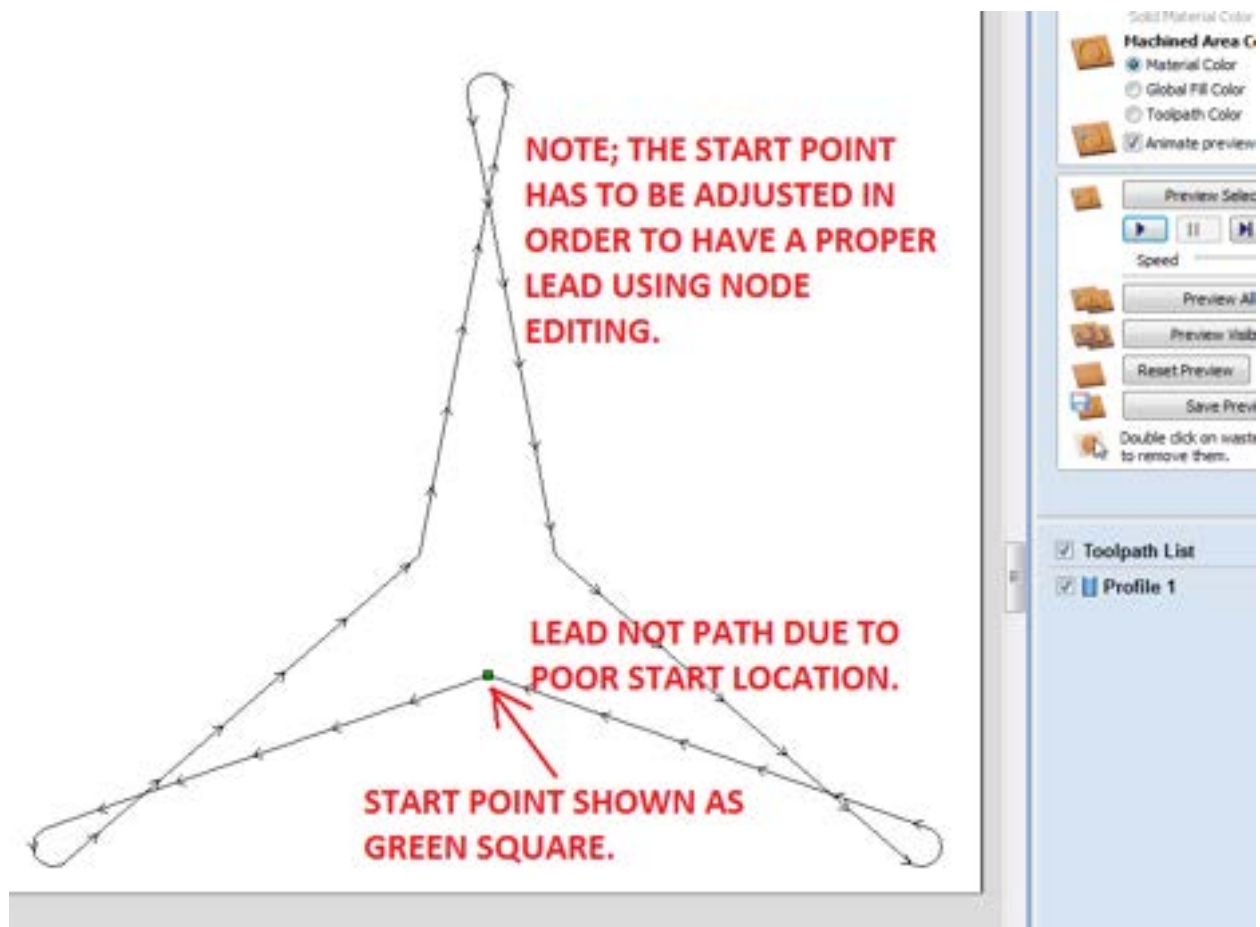
NEXT: CONFIGURE THE REST OF THE PROFILE TOOLPATH AND CALCULATE ONTO THE SELECT VECTORS.



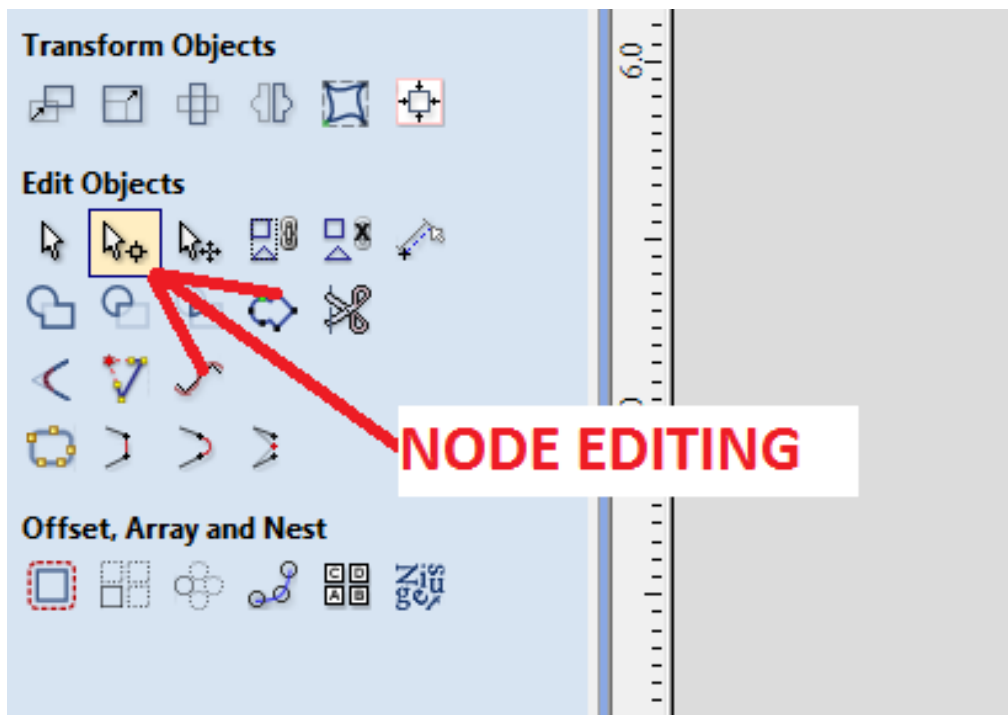
- 1) Select the Plasma tool you just created.
- 2) Select on the line cutting for this example.
- 3) Leads are added to have the arc stable before entering the finished parts cutting area. .3 to .5 of an inch depending on your application and material.
- 4) Select the graphic to be cut.
- 5) Press calculate to process the toolpath to the select vectors.

NOW LOOK AT THE CUT PATH SHOWN IN THE DRAWING'S TAB:





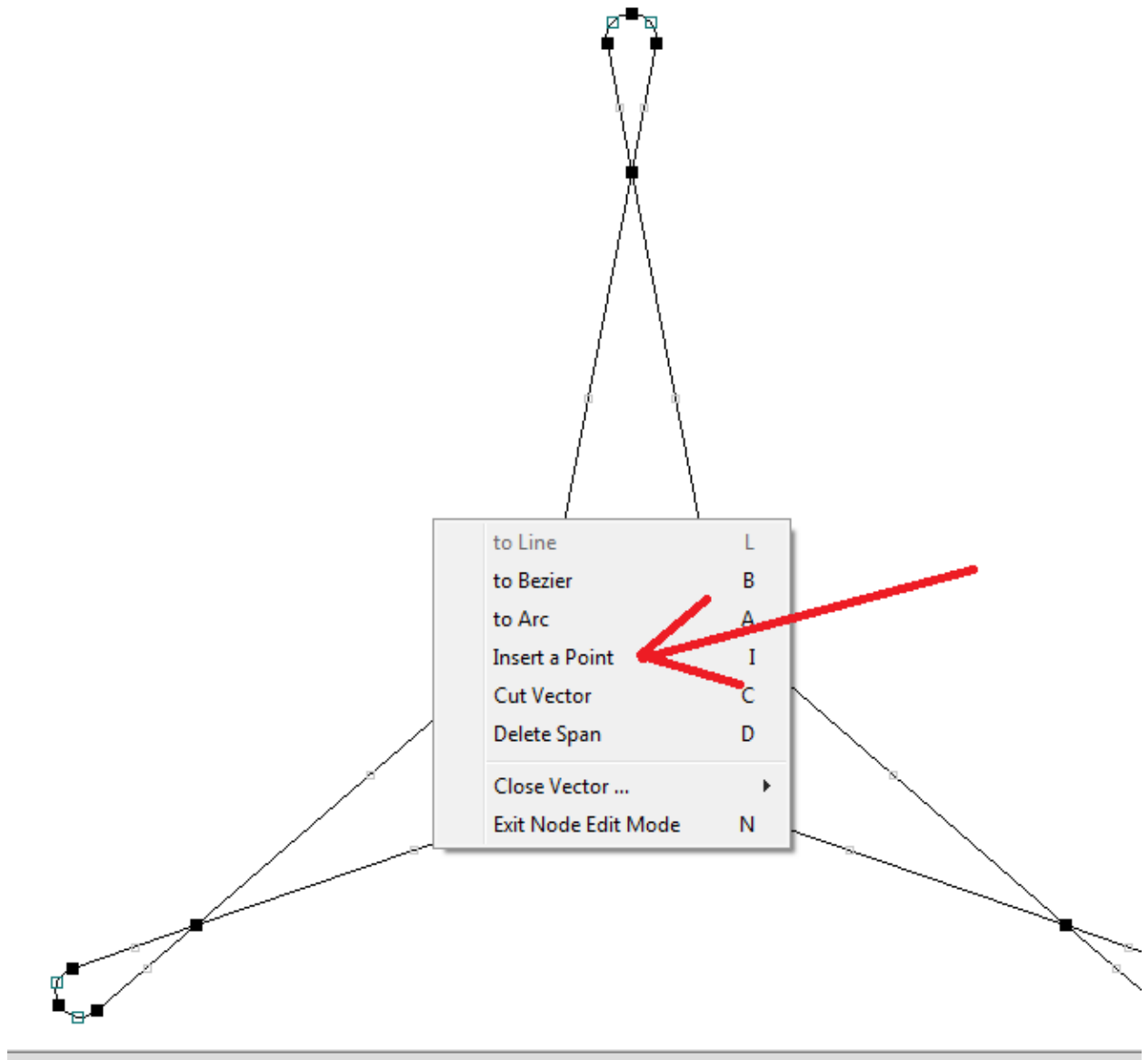
**NOTE:** The start point has to be adjusted in order to get a proper lead. This is done using node editing shown below.  
SELECT NODE EDITING SHOWN BELOW;

