

# LAGUNA

## **SMARTSHOP® FC,FCE, FIBER LASER MANUAL** **3-6 KW Max Photonics with CypCut / CypNest CONTROL SYSTEM**



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**Revision 01 (04/17/2025)**

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## Introduction

This manual provides basic safety rules and instruction that the machine operator should follow when using and maintaining the machine.

Before using the machine, please read this entire manual carefully and keep it for future use. The machine should be equipped with this manual for easy access and reference.

Be sure to comply with the requirements of this manual. If you are unclear about certain terms in the manual, please consult technician support at Laguna, 1-949-474-1200.

Follow all the Federal, State, and Local regulations that pertain to the use of a Fiber Laser.




# LAGUNA

**Laguna Support Line: 1(877)844-8314**

**You can also make a support case at:**

**<https://lagunatools.com/resources/customer-service>**

## Safety symbols:

 <p><b>CAUTION</b> Pinch point. Keep hands clear during operation.</p>	<p>Installed on the machine enclosure. Pinch hazards exist at points between adjacent moving parts or between a moving part and its adjacent structure.</p>
 <p><b>DANGER</b> Crush hazard. Stay clear of this area during operation. Lockout/tagout before servicing</p>	<p>Installed on the machine enclosure. Pinch hazards exist at points between adjacent moving parts or between a moving part and its adjacent structure.</p>
 <p><b>CAUTION</b> <b>LASER</b> <b>2M</b></p>	<p>Hazardous laser radiation. Do not stare into the pilot laser beam</p>
 <p><b>DANGER</b> <b>LASER</b> <b>4</b></p> <p><b>AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION</b></p>	<p>Invisible Class 4 laser. Do not expose eyes or skin to direct or reflected beam. Where Eye protection at all times while in production.</p>
 <p><b>WARNING</b> TOXIC FUME/PARTICLES MAY BE GENERATED BY THIS MACHINE</p>	<p>Fumes and particles generated during processing can be toxic and harmful to health. Fume extraction is required to keep employees safe.</p>
	<p>Installed on the laser head. Indicates the laser beam exit.</p>
 <p><b>CAUTION</b> Do Not Stand Here</p>	<p>Standing on top of the machine is prohibited</p>

## Product Usage:

**The machine is used to cut ordinary cold metals. It shall not be used for other purposes. Lightweight metals such as magnesium, titanium and their alloys are explosive and should not be cut with the machine.**

The storage and use environment of the machine is as follows. Violation of environmental requirements may endanger the operator or damage the machine.

Storage environment: Ambient temperature: -13°F to 122°F Relative humidity: 50%

Use environment: Ambient temperature: -13°F to 122°F; Relative humidity: 50% Altitude:

3300 FT. above sea level.



**The machine is prohibited from being used in flammable and explosive environments**

## General safety requirements:

- Before transporting, installing and using the machine, please read this manual carefully to ensure that you understand the safety-related contents.
- Keep the manual in a safe place for future reference.
- This manual should be easily accessible to users and maintenance personnel.
- This machine is limited to professional use. The operators and maintenance personnel of the machine must receive good training and obtain the corresponding qualifications.
- It is prohibited to operate, maintain or repair the machine when you are tired, drunk, or taking drugs.
- Make sure that idle people, especially children, stay away from this machine.
- The machine may only be used for the purpose for which it was designed.
- The machine may not be modified without the manufacturer's permission. Any modification and use outside the intended purpose may result in serious personal injury or damage to the machine.
- The machine must not be used in an inflammable or explosive environment. Make sure inflammable or explosive items are kept away from the machine.
- The ground on which the operator stands should be firm, flat and non-slip.
- The operating area should be clean and tidy.
- The processing area should be well lit. The lighting should be free of shadows and flicker.
- Do not use the machine in a humid environment, let alone expose it to rain.
- Do not wear loose clothing, necklaces, jewelry, ties, etc. to prevent being dragged by moving parts.
- Long hair must be tied tightly and wrapped securely to prevent it from being caught in moving parts.
- Wear personal protective equipment, when necessary, such as non-slip shoes, safety gloves, safety glasses, earmuffs, dust masks, etc. Please consult the administrator about the current safety operating procedures of this machine.

- When transporting, moving and installing the machine, please read this manual and other related document carefully. You must clearly understand the weight, center of gravity and anchor point of the machine and choose the correct moving equipment.
- Check the machine and its accessories carefully and contact the manufacturer or supplier if there are any errors and damages.
- The machine must be reliably connected to the protective earth.
- Select a power cord with sufficient size and current carrying capacity according to the full load current of the machine.
- In the power supply circuit, the user should install appropriate overcurrent and overload protection devices.
- The power connection must be completed by professional and qualified electricians.
- Do not touch any switch with wet hands to avoid electric shock. All parts of the machine tool with warning signs indicate that there are high-voltage electrical appliances or electrical components in these parts. Operators should be extra careful when approaching these parts or repairing them to avoid electric shock. For example: protective covers at the servo motor position, equipment transformers, electrical cabinet doors, etc.
- Read the machine tool manual and electrical schematics thoroughly and carefully to become familiar with the various functions and the operating methods of the corresponding keys.
- It is forbidden to change the set machine tool parameters without permission. If changes are necessary, they must be performed by professionals trained and approved by the equipment manufacturer, and the parameter values before the changes must be recorded so that they can be restored to the original state when necessary.
- Before starting the machine, check and confirm:
  1. All parts are installed correctly and firmly.
  2. All safety components are functioning properly,
  3. Tools, cleaning rags, etc., must be removed from the machine.
  4. No one is to remain in the danger zone.
- When performing maintenance or repairing the machine, disconnect the power supply and lock the power disconnect device in the "OFF" position.
- It is prohibited to clean, lubricate and maintain the machine while it is running.
- Once the machine experiences any issues, the machine should be stopped and the power should be disconnected, and the administrator should be notified in time to repair the machine.
- Do not climb or stand on the machine.

### **Special safety requirements for machines:**

- Only authorized personnel are allowed to operate or maintain the machine.
- After using the machine, the control key of the laser should be removed.
- When removing the fixed protective cover for maintenance and repair of the machine, the power isolation device must be turned off and locked in the OFF position.
- After power failure, you must wait for more than 5 minutes before touching the terminals. Because there is a high voltage between the power line terminals for a period after power failure, do not touch them immediately to avoid electric shock.
- The machine can be powered only after all fixed protective covers of the machine are installed.
- During maintenance, shut off compressed air, Oxygen, and nitrogen.
- The workshop where the machine is used should always be well ventilated.
- Laser cutting will produce harmful fumes. Make sure the machine's dust removal port is connected to the

exhaust dust / fume removal system.

- When cutting, make sure that the external fume removal equipment is in operation. It is recommended that the dust removal equipment be functionally interlocked with the output of the processing laser.
- The accumulation of nitrogen can cause suffocation. When entering the machine for maintenance, turn off the N2 source and confirm that there is no accumulation of nitrogen in the processing area.
- The laser beam exiting the cutting head is a Class 4 laser. Do not open the cutting head.
- The safety interlock system must not be disabled.
- The interlock door must not be opened when the laser is emitting light.
- The transparent window is a laser protection screen. If it is damaged, it should be replaced with a similar protection screen according to the label.
- The power supply voltage of laser used in processing is generally several thousand volts to tens of thousands of volts. The risk of injury from the high voltage of the laser and the X-rays generated by the electron tube under high voltage should be prevented.
- Oxygen is often used in laser cutting, and with the splashing of sparks during cutting, oxygen can easily lead to the risk of fire. Therefore, there should be no flammable or explosive items in the work area, and corresponding preventive facilities should be available, such as fire extinguishers.

### Laser Information

- The processing area of the machine is protected. The complete machine is a Class 1 product. There are a class 4 invisible laser and a class 2M visible guide laser inside the machine.
- Class 4 lasers are dangerous if viewed directly or if the scattered beam or skin encounters it. Class 4 lasers are also a common fire hazard.
- Short-term exposure of the naked eye to a class 2M laser beam is safe. However, users are strongly advised not to look directly into the beam or use optical instruments.
- **Companies using the machine should have a laser safety representative (LSO, Laser Safety Officer) to oversee the safe use of the laser cutting machine.**
- When maintaining lasers, laser safety goggles should be worn. The following factors should be considered when choosing goggles:
  1. wavelength
  2. Duration of exposure
  3. Maximum irradiance or exposure
  4. Maximum permissible radiation exposure
  5. Optical density
- The laying of optical cables should prevent damage to the cables, which may cause serious injuries and fire.
- Laser cutting machine operators or people who are close to lasers during operation should wear laser protective glasses with a wavelength of 1080μm. There must be good indoor lighting in the area to ensure smooth operation of the operator.
- Do not place any part of the human body under the beam, otherwise it may cause burns or even endanger life. No one should ever point their eyes directly in the direction of the laser (including the red indicator light) at any time.
- **When the shutter is open, people and non- working objects are prohibited from being within the laser irradiation range. Operators are strictly prohibited from leaving the machine during operation. If any abnormality occurs during the use of the equipment, the emergency stop switch should be pressed immediately.**

- During use, the cooling water temperature and auxiliary gas pressure should be checked frequently. Operate the equipment with the operator's license and comply with the safety operating procedures. Non-operators are strictly prohibited from operating the equipment.
- Oxygen is often used in laser cutting, and with the splashing of sparks during cutting, oxygen can easily lead to the risk of fire. Therefore, there should be no flammable or explosive items in the work area, and corresponding preventive facilities should be available, such as fire extinguishers.
- The exhaust gas generated during laser cutting is harmful to operators. Please ensure that the dust collection device of the equipment is operating normally and the workplace is ventilated.

## Machine Description

Fiber Laser is a more advanced processing method used in metal material processing. The SmartShop series fiber laser cutting machine produced by our company adopts world-renowned brands of fiber lasers, laser cutting heads, linear guides, gear racks, servo motors, CNC systems and other configurations.

The machine bed adopts high-strength integral welded body, which has been annealed at high temperature and precision-machined on a large CNC gantry milling machine, and has excellent rigidity, stability, The gas circuit components are all imported, the gas circuit design is advanced and reliable, and two different cutting gases can be installed and can be freely selected. The system adopts high pressure resistant design. When using nitrogen as auxiliary gas to cut metal materials, the nitrogen pressure can reach 300 psi. To ensure the stability of the gas system, some imported components are used, which greatly improves the stability of the gas system.

The principle of laser cutting is to use focused fiber laser for cutting. Through fiber transmission, it has high flexibility, fast speed, few failure points, low maintenance cost, convenient maintenance, high photoelectric conversion rate, and has great cost-effectiveness advantages in system matching. It is mainly used in metal crafts, hardware products, precision machinery, auto parts, sheet metal processing and other industries.

[The cutting thickness of the material is determined by the selected laser power.](#)

## Noise

### Noise Standards

is carried out in accordance with ISO 3744 and EN ISO 11553-3 standards

### Test Results

Sound power level:  $L_{WA} = 89.4 \text{ dB(A)}$ ;

Sound Pressure Level at Operator Position:  $LPA = 64.2 \text{ dB(A)}$ ;

Sound pressure level at loading and unloading locations:  $LPA = 61.5 \text{ dB(A)}$ ;

Correction coefficient:  $K_{2A} = 2 \text{ dB}$



The figures quoted are emission levels and not necessarily safe working levels.

There is a correlation between emissions and exposure levels, this cannot be used reliably to determine whether further precautions are required. Factors that influence the actual exposure level of the workforce include the characteristics of the workroom and other noise sources, i.e. the number of machines and other adjacent processes. Permissible exposure levels may also vary from country to country. However, this information will enable users of the machines to better assess hazards and risks."

## Specifications:

<b>FCE 5'x 10'</b>	Working Envelope	5'x10'
	Footprint	13' Deep x 19' Wide

<b>FCS 5' x 10'</b> <b>W/Enclosure and Shuttle</b>	Working Envelope	5' x 10'
	Footprint	36' x 24' inclusive all Devices
	Machine Weight	11,000 pounds
	Maximum Table Load	3968 pounds

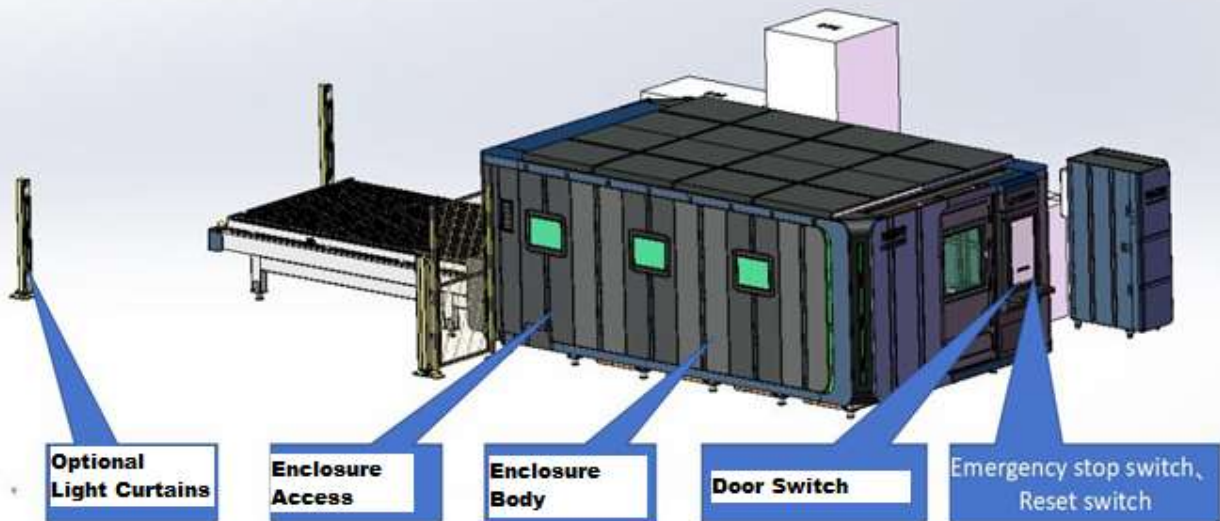
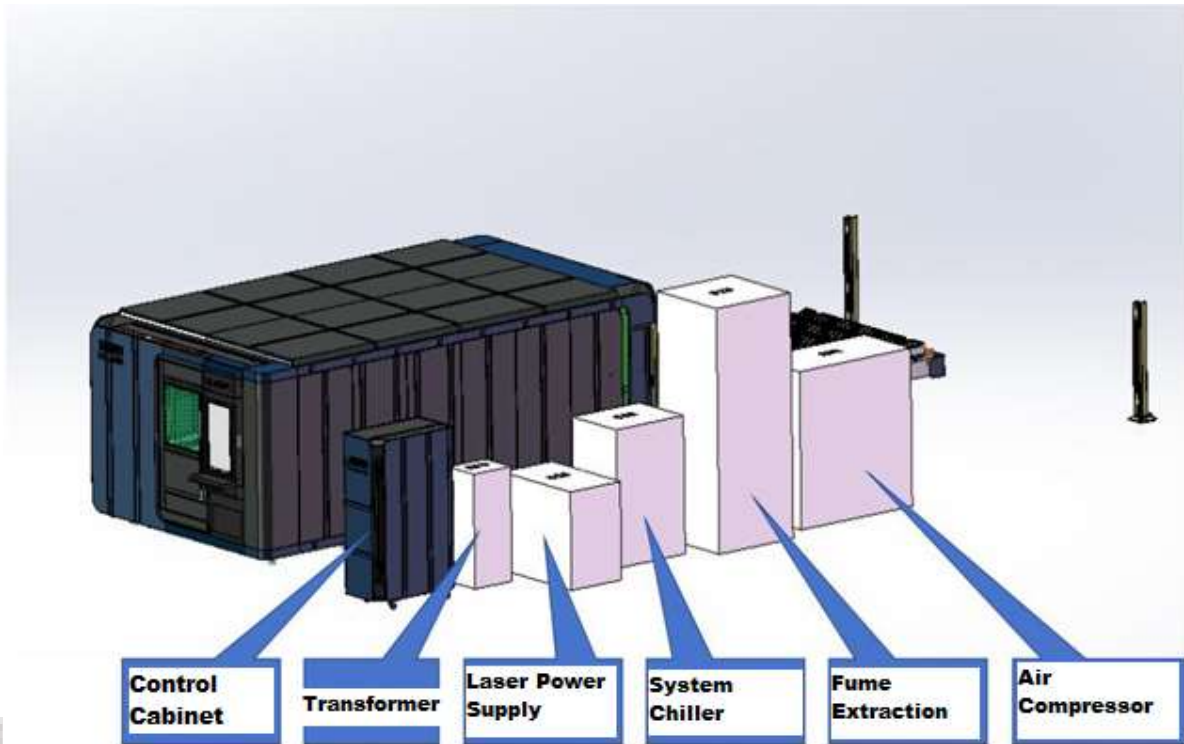
<b>FCS 6' x 13'</b> <b>W/Enclosure and Shuttle</b>	Working Envelope	6' x 13'
	Footprint	42.6' x 25.5' inclusive of all Devices
	Machine Weight	13,200 pounds
	Maximum Table Load	7716 pounds

<b>FC Open 5' x 10'</b> <b>W/Enclosure and Shuttle</b>	Working Envelope	5' x 10'
	Footprint	21.7' x 18' inclusive all Devices
	Machine Weight	10,000 pounds
	Maximum Table Load	3968 pounds

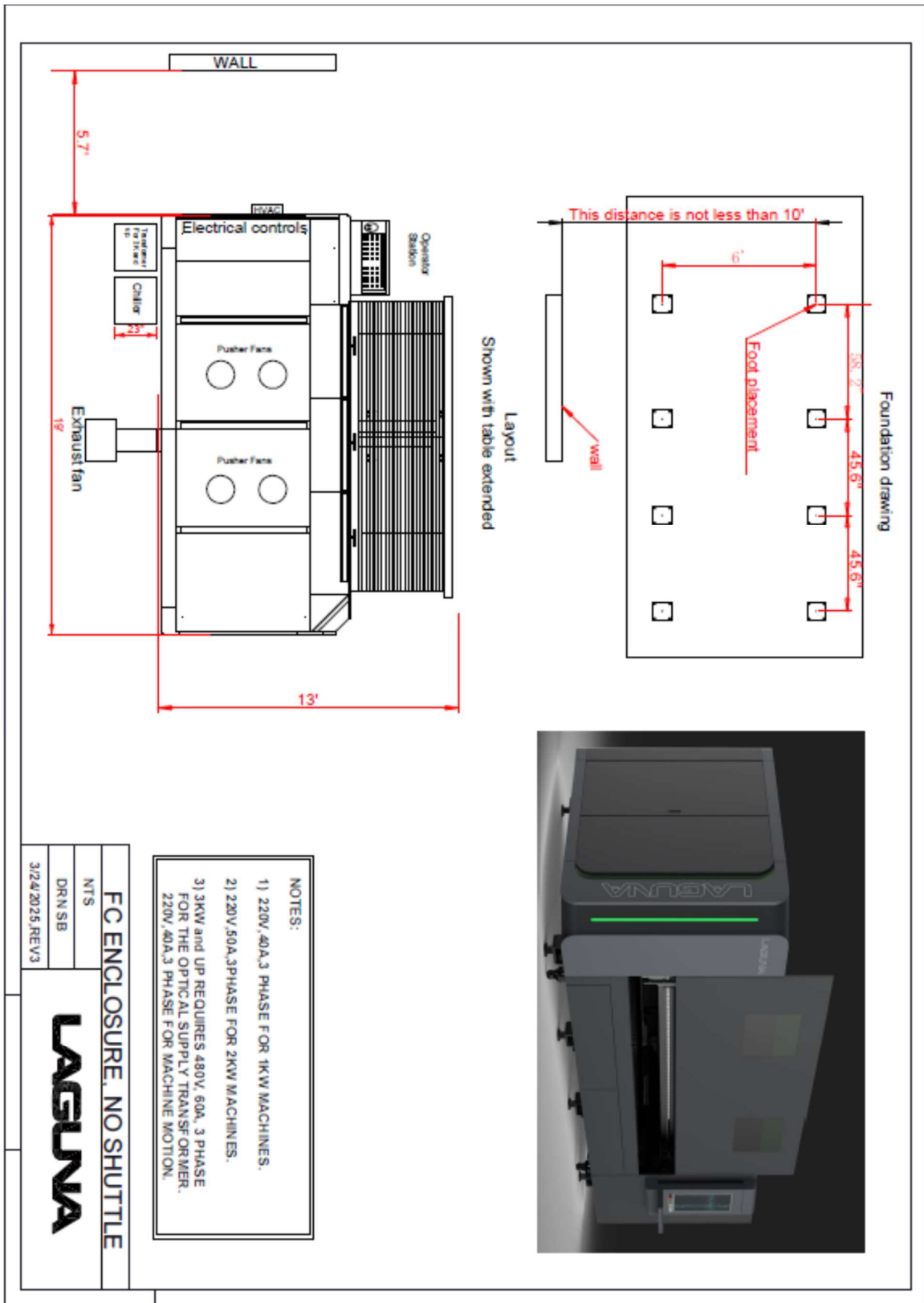
<b>FC Open 6' x 13'</b> <b>W/Enclosure and Shuttle</b>	Working Envelope	6' x 13'
	Footprint	25.25' x 18' inclusive of all Devices
	Machine Weight	12,200 pounds
	Maximum Table Load	7716 pounds

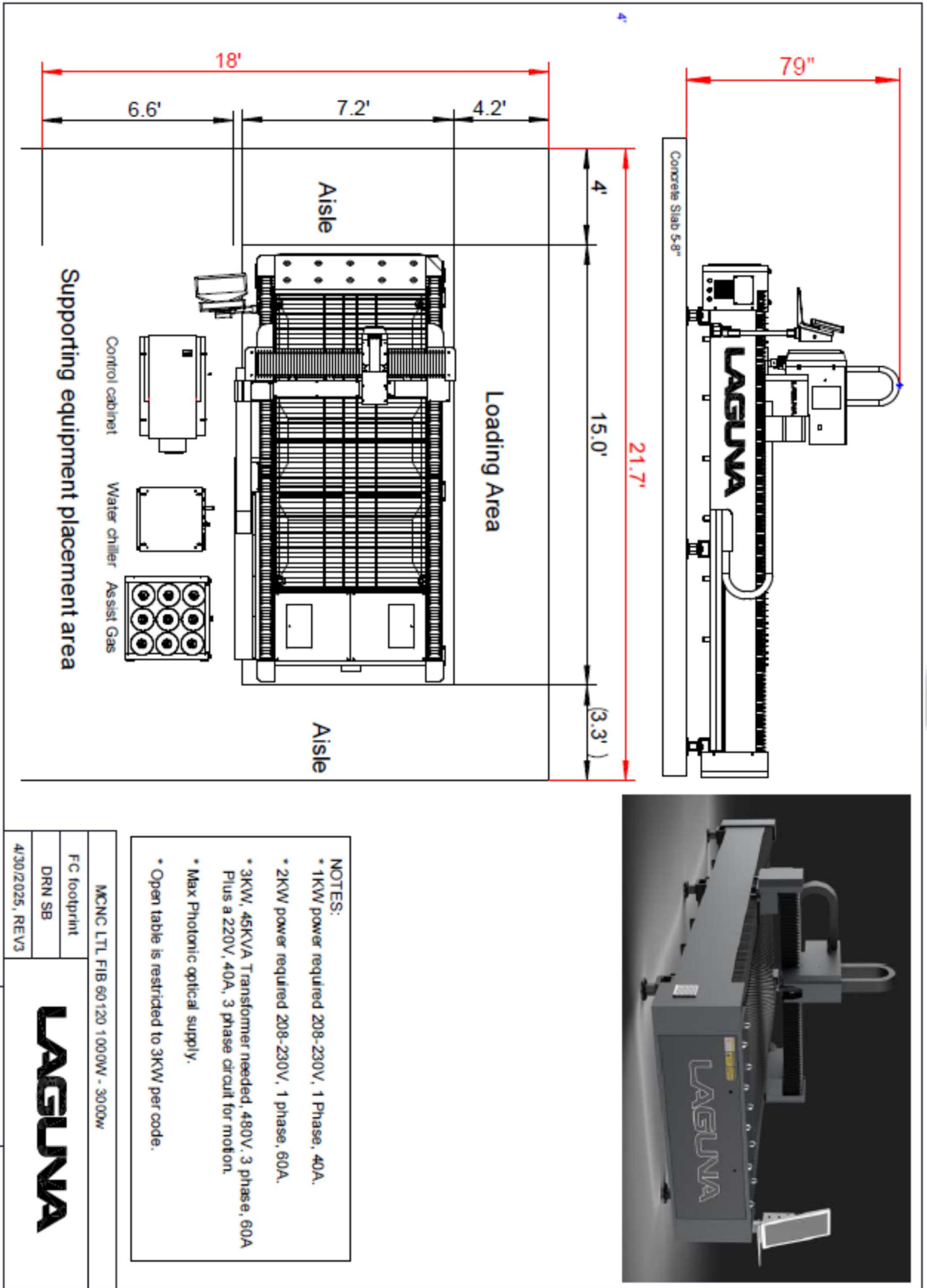
<b>All Models</b>	Position Accuracy	Plus - Minus 0.002"
	Repeatability	Plus - Minus 0.001"
	Max Speed X & Y Axis	2300 Inches Per Minute
	Max Speed Z Axis	780 Inches Per Minute

## Main components of the machine



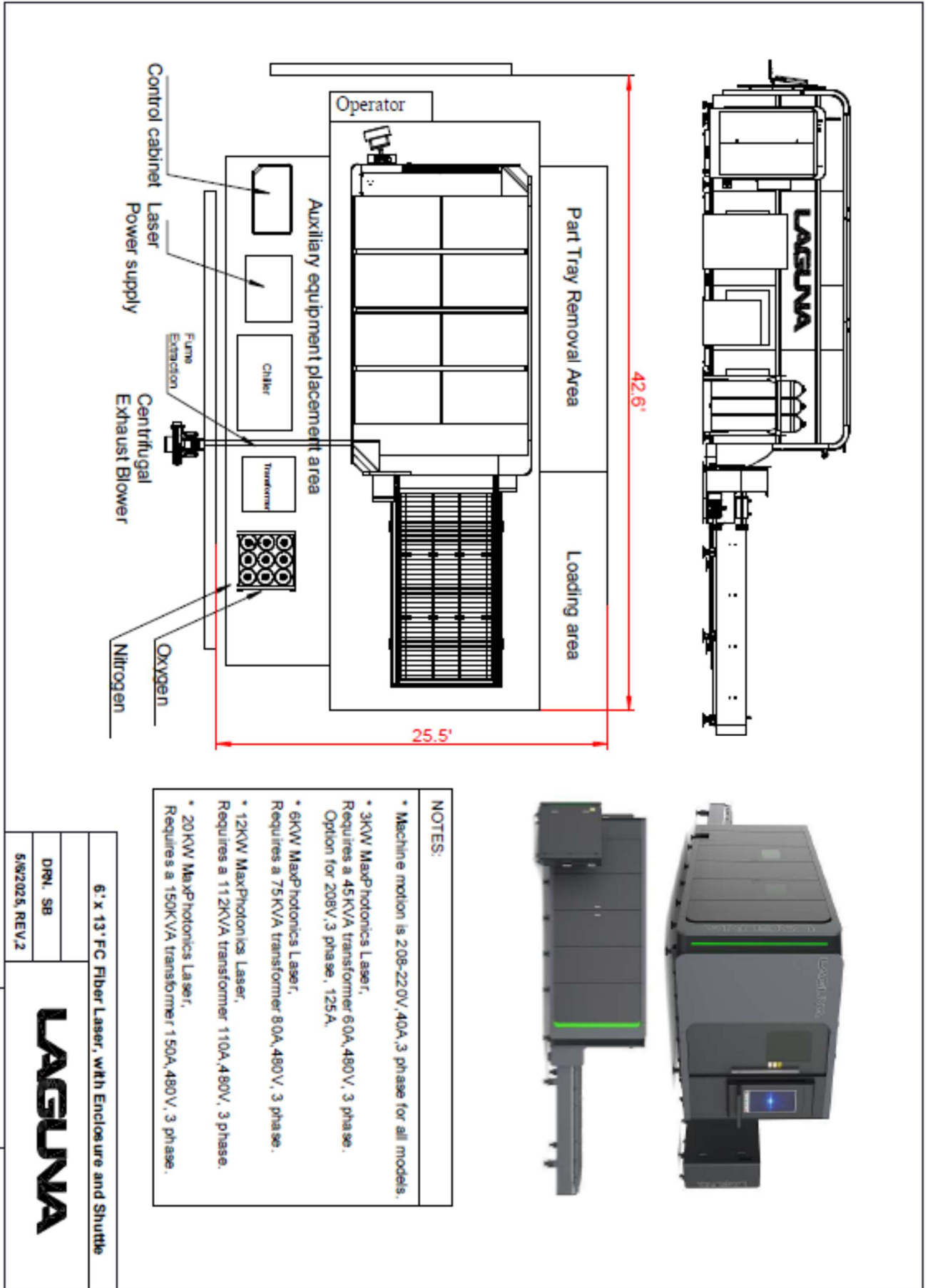
# Footprint Drawings:





- NOTES:**
- \* 1KW power required 208-230V, 1 Phase, 40A.
  - \* 2KW power required 208-230V, 1 phase, 60A.
  - \* 3KW, 45KVA Transformer needed, 480V, 3 phase, 60A Plus a 220V, 40A, 3 phase circuit for motion.
  - \* Max Photonic optical supply.
  - \* Open table is restricted to 3KW per code.