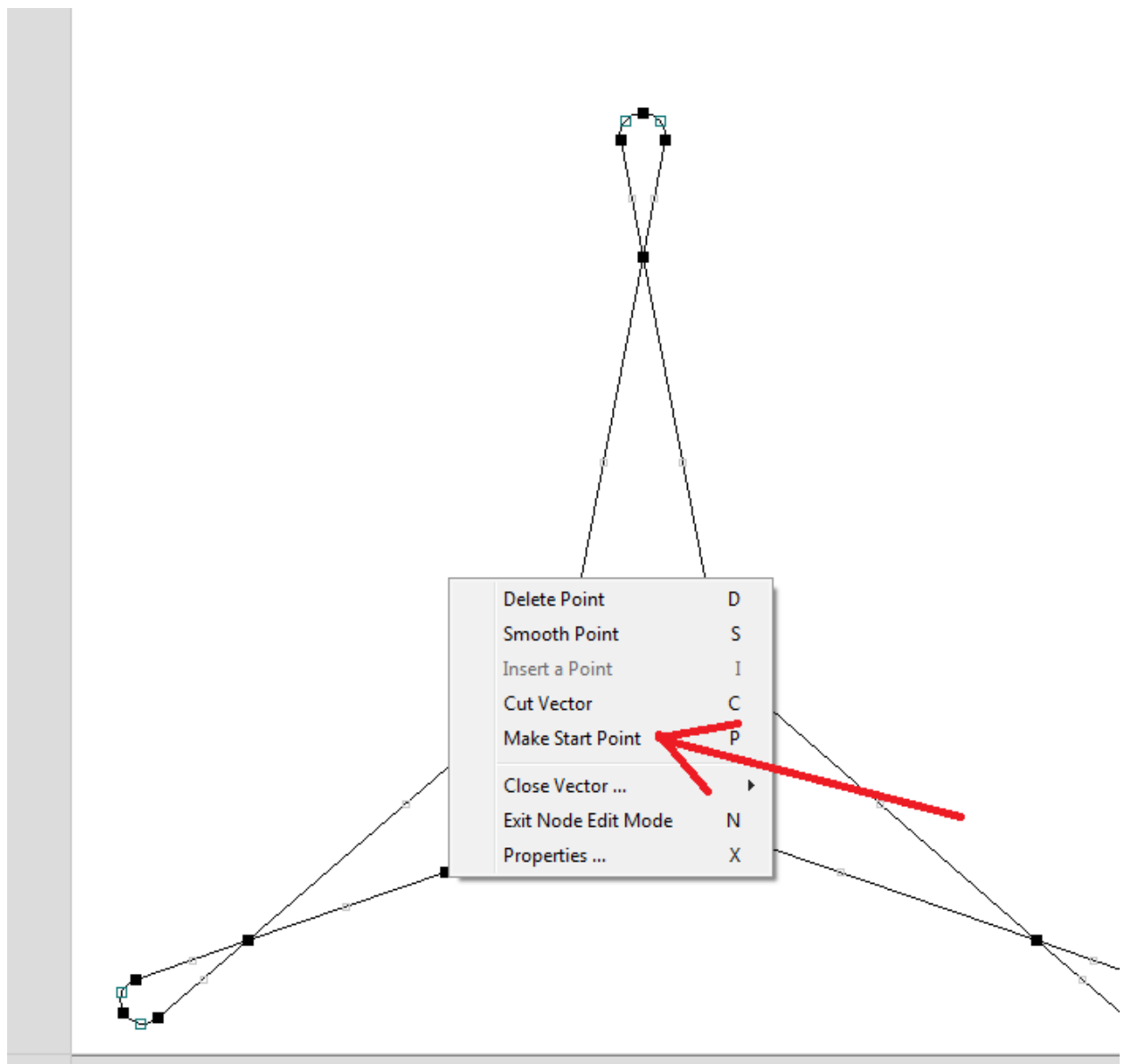


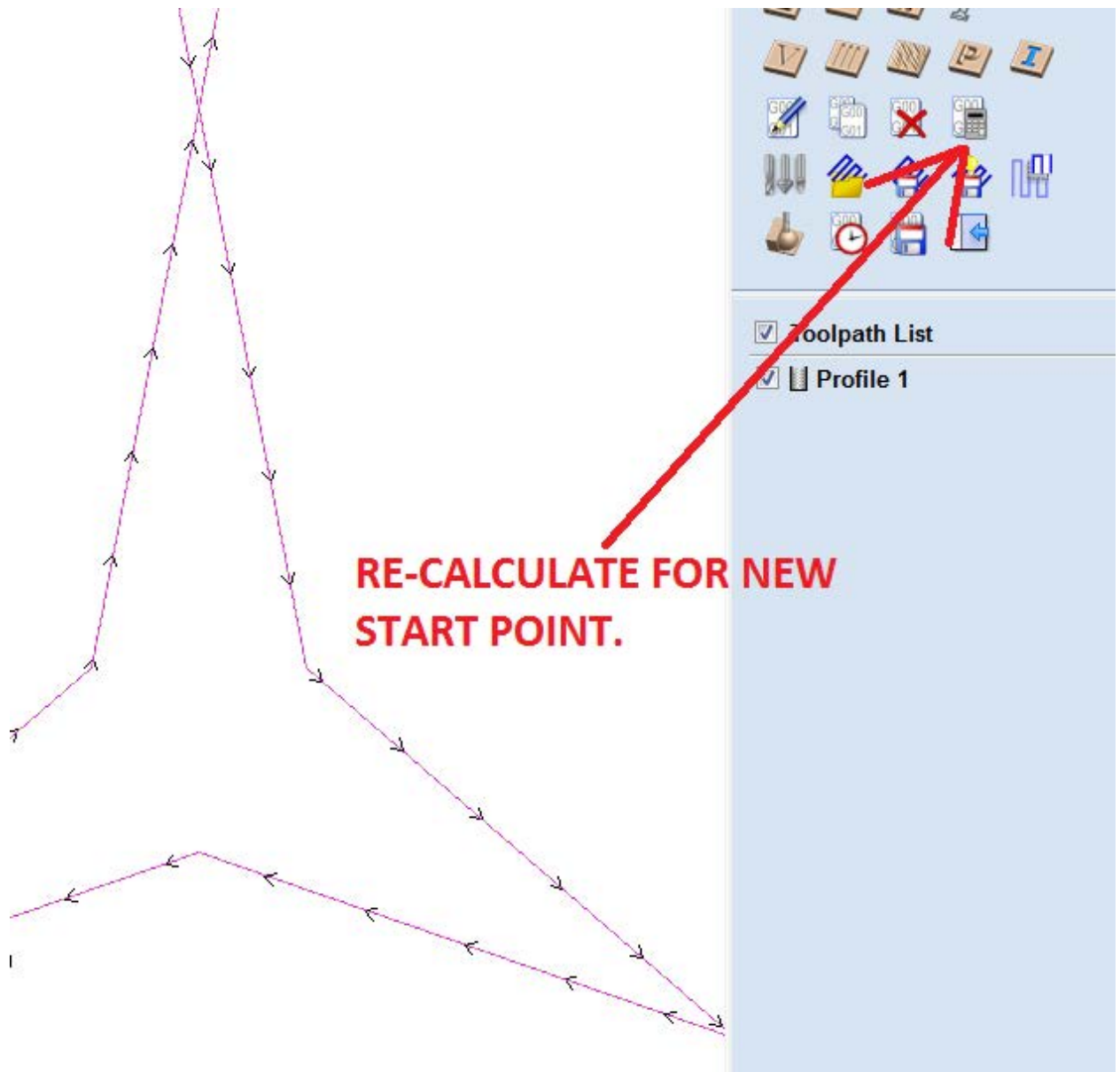
AFTER SELECTING THE NODE EDITOR, CLICK ON THE VECTOR YOU WISH TO MODIFY AND THE CURRENT NODES WILL BECOME VISIBLE, Shown Below;