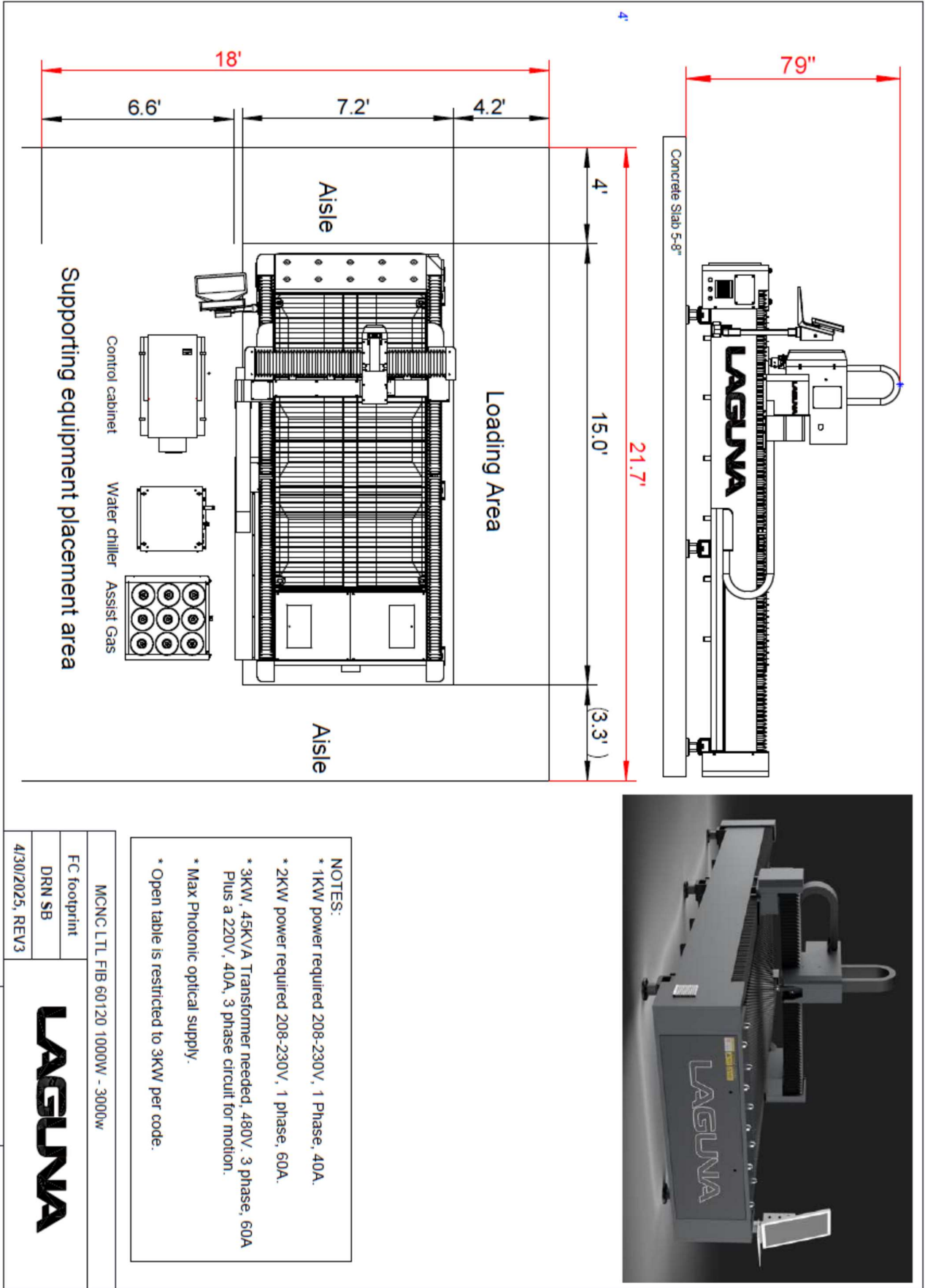
MCNC LTL FIB 60120 1000W - 3000W	
FC footprint	<b>LAGUNA</b>
DRN SB	
4/30/2025, REV3	



**NOTES:**

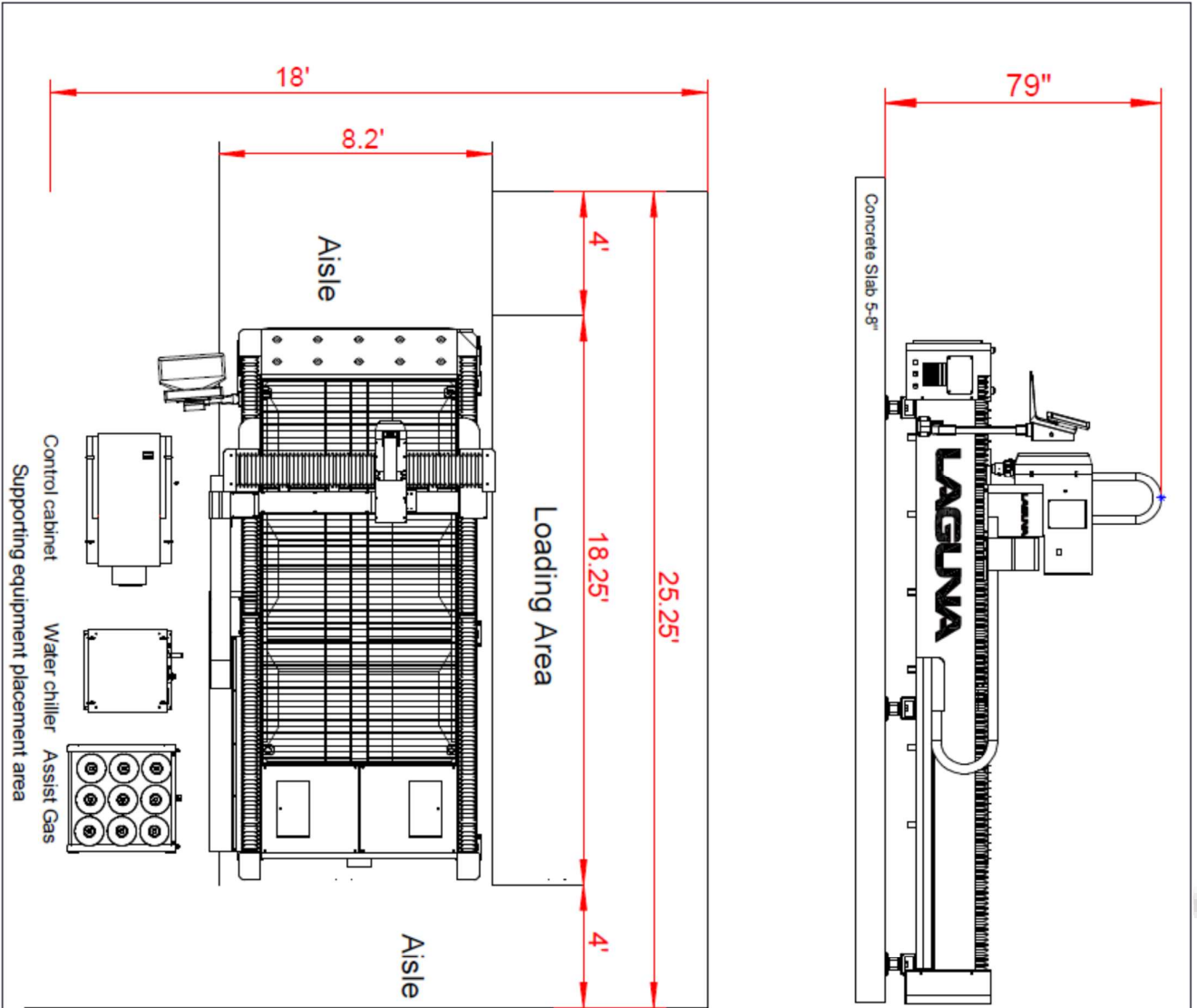
- \* Machine motion is 208-220V, 40A, 3 phase for all models.
- \* 3KW MaxPhotonics Laser, Requires a 45KVA transformer 60A, 480V, 3 phase. Option for 208V, 3 phase, 125A.
- \* 6KW MaxPhotonics Laser, Requires a 75KVA transformer 80A, 480V, 3 phase.
- \* 12KW MaxPhotonics Laser, Requires a 112KVA transformer 110A, 480V, 3 phase.
- \* 20KW MaxPhotonics Laser, Requires a 150KVA transformer 150A, 480V, 3 phase.

6' x 13' FC Fiber Laser, with Enclosure and Shuttle	
DRN_SB	<b>LAGUNA</b>
5/8/2025, REV.2	



- NOTES:**
- \* 1KW power required 208-230V, 1 Phase, 40A.
  - \* 2KW power required 208-230V, 1 phase, 60A.
  - \* 3KW, 45KVA Transformer needed, 480V, 3 phase, 60A Plus a 220V, 40A, 3 phase circuit for motion.
  - \* Max Photonic optical supply.
  - \* Open table is restricted to 3KW per code.

MCNC LTL FIB 60120 1000W - 3000w	
FC footprint	<b>LAGUNA</b>
DRN SB	
4/30/2025, REV3	



- NOTES:**
- \* 1KW power required 208-230V, 1 Phase, 40A.
  - \* 2KW power required 208-230V, 1 phase, 60A.
  - \* 3KW, 45KVA Transformer needed, 480V, 3 phase, 60A Plus a 220V, 40A, 3 phase circuit for motion.
  - \* Max Photonic optical supply.
  - \* Open table is restricted to 3KW per code.

6'X13' FC Fiber Laser, Open Table	
FC footprint	<b>LAGUNA</b>
DRN SB	
7/29/2025, REV1	

## Installation safety regulations

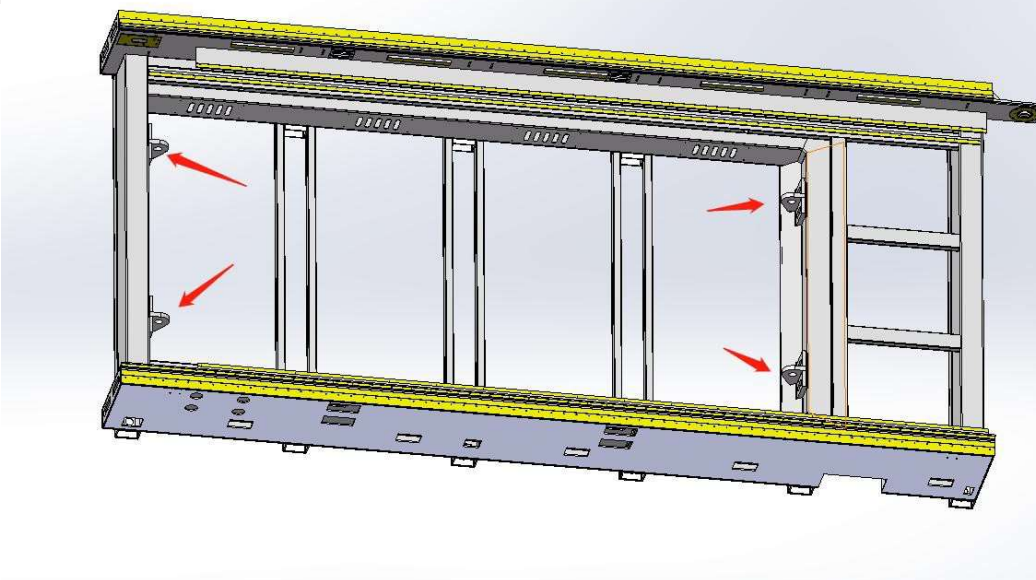


- Use appropriate equipment with sufficient capacity to move the machine. Weights are listed by frame size above.
- Ensure the balance and stability of the machine during transportation.
- When you receive the machine, inspect it for damage that may have occurred during shipping.

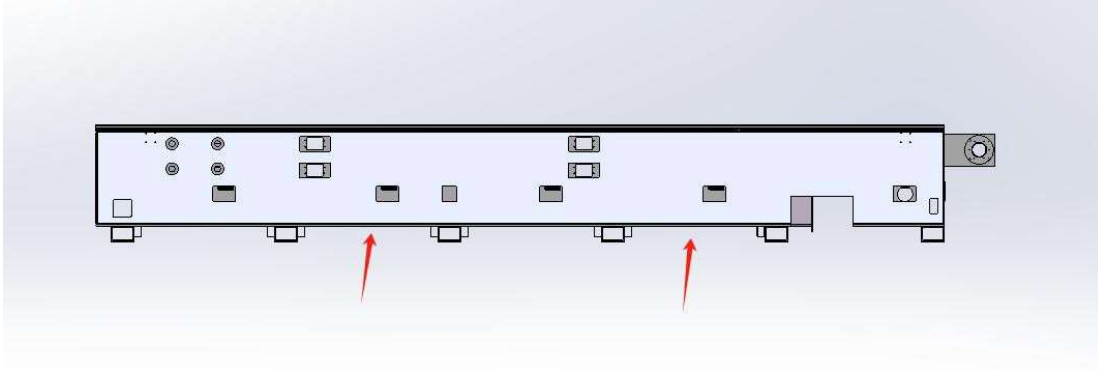
## Handling of the machine



Fork mounting point, lifting point and lifting rope angle



## Hoisting diagram



### Fork Placement:

Facility infrastructure needs to be verified before delivery. In particular, the dimensions of the door openings, the height of the pillars, the height of the cable racks, the suitability of the road surface for the use of armored rollers, etc. must be checked. The dimensions of the machine indicated on the drawing must be considered during transportation!

### Aids and handling tools

The following items must be prepared by the user:

- Forklifts for machine tools, lasers and additional equipment. A hydraulic lift with a lifting capacity of at least 10t is recommended; if a larger boom is required according to local conditions, the truck crane must have a larger lifting capacity.
- Forklift (load capacity 10 t)
- Bridge crane: load-bearing capacity 10t
- Armored rollers (1 steerable, 2 solid)
- At least 2 hydraulic jacks with a lifting capacity of at least 5 t (minimum setting height: 30 mm)
- Crowbar (1 m) and extension

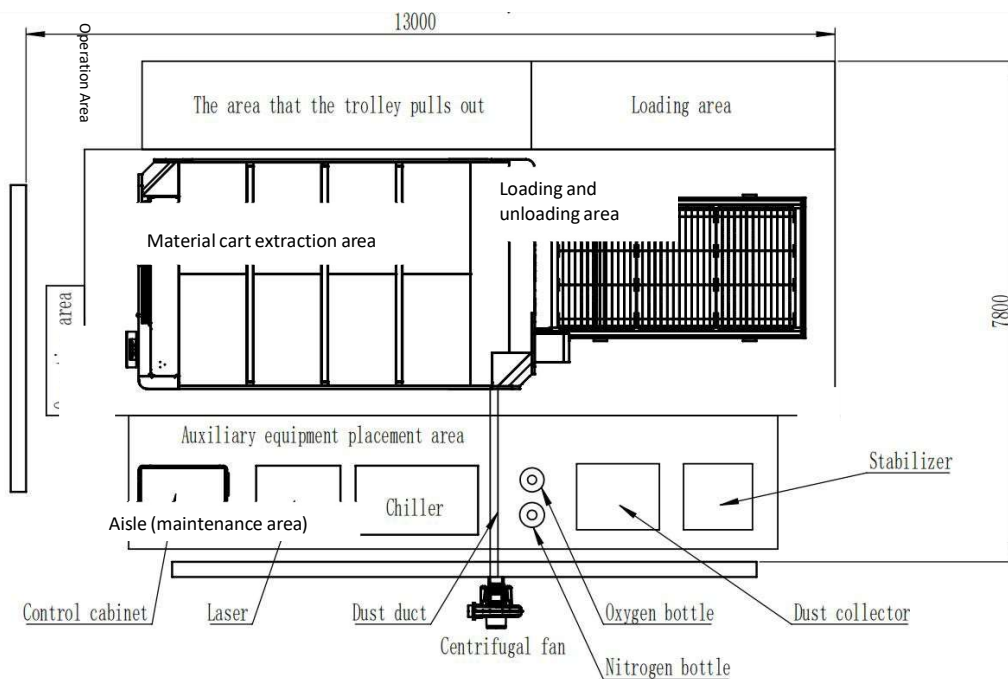
### Actions to be taken by the user:

- All transportation work must be carried out in accordance with relevant transportation regulations
- The machine tool is not allowed to be placed on the ground without a base plate, otherwise the bottom of each component may be damaged! The base plate of the machine tool support must be less than 100mm from the ground. When the machine tool is moved to the installation site, this distance from the ground must also be maintained during the movement.
- The foundation conditions at the installation site must meet the requirements of the installation conditions. The user must prepare for cutting and drilling on the floor of the installation location according to the foundation plan before the machine tool arrives.
- The machine tool is unloaded from the truck using a Forklift with the corresponding lifting capacity.

- Lasers, refrigeration units, extraction units, etc. can be transported directly from the truck to the machine installation site using a forklift.
- The machine tool is moved from outdoors to the factory on armored rollers.
- Use a bridge crane with sufficient lifting capacity in the factory or continue to move the machine tool to the installation site on armored rollers.

## Installation site

Equipment users need to provide a sufficient area for use, the ground flatness should not exceed  $\pm 10\text{mm}$  and can withstand more than 6 tons of weight. The entire installation surface of the bed and workbench support should be no less than 7 Inches thick, the compressive strength should not be less than  $30\text{N/mm}^2$ , and the load should be greater than  $30\text{KN/m}^2$ .



### Notes for Location and Infrastructure:

Note: All the above Disconnects or Breakers are recommended not to have GFI protection function. If they have GFI function, the rated leakage protection current shall not be less than 300mA, and it is recommended to be more than 500mA. If the rated leakage protection current is less than 300 mA, the leakage protection may trip.

- Power supply specification: Three-phase 480V, 3 phase.
- Machine Motion is 208 – 240V, 40A, 3 Phase.
- Quality: Three-phase imbalance <2.5%, line voltage fluctuation <5%. The machine must be equipped with a stabilized power supply, which can ensure the stability of the machine input voltage and make the entire machine tool and laser work in a relatively good state. The air compressor and fan should not pass through the stabilized power supply to prevent the instantaneous high current changes of high-power equipment from interfering with the power output of the laser.
- Environmental requirements: Good ventilation, no dust, no corrosion, no pollution, no water leakage. The recommended ambient temperature is between 41° F and 91° F.

Note: Avoid thermal deformation caused by direct sunlight on one side and wind on one side (for example, install blinds when installing at a window to avoid these situations).

- Water cooling system: water is added to the water cooler for circulation, which is used to cool lasers, cutting heads and other special equipment. The cooling circulating water requires the use of high-quality pure water distilled water. Mineral or Tap water is strictly prohibited. When the ambient temperature is less than 0 degrees Celsius, the cooling water should be replaced with antifreeze in advance before the ambient temperature is less than 0 degrees Celsius to avoid ice damage to the equipment. Pay special attention!
- The left and rear sides of the machine tool should be at least 45" away from the workshop wall; the laser and water cooler should be at least 40" away from the wall. The control unit, servo unit, display and control panel are the core components of the machine tool. They have certain requirements for the environment and should avoid electromagnetic interference, such as arc welding and EDM, to avoid affecting the normal operation of the machine tool.
- Fire safety: To prevent the occurrence of fire, the processing site should be equipped with appropriate fire extinguishers and certain fire escape routes should be reserved.

## Material preparation before installation:

1	Deionized water/ Distilled water/ Purified water	Liter/ barrel (different powers require different water additions, add water according to actual power)	L	3	For Water Chiller 1: 3000w: 25L 2: 6000w: 11 Gallons 3: 12000w: 32 Gallons 4: 20000w: 45 Gallons 5: 30000w: 53 Gallons
2	Nitrogen	Nitrogen purity 99.9 %	bottle	1	No less than 4 bottles
3	oxygen	Oxygen purity 99.9 %	bottle	1	No less than 2 bottles
4	Optic Disconnect	3P/AC380V/63A (select according to different power)	indivial	1	Disconnect after the Transformer
5	Chiller Disconnect	3P/AC380V/50A (select according to different power)	indivial	1	Chiller
6	Fume Extractor Disconnect	(depending on the power selection)	indivial	1	Exhaust fan
7	Air compressor	Need to remove oil and water	set	1	Output pressure $\geq 2\text{Mpa}$
8	Dryer	With high precision oil-water separator	set	1	With filtration
9	Ground Rod	Copper or galvanized , length,8' , diameter,5/8"	PE	1	Verifying the Ground is correct with the proper measurements.

## Assist Gas:

- **Oxygen** is used for cutting CRS Steels and HRS Steels when using this type of Gas, you will be using a Positive Focal.

Oxygen is an accelerant, it burns much hotter and creates carbon on the cut edge, so you can cut faster but not as precise in certain instances.

- **Nitrogen** is used for cutting Reflective material i.e., Stainless Steel, Aluminum or Copper when using Nitrogen, you will be using a Negative Focal. **Nitrogen is inert so the sole purpose is to assist the power supply to cut material. This is referred to as "Clean Cutting".**

## GAS Purity:

Oxygen 99.95% (Mild Steel Cutting)

Max Consumption

16.6 SCFM@ 110PSI 470 L/min@7.6 Bar

Nitrogen 99.8% (Stainless Aluminum Cutting)

Max Consumption:

50.0 SCFM @ 300PSI 1,400 L/min@ 20 Bar

Gas	Purity	Maximum content of water vapor (ppm)	Maximum content of hydrocarbon (ppm)
oxygen	99.95%	<5 ppm	<1 ppm
nitrogen	99.99%	<5 ppm	<1 ppm
argon	99.998%	<5 ppm	<1 ppm
helium	99.998%	<5 ppm	<1 ppm
Diameter of cooled gas pipe (Outer diameter)		10mm	

Impurity can be filtered out in gas supply tube, but oxygen and water vapor can permeate the light path system through nonmetal materials, which is the source of the appearance of dust and hydrocarbon. Stainless steel fittings are recommended, at the same time, operators must use filters which can remove a minimum of 0.01 micron particle to purify.

A pressure gauge with a stainless steel diaphragm is recommended. Industrial pressure gauges suck in air. Rubber diaphragm produce hydrocarbon by aging or other factors.



**CAUTION:** gas interface can not be replaced arbitrarily, especially do not use PTFE TAPE, Otherwise, the gas path will be blocked, the normal cutting will not be possible and the laser head parts will be damaged at the same time.

## USING COMPRESSED AIR VS ASSIST GAS:

This is a very complicated question and the topic concerning Laser cutting. In general, air consists of molecular Nitrogen [N<sub>2</sub>] with a volume count of 78%, molecular oxygen [O<sub>2</sub>] with a volume count of 20%. There are also small amounts of Argon [Ar] with a volume of 1.9%, Neon [Ne]. Helium [He]. Methane [CH<sub>4</sub>]. Krypton [Kr]. Hydrogen [H]. Nitrous Oxide [N<sub>2</sub>O] and Xenon [Xe].

We use a proportional valve while using O<sub>2</sub> to be able to control the cut; we use just the regulator set between 125 - 300 PSI with N<sub>2</sub>.

If we use compressed air, we need to make sure it's clean and dry. If not, this will destroy the optics of the machine.

We can use the port for N<sub>2</sub> for compressed air.

Here are a few examples:

**Carbon Steel** - Max material .250 Thickness at 33 PSI using O<sub>2</sub> would then be .05 Max material thickness using Compressed air.

**Stainless Steel** - Max material .250 Thickness at 300 PSI using N<sub>2</sub> would then be .188 Max thickness using Compressed air at 300 PSI. Not an exact direct correlation but it will give you perspective.

Note: for commissioning, please have a minimum of 2 High pressure bottles of N<sub>2</sub>, and O<sub>2</sub> for full testing. Many customers use 6 or 12 packs of gas until they know their actual usage for production.

If you use a dewar of Liquid a vaporizer is required. Failure to use one has caused considerable damage to machinery. If there is freezing of the lines, it will cause a moisture issue in the head destroying the Optic.



- Gas usage standard requirements:

1. **Oxygen:** if liquid oxygen is used, a vaporizer must be added to heat the liquid to a normal temperature gas. The pressure resistance of the high-pressure liquid bottle is 4.5MPa, the pressure resistance of the vaporizer is 4.5MPa, the flow rate is 1.0 cubic meter/minute, and the output pressure is 2.0MPa.

2. **Nitrogen:** If liquid nitrogen is used, a vaporizer must be added to heat the liquid to a normal temperature gas. The pressure resistance of the high-pressure liquid bottle is 4.5MPa, the pressure resistance of the vaporizer is 4.5MPa, the flow rate is 1.0 cubic meter/minute, and the output pressure is 3.0MPa.

3. **Air:** If high-pressure air is used to cut the plate, pure and dry high-pressure air (maximum air pressure 3.0MPa) is required.

Note:

Do not empty the gas cylinder completely. When returning the gas cylinder, the residual pressure in the cylinder must be at least one atmosphere higher than the air pressure. When the oxygen gas pressure is low, the laser cutting machine control system will alarm, please change the gas in time.

## Connecting the Power Supply:



- This operation must be performed by qualified Licensed Industrial Electrician.
- Check and make sure the voltage and frequency of the power supply match those marked on the machine nameplate.
- Always remember to connect the machine reliably to protective Earth ground.
- Provide over current protection for all power circuits
- Select a power cord that is large enough for the total power or full load current.



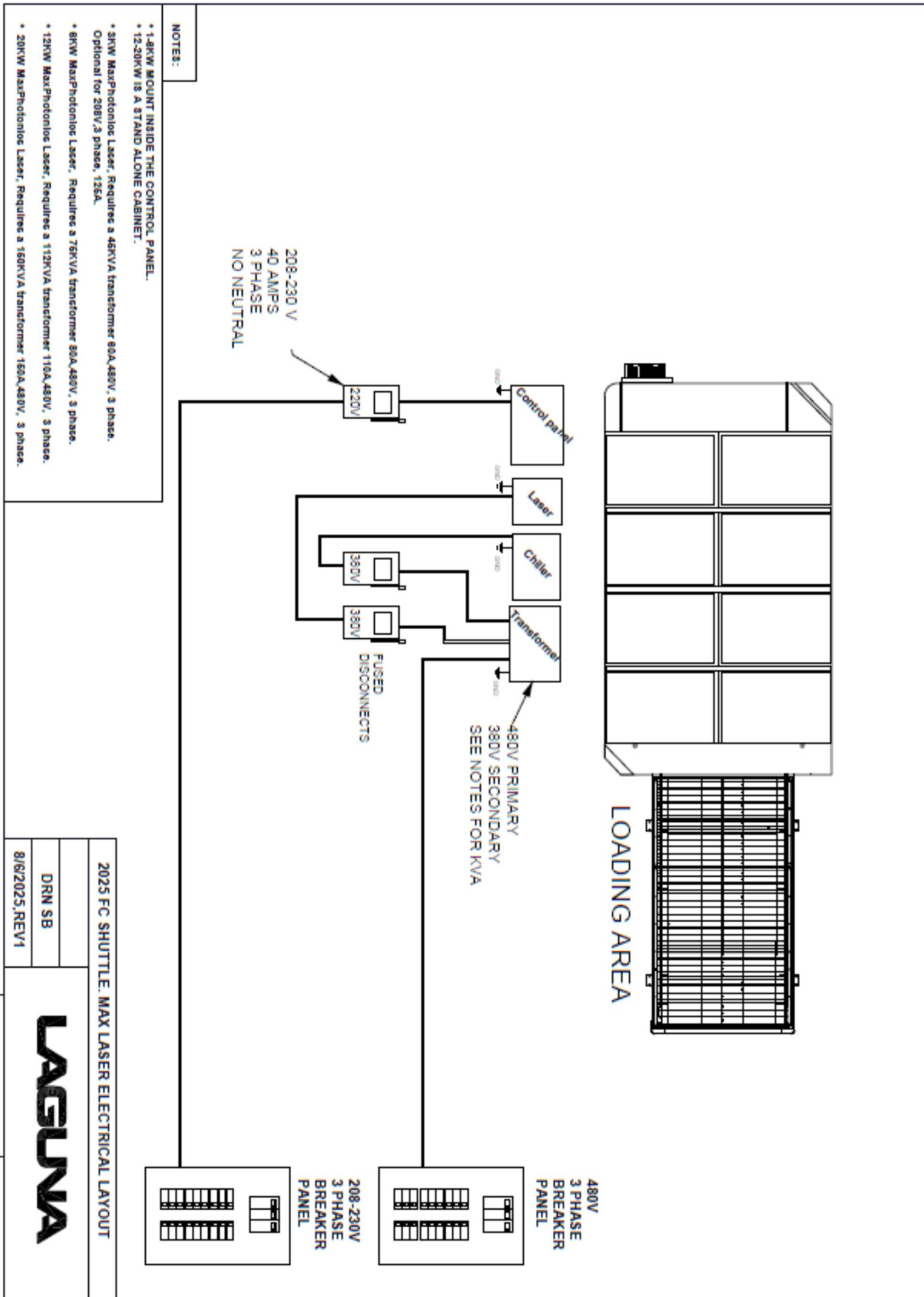
- The Lockable Disconnects for each device only shuts off the power supply of a single device.
- We Strongly suggest using a license industrial electrician for the installation and wiring of your machine.
- Follow your Local, State, and NEC electrical codes for a safe and certified installation.

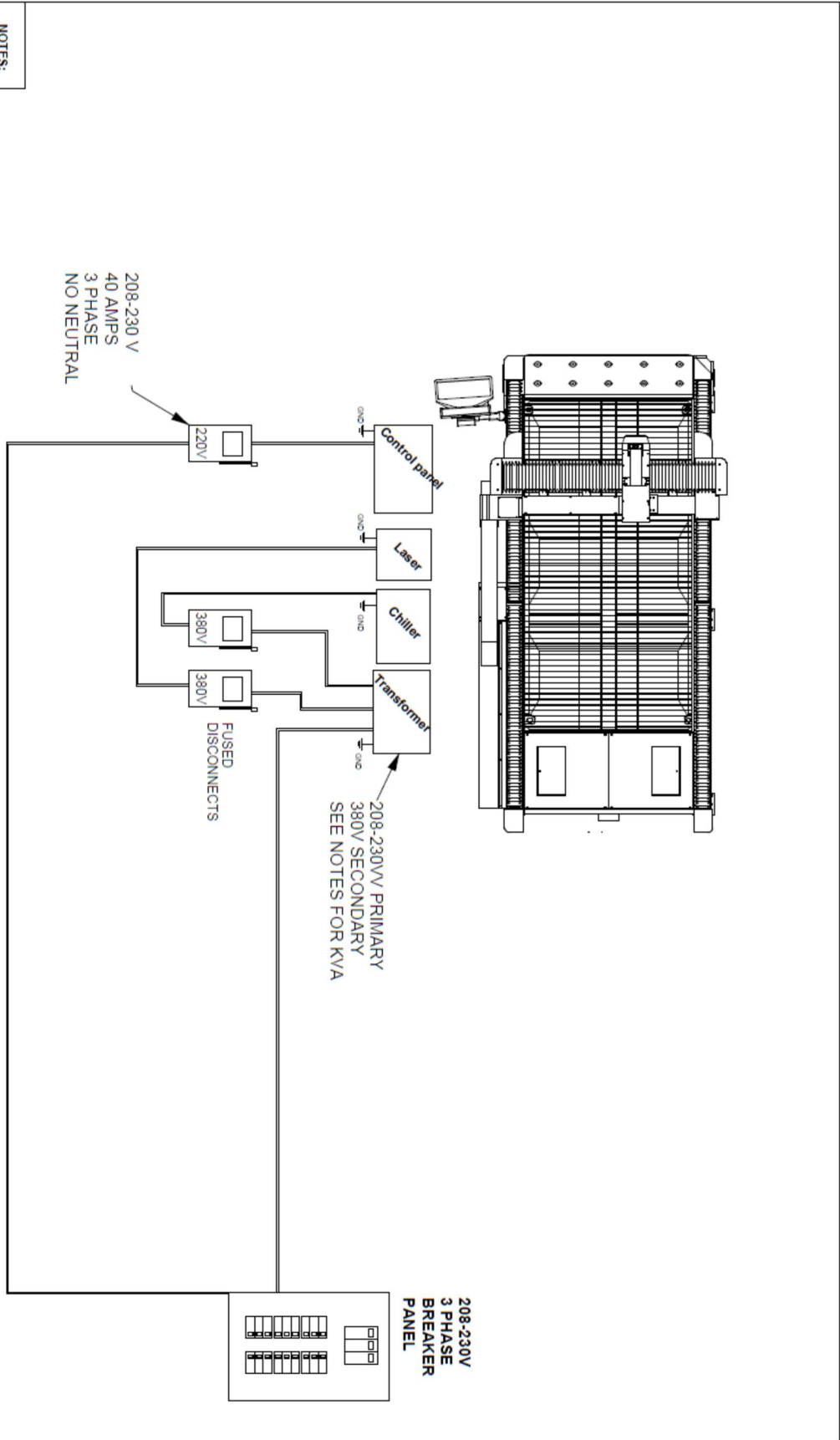
## 12KW Commissioning Requirements:

Each device should have its own power drop.

- \* The control panel requires 220volts, 3 phase, 40Amps, (Bring into control cabinet).
  - \* Transformer for chiller and Optic supply is based on the KW, all will provide 380v,3 phase, on the secondary.  
It is required that the outputs of the transformer to the devices are protected with fused disconnects near machine.
  - \* The Chiller is 380V, 30A, 3 phase, on a protected circuit from the transformer.
  - \* The Max Photonics Optical supply is 380v, is based on KW, from a protected circuit from the transformer
  - \* Your dust collector or Fume extraction devices get their own drop as well, (not included).
  - \* Compressed air is required, 100psi, 4-5 CFM of clean dry air.
- We will need the install check list completed to schedule the Install technician for the fiber laser.
  - If you would be so kind as to send a couple photos of the machine off the pallet and in place?
  - Please include photos of your electrical service and Gas supply
  - Gas regulators will be provided with the machine.
  - Please also confirm if there will be a forklift on site if needed for the assembly?
  - Please do not open the crate labeled Max Photonics. Our technicians will do this.
  - \* Having internet available is required for future support from Max Photonics or Laguna.

**Electrical Flow Layout:**



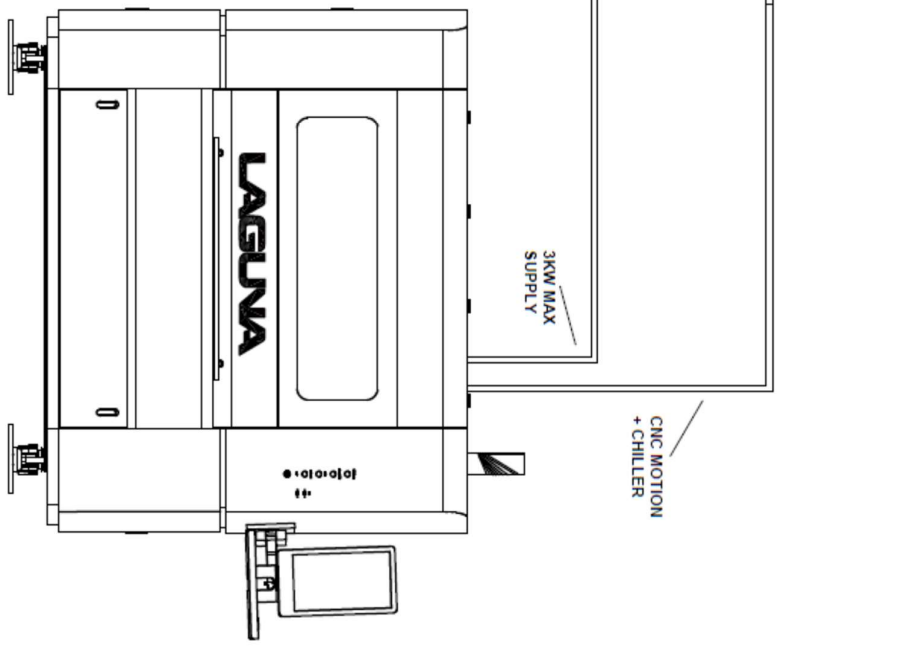
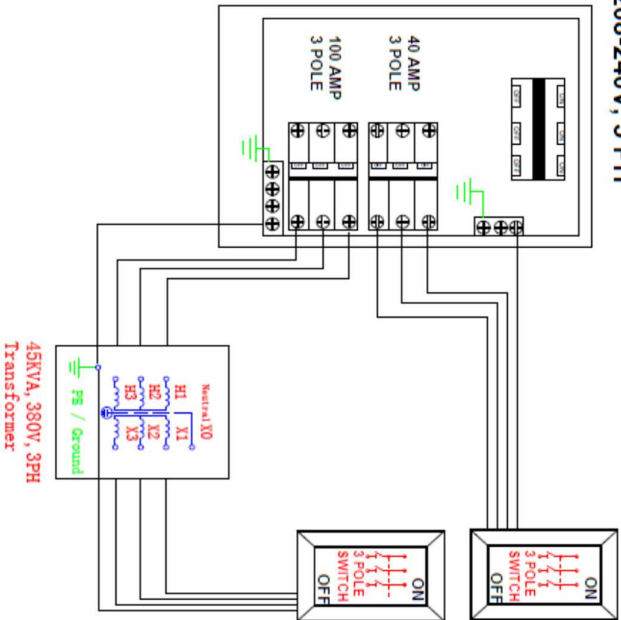


**NOTES:**

- \* 1-6KW MOUNT INSIDE THE CONTROL PANEL.
- \* 12-20KW IS A STAND ALONE CABINET.
- \* 3KW MaxPhotonics Laser, Requires a 45KVA transformer 60A,480V, 3 phase. Optional for 208V,3 phase, 125A.
- \* 6KW MaxPhotonics Laser, Requires a 75KVA transformer 80A,480V, 3 phase.
- \* 12KW MaxPhotonics Laser, Requires a 112KVA transformer 110A,480V, 3 phase.
- \* 20KW MaxPhotonics Laser, Requires a 150KVA transformer 150A,480V, 3 phase.

2025 FC MAX LASER ELECTRICAL LAYOUT	
208-230 VOLTS	<b>LAGUNA</b>
DRN SB	
8/22/2025,REV1	

### CUSTOMER LOAD CENTER, 208-240V, 3 PH

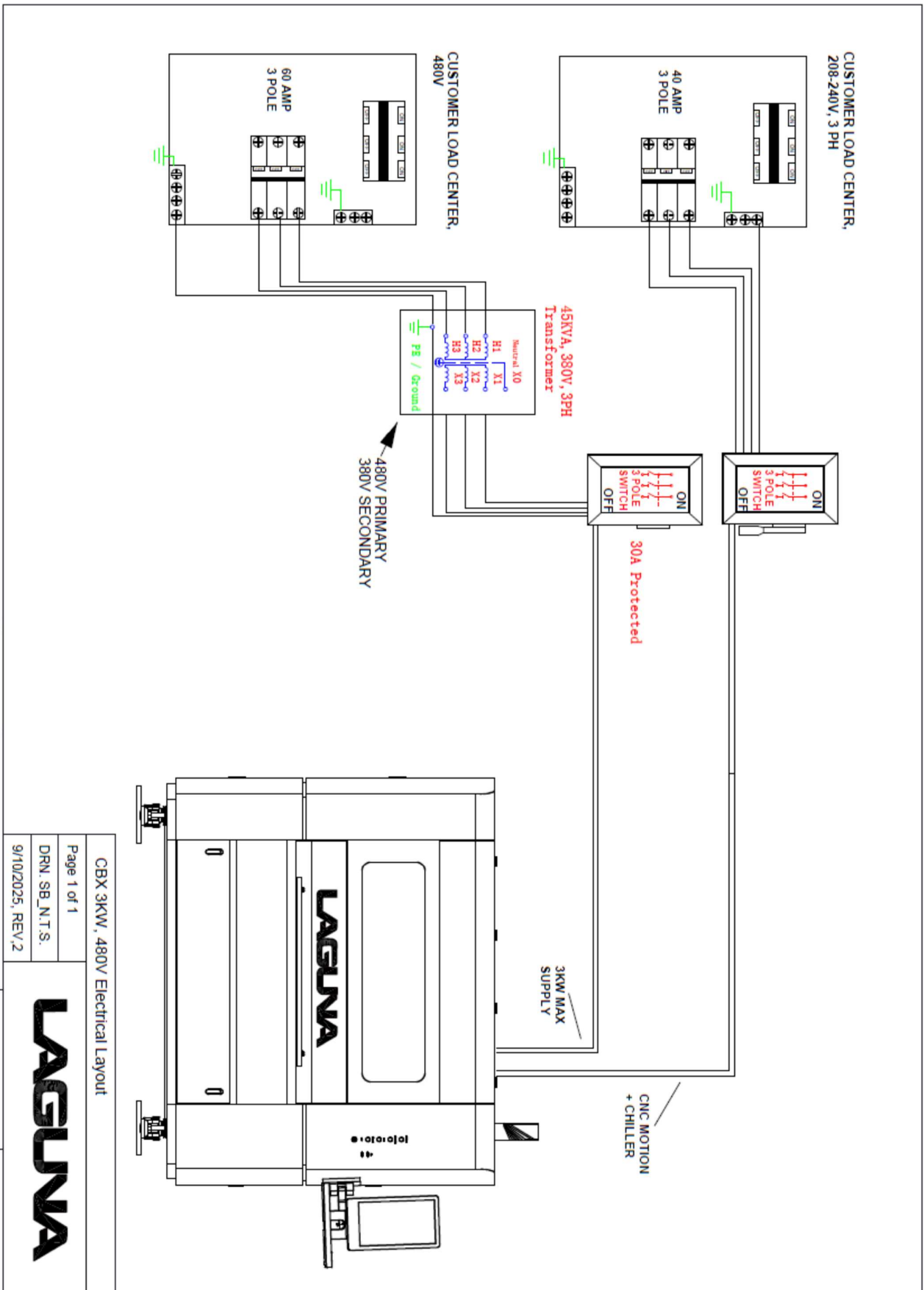


CBX 3KW, 220V Electrical Layout

Page 1 of 1

DRN\_SB\_N.T.S.

9/10/2025, REV.2



CBX 3KW, 480V Electrical Layout

Page 1 of 1

DRN\_SB\_N.T.S.

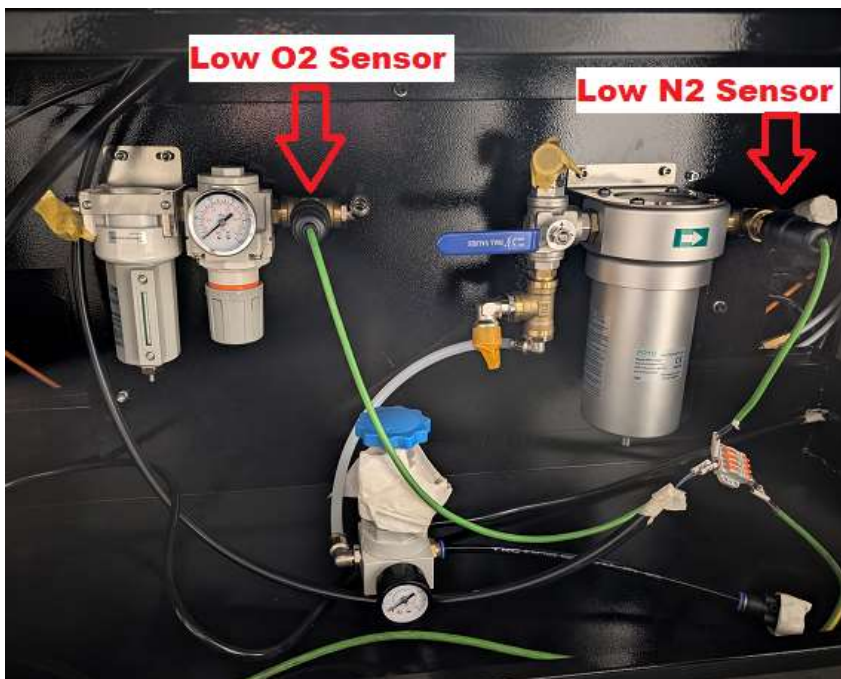
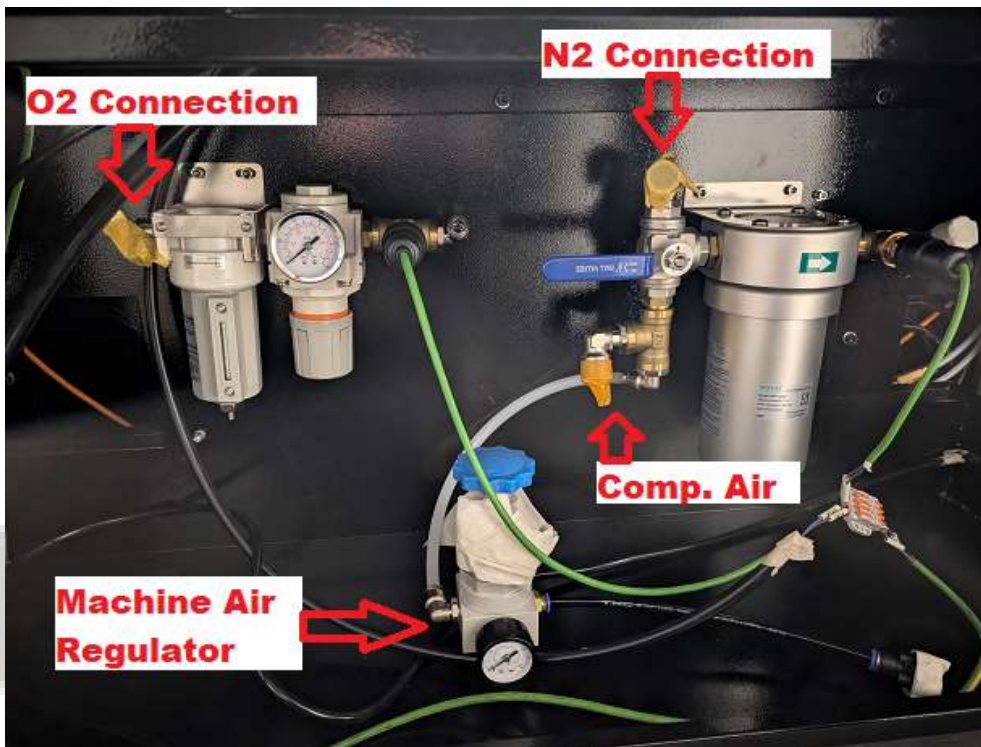
9/10/2025, REV.2

**LAGUNA**

## Assist Gas and Compressed Air connection:



Make sure the air or gas pressure is rated for the machine.



## Commissioning NOTES:

- Check and clean the entire machine to see if there are any scratches or rust, and whether all accessories and tools are complete.
- Main accessories: equipment level adjustment, water cooler installation, fiber optic device installation, laser head installation, gas connection, and fan installation.
- Installation of the whole machine: installation of the display. Connection between the whole machine and the electrical cabinet. Installation of sheet metal parts.
- Verify Power before powering on, check the external voltage, check the origin limit switch, test the movement of each axis and the return to the mechanical origin, power on the water cooler, power on the fiber optic device, and power on the fan.
- Trial cutting: loading, opening and gas inspection, red light nozzle dimming material calibration and automatic edge finding graphic process processing parameter settings.  
and connection methods of key accessories: connection between laser, water chiller and cutting head. Connection between fiber optic device and board. Connection method between gas and equipment. Connection method between control cabinet and external lines. Installation method of control card wireless handle and driver.
- Installation and introduction of cutting head: structural description of cutting head, focusing instructions, daily maintenance.
- Introduction of operating console buttons: emergency stop switch, key switch, gas button, enable switch.
- Power on and off steps: the power on and off sequence of the entire machine.
- Plate cutting operation steps: operation steps for using the control software.
- Equipment and personal safety: safety introduction and precautions for operators.
- Guiding customers in hands-on practice: Enabling customers to operate independently is the top priority of this training.
- Cutting process debugging: Different nozzle types, focal points and cutting parameters are selected for cutting conventional materials and different materials.

## Start-Up instructions:



- Operators should read this manual carefully and understand all risks when using this machine.
- Operators must be trained and qualified.
- Always observe safety regulations. Do not operate the machine when tired, under the influence of alcohol or drugs.
- Use personal protective equipment. Wear laser protective glasses, gloves, masks, earmuffs, and non-slip shoes when operating the machine.
- Do not attempt to defeat any protective measures, such as interlocked guards.



- (1) Enabling switch: Turn off the switch and remove the key after use.
- (2) Emergency stop: only stops the laser output.
- (3) Disconnect device: Only disconnect the power supply to the laser generator.

### Chiller Main Power Disconnect:

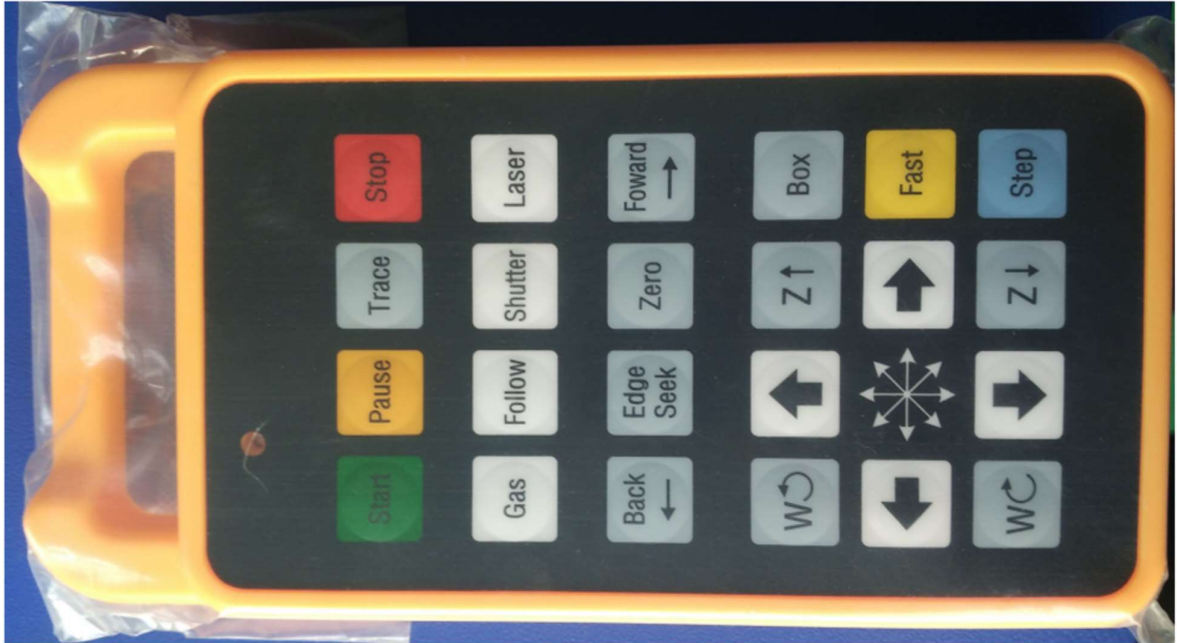


**The laser cutting machine startup procedure must be strictly followed, and the laser must be started in strict accordance with the laser startup procedure.**









## Power on/off steps

- Turn on the main switch → computer → software → gas → water cooler → optical fiber device → software emergency stop
- Check the entire equipment before powering it on, mainly check whether there are any foreign objects on the trajectory of the moving parts of the machine and on the workbench.
- External device startup: Start the main power supply equipment: main power switch, voltage stabilizing equipment.
- Chiller start-up: Check whether the status is normal, whether the water supply is normal, and whether there is any water leakage in the water channel. Wait for the water temperature to rise to 18 degrees Celsius, 64.4 degrees Fahrenheit.
- The water inlet and outlet of the water cooler are connected to the water outlet and water inlet of the fiber optic device respectively; the two water pipes for cooling the laser head can be connected to the other water inlets and outlets of the water cooler. To the fiber head and cutting head.
- Start the host computer, open the software and return to the origin.
- Start the laser and check if there is any abnormality.
- Start the auxiliary gas such as air compressor, open the required gas supply valve, and check whether the status of each filter equipment and pressure gauge in the gas line is normal.
- Shutdown steps: return to the origin → turn off the gas exhaust pipeline → turn off the water cooler → turn off the computer operating system → turn off the optical fiber → turn off the software emergency stop → turn off the main switch.


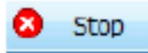
## Remote Control:


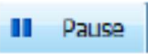



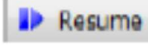
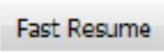
KEY	Action to initiate
Start	Starts Production
Pause	Pauses work
Trace	Machine will Move around the upcoming Graphics to be processed
Stop	Stops Current Operation
Gas	Open and close gas selected, Blow Function
Follow	Control laser head to follow the Plate
Shutter	Control for laser shutter open
Laser	Control laser On / Off
Back	Trace back along the working route
Edge Seek	Used to seek the edge of the Plate before cutting
Zero	Go back to the origin

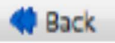
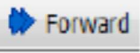
Foward	Trace forward along the working route
Box	Control the machine to go around the outer frame of the upcoming processing graphics
	Jog W Axis anticlockwise
	Jog W Axis clockwise
	Jog Laser Head Up
	Jog Laser Head Down
	Move Head forward
	Move Head left
	Move Head right
	Move Head back
Fast	Move fast, used with move key
Step	Move step by step, used with move key

## Stop, Pause, and Continue functions:

Click  or  on console panel will stop the machining. Stop the machining process, laser head will move to zero point. If you want laser head stand still cancel the option  Return to Zero when stop on console panel.

Click  or  on console panel can pause the machining process. Meanwhile you can modify the parameters in layer window, or execute the functions in console panel like burst laser, gas, turn on/off follow function etc.

Click  in CNC tool bar or  on control panel to resume the machining process from interrupted position. Click  will resume the machining process directly without piercing.

Click  or  to locate laser head backward or forward on the machining path. The distance and speed of one step set on

Back/Forward Dis:   at control panel.

## CypCut Machine Control Software:



The working and cutting performance of the machine are directly related to the material, laser, cutting gas, gas pressure and the parameters setup. Please be cautious in setting the parameters!

Improper parameter setting and operation may reduce the cutting performance, or even cause damage to machine parts and human body. CypCut system has already provided multiple protections, meanwhile manufactures and users must follow the safety operation rules in case of any accidents and injuries.

Laguna Tools does not bear any direct, indirect, incidental or corresponding losses and liabilities arising from the improper use of this manual or this product.

## Functional Capabilities:

- Support AI, DXF, PLT, Gerber, LXD file format, and standard G code created by Master Cam, Type3, ARTCUT etc.
- Support file optimization includes remove duplicates, connect unclosed segments, remove minimal graphic and distinguish inner and outer contour and set machining sequence automatically. Above functions can be customized or executed manually.
- Support graphic edit functions, including zooming, translation, mirror, rotation, alignment, replication, combination, etc.
- Support set lead line, cut seam compensation, micro-joint, bridge, inner/outer cut, seal etc.
- Automatically distinguish inner and outer contour then determine the compensation direction and check the lead line.

- Support curve split, merge and smooth; transfer text to curve; parts combination and explode etc.
- Automatic nesting can create co-edge and remnant plate.
- Users can fill the plate by array function.
- Flexible sorting functions. Users can group the graphics to lock the cutting sequence.
- Preview the cutting sequence.
- Quick set fly cut path.
- Support various piercing methods including segmented pierce, incremental pierce, pre-pierce, group pre-pierce. Users can also set separate parameters of piercing and cutting including laser power, frequency, gas, pressure, peak power, delay, cut height etc.
- Real-time frequency and power curve editing. Set slow start parameters.
- Powerful material library function allows all process parameters to be saved for reuse of the same material.
- Breakpoint memory when machining interrupted. And users can select resume the position before or after breakpoint. This will continue machining the selected graphics.

- Users can locate to specified position in stop or pause status and resume machining.

- Support intersecting line cutting.

- Support various finding edge methods with high precision.

- Supports remote control of the system through wireless operator keypad and ethernet.

## CypCut Overview

- Home tab

In the home tab we use Scale to adjust the size of parts to the size and dimensions to adjust the part according to our tolerance

- Zero Ref

Zero ref is used to set the origin point of the part or nest that will correlate with the real Position-world Origin point of the machine controller.

- Shutter and Aiming

**Particularly important these need to be turned on to cut and shut off when leaving CypCut. Aiming is the guide light.**

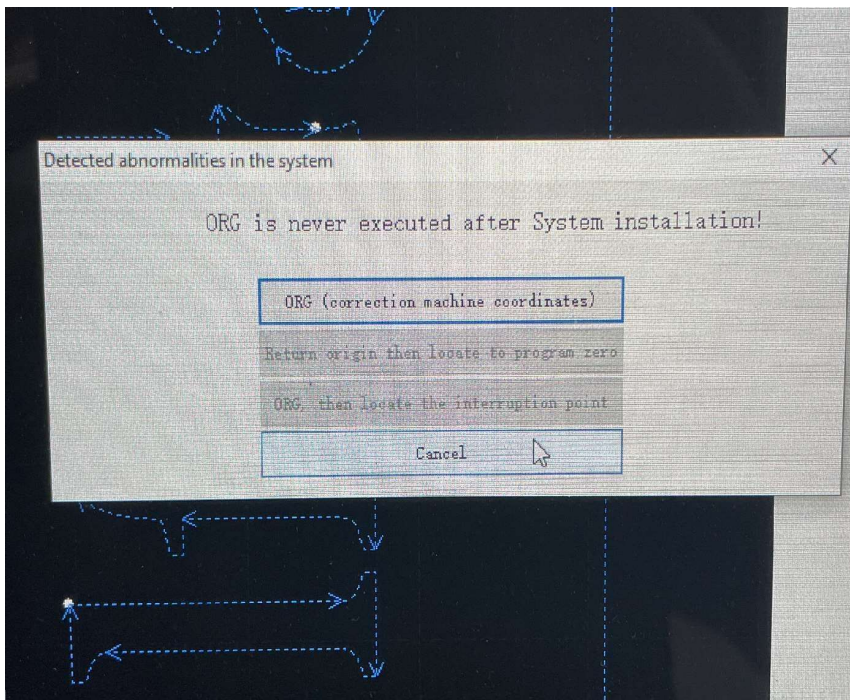
The screenshot displays the CypCut software interface with several annotations:

- Home Tab:** A red box highlights the 'Home' tab in the top menu bar. A green callout box points to the 'Home', 'Nest', and 'CNC' tabs, stating: "The three tabs you will use the most are Home, Nest and CNC".
- Scale:** A red box highlights the 'Scale' button in the 'Transform' sub-menu. A red callout box points to it, stating: "Scale is used to scale the size of parts."
- Zero Ref:** A yellow box highlights the 'Zero Ref' button in the 'Start Position' sub-menu. A yellow callout box points to it, stating: "Zero Ref is used to set the origin point of the part that will correlate with the real world 'Origin' point on the machine controller."
- Shutter and Aiming:** A red box highlights the 'Shutter' and 'Aiming' buttons in the 'Machine Control' panel. A red callout box points to them, stating: "Make sure both Shutter and Aiming are turned off as shown here before exiting Cypcut."

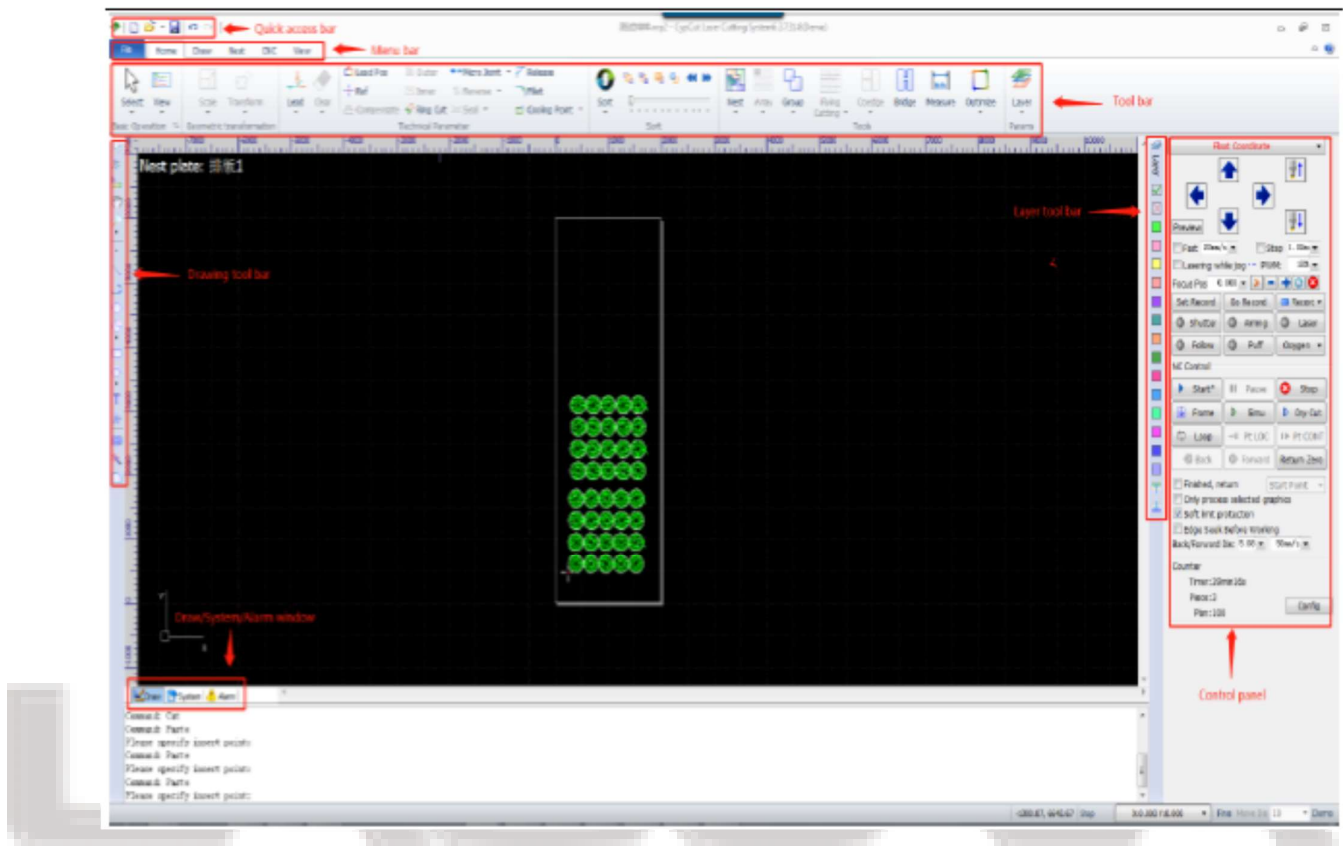
The main workspace shows a nesting layout of parts on a dark background. The status bar at the bottom indicates "Select 2 graphics, size: 128.61 x 90.00".

## Machine Origin on Power-Up:

- When opening CypCut you will be directed to origin machine, it will give you three options.
- Option one. Org. will return machine to machine home coordinates.
- Option two. Will locate to last programs last Zero position.
- Option three. Will return the machine to the last point of interruption i.e...  
In case the machine was accidentally shut down or lost power.



## Main Screen:

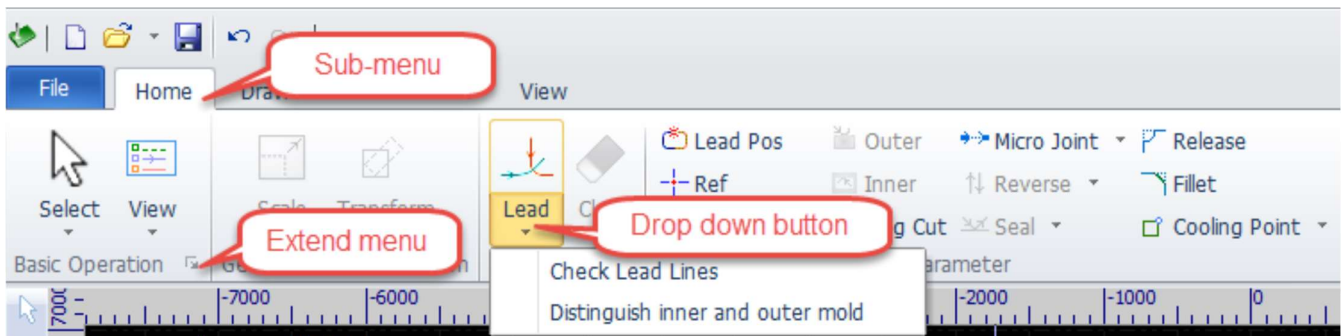




- The center zone in black is the drawing board; the white frame is the machine working area.
- The grid of drawing board and ruler will adjust when zooming the view.
- On the main screen from top to bottom is **title bar**, **menu bar** and **tool bar**. You can find the most used functions in the tool bar where the **function button group** is displayed with clear icons.
- The menu bar includes 'File' menu and 5 other tool menus 'Home', 'Draw', 'Nest', 'CNC' and 'View'. Click the menu and it will display the related tool bar.
- At top left is "**Quick Access Bar**", which is used to **create**, **open** and **save** files, **undo** and **redo** the last operation.

- On left side is "Drawing toolbar"; the basic drawing functions are provided here. The first five buttons are used to switch the drawing mode, including **selection**, **node editing**, and **sequence editing, dragging and zooming**. The other buttons below correspond to the graphic, click to insert new graphic on drawing board. There are three keyboard shortcuts at the bottom, which are **align center**, **explode graphic**, and **add fillets**.
- On the right side is the "**Technique toolbar**" including 1 'layer' button and other 17 buttons of different layer color. Click '**Layer**' button will open '**Cutting Technique**' window where users can set most of the parameters related to the material cutting.
- 17 buttons each correspond with a layer, click the appropriate button and it will appoint a layer to selected graphic; info graphics selected, click layer color button next time your drawing a graphic will use it as default layer. Appoint first layer to a graphic, controller will define this graphic as '**background layer**' and not machining. The last and second to last layers are special, the graphics of these 2 layers will be cut at last or at first. The second last layer is usually used as marking layer.
- There are three scrolling text ribbon windows at bottom. On the '**Draw**' window will display all information related to the drawing command; On the '**System**' window will display all system information except drawing, each message printed with timeline and marked with different color so users can recognize these message as error, alarm or notice etc. On the '**Alarm**' window displays all alarm messages of red color.