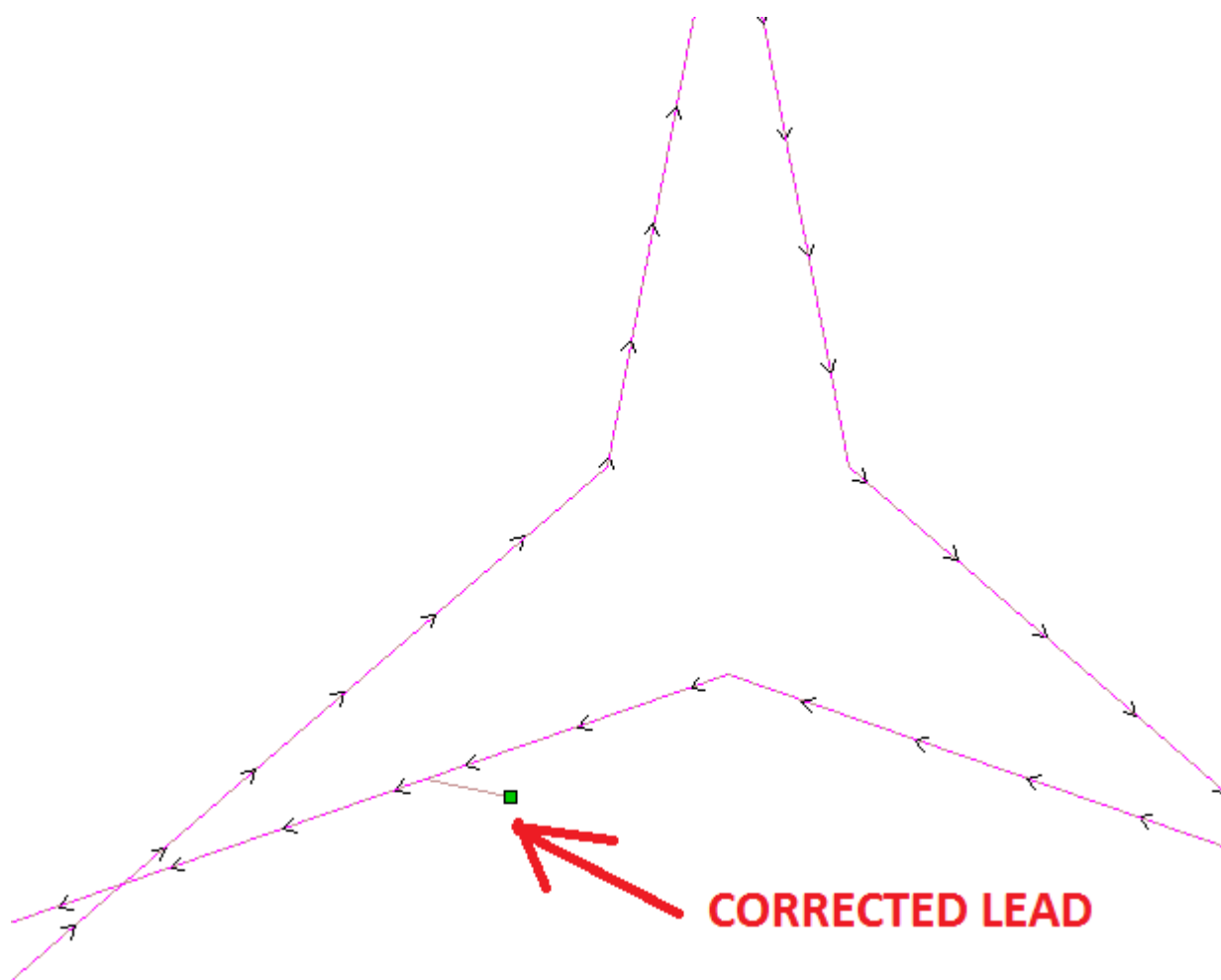
- 1) While in Node editing right click on a straight portion of the vector and select, (Insert a Point).
- 2) Hold over the new node you added and right click the mouse again to select (Make Start Point).
- 3) With the new node now green showing it's the start point. You then need to re-calculate the tool path and the lead can then be added properly to give the ARC stability before entering the finished cut path.



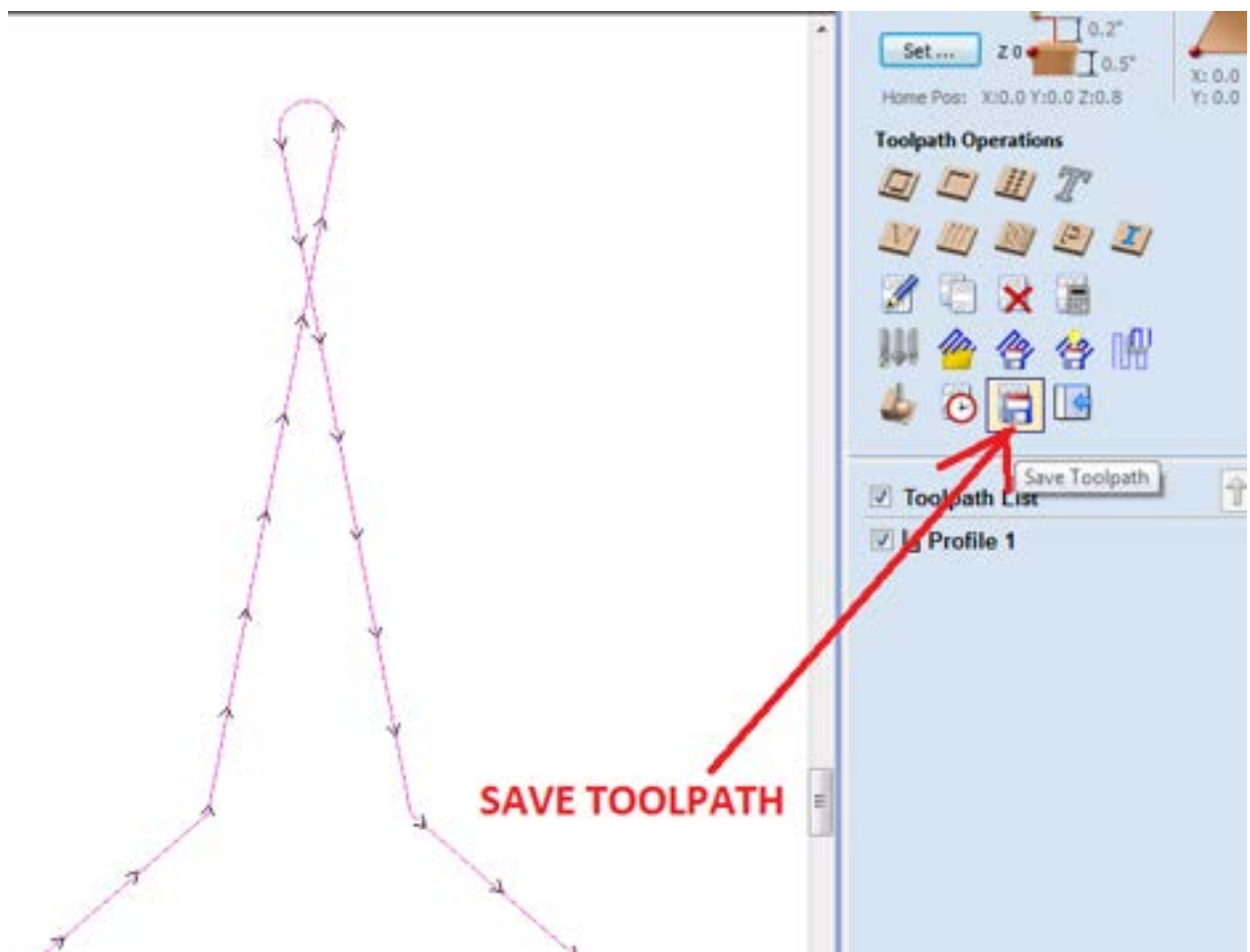






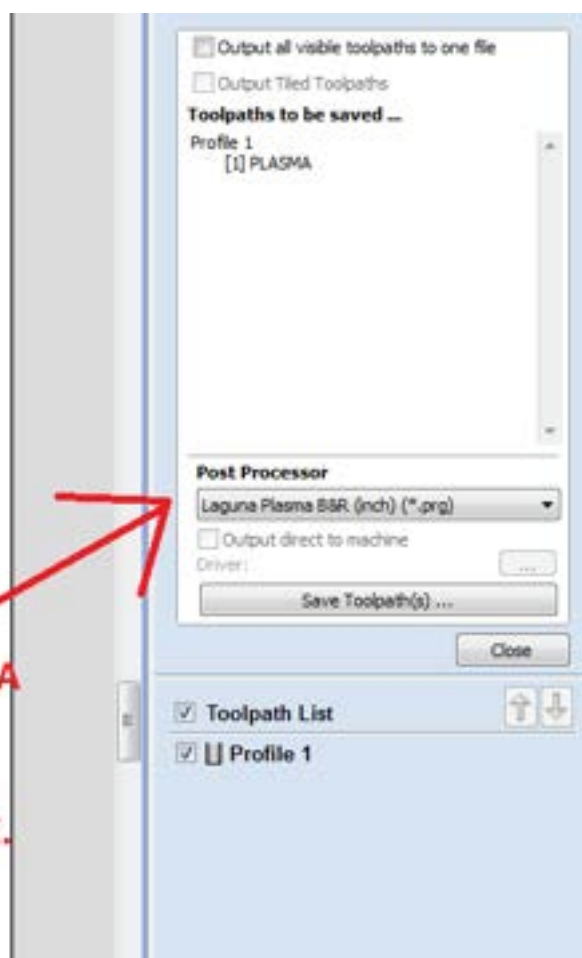


NOW that the tool path is corrected and a useable lead is present, you need to save the tool path to create the G-code using the Plasma Post Processor.  
AS SHOWN BELOW:





**SELECT LAGUNA PLASMA  
POST.  
THEN CLICK SAVE AND  
TRANSFER TO MACHINE.**





## Plasma CNC Install Check List Form

The following checklist must be completed and faxed to the Laguna Tools before the install will be scheduled. Failure to have all of these items addressed prior to Laguna Tools Technician arriving will result in additional charges.

1. Primary power for plasma power supply. \_\_\_\_\_
2. Air compressor must be capable of ***maintaining*** 120 psi. \_\_\_\_\_  
(In some instances this may require a dedicated air compressor.)
3. Alternate gas supplies must also be able to maintain 120 psi \_\_\_\_\_
4. Proper regulator(s) and gas hose(s) from gas supply to gas box \_\_\_\_\_
5. Water for secondary water mist must be filtered and have adjustable pressure regulator. \_\_\_\_\_
6. System ground should be tested and updated to meet attached requirements.  
This should be done prior to technician's arrival as it could take considerable time depending on soil conditions in your area. (Grounding to building not acceptable. Per attached grounding procedure and testing information) \_\_\_\_\_
7. Have you made arrangements for the supply of proper consumables? \_\_\_\_\_

There is no such thing as a turn-key install as there is no way our technicians can possibly anticipate all of the problems we may encounter with your particular install. Customer shall supply a helper to assist the technician.

Authorized Signature \_\_\_\_\_ Date \_\_\_\_\_

1. Primary power. Refer to operation manual for correct wire and fuse size. This will vary depending on power source, (100 amp, 200 amp, 300amp) Input power (208, 230 460 volt 3 phase) Customer will be responsible for power to be connected to the Power Source.
2. Compressed Air. Compressor needs to supply at a minimum of 120 psig to a maximum of 135 psig. 8.3 bar at 300 SCFH maximum usages. 550 SCFH when running Air plasma / Air shield. Compressed air need to be oil free and dry. Use of a moisture trap and or dryer is highly recommended. **Moisture will cause decreased cut quality, parts life and damage to the torch & cartridge. Oil when mixed with oxygen under pressure can cause a flash fire in the torch**
3. Oxygen, Nitrogen, H35 gases are to be supplied at a minimum of 120 psig to a maximum of 135 psig. 8.3 bar at 300 SCFH maximum usages.
4. Regulators used will vary depending if the gas source is supplied by high pressure cylinder, liquid cylinder or liquid bulk supply. Regulators should supply a maximum of 200 psig at above flow rates. Recommended style would be Victor Edge **ESS4-125-540** for oxygen, high pressure cylinder. Gas Hose should be 3/8 neoprene or synflex 3/8 diameter. **Rubber hose is not recommended.** Runs over 50ft may require larger diameter hose.
5. Water supply for use with 'Water Mist Secondary' should be filtered to remove sediment and softened if water has lime and other corroding contaminants. Water pressure should be between 50 and 80 psig, flow @ 10GPH. 60 psig at 3.5 GPH is optimum.
6. Earth Ground. A 1/2" copper rod should be driven into the soil within 10 feet of the power source. Checking ground for proper conductivity is essential to eliminate high frequency problem.
7. Have enough Consumables to run estimated production for 30 days. Determine what types and thickness of material and gases used to be cut or Laguna Tools will be glad to suggest which consumables to order.



## **Machine drawing.**

**Note: The wiring may vary from the following drawings dependent on the options that you ordered**

### **Need the electrical Drawings if available**

## **What is plasma?**

Plasma is a gas heated to an extremely high temperature and ionized so that it becomes electrically conductive. Plasma arc cutting uses the plasma as an electrode to transfer a electrical arc to the work piece. The heat of the arc melts the work piece and the force of the plasma and shield gases blow away the molten metal to cut the work piece.

Different metals react differently to plasma cutting. Carbon steel can be oxidized, and is usually cut with a plasma containing oxygen to take advantage of the exothermic process. Higher levels of oxygen in the plasma result in higher heat and higher rates of oxidation. The result is a faster and cleaner cut. Stainless steel and aluminum are not subject to rapid oxidation and depend entirely on the plasma's heat for the cutting process. Because plasma produces much higher heat than the oxygen-fuel cutting process, plasma can cut stainless steel and aluminum quickly and cleanly.

## **Choosing a plasma process**

Thermal Dynamics systems offer a variety of plasma cutting processes for precision and general purpose cutting. Ultra-Cut systems offer precision cutting as well as conventional cut options. Auto-Cut O<sub>2</sub> systems offer high speed oxygen cutting, precision non-ferrous and conventional cut options. Auto-Cut systems offer conventional mild steel mild steel and precision non-ferrous options.

Process		Used for	Advantages
Plasma	Shield		
O <sub>2</sub>	Air	Mild Steel Precision 50-300 amps and High Speed Oxygen process	Weld ready cut surface
O <sub>2</sub>	O <sub>2</sub>	Mild Steel Precision at 30 amps	Weld ready cut surface
N <sub>2</sub>	H <sub>2</sub> O	Precision non-ferrous	Best cut quality on stainless and aluminum to $\frac{3}{4}$ "

N <sub>2</sub>	N <sub>2</sub>	Conventional thin non-ferrous	Better parts life than air Better cut surface than air on non-ferrous
H35	N <sub>2</sub>	Thicker non-ferrous > 1/2" aluminum > 3/4" stainless	Faster cutting on thicker SS and aluminum Weld ready cut surface H35 = 65%Ar / 35%H <sub>2</sub>
Air	Air	Conventional mild steel	Economical cost of operation Good cut quality
Air	Air	Conventional non-ferrous	Economical cost of operation

## Cut charts

Thermal Dynamics provides a cut parameters chart for every process and output current combination.