- At the bottom is 'Status' bar showing message according to different operations. The left status bar shows graphic message, on the right side displays cursor position, machining status, laser head position. The right most is to fine tune the graphic position and display the control card type.
- On the right area of the main page is 'Control panel' where users execute the most used machining operations. From top to bottom are the coordinate system selection, manual control button, machining control, process setting and production counting.

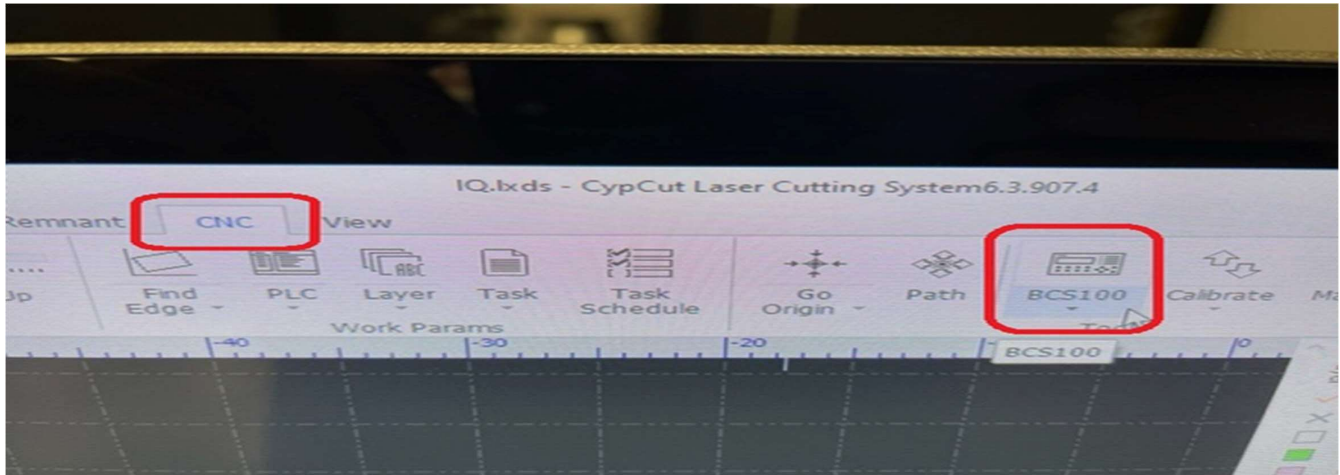
## Toolbar:



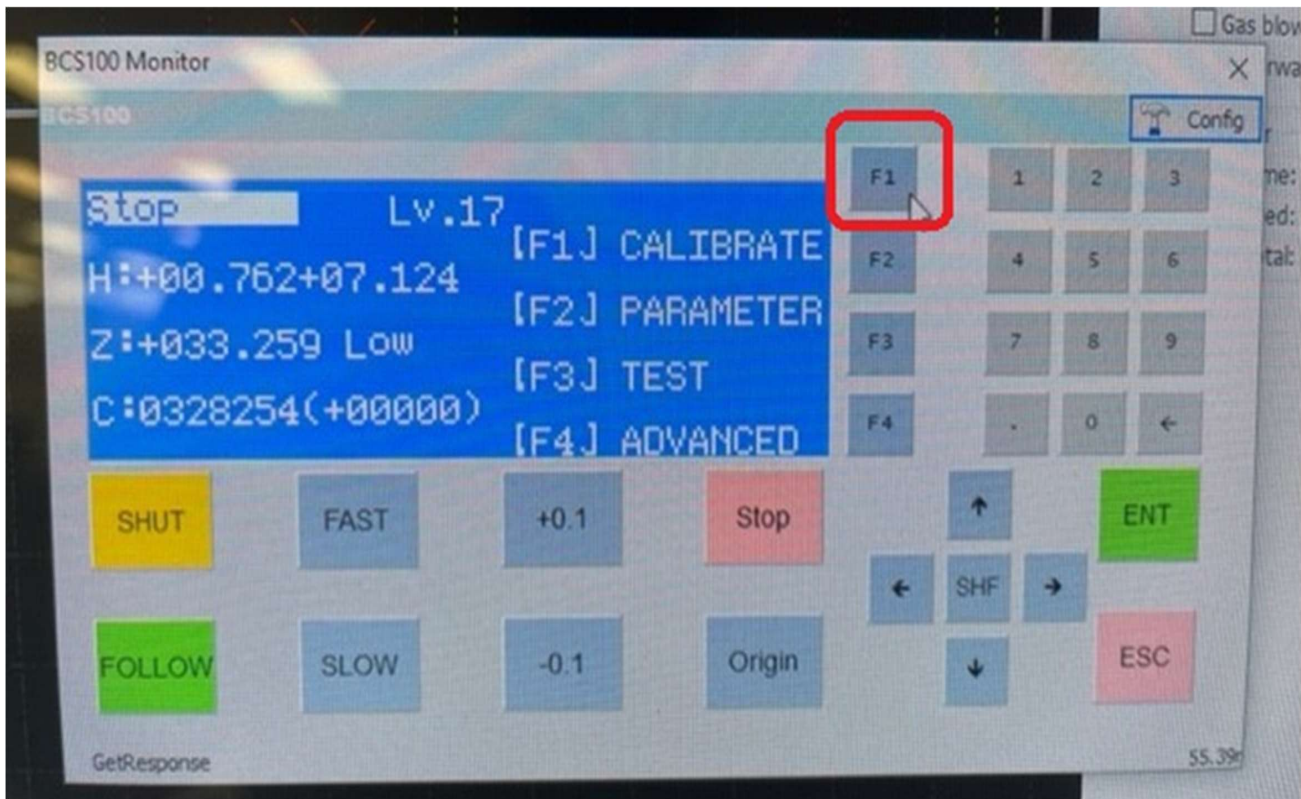
- The toolbar is divided into five sub-menu 'Home', 'Draw', 'Nest', 'CNC', 'View'. Click sub-menu title will switch to the related page; in machining process will show 'Working' page and cannot switch to other page until process stops.
- In each sub-menu there are function buttons divided into different region; the first button in each sub-menu is usually in large size for convenient operation; Click the  icon will open a dialog box.
- The  " Under" function button is drop-down menu provide more operation options. Click the icon and drop-down menu will open different dialog boxes with different options.

## Calibration of Height Control:

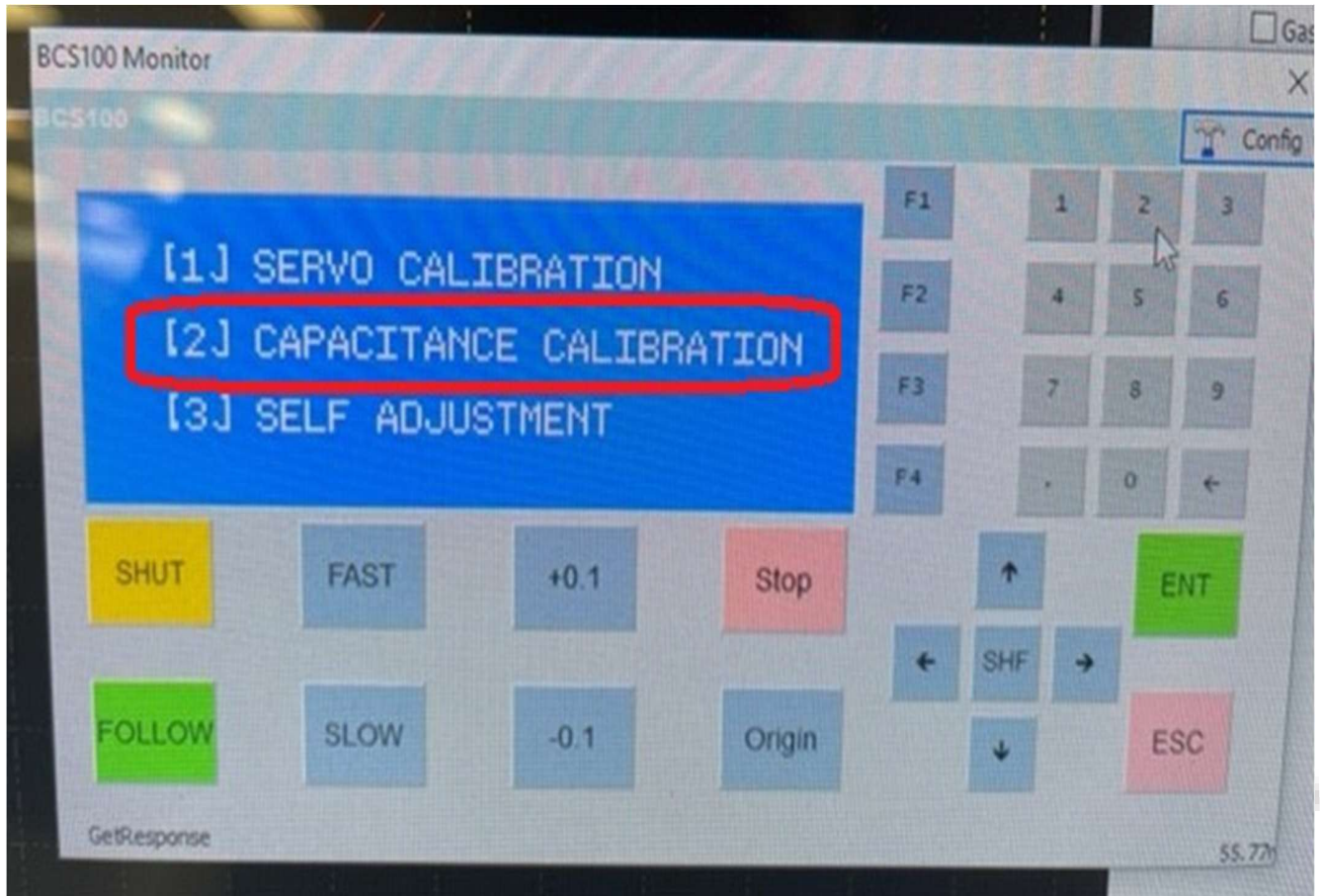
- Go to CNC Tab
- Click BCS100



- Click F1 (While in BCS100 mode use the mouse to click your selected input, (DO NOT USE KEYBOARD)).

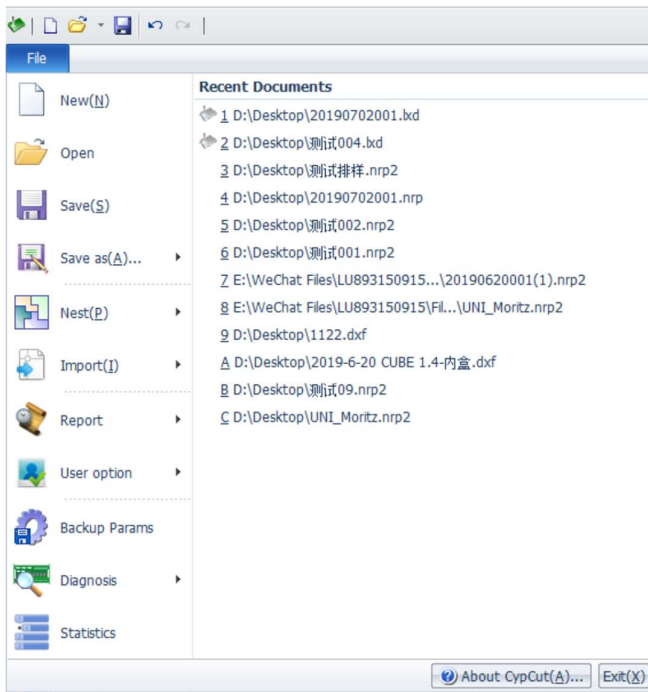


- **Press 2 (Capacitance Calibration)**



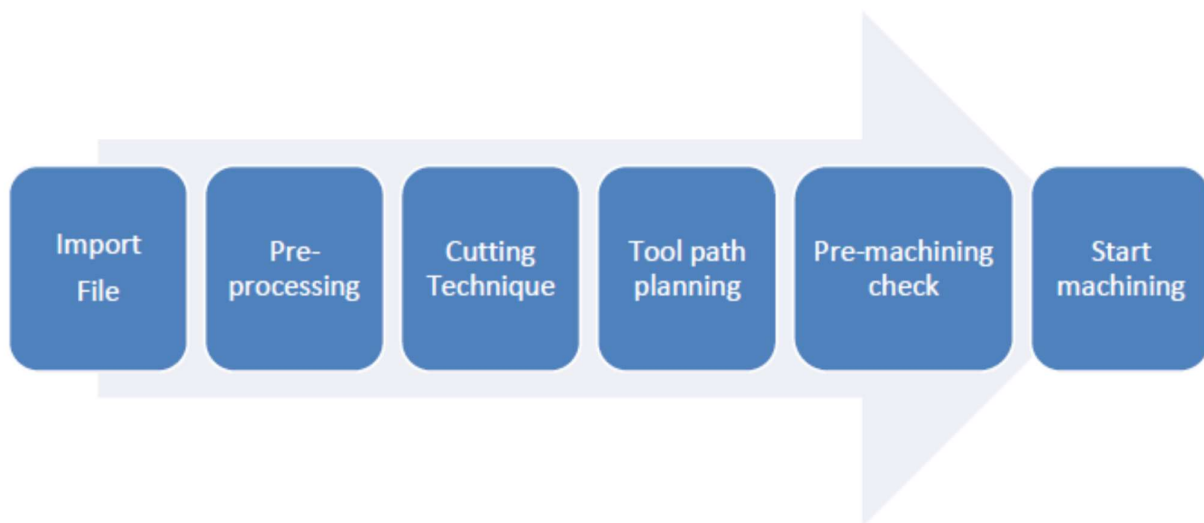
- **Follow Instructions on screen (Move head to about .250 inch above material) Press Enter.**
- **Everything should read Excellent, Press enter to save results (A curved line should appear to show you have done job correctly).**
- **This method is also used when you have a Diminished Capacitance Alarm**
- **This method should be used at least once a day.**

## File Menu:




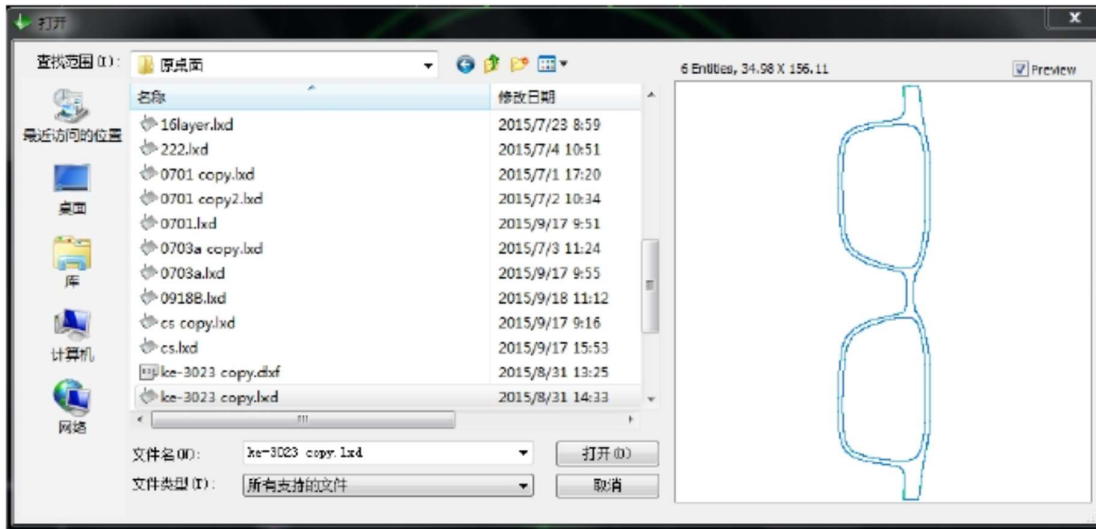
- The right column lists the recently opened file you can quickly find the file needed from the list.
- Click 'save as' will save the file as Lxd or Dxf format.
- From 'File-Import, adding a file will not clear current graphic. If you just need to open a file, just click File-open.


## Operational Production Process:



## Import File:

Click  button on the top left and select the file to open. Preview window of open file dialog box will help you quick locate the file you need.



You can also draw a part in CypCut, click  and use functions at left toolbar.

## Pre-Processing:

While importing graphics, CypCut automatically removes minimal graphics and duplicate lines, merges unclosed lines, automatic smoothing and sorting. Generally, you can start to set cutting parameters without other operations. If the automatic processing cannot meet your requirements, you can open the menu "file" - "user parameters" to set the function options you need.

- Generally, the software considers that all the graphics to be processed should be closed lines. If you open a file containing non-closed graphics, the software may prompt A message and display them in red. This function may be turned off.
- To view the **unclosed** graphics on the drawing board, you can click

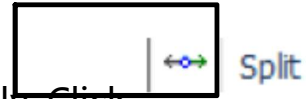


and



and under 'View' button in Home menu to highlight the

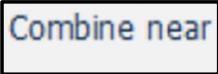
unclosed graphics; you can also select unclosed graphics by clicking 'Select' and choose 'Select unclosed curve'.



- **SPLIT**, If you need to split a graphic manually, Click

Under the "Optimize" drop down menu and click on the graphic where you want it split.


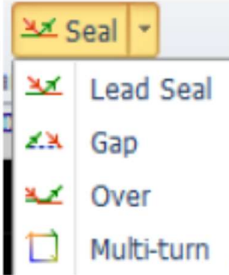


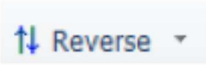
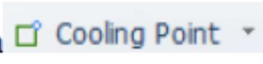
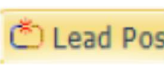
- **MERGE**, to merge Graphics, select the graphics you want

combined, then click,  under the "optimize" drop down menu.

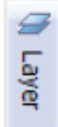
# LAGUNA

## Cutting Techniques:




You may use most of the functions under "**Technical parameter**" column in the Home menu bar, including setting lead lines and compensation, etc. The large size

button  used to set lead lines, and the button  used to set the over-cut, gap or seal parameters. The button  is used to set compensation. The button  is used to set a micro-joint that will not be processed on the object. The button  is to reverse the machining direction of a single object selected. The button  is to set the cooling point. Click  button, then point on the graphic where you want the cutting to start at will set a start point. If you point outside graphic then point to the graphic will set a lead line.

You can press Ctrl+A select all graphic, click 'Lead' set parameters then program will set lead line automatically. Click 'Lead' drop-down menu select 'Check', program will check if lead line cross with graphic or in wrong direction and optimize the result.

Click button  on the right toolbar to set the detailed cutting parameters. The layer parameters setting dialog box contains almost all the parameters related to the cutting performance.

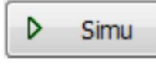

## Cutting Path Planning:

- Set the cutting sequence of the graphics as needed. Click  in Home or Nest column and it will automatically set the cutting sequence of all graphic. Open drop-down menu you can choose sorting pattern and recognize inner and outer contour of the parts graphic.
- You can also choose Manual sort to optimize the auto-sort result by clicking  on left toolbar, then click the graphic to set the sequence. Click one graphic and click next will define the cutting sequence of these two graphics.
- Select the graphics that have been sorted (set sequence) and click  button in Home menu will set a group. The sequence of the graphics within a group will be fixed. And the group will be defined as a whole object.
- Right click a group and select group sort you can modify the sequence of the graphics within a group.

### Pre-Machining Check:

Users can check the tool path before start machining. Click **Align** button will align the graphic; drag the **Progress bar** will quick show the graphic sequence; click **Interactive preview** button can check the sequence one by one.

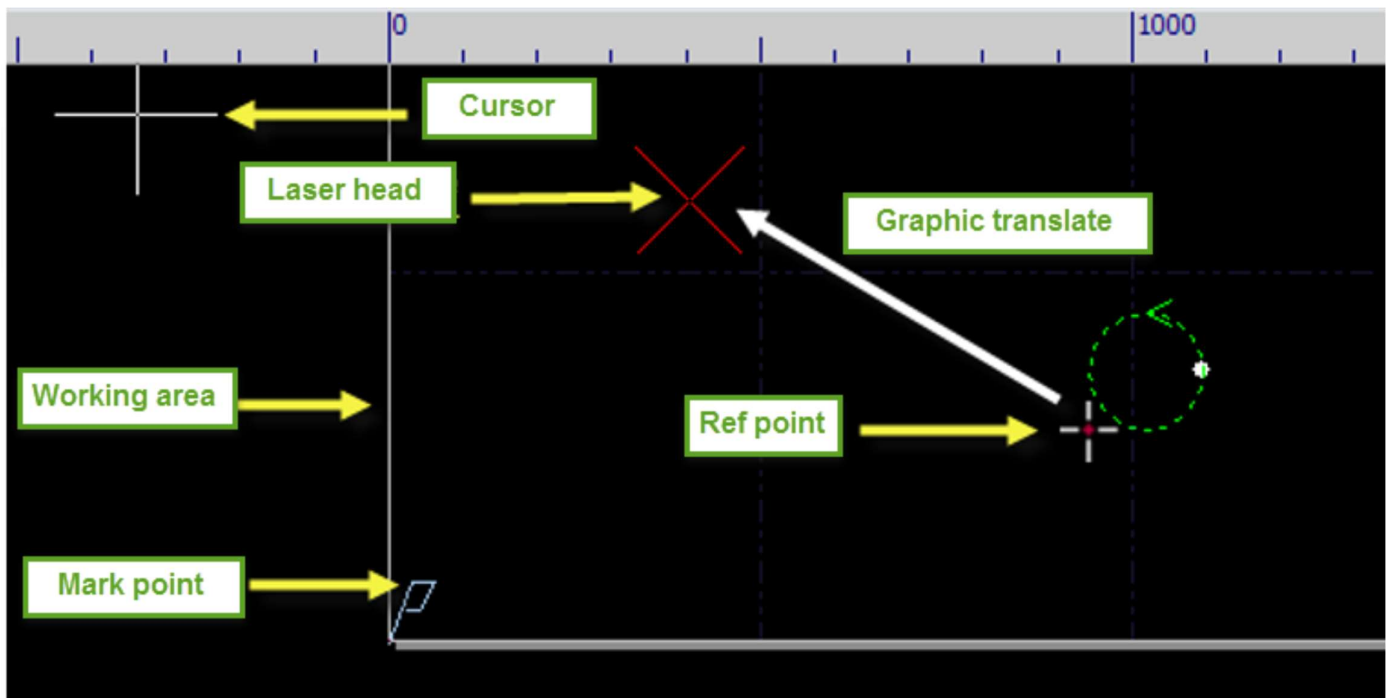


Click  button on console panel program will simulate the machining path and machine not running. Users can adjust simulation speed in  sub-menu.

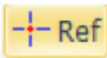
## Start Production:


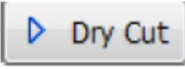
Please take notice that it requires compatible control card and dongle to start machining.





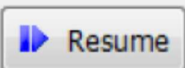
- Before starting machining, it has to match the position of graphic and machine bed. Click "Preview" button  on the left side of the control panel and it will show the position of graphic on machine bed.
- This position is calculated by the reference mark location on the screen and the laser head position on the machine. There are some symbols on the screen, click 'Preview', the 'Reference' mark will move to the laser head position.

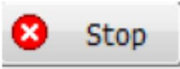


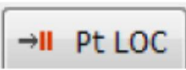
If the Red Cross does not match the real position of laser head, please check the mechanic origin and correct the origin by CNC-Return origin. If click 'Preview' and graphic is partly or fully outside the white frame, it means machine will exceed the travel range.

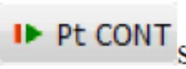
Click  in Home menu can modify the reference position of the graphic. For example, if laser head is at left bottom of the graphic then set the reference as left bottom.

After check the position, click  on control panel, laser head will move along the rectangular frame of the graphic, you can check if the machining area on machine bed is right. You can also click  to simulate the whole machining path on the machine bed without laser/gas to check if there is improper process.

Click  start machining, Click  pause the process and you can manual control laser head up and down, open or close laser and gas etc.; In pause status users can click   to move forward or backward along the graphic path. Click  resume the machining process.

Click  end the machining process. Laser head will return to the pre-set position. If you didn't change graphic or start new machining process, click



 will locate to the break position where last machining was end and click

 start machining from break point.

## Graphic Editing:


• In Home menu -'View' column provides various options of graphic display. Click the option button, and it will take effect immediately and you can see the display effect change on the screen.



- The option button shows in yellow indicates the option enabled. If the option button is not yellow in color means function not enabled. For

example,  is enabled, the graphic will show the cutting path with arrow symbol,  will close the arrow symbol on the screen.

When ' Show Micons' opened, you can see the white mark at position where you add micro-joint:



When you click  Center the graphic will show in the center of the white frame.

Click  right down  button will open an option box providing detailed setting options where allow users to open or close graphic absorb function, ruler etc.

Scroll the mouse on the screen will zoom the view. Click F3 will center all graphic on the screen, click F4 will center the machine frame on the screen. Right click mouse will prompt option box, select zoom you can also execute same operations above.

## Selecting Graphis:

CypCut provides various ways to select graphics. The basic operation is 'Click', click the graphic will select it. Another commonly used operation is 'Frame', dragging the cursor on the screen will create a frame box. There are 2 patterns of 'Frame': Press and hold from left to right will create a blue box, only when a whole part was framed in the box is selected. From right to left will create a green box, if part of the graphic is framed in the box, the whole graphic will be selected.

The 'frame' effect of these 2 patterns is shown below. Left image is effect framing from left to right, 'BC' will be selected; right image is effect framing from right to left, 'ABCD' all selected. It's flexible to select graphic by these two patterns.



Hold the Shift key when selecting a graphic, you can select or deselect graphic without changing the select result of other graphics.

Click 'Select' will open a drop down menu providing more options:

- Basic operations: Select all (Ctrl+A), Invert, Copy (Ctrl+C), Paste (Ctrl+V), Cut (Ctrl+X), Deselect, Copy with base point.
- Graphic operations: Select unclosed graphics, select similar graphics, select inner/outer contour, and select graphics smaller than specified size.
- Layer operations: Select the layer (used to select all the graphics in a layer) and lock the background.
- 'Disable Drag and Copy' will disable the operation that press Ctrl and drag the graphics to duplicate graphics. This will prevent the malposition of nested graphics.

'Select similar graphics' will select all graphics with same shape. For example, select a circle of 5mm radius, then click this option will select all circles of 5mm radius.

## Geometric Transformation Tools:

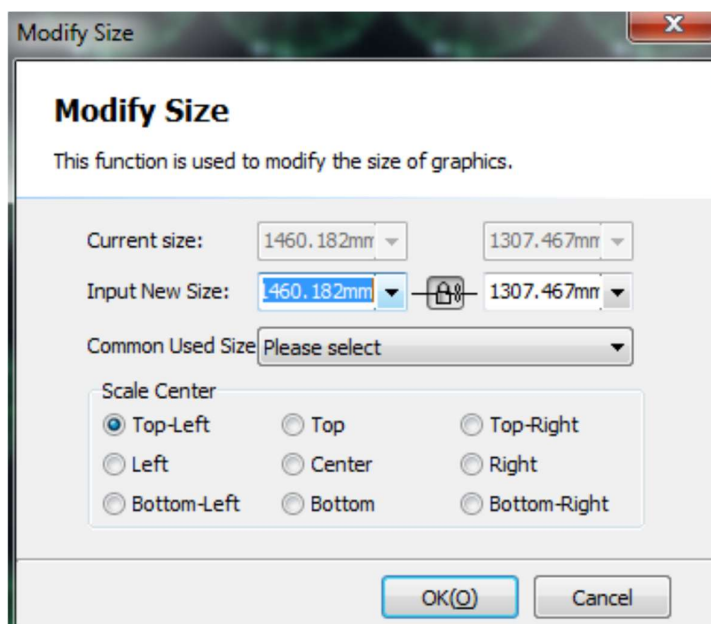
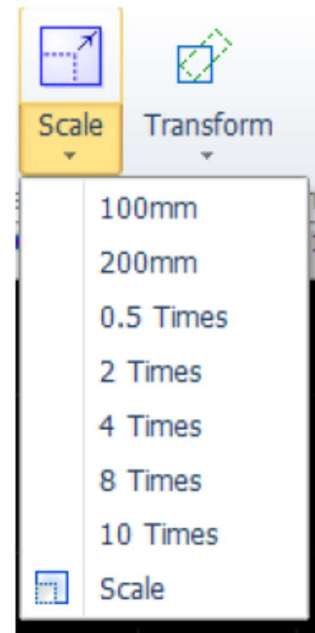
'Geometric Transform' under Home page provides abundant functions of transforming geometry including **mirror, rotate, align** and **zoom** etc.




### Size Modification

CypCut provides 7 options under 'Scale' drop down menu to quick modify the graphic size. Pictured as right:

For example, '100mm' will zoom the width of graphic to 100mm in scale, '2 Times' will scale-up graphic 2 times in size.

If you want to input an accurate dimension, click Scale button will prompt the below dialog box. Input new size and click Ok to finish the size modification.



If the lock icon in this state , the scale of length and width is coupled, if you want to modify the length and width separately click the icon  turn to state .

"Scale center" specify the position between new graph and the original one. For example, "Top left" indicate the graph in new scale at the top left of the original one.

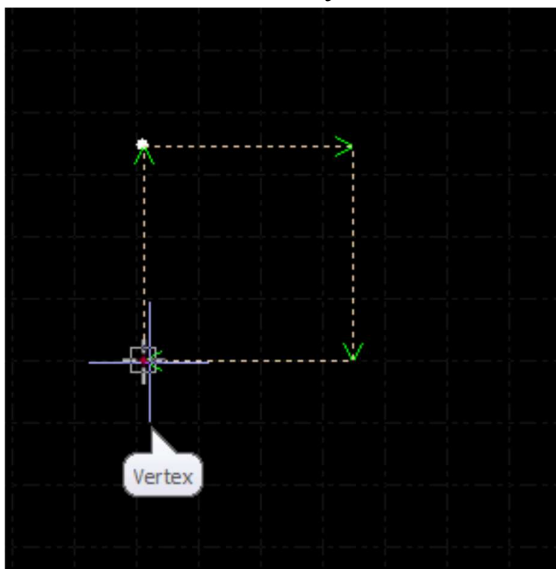
Notice: The lead lines and seam compensation etc., will not change with the size modification.

### Dynamic Transformation:

CypCut provides 3 patterns of dynamic transform including dynamic scaling, rotating and mirror. First select the graphic and click transform button then follow operation tips at screen bottom.

For example, to rotate a rectangle 45° in the base line of left bottom, you can follow the operations:

- 1) Select graphic.
- 2) Click transform drop down menu select 'Rotate', at bottom window will prompt 'Please specify base point:
- 3) Move cursor to the right corner, cursor will be absorbed to the rectangle corner automatically:



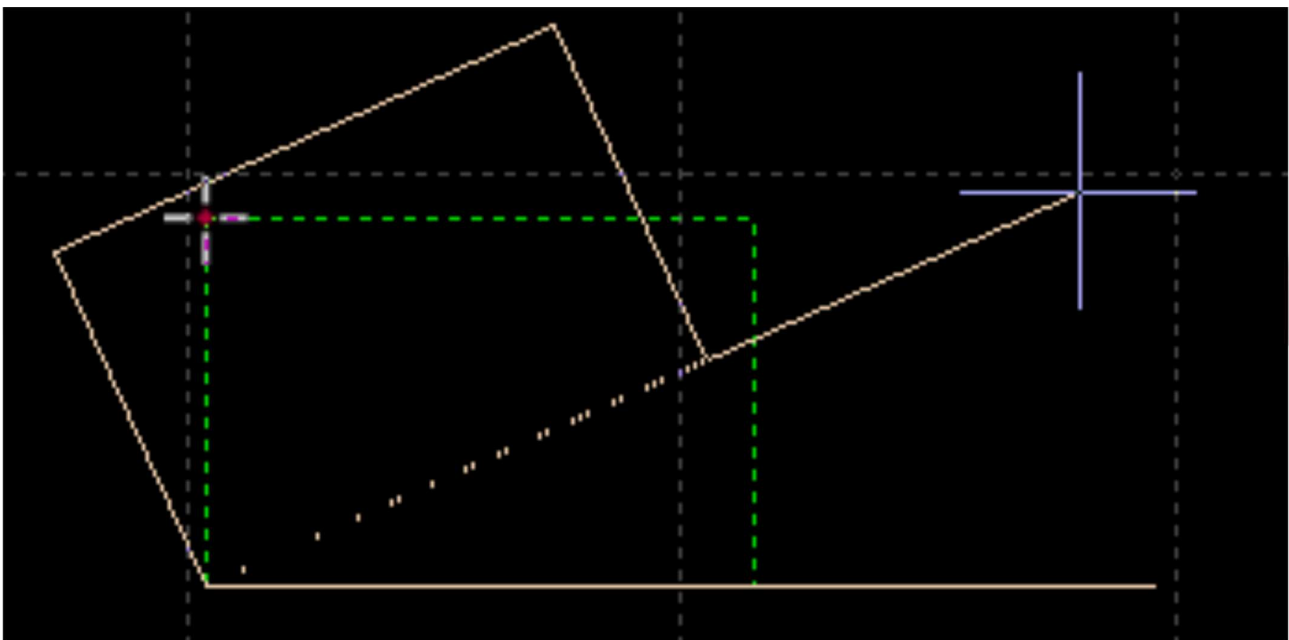
4) Click the corner, bottom window will prompt 'Please specify the start point or rotation angle:'

5) Input 45 and click Enter will finish the operation.