Material → **Mild Steel**  
 Current Level → **30A**  
 Process → **O<sub>2</sub> Plasma / O<sub>2</sub> Shield**



Gas Control Settings

30A Mild Steel (O <sub>2</sub> /O <sub>2</sub> )													
Material Thickness			Pre Flow Pressure (Air)	Cut Flow Rates / Pressures				Arc Voltage	Torch Working Height	Travel Speed	Initial Piercing Height	Pierce Delay	Kerf Width @ Rec. Speed
				Plasma (O <sub>2</sub> )		Shield (O <sub>2</sub> )							
(ga)	(in)	inch	(PSI)	Ball	(PSI)	Ball	(PSI)	Volts	(in) ±0.005	(ipm)	(in)	(sec)	(in)
20		0.036	60	22	120	21	120	128	0.050	130	0.120	0.2	0.058
18		0.060	60	22	120	21	120	143	0.060	80	0.120	0.3	0.070
14		0.075	60	22	120	21	120	145	0.070	45	0.120	0.3	0.072
12		0.105	60	22	120	21	120	148	0.110	40	0.150	0.3	
10		0.135	80	22	120	21	120	154	0.130	30	0.150	0.3	
	3/16	0.188	80	22	120	21	120	154	0.120	25	0.150	0.4	

Pierce Data

Arc Voltage for Torch Height Control

Material Thickness	Pre Flow Pressure (Air)	Cut Flow Rates / Pressures				Arc Voltage	Torch Working Height	Travel Speed	Initial Piercing Height	Pierce Delay	Kerf Width @ Rec. Speed
		Plasma (O <sub>2</sub> )		Shield (O <sub>2</sub> )							
(mm)	(Bar)	Ball	(Bar)	Ball	(Bar)	Volts	(mm) ±0.1	(mm/min)	(mm)	(sec)	(mm)
1	4.1	22	8.3	21	8.3	130	1.3	3050	3.0	0.2	1.5
2	4.1	22	8.3	21	8.3	145	1.9	1130	3.1	0.3	1.8
3	4.1	22	8.3	21	8.3	150	3.0	910	3.8	0.3	2.0
4	5.5	22	8.3	21	8.3	154	3.2	710	3.8	0.3	2.1
5	5.5	22	8.3	21	8.3	155	3.0	640	3.8	0.4	1.9

Plasma Marking Parameters

Marking (with 30A Mild Steel Parts)												
15A Arc Current  Burn-through may occur on thicknesses < 1/16" (0.063") / 1.6 mm	Pre Flow Pressure (N <sub>2</sub> )	Cut Flow Rates / Pressures				Arc Voltage	Torch Working Height	Travel Speed	Initial Piercing Height	Pierce Delay	Marking Quality Degrades as Thickness Decreases	
		Plasma Pressure (N <sub>2</sub> )		Shield Pressure (N <sub>2</sub> )								
		Ball	Press	Ball	Press	Volts	In ±0.005 / mm ±0.1	ipm / mm/min	In ±0.005 / mm ±0.1	(sec)		
	20psi / 1.4 bar	20	40 psi / 2.8 bar	70	80 psi / 5.5 bar	145	0.1 / 2.5	300 / 7600	0.1 / 2.5	0		

## Consumable parts

### Parts selection

Consumable parts are specifically designed to perform in specific conditions. Using the wrong consumable parts will result in short parts life and poor cut quality. Use the cut charts to determine which consumable parts to use in any specific application.

### Installing consumable parts

The XT torch is a precision instrument. Take care when installing consumable parts to keep the parts clean and free from any contamination that might cause a gas or coolant leak inside the consumable parts cartridge.

## Assembly Sequence, 30-150 Amp Consumables

### 7.04 Torch Consumables Installation

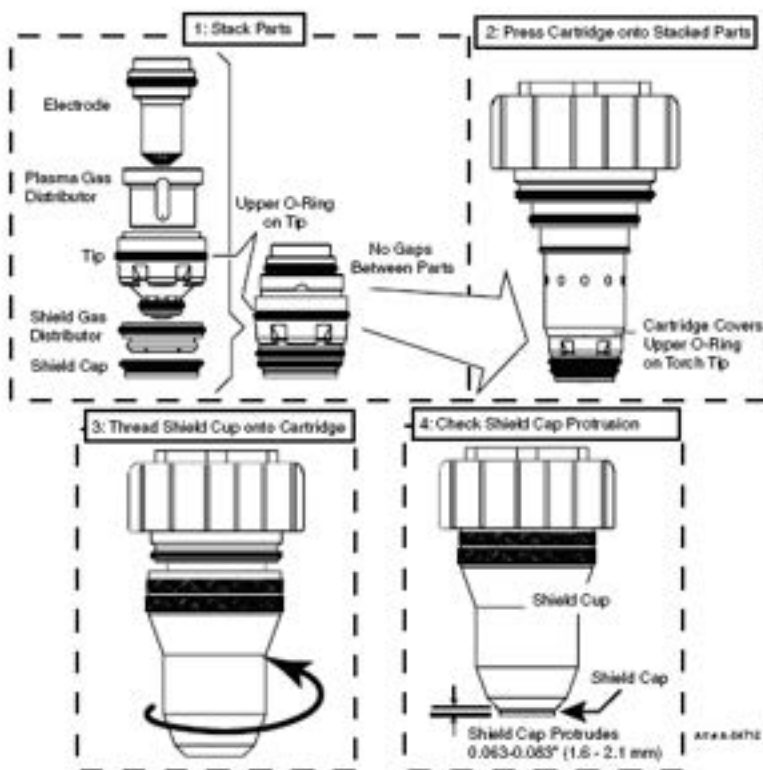


#### WARNINGS

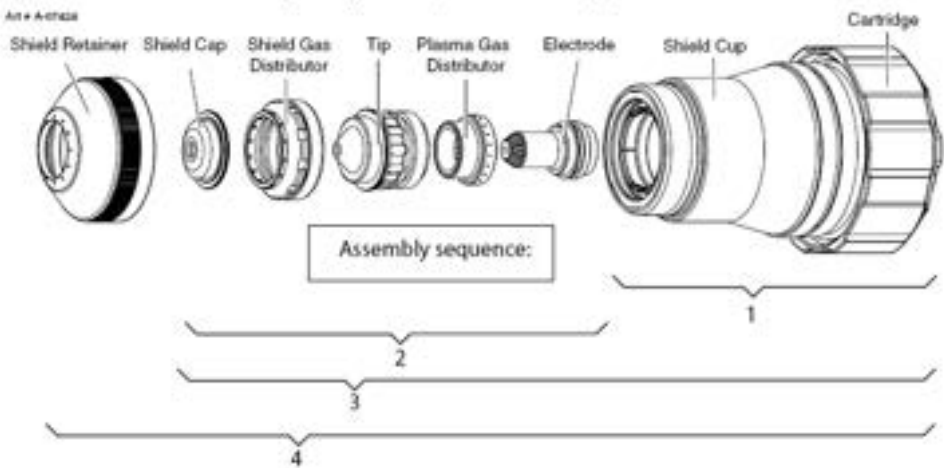
Do not install consumables into the Cartridge while the Cartridge is attached to the Torch Head. Keep foreign materials out of the consumables and Cartridge. Handle all parts carefully to avoid damage, which may affect torch performance.

ATA A-0007

1. Install the consumables as follows:



Assembly Sequence, 200/300 Amp Consumables



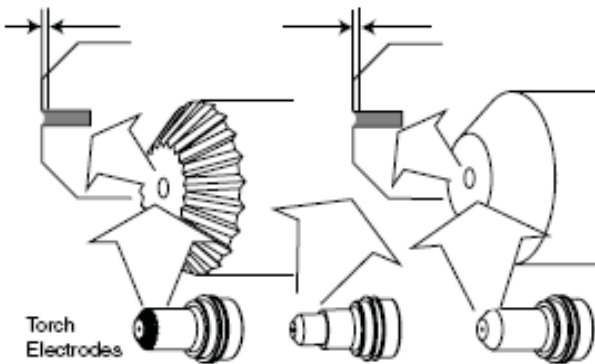
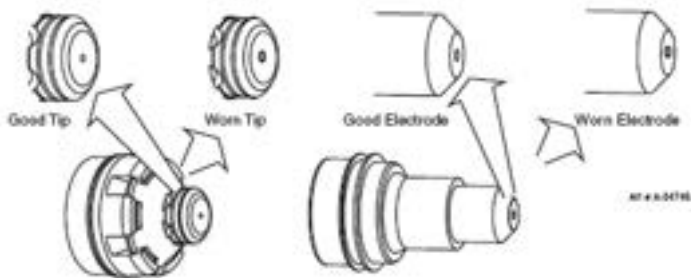
# Consumable Parts Life

Tips and electrodes wear under normal usage. Tips and electrodes should be changed before failure to avoid damaging the other consumable parts or the material to be cut. Optimum life will vary according to specific cutting conditions. Keep a count of cuts per set of tip and electrode in a given application to establish the most effective time to change consumable parts sets. The pilot arc is more erosive to the tip and electrode than the cutting arc is, so an application that demands more pilot and pierce sequences will erode consumable parts faster than an application that uses longer cuts but fewer arc starts.

Tip – Tips wear as the arc erodes the tip orifice. When the tip is no longer round or has become enlarged, it should be replaced. Tip life is best when cuts are made at optimum speed. Cutting too fast or too slow causes the arc to bend and biases erosion, resulting in an orifice that is oval shaped.

Electrodes – The electrode wears from the hafnium or tungsten insert at the end of the electrode. The face of the insert is liquefied by the heat of the arc and droplets erode from the insert as cutting progresses. Proper gas flow will support longer electrode life. An electrode should be replaced when the electrode insert is pitted to a depth of 1/16 inch (see chart below).