If you want to rotate the rectangle and align with another graphic, first step same with above, then follow the below steps:

6) Click the right corner of rectangle will create a base line.

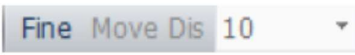
7) Bottom window prompts "Please specify end point of rotation" meanwhile move cursor graphic will rotate and click mouse at target position. As shown below:

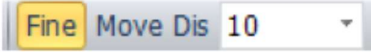


Dynamic mirror operation same with the rotate.

## Translation and Copy Functions:

You can quick translate the graphic with direction button. First click


 button at the right bottom of the screen to enable the function

. Activate the button then you can input the fine tune parameter. Select a graphic click the direction button it will move at this direction and in fine tune distance. This function used to move away a graphic temporarily and move back the graphic exactly where it was. Press Ctrl button and direction key in the same time will duplicate the graphic. For example, press 'Ctrl+right→' buttons will duplicate the selected graphic at the 100mm right side of the original one.

## Coordinate and Parameter Input:

In some cases, users need to draw graphics at an accurate coordinate. In CypCut users can input coordinates directly. Input format is < X coordinate> <comma,> <Y coordinate>. For example, the coordinates (100,100) input in CypCut is "100,100". The input coordinates and parameters are shown in blue.

Most of the drawing operations allow both mouse click a position and coordinate input. The following steps show you how to draw a rounded rectangle of length 300mm, width 200, fillet radius 25mm.


- 1) Click  button at left toolbar, meanwhile bottom window will prompt 'Please specify start point'.
- 2) Input '0, 0' press enter, then prompt' please specify cross point'.
- 3) Input '300,200' press enter, prompt' please specify radius'.
- 4) Input 50 press enter. All operations are completed. As shown below.

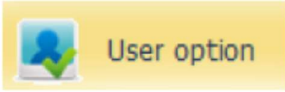
```

Please specify cross point:
*Cancel*
Command: Delete
Command: New Rectangle
please specify start point:(369.872, 199.8971)
Please specify cross point:(943.3059, -72.0406)
Completed
  
```

## Automatic Absorption:

The drawing operation will activate the automatic absorption, including absorb to the grid, graphic key point, absorb to graphic boundary etc.

You can close the automatic absorption function in  menu-

, in 'Drawing' page deselect the  Auto attach keypoints option. You can also set absorb precision in this dialog box.

## Drawing Graphics:

CypCut provides graphic drawing function. On the left toolbar from top to bottom is: Isolated point, straight line, poly line, circle, arc, rectangle, polygon, text, standard parts. The first 5 functions are standard drawing functions similar with CAD.

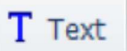
Drawing isolated point, line, poly line, circle, rectangle are easy to operate will not put details here. There are two options under Draw - circle drop down menu: **'Replace circle as point'** and **'Replace by circle'**. This function can replace circle as isolated point or replace graphic as circle.

In Polygon drop down menu there are rounded rectangle, polygon and star shape. To draw a rounded rectangle you have to draw a rectangle first then specify the fillet radius or directly input fillet radius in bottom window; To draw a polygon or star shape, you have to specify the number of edges (from 3 to 100); The number of edges for star shape is the point angle number. Besides, in Draw menu, under

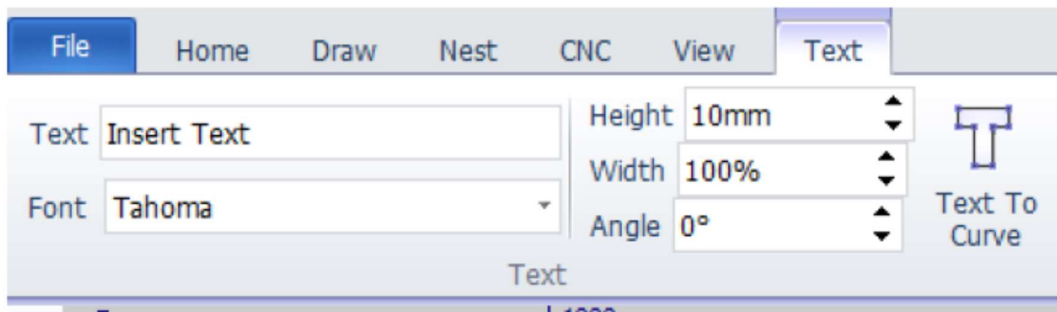


there is Obround shape option, the way to draw Obround similar with rectangle, then add a semicircle to both ends of the rectangle.

## Inputting Text:


In CypCut users can input Text and transfer text into curves. Click  in left toolbar and point at screen to insert text.

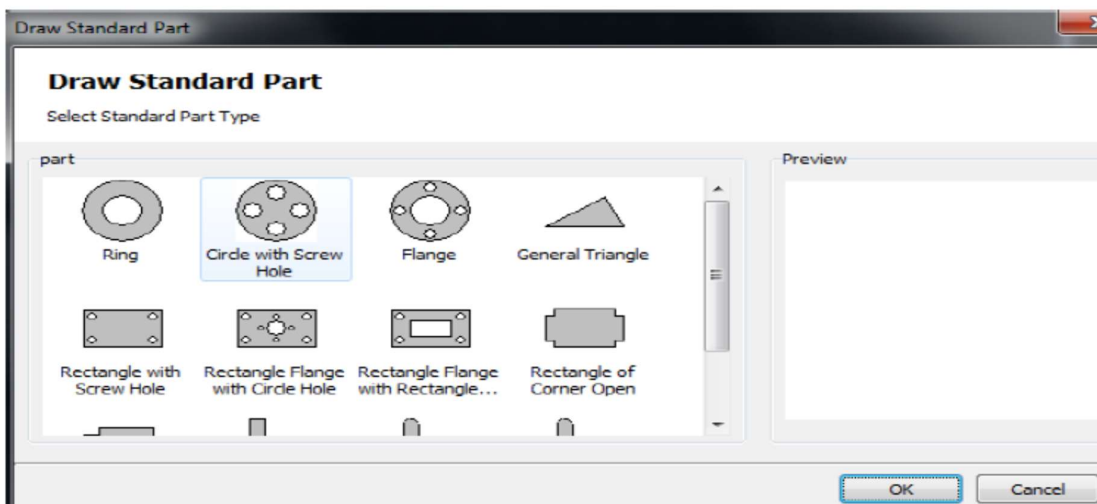
Select text there will be a 'Text' column at the top toolbar, users can modify the text, type and size etc., as shown below:



Please take notice that after transfer text to curve above functions will be not available. After you finish all design and settings of the text, transfer the text to curve at last operation.

## Parts Library:

There is standard parts library in CypCut. Click  button on left toolbar you can draw commonly used parts. Select the part shape then set the parameters. As shown below:



## Measure Function:

CypCut provides a tool for measuring the distance between two points.

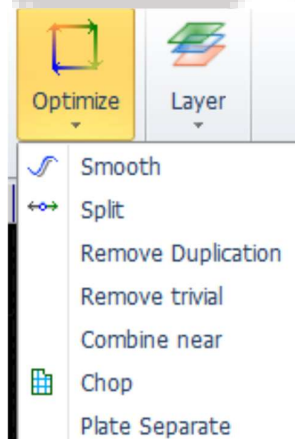


Click **Measure** button and select a point on drawing board then click another point, bottom window will show position message between these 2 points.

```
Command: Measure Length
please specify start point:(369.872, -72.0406)
Please specify measure end point:(943.3059, -72.0406)
Length:573.4339, X Direction:573.4339, Y Direction: 0.0000
```


## Graphic Optimization:

CypCut will automatically optimize the file. Under Home-Optimize drop down menu users can manually select optimize options.

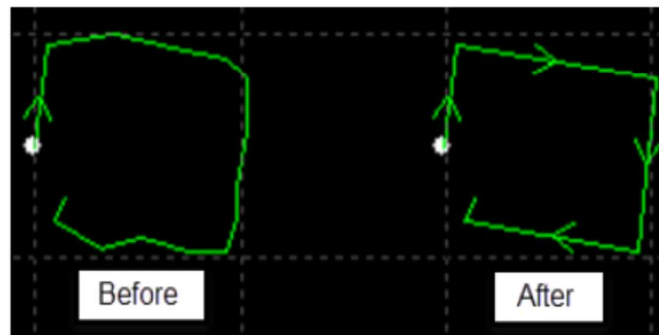


Select graphic, click “option” and follow the hints to finish the operation.


## Smooth Function:

Select the poly line need to optimized then click  Smooth button, dialog box will prompt users to input smooth precision, click enter will take effect.

The smooth result shown below. This result get by input a large precision value so it's easy to observe the smooth effect. Users can set the smooth precision as needed.



## Split Function:

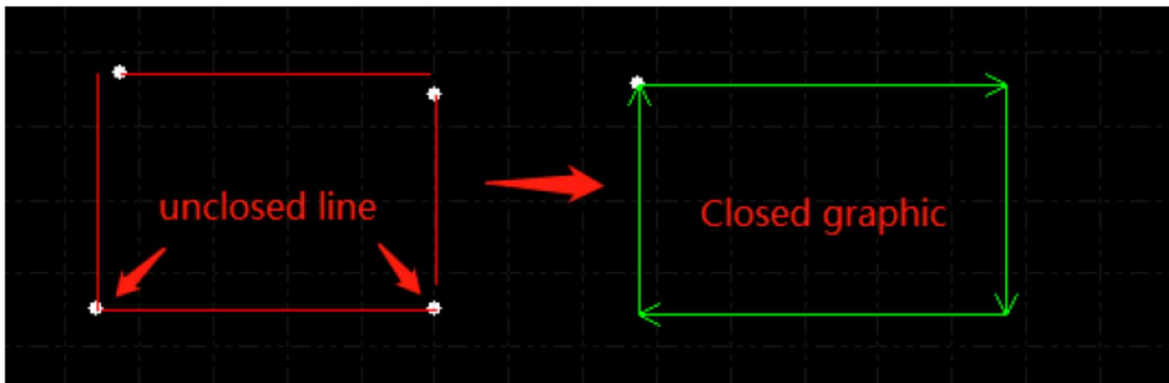
Split function is to break the graphic of closed curve and split as separate graphic for editing. Click  Split at the split position. The split function will be activated until press ESC to disable the function or switch to other command.

## Remove Duplication:

This function will remove overlapping lines on a closed Vector.

## Combine Near:

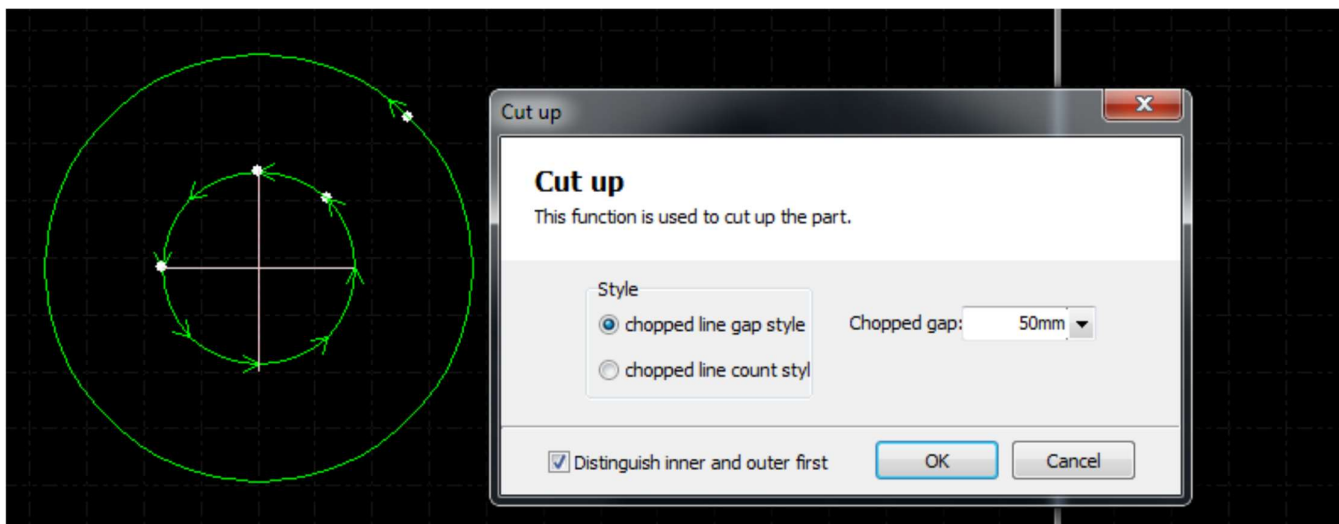
The graphic created by AutoCAD might be visually closed contour but not in fact. Users can use this function to combine unclosed contour. Select the unclosed contour and click **Combine near**, input combine precision.



Please take notice that there might be excess line at geometry end, split and remove the excess line then combine the contour.

## Chop Function:

This function is to add cut lines on cut holes to prevent tip-up collision. The cut lines in white color to be different with part graphic.





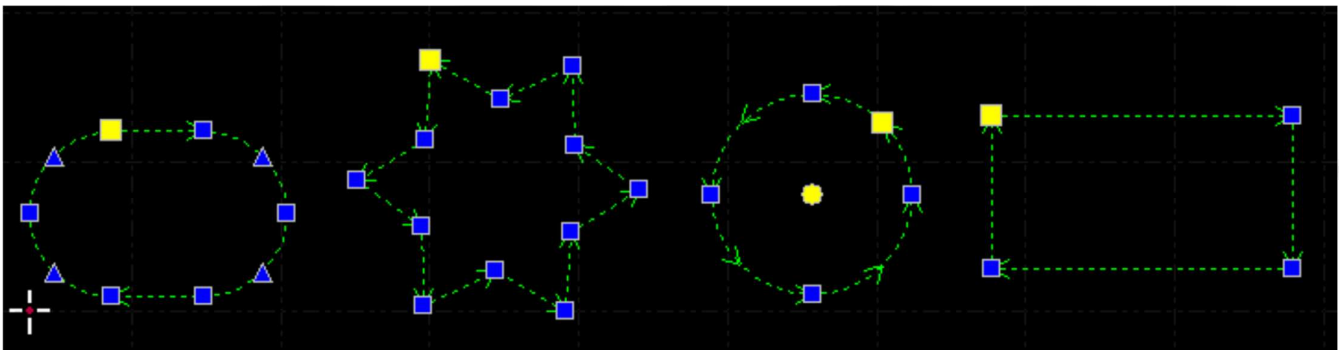
## View:

Users can zoom and edit graphic, adjust graphic position and sequence etc. Function entry is on the top of the left toolbar. From top to bottom is select, node edit, manual sort, pan view and zoom.



## Node Editing:

CypCut provides node editing function for fine-tuning graphics. Select graphic and click  you can see the nodes of the graphic. Drag a node to adjust the graphic. Click  again will disable the function.



**Nodes in blue and yellow are both editable.**

## Cutting Techniques and Layers Explained:

**NOTE:** Incorrect or aggressive parameter settings can cause damage to the head and machine outside of warranty coverage. If you must modify your parameters greatly to continue cutting as before then there is a problem that needs attention.

If after completing the standard checks and the problem persists, please contact Laguna Technical support.

We have seen many component failures that could have been avoided. Repeated large adjustments of feed rate or gas is a sign of another issue.

### Layers:

When we speak layers, these are the Parameters we use for cutting. In this window we will find the items.

**Layer Parameter Settings**

Material: Cold rolled steel | Thickness: 0.0mm | nozzle: Default | Recommended Technique

Reduce lift |  Pre-pierce |  Defilm |  Recoil |  Multi-cut | 0 |  Gas on |  Not cut |  Not follow | Mode: Standard

**Cut** Pierce Corner

**Cutting parameter**

Cut speed: 100 mm/s  
Lift height: 10 mm  
Nozzle height: 1 mm  
Gas type: Oxygen / Nitrogen  
Gas pressure: 5 BAR  
Peak power: 100 %  
Actual power: 1,000 W  
Duty cycle: 0 %  
Pulse freq: 1000 Hz  
Beam width: 0.1 x  
Focus pos: 0 mm  
Laser on delay: 200 ms  
Laser off delay: 0 ms

Slow start |  Refinement

Length: 2 mm | Duty cycle: 100 %  
Speed: 3 mm/s | Frequency: 1000 Hz

Slow stop |  Refinement

Distance: 2 mm | Duty cycle: 100 %  
Speed: 3 mm/s | Pulse frequency: 1000 Hz

Power curve |  Frequency curve |  Absolute value | Edit

Low-pass freq: 4 Hz  
Cutting acc: 2000 mm/s<sup>2</sup>  
Curve precision: 0.05 mm  
Corner precision: 0.10 mm

User Notes

OK(0)

You can use either of these buttons to open the "layers" Window

To be able to save changes you have to press OK. Simply exiting out will not save the parameters.

Cut Speed: The speed of laser while cutting


Lift Height: The pickup height of the head in between cutting operations

Nozzle Height: The height of the nozzle above material while cutting

Gas Type: Oxygen / Nitrogen

Gas Pressure: Only Gas pressure you can control is oxygen.

Focus position: Depends on material. If using crs or hrs you will use oxygen and a positive focus position. If using reflective material or Stainless Steel, you will use nitrogen and a negative focus position.

There are 16 layers in CypCut, users can set the cutting parameters to each layer including cutting speed, laser power, gas pressure and nozzle height etc. The last two layers are 'process at the first' and 'process at last'. Click 'Layer'  in Home menu will open layer parameter window contains almost all parameters related with machining. The first page is 'Global parameter' used to set default parameters used universally in machining. The other pages list all the layers applied, click the layer page to set the parameter of this layer.

**Cut Speed** - This is the speed that the machine cuts at this speed determines the sides of the cut. You can tell by the edges if we are too fast or too slow.

**Lift Height** – This is the height the head comes up after it completes a cut. If you keep it low this will speed up productivity problem with this your tip touch will stop cutting if a piece of material comes up the higher probability the head will miss any item that pops up but the downside of this, it will cause you to cut slower.

**Nozzle Height** – This is the height of the nozzle while cutting.

**Gas Type** – We use two types of gas in our machine setup.

**Gas Pressure** – In our machine configuration we can only adjust Oxygen. Nitrogen is controlled by a regulator.

**Focus Position** - This is also known as the focal we spoke of above.

Layer Parameter Settings

Global Parameter **layer1** Evaporation Layer

Material: carbon steel Thickness: 2.0mm nozzle model:

Short Move  Pre-pierce  Evaporation film  Path Cool  Multi-times 0  Keep puffing  Disable  Disable Follow Standard

Cut Pierce Lead

**Cut Speed:** 16.662 mm/s

**Lift Height:** 9.91 mm

**Cut Height:** 5.994 mm

**Cut Gas:** Nitrogen

**Cut Pressure:** 6 BAR

**Cut Cur:** 0 %

**Cut Pwr:** 0.1 %

**Cut Freq:** 1 Hz

Beam Size: 0 x

Cut Focus: 5.994 mm

Delay Time: 0.0011 min

Laser off delay 0.0011 min

Slow Lead Length: 0 mm Speed: 2.007 mm/s

Slow Stop Length: 0 mm Speed: 2.007 mm/s

Dymc Pwr Adj  Dymc Freq Adj  Show in Abs Curve edit

User Notes

OK(O)

**Notice:** The parameter options may differ for different laser source and gas configuration, the parameter in the image can only be reference, users must set the parameters by actual software display in your own machine.

### Parameter descriptions:

Cutting speed	Set the target speed of actual cutting. Because of the acceleration and deceleration in machining workpiece corner, the actual cutting speed is usually slower than the set value.
---------------	--

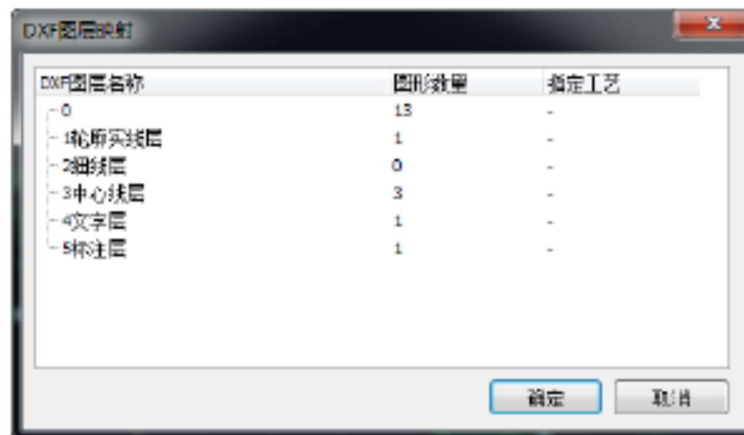
<b>Lift height</b>	After process a graphic segment laser head will lift to this height and move to next start point. When pause the machining, laser head will lift to this height.
<b>② Machining mode</b>	
<b>Standard</b>	Machining will follow the preset parameters.
<b>Fixed height cutting</b>	Laser head will be at a fixed height in whole cutting process.
<b>Extra plate follow</b>	Select this mode, the laser head will start outside the plate and follow to cut height once move within the plate.  Locate laser head at a suitable position, in CypCut-CNC-BCS100-Save extra-plate follow reference height set the parameter.
<b>③ Machining parameters</b>	
<b>Cut height</b>	Set the following distance between nozzle and plate.
<b>Gas type</b>	Set the type of auxiliary gas used in cutting.
<b>Gas pressure</b>	Set the pressure of auxiliary gas in machining, this requires proportional valve.
<b>Peak power</b>	Set the peak power of the fiber laser. Peak power determines the maximum cutting power that the machine can achieve. If the peak current is set to 80%, the maximum cutting power is $3000W * 80\% = 2400W$ .
<b>Cut pwr</b>	The duty cycle of PWM modulation signal.
<b>Cut Freq</b>	The frequency of the PWM modulation signal which is the times of laser fires within 1 second.
<b>Cut Focus</b>	The position between focus with nozzle tip.
<b>Delay Time</b>	The duration of laser firing to confirm laser cut through the workpiece at the start.
<b>Laser-off delay</b>	A delay before turn off laser.
<b>Step time</b>	Set the time required that laser head descends from pierce height to cut height.

<b>Extra puffing</b>	After finish pierce actions, it will turn off laser and open gas to cool down the material temperature.
<b>④ Other parameters</b>	
<b>Disable</b>	This layer is not going to be processed.
<b>Disable follow</b>	When machining this layer it will close follow function, laser head will be at a fixed height.
<b>Keep puffing</b>	Gas is open in the whole machining process.
<b>Short move</b>	This function related with the 'Move optimization in short move' parameter. If the distance from one graphic end point to next graphic start point shorter than this value, Z axis will not lift up on this path.
<b>Pre-pierce</b>	It will pierce at all graphics start point or lead line then start cutting. In 'Global parameter' window there is 'group pre-piercing', enable this function it will execute pierce of one group and complete machining of this group then move to next one. Notice: pre-pierce cannot be selected with evaporative film.
<b>Evaporate film</b>	It will execute filming parameters along the graphics then start cutting. After you select this option there will show a evaporation layer page.
<b>Path cool</b>	After finish machining of one graphic it will turn off laser and blowing gas along the graphic to cool down the material reduce the heat effect to the workpiece precision. After you select this option it will show a Cool layer page.
<b>⑤ Slow lead</b>	
<b>Length</b>	This used in cutting thick material, it will start cutting in a slow speed to make sure plate cut through.
<b>Speed</b>	The speed in this start length.
<b>⑥ Power curve</b>	

<p><b>Real-time power/frequency regulate</b></p>	<p>After you enable this function you can edit the power/frequency curve, and program will regulate the laser power and frequency according the curve. This function is very practicable improving corner precision. Notice: 'Dymc freq adjust' cannot select alone.</p>
--	--

## Layer Mapping:

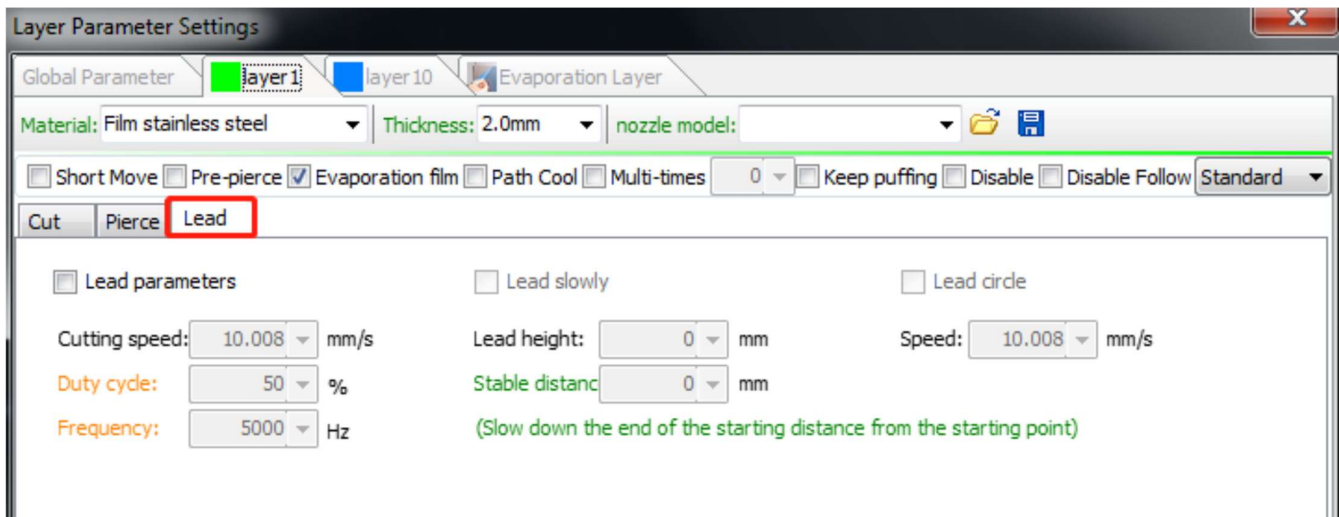
Click 'Layer' drop down menu users can lock or display a specified layer by select options. When there are more than one layers when import DXF file, click 'layer mapping' it will distinguish layers. Shown as below:



## Lead Line Technique:

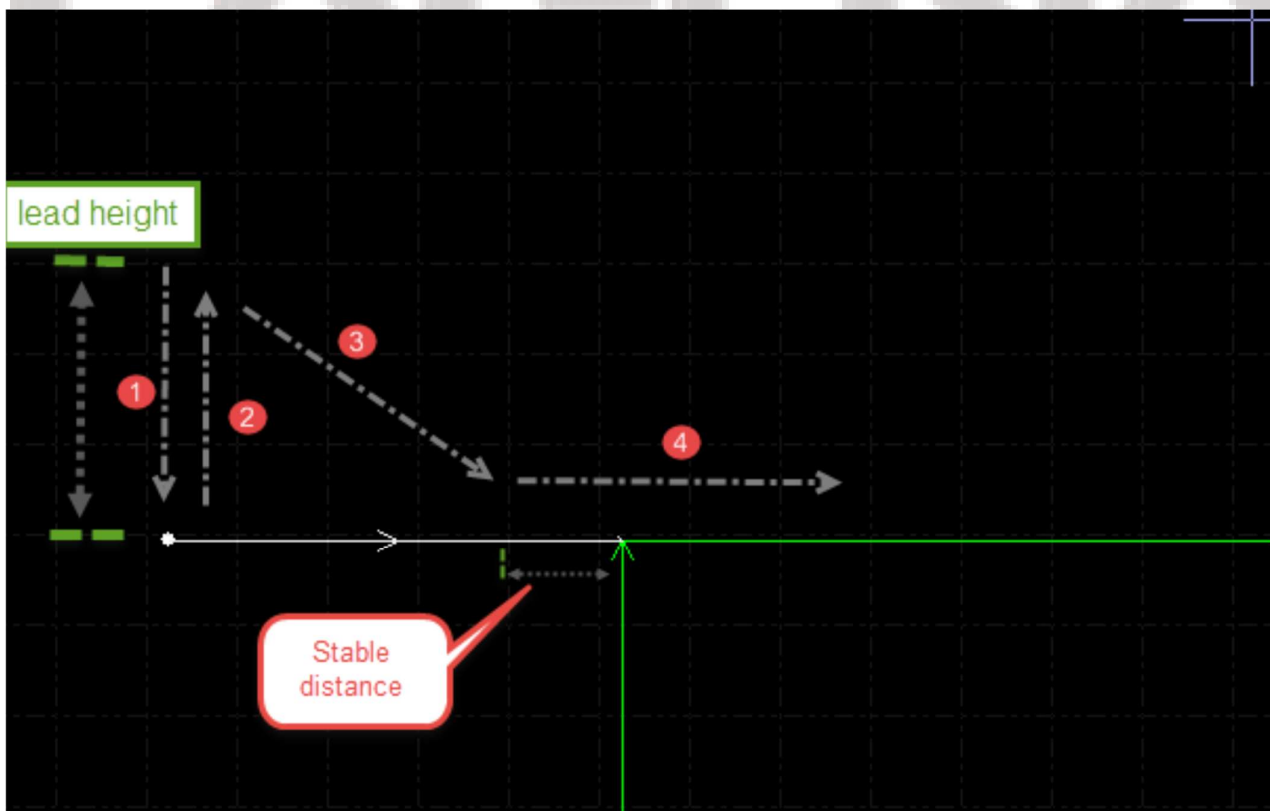
When cutting thick plates of stainless steel, it will generate plasma cloud which will absorb laser energy and reduce the cutting energy, gas can hardly blow off the plasma cloud at cut height. Lead line technique is applied to solve this issue. After executing pierce, laser head will stay at a higher position and blow off the plasma cloud, then slow the speed in horizontal direction to make up for the pressure loss.

When cutting thick plate, you can set lead line technique including speed, power, lead height and stable distance.




The actions process lead line:

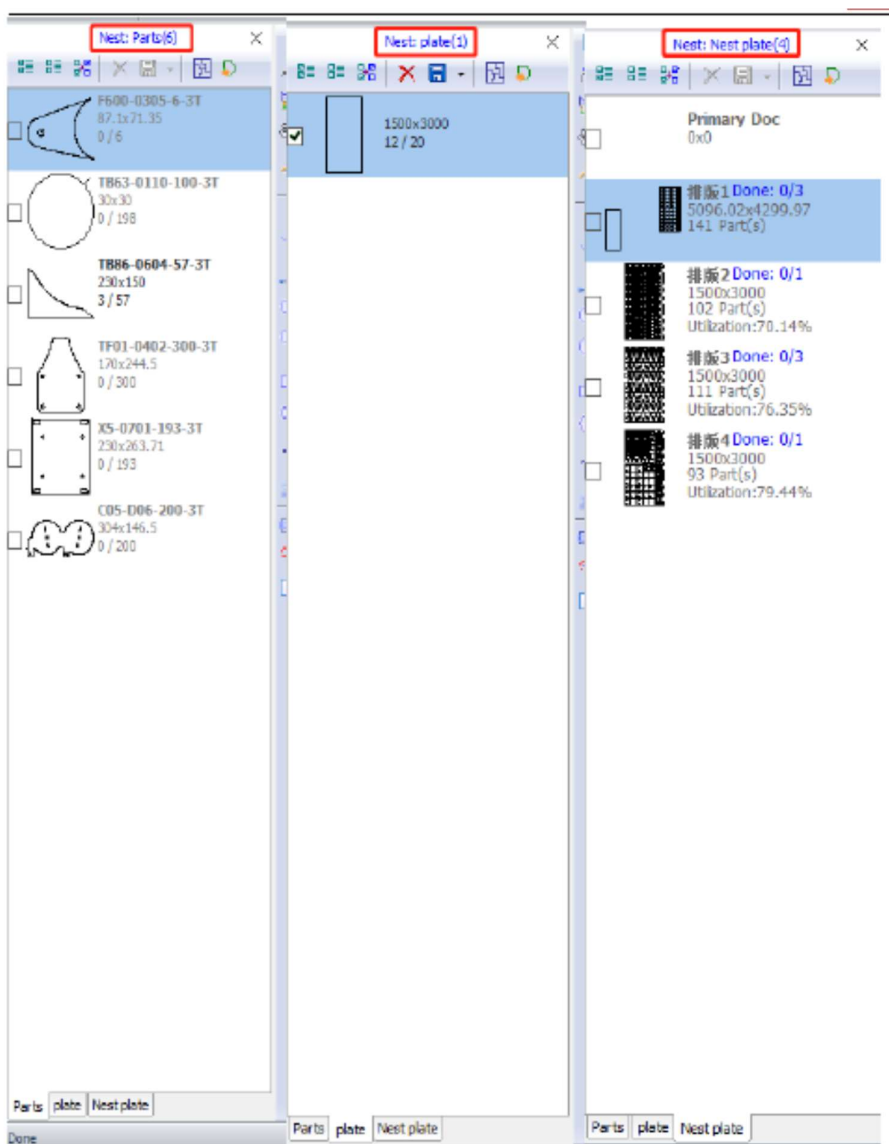
1. Pierce at start point of lead line.
2. Laser head lifts to the lead height to blow off plasma cloud.
3. Laser head descent to the cut height and cut at 'lead speed' in the length of 'stable distance';
4. After cutting out of the stable distance it will start normal cutting.



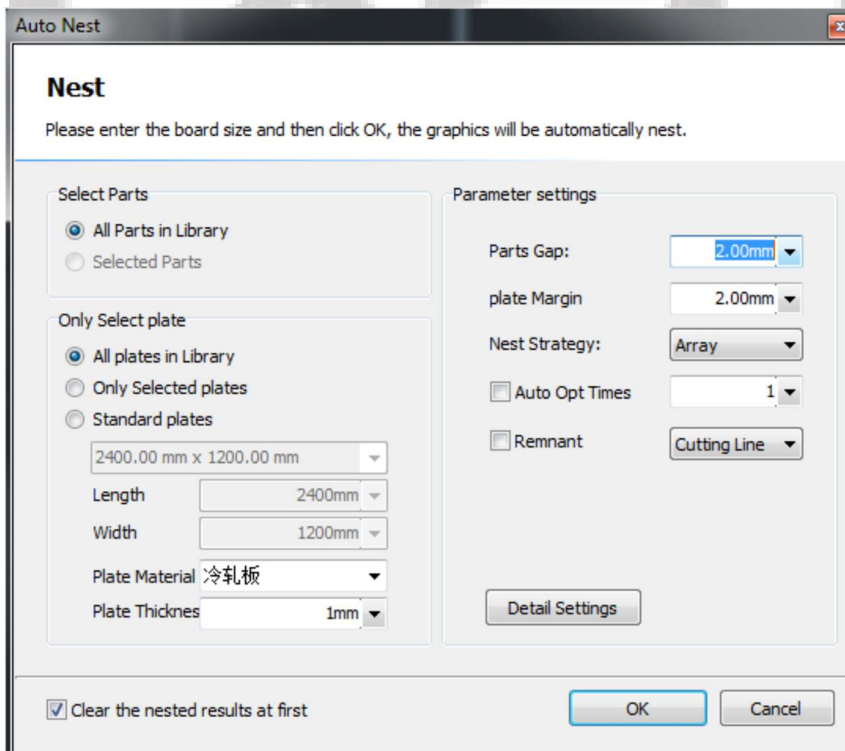
## Nest:

Nest function is used to layout the parts in a plate with highest utilization. Users can click nest button to finish nesting. CypCut also provides options to customize the nesting like: Parts gap, plate margin, rotation angle, co-edge and remnant management etc. You can find nest function button  in Home menu and Nest menu.

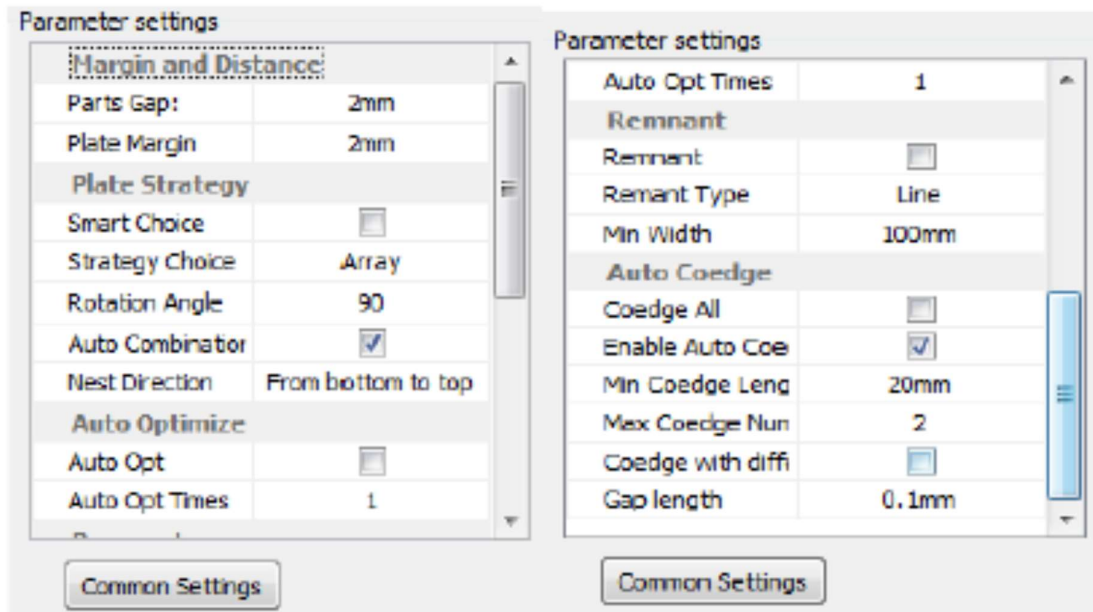
In nesting operation there will be a side bar at left screen to display the parts, plate and nested plate.



- **Parts library** will list all parts, you can add new parts by right clicking at parts lib and select 'load parts', or you can select parts at drawing board right click the part select '**add to parts lib**'. The parts type limit is 50. Right click at side bar you can choose to import standard part, delete part or save un-nested parts.
- Plate library lists the plates and plate quantity; you can add new plate same operation with adding parts. Right click side bar you can choose to delete plate or save as file.
- Nest plate lists all nested plates and already processed plates. CypCut now only supports 20 plates nesting at one time.
- Users need to set basic parameters for nesting. 'Part gap' is the minimum space between parts; 'Plate margin' is the plate margin left when nesting; 'Nest strategy' only supports array in CypCut.



In 'detail settings' you can set parts rotation angle allowed, layout direction, co-edge and remnant material management.



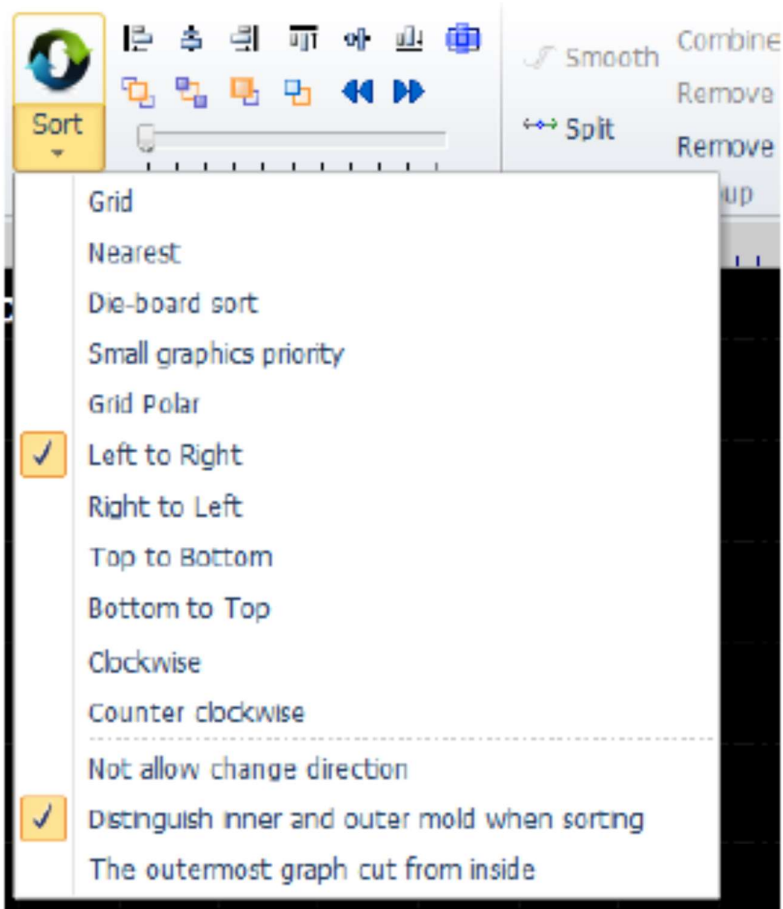
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## CypNest Import Notes:

To open nrp or nrp2 (file package generated by CypNest nesting software), it will list all nested plates, also processed times and planned process times. The processed time will add up after the current plate task is finished machining. When the processed times reach the planned times, it will switch to the next file.


## Sorting and Path Planning:

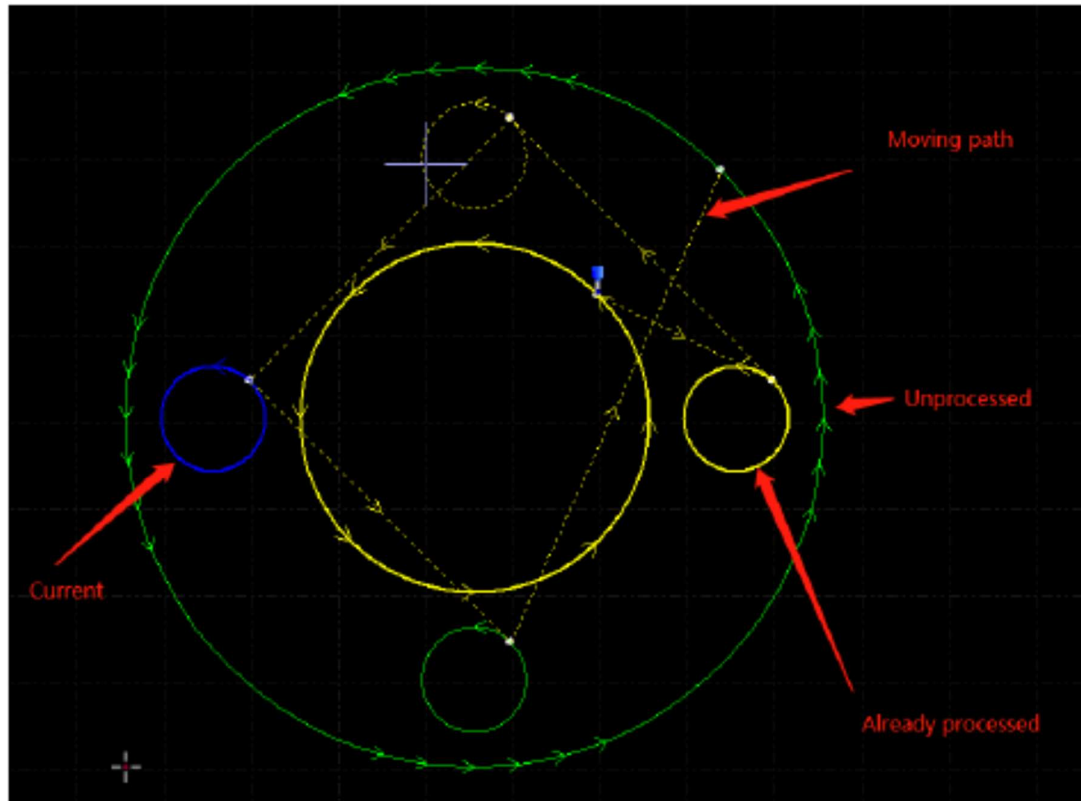
The below function column is in the 'Draw' menu which list all sort patterns and align tools.




If no requirement to the sorting result, just select 'grid sort'.

## Cutting Sequence Preview:


Drag the progress bar or click  you can preview the machining sequence of the graphic. Below picture shows graphic status when preview sequence:







Sequence preview is completely interactive, easier to control the progress forward or backward. You can view the move path to check the overall sequence. Open 'View'


drop down menu select  Show Move Path

## Manual Sorting:

If you want to adjust sorting result, you can manually edit the graphic sequence. Select graphics then click , the buttons from left to right is:

First		The selected graphic will be the first to process.
Last		The selected graphic will be the last to process.
Prior		Adjust the sequence of the selected graphic one step forward.
Next		Adjust the sequence of the selected graphic one step backward.

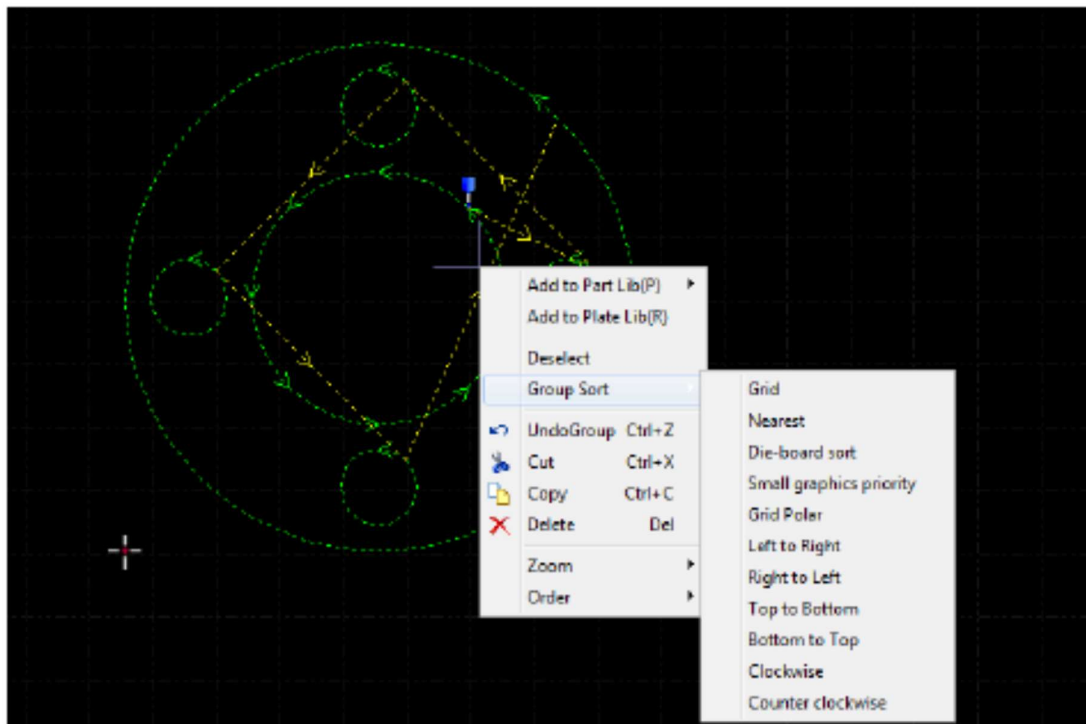
After finish sorting, you can click  to check the sequence one by one.

You can open 'Manual sort mode' to edit the sequence. Click  on left bar of main screen will enter 'manual sort' mode. It will display the graphic sequence and path. Click graphic one by one as you required sequence. If one graphic click accidentally, click this graphic again or right click to cancel the operation. If you just want to edit the sequence between two graphics, just click a graphic drag a red line to the other graphic will set the new sequence of these two graphics.

## Group Sorting

If you want to fix the sequence of certain graphics, you can group these graphics. The sequence of the graphic within a group will not change in other sort operation. When process the graphics within a group, it will not process other graphics doesn't belong this group till the group is finished.

If you only want to sort a certain graphics, group these graphics and use 'group sort' function. Select graphics and click 'group'-right click group - select 'group sort'.




## Lead Line:



### Distinguish Between Inner and Outer Contours:

CypCut will distinguish the inner and outer contour automatically when import external file like DXF. Inner and outer contour will reverse in editing the graphic. If

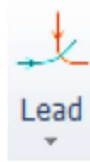


you need to distinguish inner and outer contour again click , select in drop down menu 'distinguish inner and outer contour when sorting' or click 'Distinguish inner and outer contour' under 'Lead' drop down menu.

CypCut distinguish the inner and outer contour by the boundary relations. It will define the outmost contour as outer contour, the second is the inner contour, the next is outer contour, and unclosed graphic will not be defined as a contour. If you want to set one contour as outer contour, select the contour and contour within as a group. Then right click use group sort will distinguish the inner and outer contour.

When add lead lines, outer contour cut from outside, lead line add to inner contour will start from inside. Click  Inner  Outer in Home menu you can manually set inner or outer contour.

## Automatic Lead Line:



Select the graphic will and click **Lead** under Home menu. Set the parameters

like below image:

**Lead Lines Params**

**Set Lead Line**

This function is used to set lead lines.

**Lead in**

Type:  Length:   
 Angle:  Radius:   
 Add small hole at start point Hole Radius:

**Lead Out**

Type:  Length:   
 Angle:  Radius:

**Lead Position**

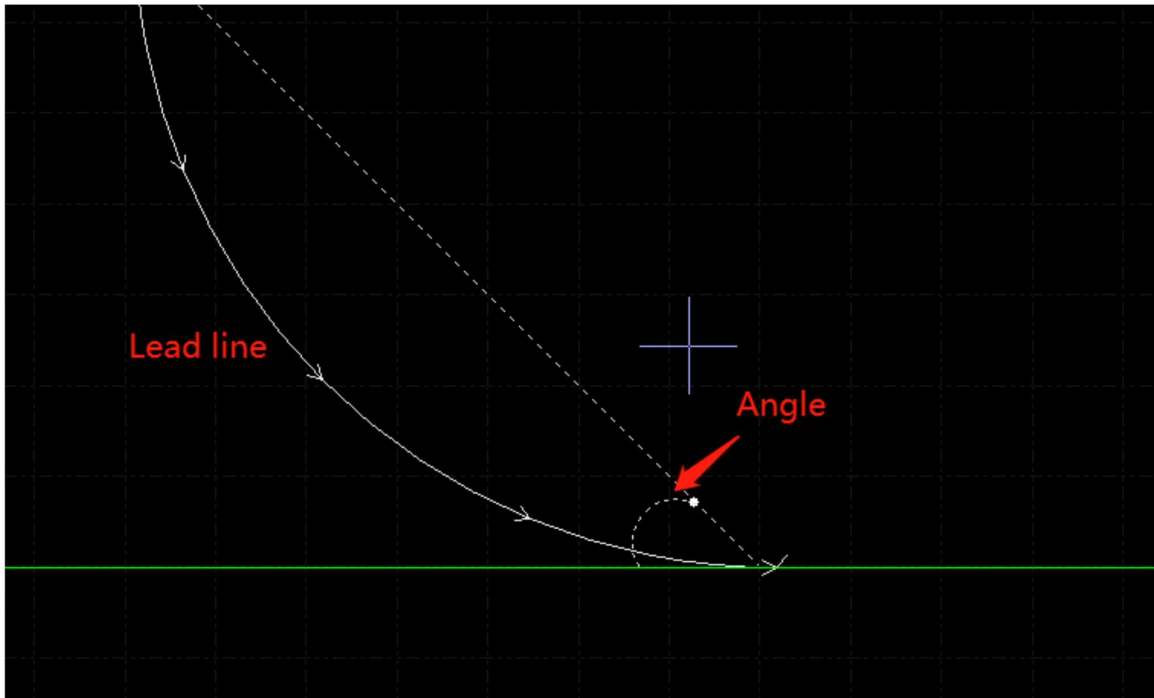
Automatic Lead Position  
 Introduce from vertex  
 Introduce from long edge  
 Set by Universal (0~1) param   
 Change leads type, remain position

**Options**

Only for Closed Graph  
 Only applies to outer  Only applies to inner

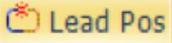
**Users can add different type of lead line including straight line, arc, straight line and arc, and other settings including lead angle, length and radius. You can also add little circle to the lead line starting point.**

When select lead line as arc type, the end of arc will be tangent with graphic. The line connects arc two ends form the angle with graphic boundary. The lead-out line is like this.



Please take notice that executing auto-add lead line will change the previous setting. You can select  Change leads type, remain position to fix the lead line position.

## Manual-set Lead Line

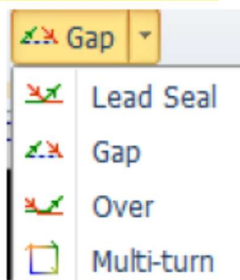
Click  to change the lead-in line manually. Click on graphic only change the lead in line position, lead length and angle remain same.


Click outside the graphic then click back on graphic will create a new lead line.

## Check Lead Line

Click 'lead' drop down menu and select 'check lead line'. This function will examine all lead line and adjust lead line length if it's too long and cross with graphic. Click 'distinguish inner and outer mold' it will examine all lead lines and adjust lead line direction according the lead line is add on inner or outer contour.

## Overcut, Gap, Seal and Multi-Cut:



There are 4 options  Multi-turn in technical parameter column. Select graphic and click function button will take effect. The 'gap/overcut' setting will not take effect to the graphic already set gap or overcut.

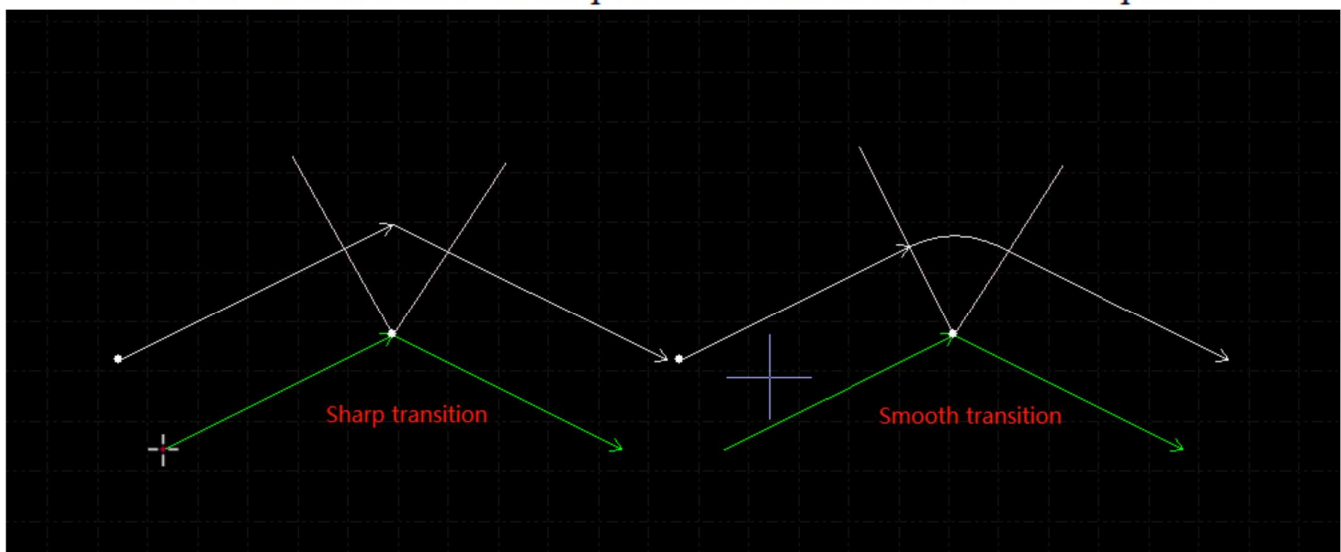
## Seam Compensation:

Select graphic and click  **Compensate** in toolbar to add cutting seam compensation.

Seam compensation should be accessed by measuring real cutting result. The compensation displayed in white on drawing board. Machining will refer compensation line as tool path. Original graphic still display on drawing board but not as actual tool path.

The compensation is inside/outside contour can be set manually or automatically.

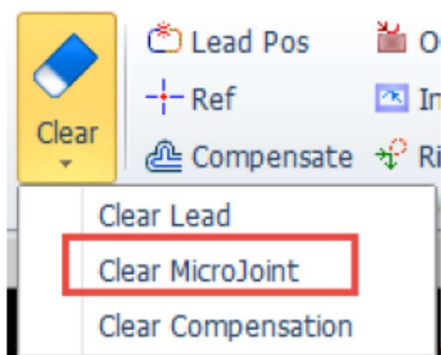
Users can also add fillet on compensation line at corner like below photo:



In the photo, the line of green is original graphic, white line is compensated path. It requires smoothing at corner. Usually round corner will smooth the machining path and assure the consistence of graphic and cutting result.

Users can edit compensation parameter and build a library in compensation-configuration-edit.

To remove the compensation you need to select graphic first then click




drop down menu select 'clear compensation'.



### Micro-joint:

**Micro-joint is to add a small distance joint on the graphic. Laser will not fire on the graphic where add micro-joint. By doing this parts will not fall from the plate skeleton also prevent tip-up collision. Micro-joint displayed as a breach on the drawing board:**

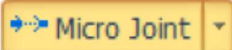




Click  Micro Joint in technical parameter column to activate the function then click on the graphic where need to add micro-joint. You can click multiple times to add more than one micro-joint until press ESC or switch to other command. You can also click on the compensated line to add micro-joint.

Micro-joint length setting will not change the previous set micro-joint.

You can also add auto micro-joint. Click  drop down menu and select  will prompt a dialog box for parameter setting. You can add by micro-joint count, for example, if set 10, each graphic will add 10 micro-joints; or by distance, set 100 it will add a micro-joint every 100mm interval.


Micro-joint will divide the graphic into separate segments. If you want to edit

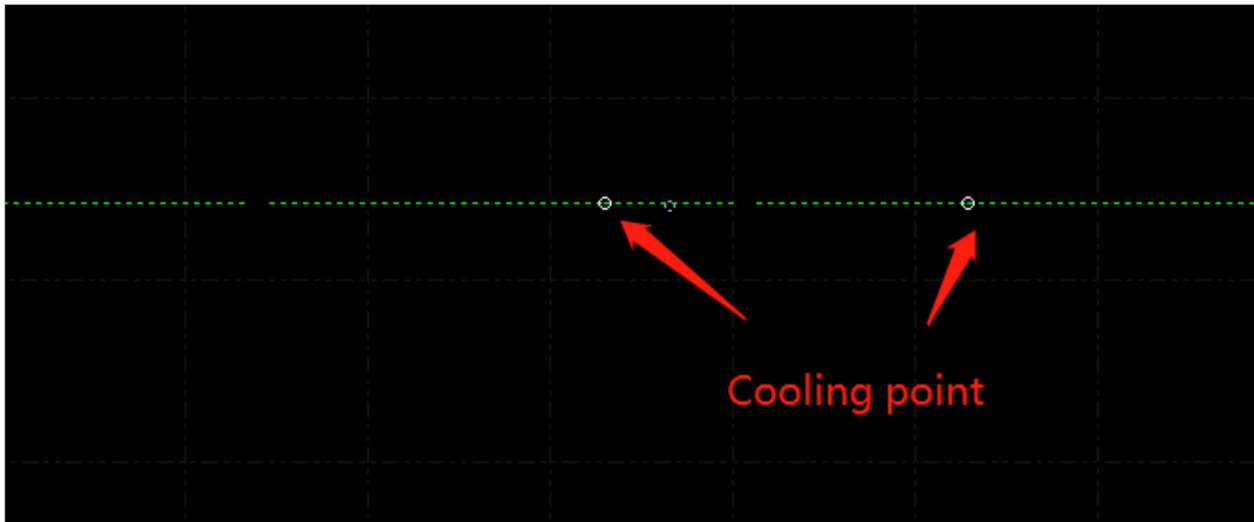
each segment separately, select    in drop down menu. After execute 'explode micro-joint', each segment is an individual object to edit, you can add lead line on each segment.

To delete micro-joint, select the graphic then click 'Clear micro-joint' under 'Clear' drop down menu.

CypCut V731 and above adopts FlyCut strategy cutting micro-joint segment, the laser head will not lift up and pass the micro-joint segment without slowing down, which will increase the machining efficiency.

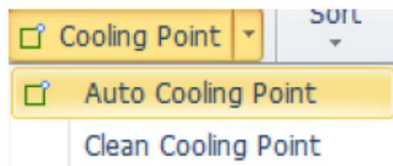
### **Cooling Points:**

Click  button then click on the graphic will add a cooling point. When the machining executes cooling point, it will turn off laser and open gas maintain a preset delay, then open laser turn off gas and resume normal machining again. The cooling point is shown as a solid point white dot in the drawing board as follows:



Like micro-joint, the cooling point can be clicked continuously to insert more than one. After you finish setting micro-joint and compensation can still add cooling point.

CypCut can also add cooling point automatically. Click




drop down menu and select 'Auto cooling point' and set parameters in dialog box. There are two positions users can select to add cooling point automatically: sharp corner and lead line. The cooling point add on lead line will integrate with lead line. For example, if click 'Clear cooling point' will not delete the cooling point on lead line. Only delete lead line can remove the cooling point add on lead line.

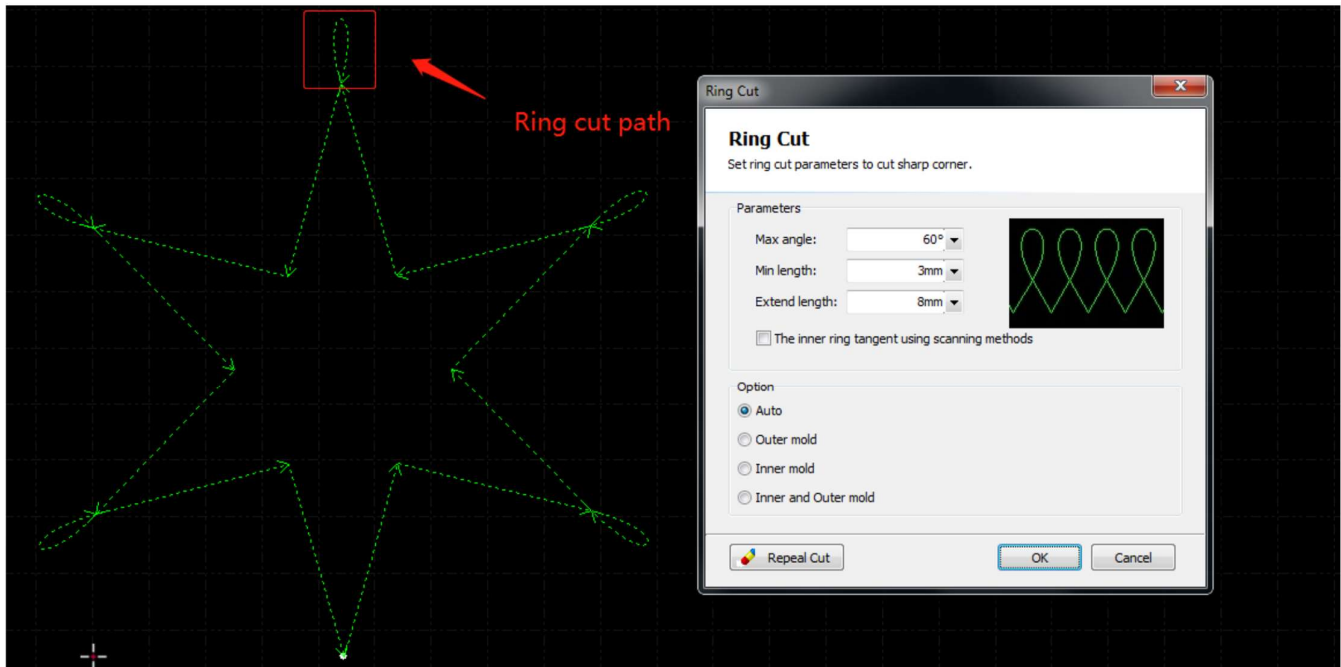
Press shift and click cooling point you can delete it. If you want to delete cooling point, click drop down menu of cooling point and select 'clean cooling point'.