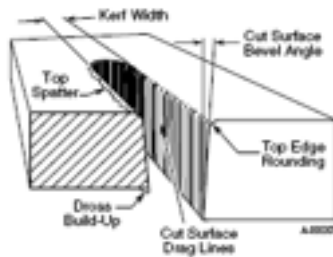
Replace the Gas Distributor if it is charred or cracked.  
Replace the Gas Distributor if the flange is damaged in any way.  
Replace the tip and/or electrode if they are worn.



Amperage	Plasma Gas	Recommended Wear Depth for Replacement	
		Inch	mm
30	O2	0.04	1
	Air	0.04	2
50	O2	0.04	1
	Air	0.08	2
70	O2	0.04	1
	Air	0.08	2
100	O2	0.04	1
	H35	0.08	2

Alt # A-04704\_AB

## Cut characteristics



Cut Surface – Cut surface is influenced by process and positioner precision more than by other parameters. For smoothest cut face on different materials, use: mild steel – oxygen plasma

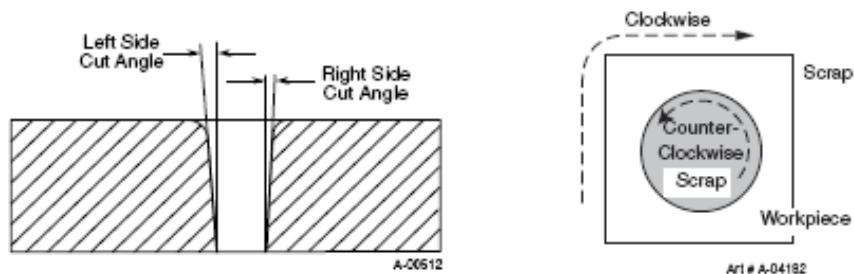
stainless <  $\frac{3}{4}$ " – nitrogen / WMS

>  $\frac{3}{4}$ " – H35 / nitrogen

aluminum <  $\frac{3}{4}$ " – nitrogen / MS

>  $\frac{3}{4}$ " – H35 / nitrogen

Direction of cut – The plasma has a clockwise swirl as it exits the torch tip. Considering the direction of torch travel, the right side of the cut will always show less bevel and top edge rounding than the left side. Program cuts so that the right side will be on the finished part and the left side will be scrap.



Top edge rounding – Caused by the heat of the plasma arc at the top surface of the cut. Proper torch height control can minimize or eliminate top edge rounding. Excessive top edge rounding is often a sign that torch cutting height should be lower.

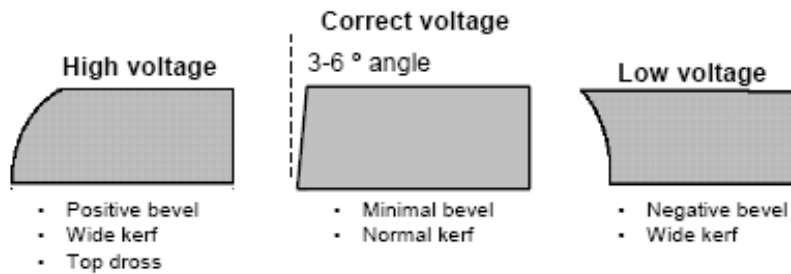
Top spatter – Top spatter is caused by fast cutting or by too high a torch height setting. Reducing cut speed or lowering torch cutting height will reduce top spatter. Top spatter is easy to remove.

Bottom dross – Molten metal may build up on the bottom of the plate. Faster cut speeds reduce bottom dross as less material is melted. Bottom dross that is easy to remove is an indication of slow cutting speed. Bottom dross that is difficult to remove or requires grinding is an indication of too fast cut speed.

Kerf – Kerf width is specified in the cut charts and can be calculated into cut programs. The kerf width is related to tip orifice size and higher current cutting will produce a wider kerf. Higher torch height will also result in a wider kerf.

Bevel angle – Precision cut processes produce bevel angle in the 0-3° range. Conventional plasma cutting will produce larger bevel angles. Proper torch height control will produce the smallest bevel angle, as well as improved kerf width and minimal top edge rounding. A slower cut speed can be used when cutting circles and corners to reduce bevel.

## Effect of Height Control Settings – General Purpose Cut



Nitride contamination – Air plasma cutting will produce nitride contamination of the cut face on carbon steel and stainless steel. Nitride contaminated surfaces will require grinding before welding to eliminate weld porosity. The depth of the contamination will be close to the Heat Affected Zone, between .005 and .010" in depth.

Nitride contamination can be eliminated by using a process other than air plasma; oxygen plasma for carbon steel, H35 or nitrogen/WMS for non-ferrous materials.

Cut speed – Cut charts specify a cut speed that will produce high quality cut performance. Any plasma system can cut at faster or slower speeds, but cut performance will be affected. Cut speed should be reduced for corners and tight curves to reduce bevel and corner rounding.

Optimum cut speeds produce a trailing arc which will be visible in the slight arc lines visible in the cut face. Arc lines are useful for evaluating cut speed on mild steel, but less so for aluminum and stainless steel. Arc lines that trail at less than 15° indicate that cut speed is in the optimum range when air or oxygen plasma processes are used. Optimum cut quality in precision cutting processes will result in arc lines that are near vertical. A slow cut speed may show arc lines that angle forward and a fast cut speed will show arc lines at a sharper angle relative to the top of the plate.



## Aluminum

### Cut speed too fast



Cut drag lines are more than 15 degrees trailing the torch (torch movement right to left)  
High speed bottom dross, easy to remove

### Cut speed correct



Cut drag lines trail are visible, but cut surface is smooth  
No dross

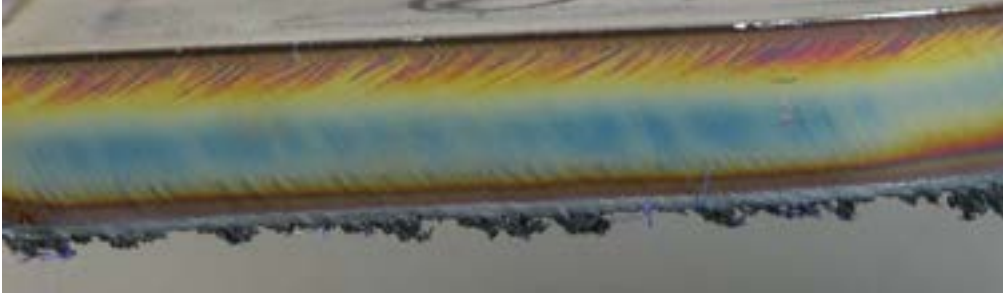
### Cut speed too slow



Cut drag lines are more pronounced and cut surface is rougher

## **Stainless Steel (H35 plasma)**

### **Cut speed too fast**



Gold heat discoloration swept in both directions  
Cut drag lines more than 15 degrees trailing  
High speed bottom dross, hard to remove

### **Cut Speed correct**



Smooth cut surface  
No dross

### **Cut Speed too slow**



Heat discoloration is concentrated in the bottom half of the cut  
Hard bottom dross, hard to remove

## Mild Steel (O<sub>2</sub> plasma)

### Cut Speed Too Fast



Trailing cut drag lines  
Light bottom dross, hard to remove, some top spatter

### Cut Speed Correct



Cut drag lines near vertical  
No dross

### Cut Speed Too Slow



Cut drag lines lead the torch  
Heavy bottom dross, easy to remove

## Mild Steel (Air plasma)

### Cut Speed Too Fast



Cut drag lines curve and trail torch movement  
High speed bottom dross, hard to remove

### Cut Speed Correct



Cut drag lines near vertical  
Minimal dross

### Cut Speed Too Slow



Cut drag lines vertical or leading the torch head  
Thicker bottom dross, easy to remove

## Piercing

Piercing causes the molten metal to form a puddle on top of the plate. On thicker plate, pierce height is calculated to keep the torch away from the plate so that the molten metal does not adhere to the consumable parts and shorten parts life. Hold pierce height as the cutting table starts movement to allow the torch to clear the pierce puddle before moving to cut height. Using the Inova height controller, this is done using the Set Pierce Time function on the edit screen.

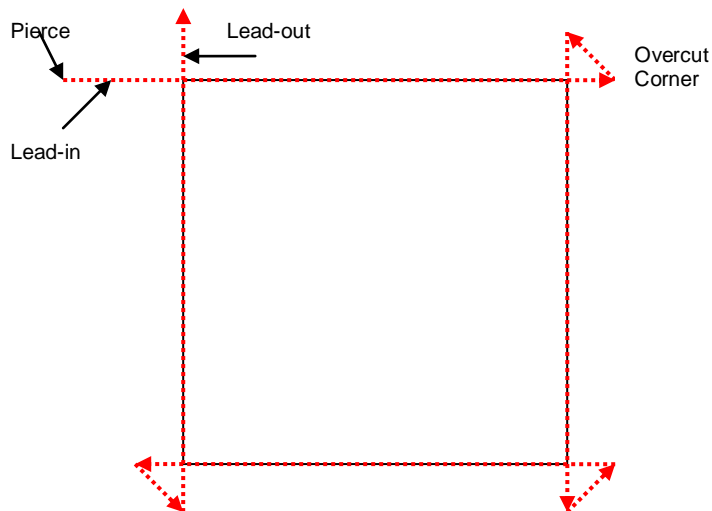
## Lead-in and lead-out

Lead-in and lead-out should be calculated to allow the torch to move to cut height before starting the final piece contour of the cut and to move away from the final piece before beginning end of cut current ramp down.