Cooling point is often used in processing workpiece corner, it will pause at cooling point, turn off laser and gassing to lower the corner temperature avoid corner burned.


## Ring Cut:


This function facilitates cutting small sharp and perfect corners.

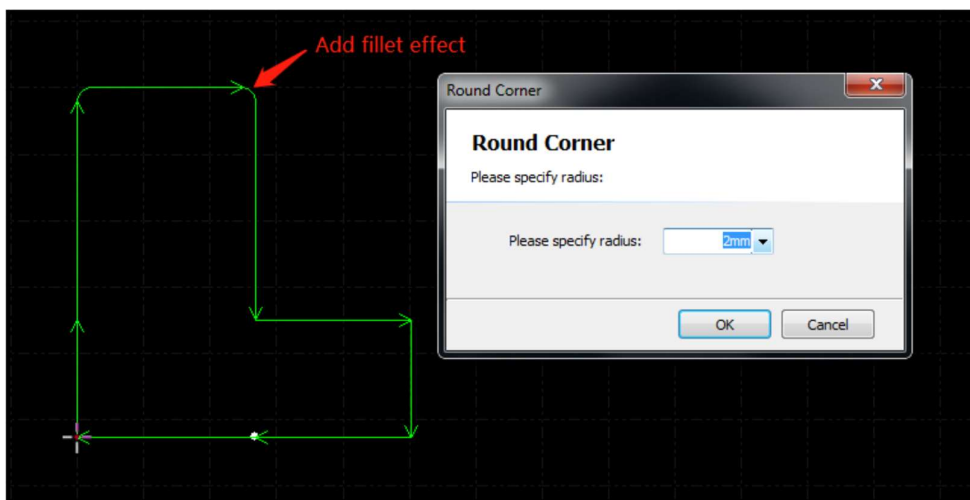
Select graphic and click  to create an extra path to improve sharp corner cutting performance.

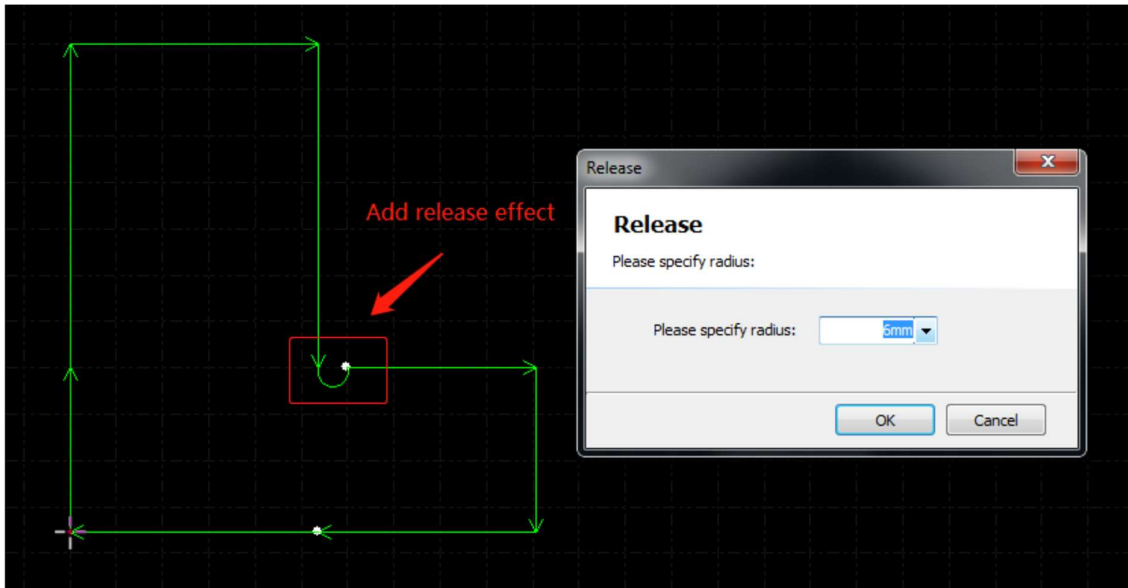


## Fillet/Release:

Click  to transfer sharp corner into rounded corner.

Click  to create a release notch for bending process.





## Group:

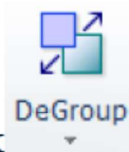
Group function in CypCut is to integrate multiple graphics as a group. A group will be recognized as an independent object. The sequence and position of the graphics within a group are all fixed and will not change by other operations.

Select the graphics and click



will create a group. If you need to disperse a

group, select the group and click



. If you need to disperse all groups click

drop down menu of group and select Degroup all

'Degroup' will not disperse the graphics only the group. 'Explode graphics' will disperse the graphics as line segments.

'Multi contour cut together' will create a path connect the group which will reduce the piercing times and improve the efficiency. 'Explode multi contour cut' will clear the connecting path.

- For a group, if there is one graphic that contains all other graphics, this graphic will be defined as **outline**. The group with outline will be defined as a '**part**'.
- It's recommended that CypCut users create '**Group**' to integrate a part not just group graphics randomly. We might use term '**part**' with the same concept as '**group**'.
- CypCut will integrate co-edge graphics as a group. In addition, use 'Bridge' function to connect a group with other groups, the result will be a group.

### Group Sorting:

- The group will be defined as an independent object in sorting. The sequence of the graphics within a group won't change in sorting.
- If you need to edit sequence of graphics within a group, select a group and right click, select 'group sort'. "Group sort" operation will not change the sequence of graphics in sub-group. It will distinguish inner and outer contour of graphics within a group by geometrical relations.

### Machining of a Group:

- A Group will be defined as an independent object, until a group is fully processed it will not move on to the next graphic. Piercing groups follow the same rule.

Please take notice that the outmost contour of a part/group will always be processed at last.

## Flying Cut:

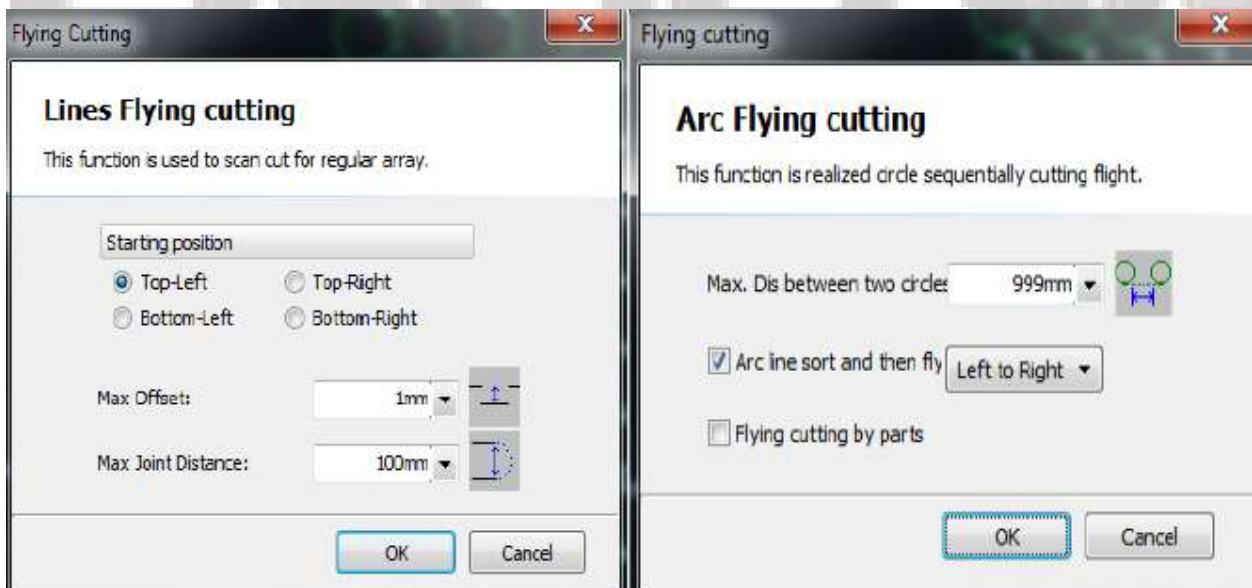
When the graphics are standard shapes like rectangle, circle or polygon and layout in principles, you can use flying cut function to improve the machining efficiency.

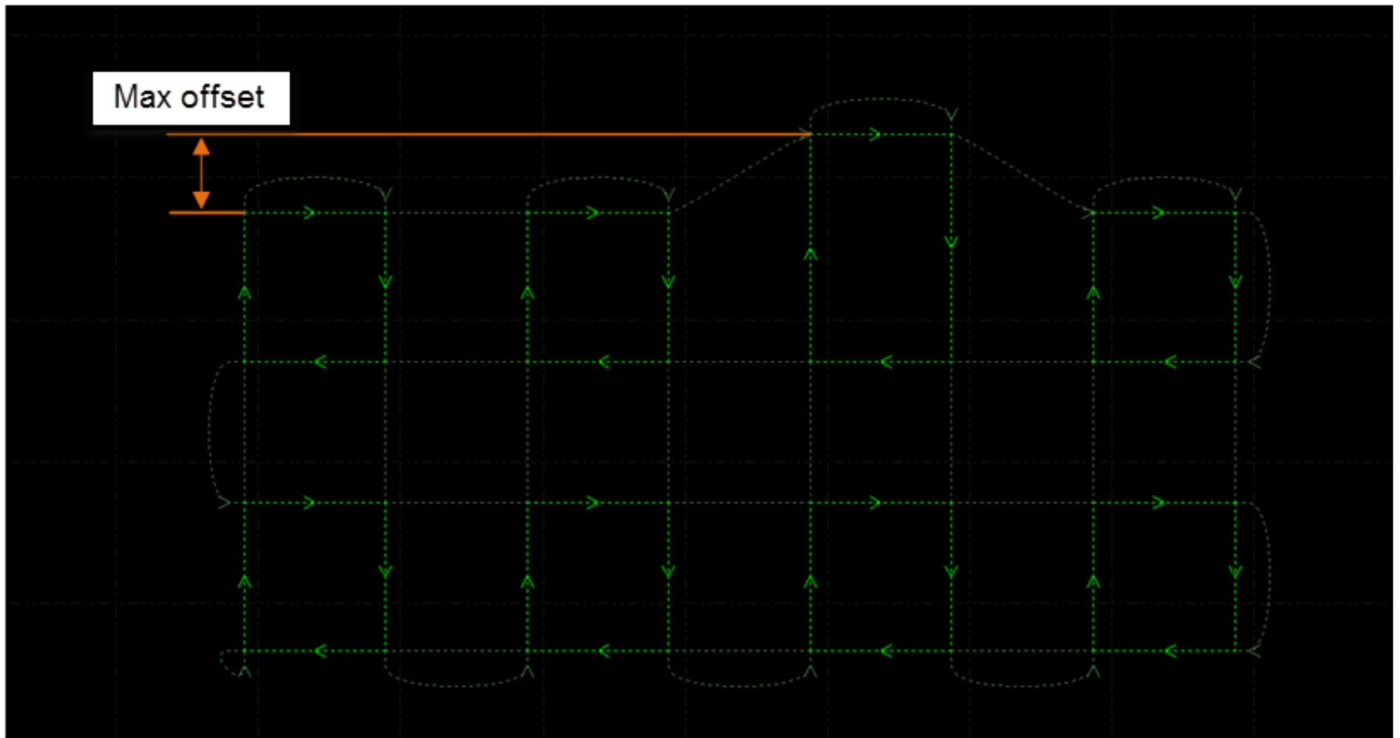
Before use flying cut, execute sorting first, this will optimize the cutting path.



Click drop down menu of **Flying Cutting** select flying cut patterns and set parameters.

- Start position defines where to start flying cut. Max joint distance: it will create a smooth cutting path to turn around if the turning distance is shorter than this value. Max scan length: if the distance between two graphics is longer than this value it's not able to create fly cut path.



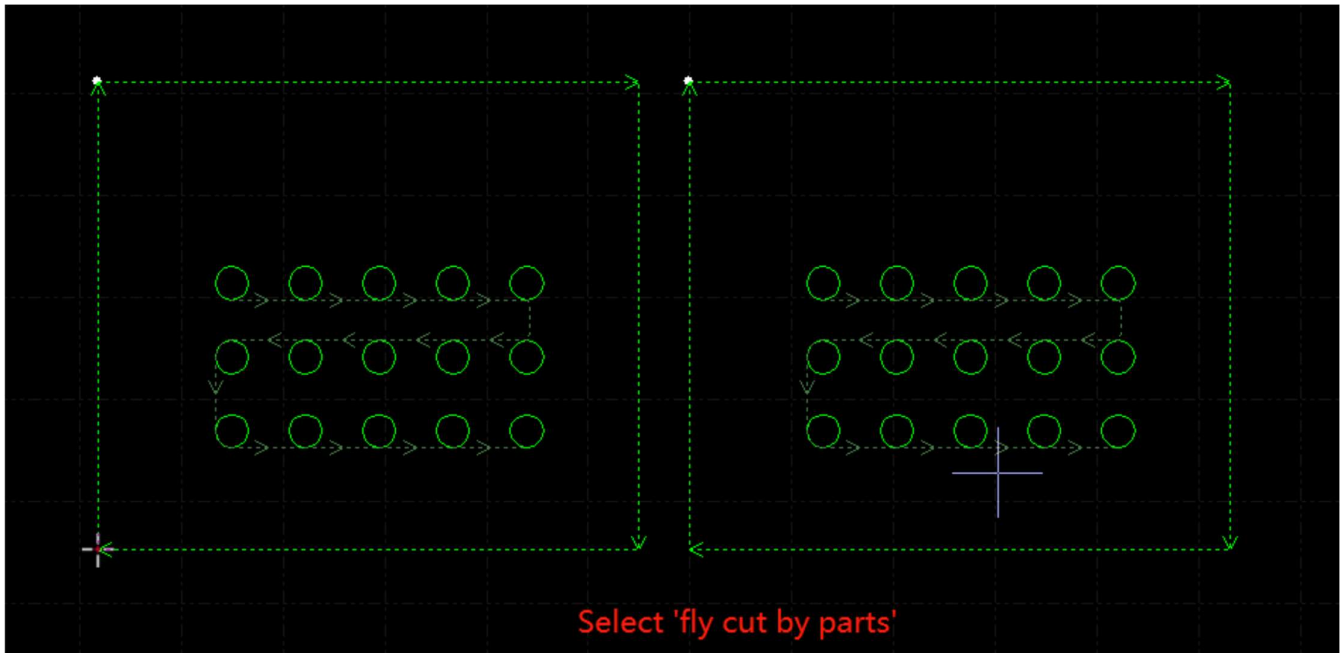


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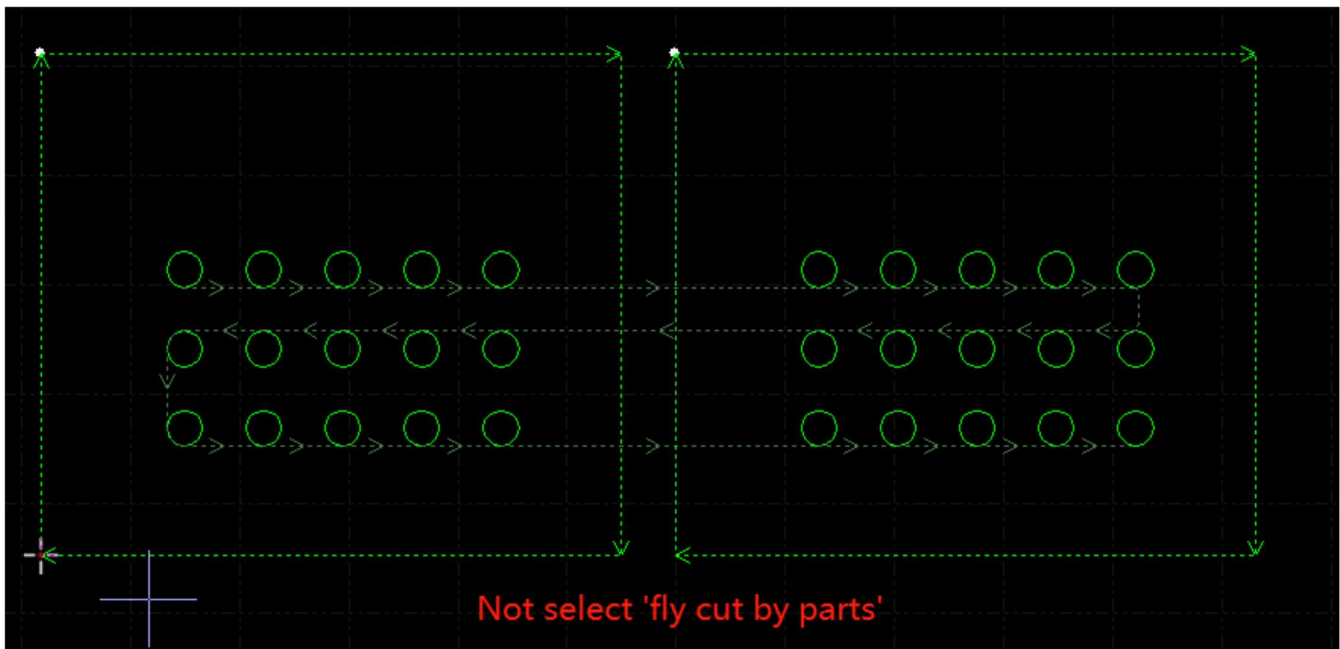
When the graphics in a layout are all circles, select 'Circles flying cut' pattern.

Max distance between two circles: only the distance between two circles shorter than this value can create fly cut path.

Select  Arc line sort and then t will execute sorting first then create fly cut path, if select with  Flying cutting by parts it will process the graphics within a group then process next group.



Select  Flying cutting by parts only, it will execute sorting then create fly cut path.




In global parameter page, set a fly cut over-cut distance will assure parts will fall down from skeleton plate.

## Co-edge

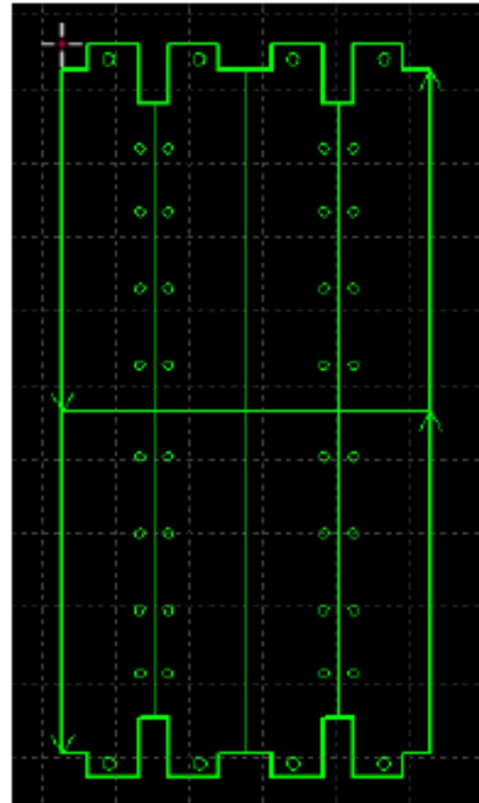
Merge the shared line of two parts as one will reduce the cutting length. In CypCut, the parts of space smaller than 0.1mm can use co-edge function. CypCut provides graphic absorb function to snap two graphics and merge the shared lines.



Select the graphics and click , it will merge the shared lines of the selected graphics.

CypCut cannot merge the inward concave lines of the graphics.

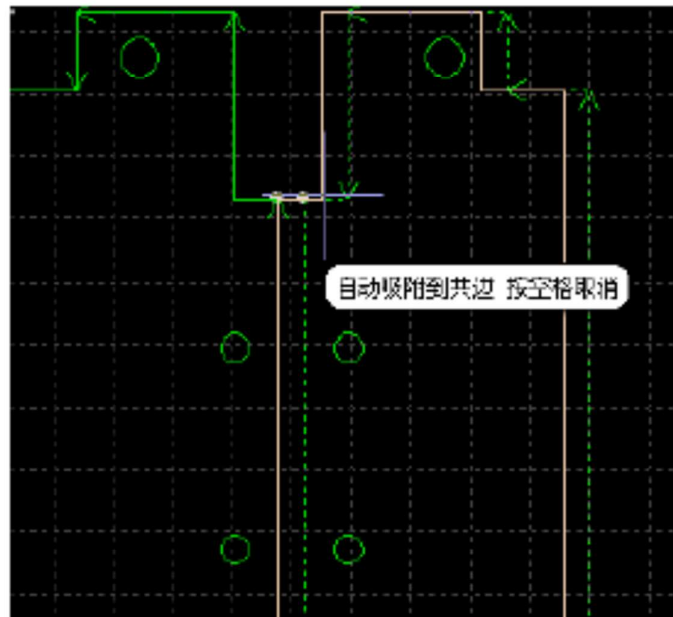
The graphics merged shared lines will be integrated as a group. If the graphics which are going to merge the shared lines contains other graphics inside like circles, you have to group the graphics first.



## Automatic Absorb

When drag the graphic, it will attach to another graphic automatically when in the position fit for co-edge. Absorb function will help you quick adjust the position of graphics fit for co-edge.

Once graphics attach with each other with shared lines, click



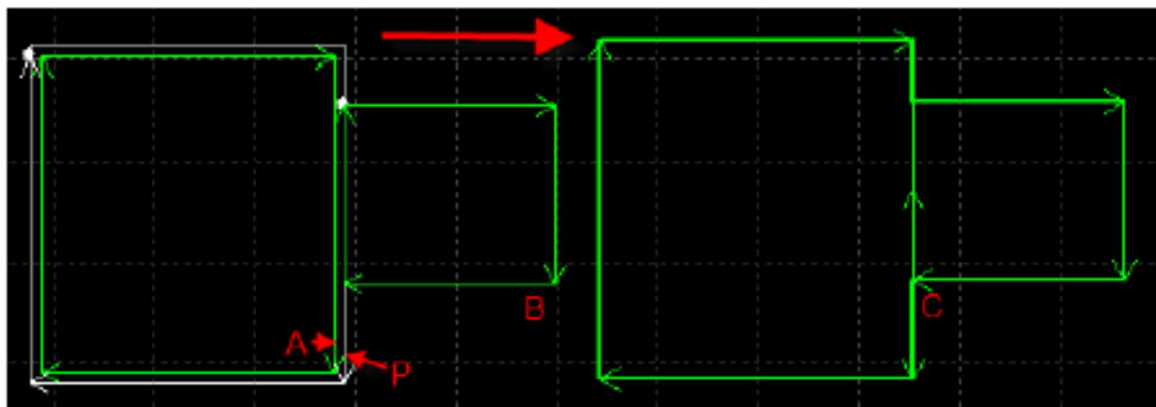


Coedge

will create the co-edge. If you want to disperse the graphics with co-edge, click 'explode graphics' under 'group' drop down menu.

### Co-edge with Compensation

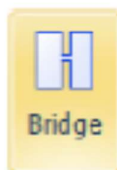
If you want to add cutting seam compensation to the graphics, you have to add compensation first then execute co-edge. The graphics of co-edge add compensation, then only compensation line remained.



For example, in the above picture, graphic P is the compensation line of the graphic A, only graphic P can co-edge with graphic B because graphic A is not real cutting path.

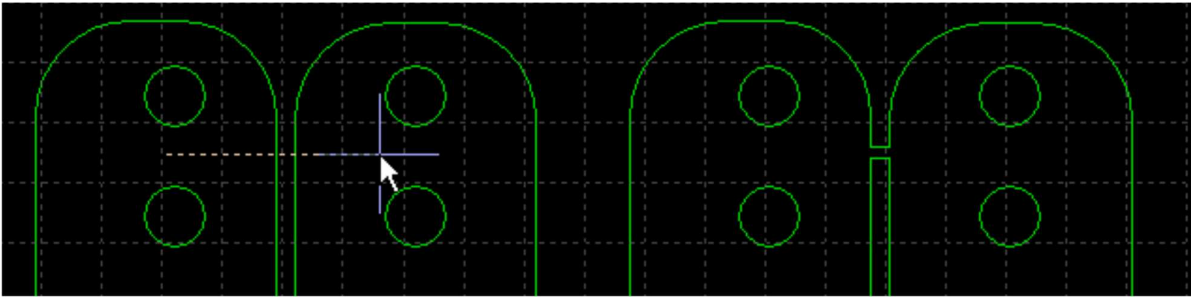
### Bridge

When a workpiece contains several parts and you want to keep them connected, you can add bridge between graphics. And graphics with bridge also reduce the pierce times.



Bridge

Click and drag a line segment on the drawing board, the graphics cross with the line segment will be bridged like below image.



- There are two parameters to define the bridge function. One is the **max distance** between two adjacent graphics, only the distance between two graphics smaller than this value can add bridge. The other is the **width of the bridge**.
- The graphics add bridge will be recognized as group, please be careful that the continuous cutting will cause heat affect to cutting quality.

## Array:

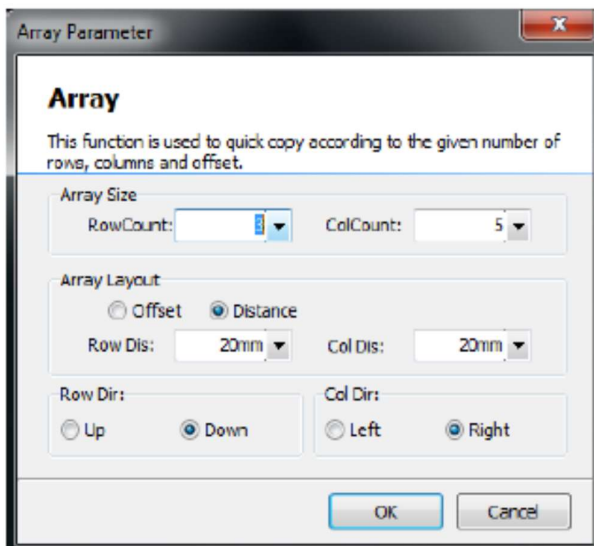
The 'Array' function used quick duplicate a graphic, there are 4 patterns of Array in CypCut.

## Rectangular Array:

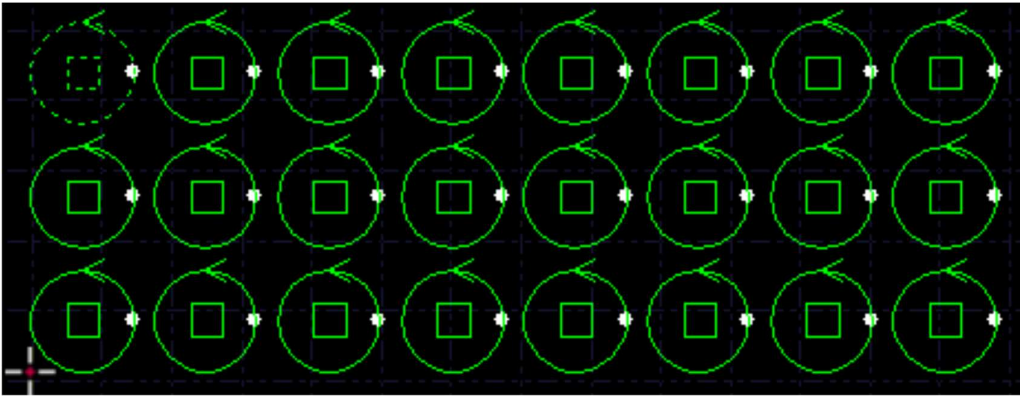


Array

Click under Array drop down menu will prompt the below page:

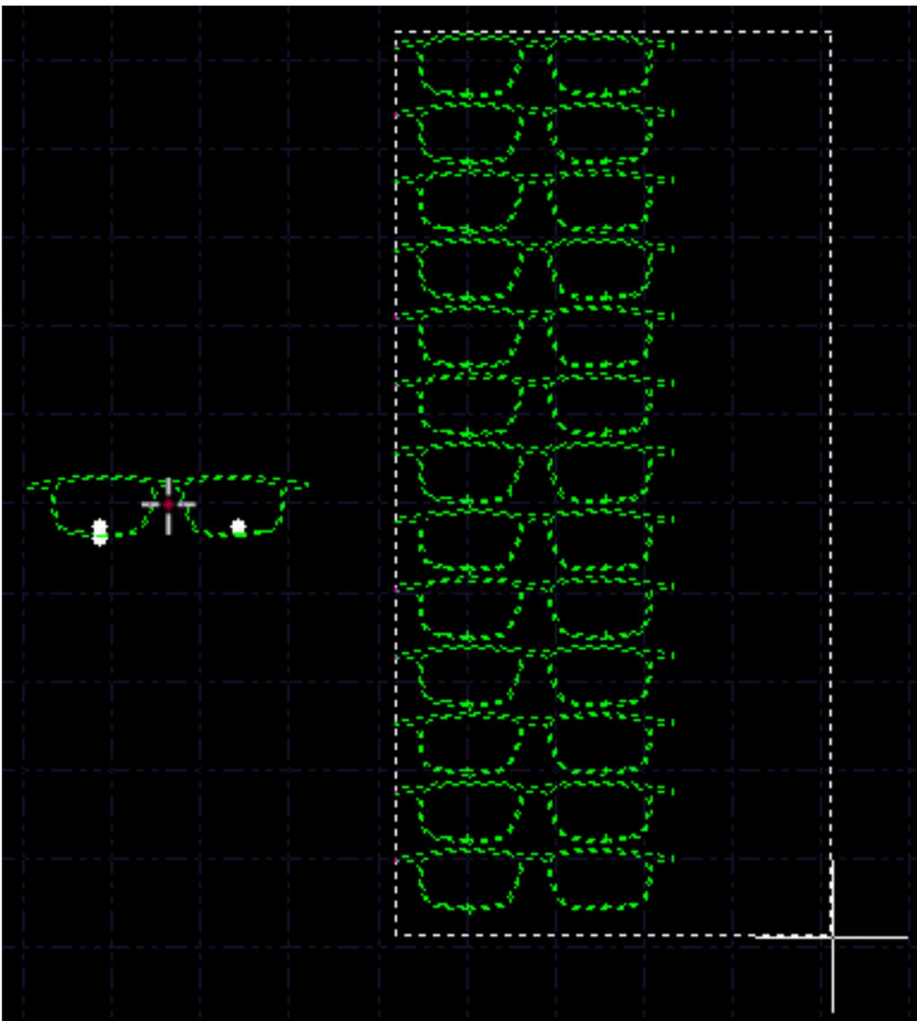


Set the lines and columns of the array will duplicate the selected graphic.