## Corners

The cutting arc normally trails the torch tip orifice. When the torch makes an abrupt change in direction this trailing arc cannot change direction as quickly at the bottom of the cut as at the top of the cut. This results in undercutting of sharp corners. 2 techniques can be used to minimize this effect.

1. Use cut-outs – Overcut past the corner of the shape, then return and cross over the cut line to achieve a square corner. Triangular or looped overcuts are commonly used.



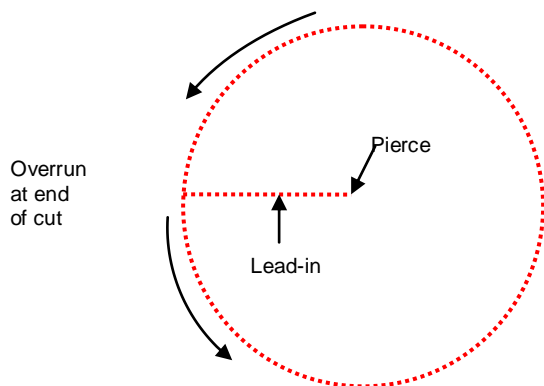
2. Use the CNC corner slowdown function to hold torch height as it enters and leaves the corner. As the speed decreases, the arc voltage will increase, driving the torch down, so corner slowdown will lock out the height controller during the corner cut, keeping the torch at the programmed height, regardless of arc voltage variations.

## Cutting Circles

Circle cutting demands precise motion control and circle cut quality will vary as the circle diameter approaches the thickness of the plate. In general, a circle that is equal in diameter to the thickness of the plate being cut is the minimum circle diameter possible. Cut quality will decrease markedly when the circle diameter is less than 1.5 times the thickness of the plate being cut.

For maximum circle cut quality:

1. Slow down cut speed. Smaller circles may require a cut speed that is 60-50% of the speed specified in system cut charts. A slower cut speed will eliminate trailing arc and allow the arc to cut at closer to 0° of bevel.
2. Maintain constant cut height through the circle. This may require locking out the height controller. As the cut speed slows, arc voltage increases and the height controller tends to drive the torch down, changing cut bevel. Avoid torch height movement by locking out the height controller during the circle cut.
3. Start the cut in the center of the circle and use a 90° lead-in to the circle. When the positioner is in top running condition, a 90° lead-in will produce less distortion at the circle initiation. A cutting table with backlash may produce a better cut when a radial lead-in is used.
4. End the cut by overburning the circle cut line rather than by using a lead-out. Time the cut to end just as the arc completes the circle. A lead out or too much of an overburn will cause the arc to cut more of the outside of the circle and cause a distortion at the point where the circle cut is completed. Many CNC systems use an advanced off feature to ramp down cutting current end of cut. Use of the advanced off feature will improve circle cutting.



## **N<sub>2</sub>/Water Mist Secondary®™**

In this process, tap water is used instead of a shield gas. The water is vaporized as it passes through the torch head and a portion of the molecules separate onto hydrogen and oxygen. This vapor protects the cut surface from ambient air contamination and eliminates nitriding in the cut surface.

Cutting with the N<sub>2</sub>/WMS process is economically efficient and produces genuine precision cut quality over a broad range of non-ferrous applications.

Considerations:

- Water supply should be at least 55 psi.
- Hard water will leave mineral deposits, just as it does in sinks and faucets. A standard water softening filter will prevent mineral deposits that can interfere with water flow in the torch passages.
- Ohmic sensing to establish initial torch height is ineffective when water is present. The ohmic clip should be removed from the torch for N<sub>2</sub>/WMS cutting. The ohmic sensing system will sense the level of any water on the plate rather than the true position of the plate.

## **Underwater Cutting**

Cutting under water is used by some operators to capture smoke and reduce flash and noise. Cutting under water is possible with Ultra-Cut and Auto-Cut systems.

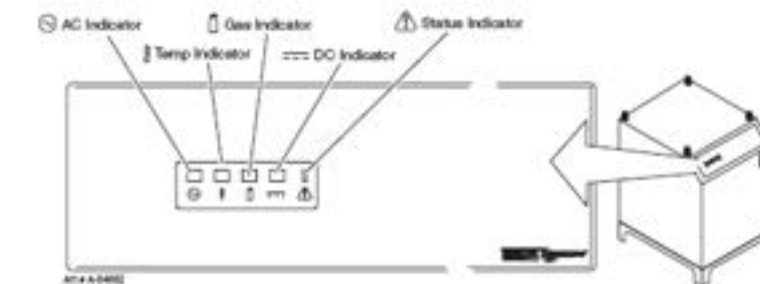
Considerations:

- Cutting under water will reduce cut capacity and speed by up to 30 %
- The cooling effect of water on the bottom of the plate will facilitate formation of dross
- Cutting aluminum under or over water releases hydrogen, which can explode
- Cutting with N<sub>2</sub>/WMS process is not recommended
- The water in the table will become contaminated with cut residue and can be a toxic waste

## Power Supply Status Codes

Auto-Cut and Ultra-Cut systems display system status codes that are useful for optimizing system performance and for troubleshooting. The status code is displayed on the power supply front panel.

Power Supply Control Panel



### AC Power Indicator

Indicates AC power is being supplied to the system when the ON/OFF switch is in ON position. When switch is first set to ON, the indicator will blink, indicating gas purge at power on.



**TEMP Indicator:** Normally OFF. Indicator turns ON when the internal sensors detect temperatures above normal limits. Let the unit cool before continuing operation.



**GAS Indicator:** Normally ON. Indicates adequate gas pressure for operation in the system.



**DC Indicator:** Indicates the power supply is generating output DC voltage.



**Status Indicator:** Shows system status. The number of flashes indicates the status. Refer to the Status Code Section for details. On power supply start-up, the indicator flashes to show the revision level of the operating software installed in the system.

The Status Indicator flashes a 2 part code that indicates the status of the system. When the Status Indicator is dark the system is ready to cut. It is normal for the Status Indicator to flash when the GCM mode switch is placed in set mode. At system start up, the Status Indicator flashes a 2 part code to indicate the CCM firmware version that is loaded into the system. This code appears only once at start up. During normal operation the Status Indicator may flash a code indicating an error or a condition that should be corrected. Some codes will cause the system to cease operation to prevent damage to the hardware. Other codes will not cause the system to cease operation, but will continue until the condition which caused the code to initiate is changed.

Status codes appear in a 2 part sequence. The Status Indicator will flash a number of times to indicate the first number in the code sequence, then pause for 1.2 seconds and flash the second number of the code. After 4 seconds, the code sequence will repeat.

Example: The Status Indicator blinks 4 times, pauses, then blinks 3 times. This code (4-3) indicates overheating coolant and will continue until the condition is corrected.



### Status Indicator Codes

Fault Code Key		
Error Code	Error	Remedy / Comments
1-1	System not Enabled or Missing AC Input Phase	Plasma Enable Off; External E-Stop Activated or CCM TB1-1&2 jumper missing; Missing AC Phase; No power to GCM 2000 or 2010 Gas Control, check GCM control cable connected, reset CP4 or CP5 circuit breaker in power supply, blown fuse F19 in GCM.
1-2	Pilot Ignition Failure	Pilot did not start within 15 seconds. Preflow pressure too high; Defective Arc Starter
1-3	Lost Pilot	Pilot went out without shutoff signal; Preflow pressure too high; cut current set too low for consumables.
1-4	Loss of Transfer	Arc transfer (>50 ms.) then arc lost with START still on. Standoff too high; Current set too low.
1-5	Off the Plate	Function not currently enabled
1-6	Pilot Timed out w/o Transfer	Must transfer from Pilot to Cutting Arc in 85 ms. (SW8-1 OFF) or 3 sec. (SW8-1 ON). Standoff too high or void in work under torch; cut current too low for consumables; Preflow pressure too low.
1-7	Tip Saver	Function not currently enabled.
1-8	Possible Shorted Torch	Detected tip voltage too close to electrode voltage. Plasma flow/pressure too low; Plasma leak; cut current too high; shorted torch body; consumable parts worn out.

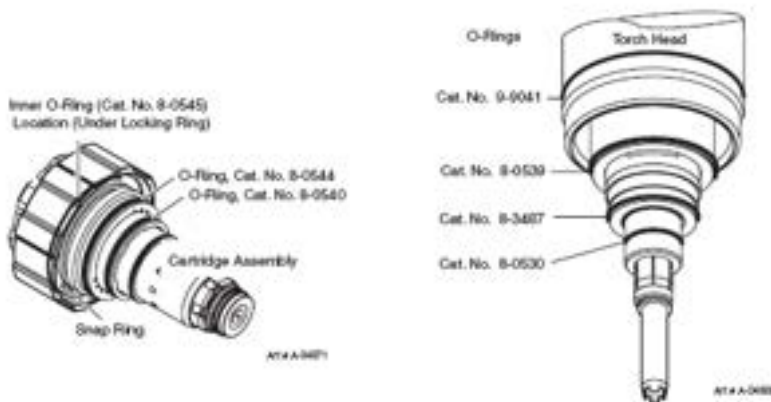
Fault Code Key		
Error Code	Error	Remedy / Comments
2-1	Missing Phase	Blown fuse, Broken or loose connection on power cable
2-2	Wrong input voltage	Inverter(s) not configured correctly for input voltage; Poor power quality (brownouts, dropouts); Input power capacity / wiring too small causing voltage drop; broken or loose power cable connections.
2-3	Inverter or Pilot Regulator Over Temperature	Failed fan; Ambient above 40 deg C. (104 F); Blocked airflow
2-4	Power Supply not Ready	Defective inverter
2-5	DC Output Low	Output less than 80 VDC; Defective inverter, shorted output; Shorted pilot regulator (chopper); CCM voltage sense (J6) wire open or disconnected.
2-6	Primary over current fault	Over current detected in inverter primary circuit, remove power to reset; defective inverter; voltage surge;
2-7	Unexpected current	Current >20A in work or pilot leads before pilot ignition; Possible shorted torch; Defective current sensor.
2-8	Unexpected current in pilot circuit	Current > 5A in pilot circuit; wrong or mismatched consumables; Pilot lead shorted to negative in torch tube; Possible shorted torch
2-9	Unexpected current in work lead	Current > 5A in work lead; Short to chassis in RAS; Negative lead short to ground.
3-1	Gas Control Communication fault, Cannot establish Communication with gas control.	If GCM 1000: Control cable not connected or Basic ID signal open. GCM 2010 & 2000: Dirt on fiber ends or in connectors, blow out with clean dry air; fiber not locked into connector; sharp bends in fiber; fiber defective; Gas Control PCB defective, replace. CCM defective, replace.
3-2	Gas Control Communication reply fault, connection was established but CCM did receive a reply to a process request.	Gas Control did not reply to signal from CCM in allowed time. Dirt on fiber ends or in connectors, blow out with clean dry air; fiber not locked into connector; sharp bends in fiber; fiber defective. If problem persists Gas Control PCB likely defective, replace board.
3-3	Gas Pressure Low	If GCM 1000, Plasma < 15 PSI; faulty or disconnected pressure SW. If GCM2010_AG, GCM2000_AC or later or Gas Control has been updated with 19X2219_AG or later PCB: Plasma or Shield input out of range 105-135. If GCM2010_AG, GCM2000_AC or later or Gas Control has been updated with 19X2219_AG or later PCB: Plasma or Shield input out of range 105-135 PSI; Unplugged or Faulty pressure sensor.
3-4	Gas Control not ready	Purging; not in RUN mode; Gas Control faulty, replace PCB.
3-5	Gas Control Protocol Fault	Application error or firmware compatibility fault
3-6	Invalid Current Control level from GCM	GCM sent output current level outside the range of the power supply, Check firmware compatibility
3-7	Gas Control returns wrong command sequence	Check firmware compatibility
3-8	CCM and Gas Control type (Autocut-Ultracut) mismatch	Install correct CCM or Gas Control for system
3-9	Gas Control Communication reply fault	Reply not compatible with request; Check firmware compatibility
3-10	Warning. -- Gas Control firmware needs update	System will function but control may not be optimized for best performance / consumable life

Fault Code Key		
Error Code	Error	Remedy / Comments
4-1	Coolant Level low fault	Check coolant level, add as needed.
4-2	Low coolant flow after power on purge. Not cutting: < 0.7 gal/min for 15 sec; Cutting: flow between 0.35 to 0.7 gal/min for 3 sec. or immediately if < 0.35gal/min;	Suction leak introducing air into coolant, suspect rear panel filter seal; clogged filter; defective pump.
4-3	Coolant overheated (>70 deg. C, 158 deg F)	Coolant fan failed; radiator fins clogged with dirt; Ambient temperature > 40 deg C.
4-4	Coolant System not ready. During power on purge / priming, flow did not reach 0.35 gal/min for at least 5 seconds	If new installation recycle power to restart pump, may take a few times to fill hoses; Damaged torch coolant tube; Suction leak introducing air into coolant, suspect rear panel filter seal; clogged filter; defective pump.
4-5	Low Coolant Level - Warning	While cutting detected low coolant level, does not stop out. Add coolant as required.
5-1	CANBUS Failure to Acknowledge fault.	If GCM 1000, Basic ID signal missing; Other gas controls, Fiber disconnected or broken, Transceiver (what fiber plugs into) fault, replace Gas control PCB or CCM
5-2	CANBUS Off due to excessive data errors;	Dirt on fiber ends or in connectors, blow out with clean dry air; fiber not locked into connector; sharp bends in fiber; fiber defective;
5-3	CANBUS data error warning. Errors increasing, will soon fault.	Dirt on fiber ends or in connectors, blow out with clean dry air; fiber not locked into connector; sharp bends in fiber; fiber defective;
5-4	CCMMessage not sent	Dirt on fiber ends or in connectors, blow out with clean dry air; fiber not locked into connector; sharp bends in fiber; fiber defective; CANBUS hardware error (CCM or Gas Control PCB)
6-1	CCMAnalog Voltage Error	Replace CCM
6-2	CCMADC or DAC error	Replace CCM
6-3	Coolant Flow too High error, flow > 2.7 gal/min	Torch coolant tube broken or missing; CCM fault, replace CCM
6-4	CCMData Memory error	Replace CCM

## Scheduled Maintenance

### Lubricate Torch Cartridge O-Rings

Lubricate all three O-Rings on the Cartridge Assembly and all three O-Rings on the Torch Head periodically with O-Ring Lubricant supplied. Remove the snap ring on the cartridge assembly and slide the locking ring downward for access to the O-Ring under the locking ring.



#### CAUTION

Use only Thermal Dynamics No. 9-4893 O-Ring Lubricant (Christa Lube MCC-128) with this torch part. Use of other lubricants may cause irreparable damage to the torch.

An O-ring replacement kit with both torch and cartridge rings is available, catalog number 9-9488.

### Coolant

Torch coolant becomes conductive with use and eventually will cause a shorted torch condition. Torch coolant should be replaced every six months. Also remove and clean the external coolant filter and the smaller filter located near the flow sensor.

Torch coolant is available pre-mixed or as concentrate.

Catalog Number	Description	Propylene Glycol / Deionized Water Mix	Freeze Protection
7-3580	Extra-Cool™	25/75	10°F / -12°C
7-3581	Ultra-Cool™	50/50	-27°F / -33°C
7-3582	Extreme-Cool™	Concentrate to be mixed with De-I™ Water	-65°F / --51°C
7-3583	De-I Water™		32°F / 0°C

## Periodic Maintenance

Power Supply Maintenance Schedule
<b>Daily</b>
Check coolant level; add coolant as needed.
Check gas hose connections and pressures.
Check cooling fan; clean as needed.
<b>Monthly</b>
Check cooling fan and radiator; clean as needed.
Check gas hoses for cracks, leaks, or abrasion.
Replace as needed.
Check all electrical connections for cracks or abrasion. Replace as needed.
Clean water filter (if using H <sub>2</sub> O Mist)
<b>Six Months</b>
Replace coolant filter.
Clean coolant tank.
Vacuum out any dust buildup inside power supply.

## Troubleshooting Torch Coolant Leaks

Never operate the system if coolant leaks from the torch. A steady drip indicates that torch parts are damaged or installed improperly. Operating the system in this condition can damage the torch head. Refer to the following chart for guidance on coolant leakage from the torch head.



## Technical Service Contact Numbers

Thermal Dynamics Technical Service is available for telephone or e-mail support. Technicians are available to assist with installation, application and repair issues.

Technical Service Toll Free – 1-800-PLASMA2 (752-7622)

Automation Technical Service – 1-888-832-3477

Automation Customer Care – 1-866-279-2628

General Customer Care – 1-800-PLASMA1 (752-7621)

E-mail - [tdctech@thermadyne.com](mailto:tdctech@thermadyne.com)

[www.thermal-dynamics.com](http://www.thermal-dynamics.com)

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