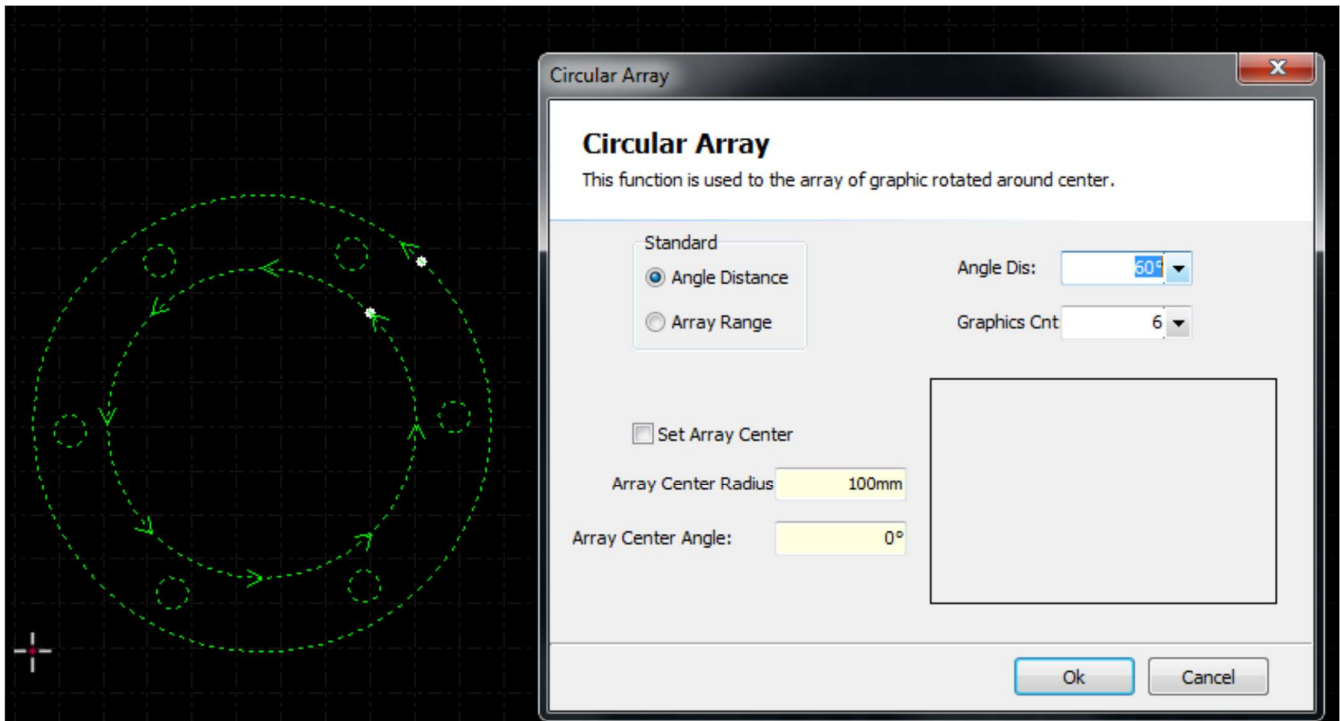
## Manual Array:

Select '**Manual Array**', set the line space and column space, drag the cursor will duplicate the selected graphic.



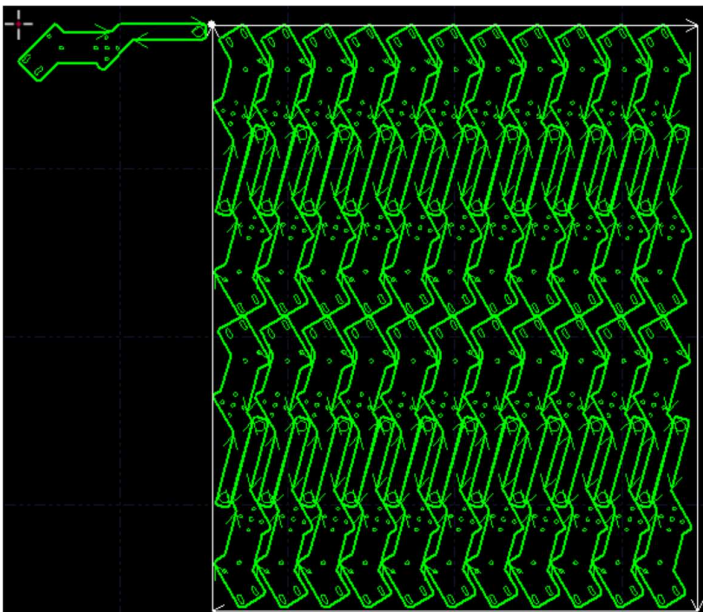
## Circular Array:

This pattern will duplicate the graphics in a center and create a circular layout.



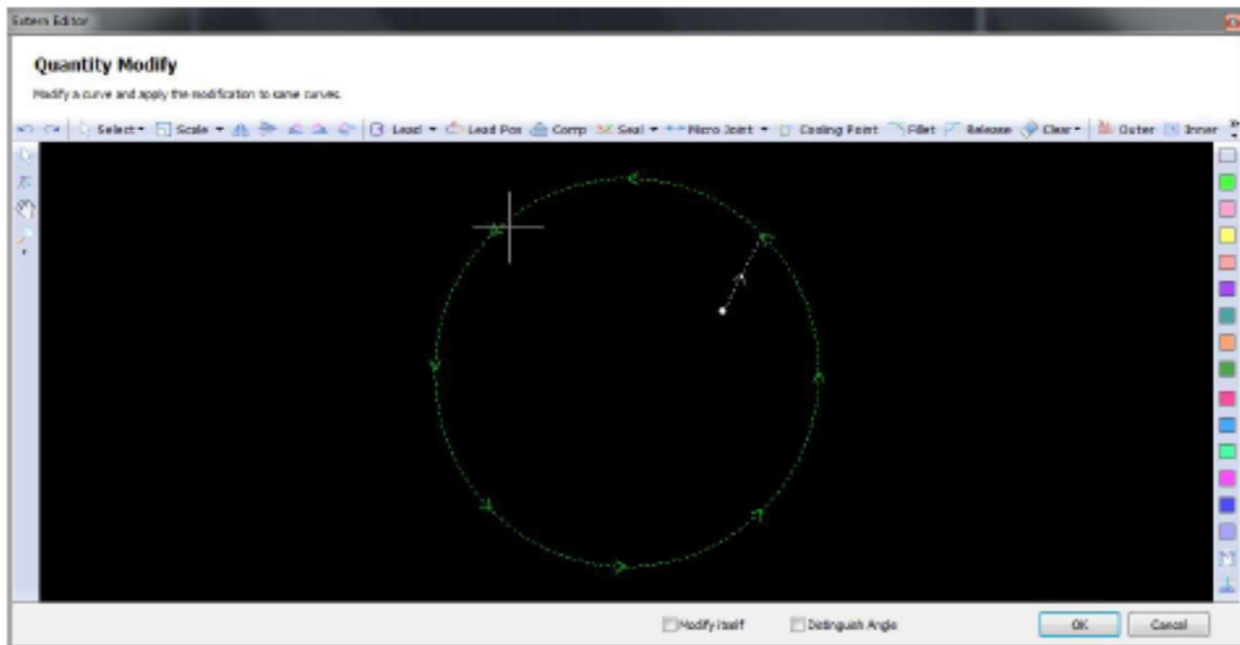
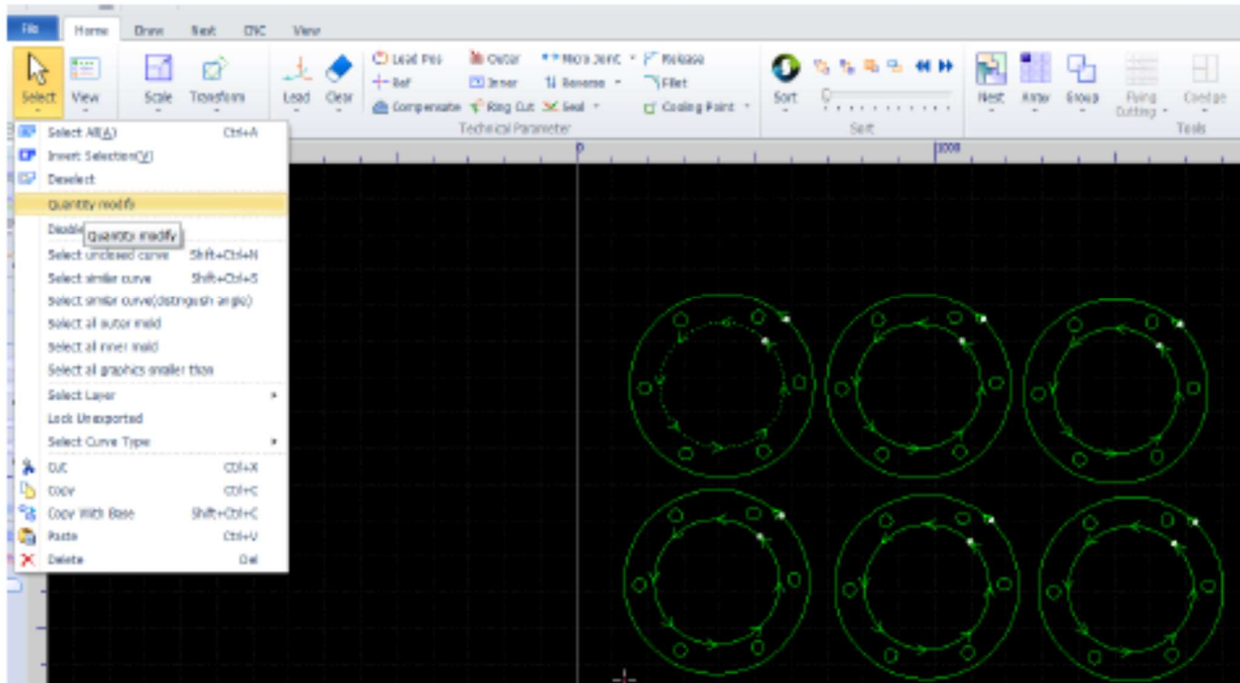
## Full Fill Function:

This pattern is used to duplicate the graphic and cover the whole plate by pre-set plate dimension.



## Quantity Modify:


Select the graphic and click **Quantity modify** in Home menu will open the quantity modify window, if you set lead line to the graphic, it will apply to the graphics same with the current graphic.

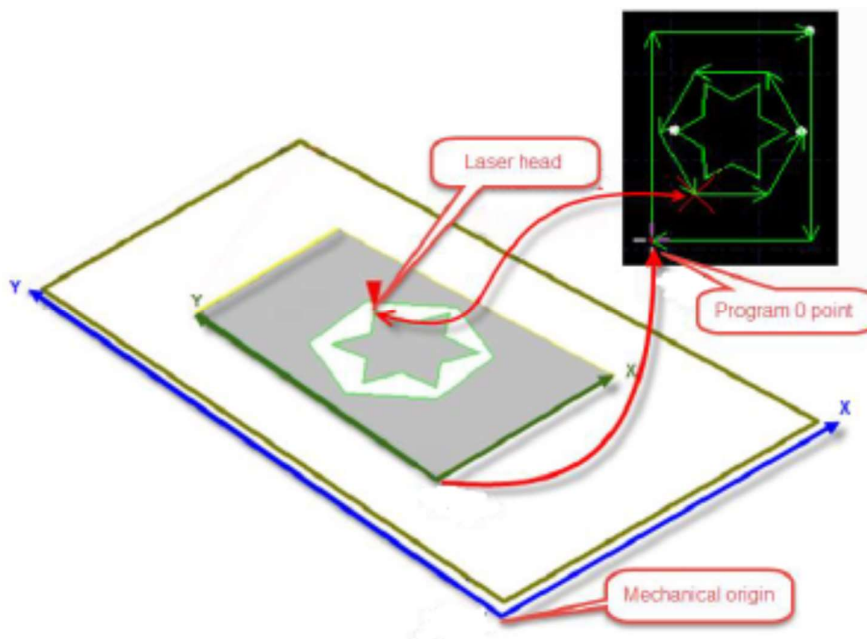


## Machining Control:

CypCut integrates CAD and CAM functions, all operations including edit file and the setting of parameters can be done in the office or your own computer. Then you can open the file on machine for processing directly.

## Coordinate System:

Modeling coordinate designing graphic not relevant with the machine, zero point marked by . The coordinate referred in machining process and machine position are shown below:



Click  in console will display the laser head position correspond with graphic.

CypCut defines coordinates with same rules no matter what mechanism applied. Stand front of the laser head, laser head towards right is X+ direction, towards back is Y+ direction which means the left bottom is the minimum coordinate.

## Program Coordinate System

Mechanical coordinate is consistent, CypCut also adopts workpiece coordinate. Workpiece coordinate X/Y direction same with

the mechanical coordinate system, only 0 point different and called **program 0 point**. Program coordinate system is divided into floating coordinate system and workpiece coordinate system.

Click the button above the console panel you can select 'Floating coordinate', 'Workpiece coordinate' or 'external coordinate'.

**Floating coordinates used in cutting samples or small quantity parts. Laser head will start machining from current position.**

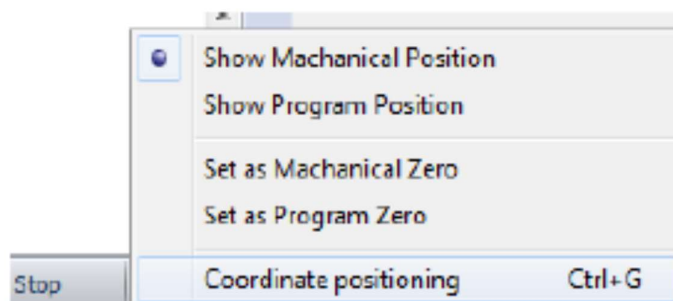
If select workpiece coordinate, the zero point is manually set by users. Workpiece coordinate applied for large quantity production. This will assure machining starts from same position on the machine every time.

Click the status button

at bottom

screen.

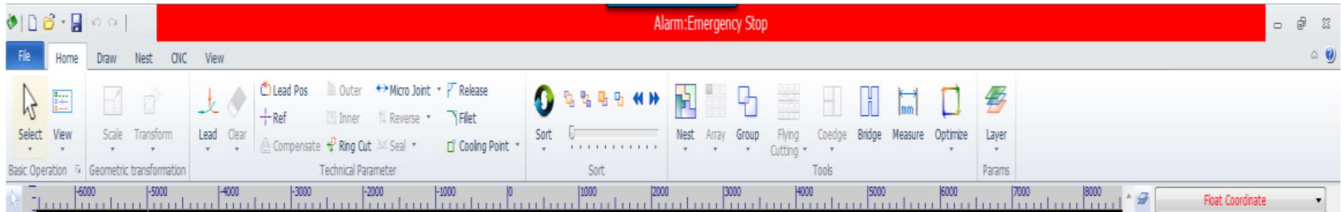
You can select to display



mechanical coordinate or program coordinate and specify the zero point of the coordinate. Select 'coordinate positioning' will locate the cutting head to the specified coordinate position.

## Alarm Information:

CypCut monitors all components when machine running. Once monitored an alarm will stop the machining and display the alarm message in red title. Motionfunction will be disabled until the alarm removed. Check the alarm source and remove the alarm then resume the machining. The alarm title shown as below:



- The 'Alarm' window at the bottom of the screen also displays the alarm message. After removal of the alarm source the alarm title will disappear but alarm message in alarm window is recorded.
- Double click 'System' window can check all history records and software events.
- Besides alarm CypCut will display the warning, notice and important message in different color once monitored abnormal process. These messages will not stop the machine but still suggest notice these information and take precautions in advance.
- The alarm can be automatically or manually removed. In 'Layer-Global parameter' window, at the right bottom there is option 'all alarm need reset manually'.

Below are restrictions once alarm activated:

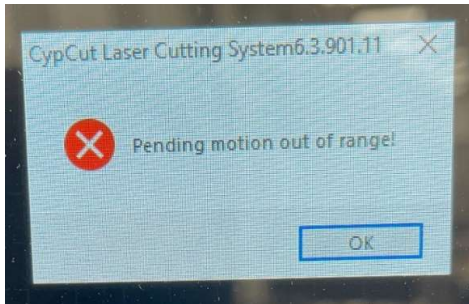
- Disable servo when emergency stop alarm activated (prevent accident motion)
- Disable X/Y motion functions when BCS100 alarm detected (under this status, Z axis condition unknown, it might be collision if X/Y move)
- Disable XYZ motion function when emergency stop alarm activated (in complete stop status)

'Move need confirm when BCS100 alarm' .

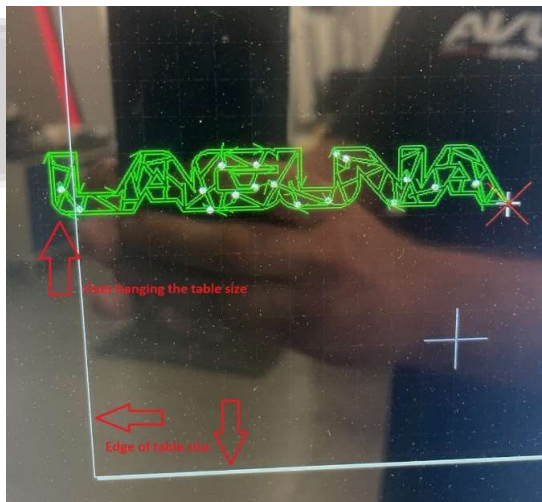
## Motion out of Range

File is trying to move out of useable range:

- 1) If you get this alarm, here are a few things to check.



- 2) Make sure the size of your file can fit in the table size. Ex: 5x10 work surface cannot cut an 11-foot part. Also, your zero point (Origin) may be too close to the edge so your file may be overhanging the boundaries. Once you hit "Frame" it will move the file to reference where the head is at. Example below.



- 3) If your file is sized correctly, your origin is correct and within the table size, you may have a random object outside of the table size. Try hitting "CTRL+A" to highlight everything and delete it. Import the file again and see if you're good.

**IF NOT!** Do the following: Highlight your file > CTRL+C (COPY) > Delete it > CTRL+A (Select all) > Delete it > CTRL+V (Paste).

## Soft Limit Protection:

CypCut provides software limit function. You can enable this function

Soft limit protection in console panel.


When the system detect motion area will exceed the preset limit, it will prompt message box to warn users and stop sending motion command to prevent collision.

Check the graphic one the drawing board make sure it's within the white frame.

System will monitor the current position in real time and stop the motor function once detected exceed the soft limit.

Notice: Soft limit protection relies on correct coordinates. Therefore, every time after change the machine config or system abnormal shut down happens users must execute return origin to correct coordinates.

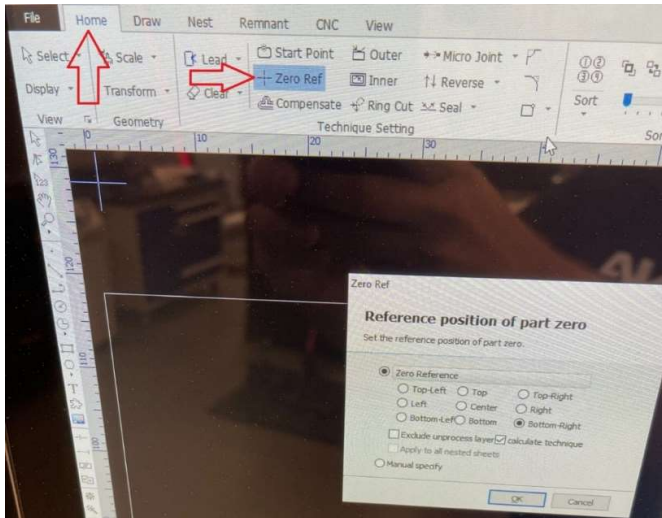
## Frame Function:

Click  Frame laser head will move along the outline of the workpiece in a rectangle frame to help users identify the machining position and workpiece dimension on the plate. Frame speed is set in 'Layer-global parameter-frame speed'.

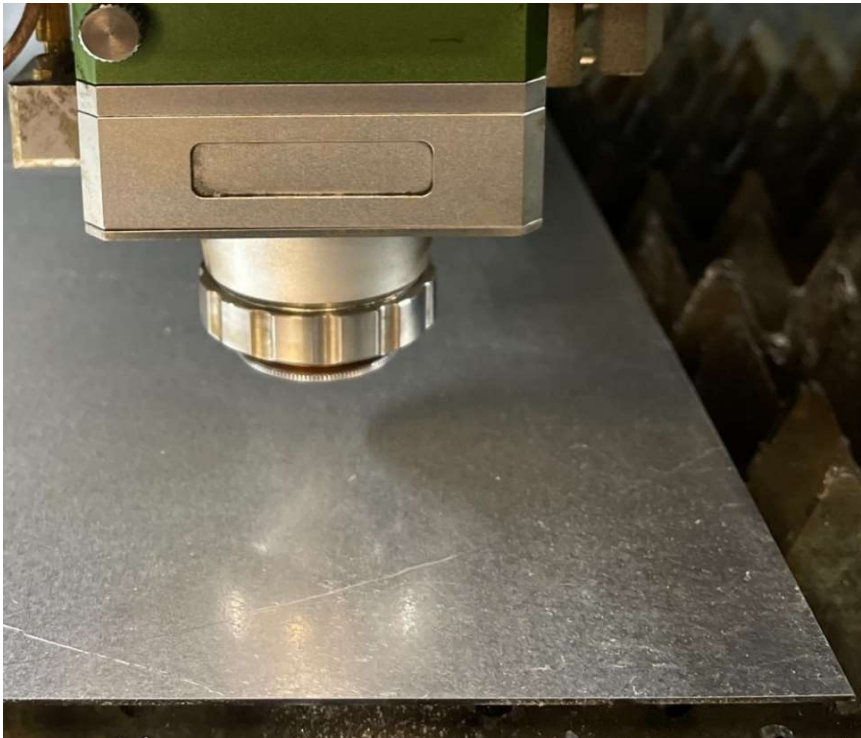
Notice: If the plate not up-right put on the machine bed and executed seek-edge operation, frame direction is also not up-right.

## Edge Finding Function: Squaring the software to material

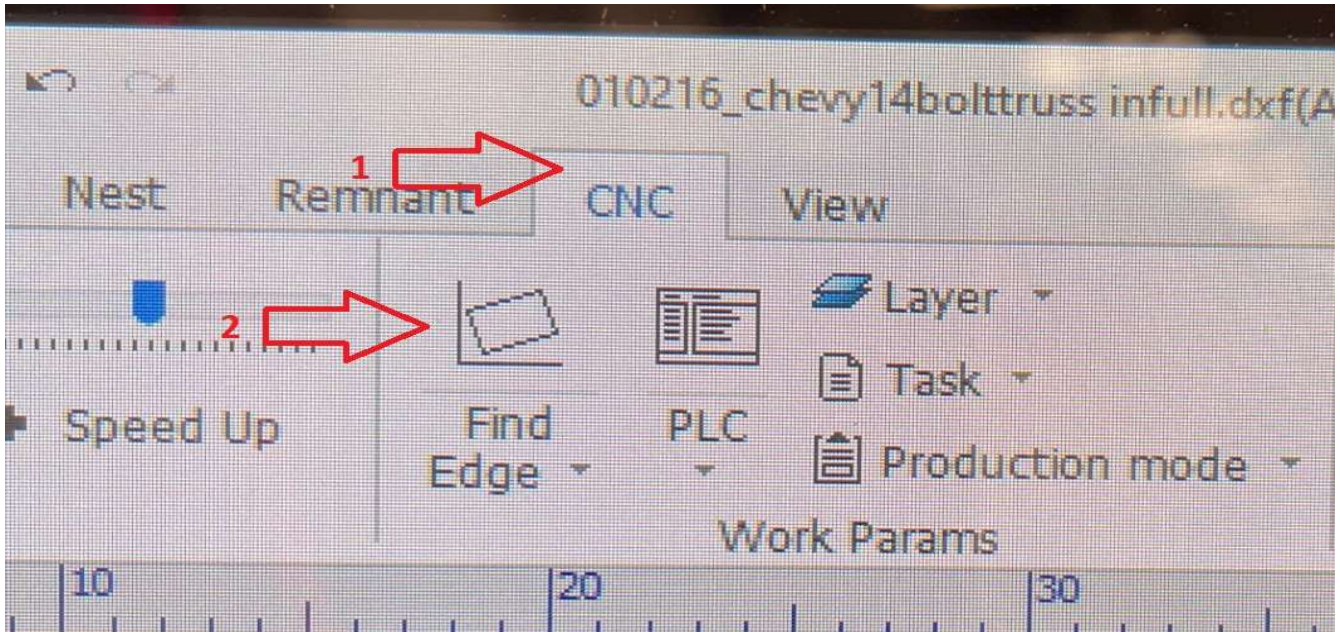
1. First you need to know your zero reference. If you have it set to bottom right, then you will need to start at the bottom right of your material.



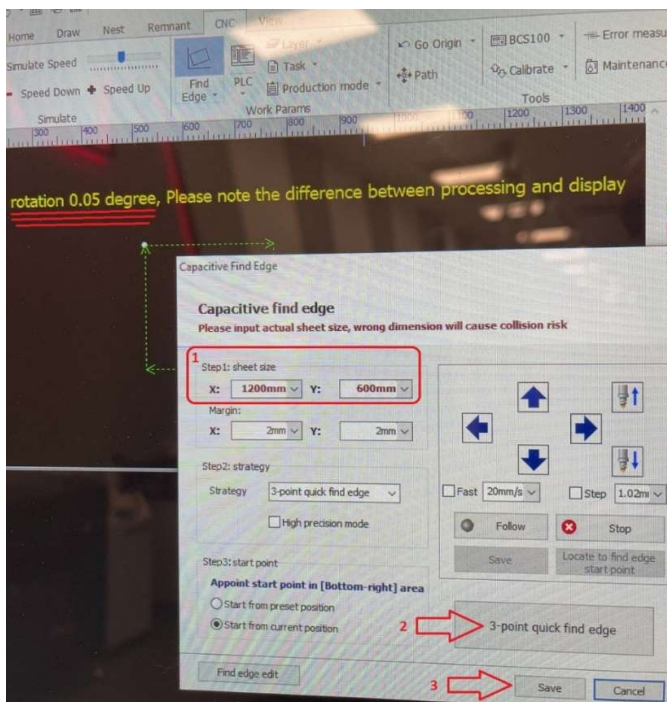
- 2) Bring your head to the corner of your sheet of material. (Based off your zero reference) Make sure the head is a few inches into the material.



3) Go to the “CNC” tab the select the icon above “Find Edge”




4) Input the size of your sheet for X and Y. Then select “3 point quick find edge” once you select it, the head will move down to sense the material and measure to the edge. After it is done, it will return to the corner of the material so set your start point and hit “SAVE” (The rotation will appear at the top of your software)

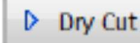


## Dry Cut:

If you need to modify the parameter in the machining process must pause the

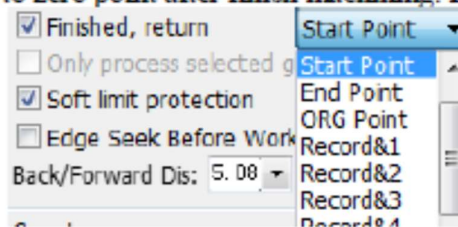
process then click the  button. Users can pause the machining and modify the parameters in layer window, settings will take effect after resume the process.

Supported version: CypCut V731 and above.


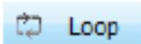
Click  laser head will move along the actual cutting path with same speed and acceleration but laser, gas and follow function turning off. Meanwhile other functions like pause, resume, forward, backward and break point information all same with the actual cutting. Dry run can used to check the machining process without cutting the plate.

If you want to open follow function in 'Dry run', select  Enable follow in dry cut in layer parameter window-global parameter.


By default setting, laser head will return to zero point after finish machining. If you want laser head return to a specified position you can set on console panel including zero point, start point, end point, origin and mark point. If

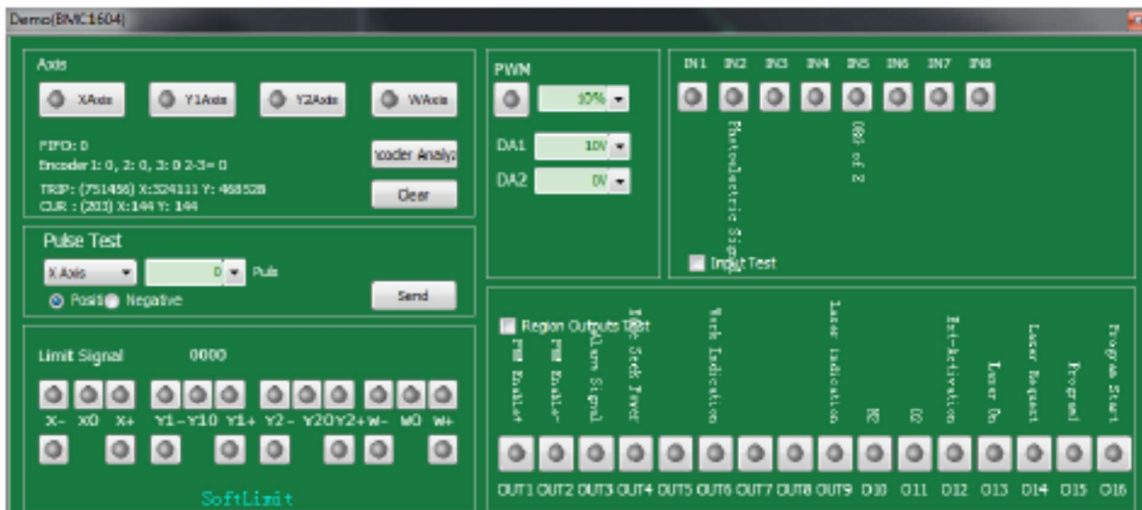


Finished, return not selected, laser head will stand still at where finish the machining. If you are using 'floating coordinate', it's recommended that select 'zero point'. If you want laser head return to a mark point, select 'record&'.

After a machining process completed it will add up 1 on 'Piece' at console panel. When the 'Piece' reach the 'Plan' times it will prompt message to remind user. You can set in  including target machining times and laser head actions after machining process completed. If you need to cycle the machining click  and finish the setting.

## Diagnosis Window:

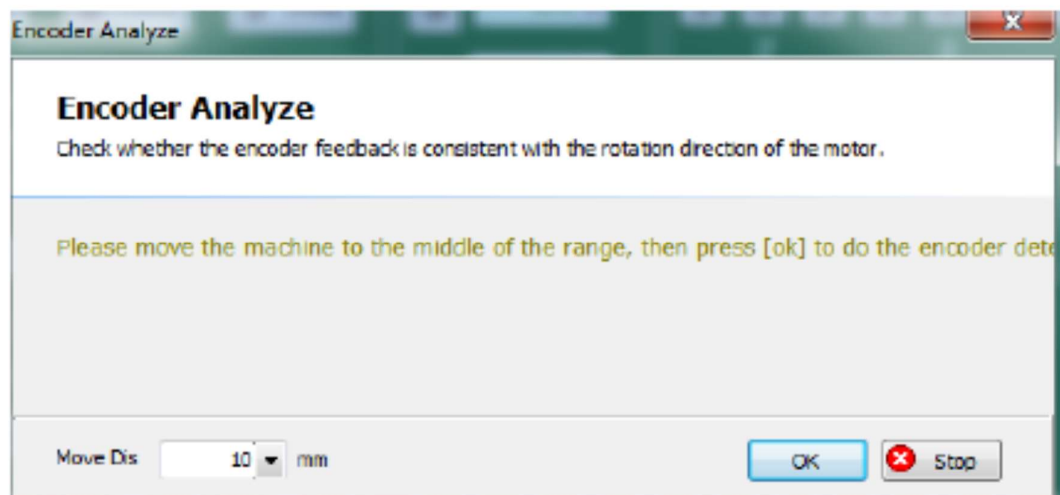
Users can click  **Diagnosis** to check all signal status in machining process to debug.



It also monitors signals of each axis and encoder feedback. Users can send pulses to any of these 4 axis and check if pulse equivalent set right by comparing encoder

feedback. Limit signal activated means laser head hit limit switch or other situation trigger the limit sensor. PWM monitors laser status of turning on or off. It also monitors signal terminal status of 15 inputs and 20 outputs.

'Encoder analysis' can check if encoder feedback same with the motor rotation. Some functions require consistency of the encoder feedback and motor rotation.



- **CypNest: Nesting and Pre-production Software:**

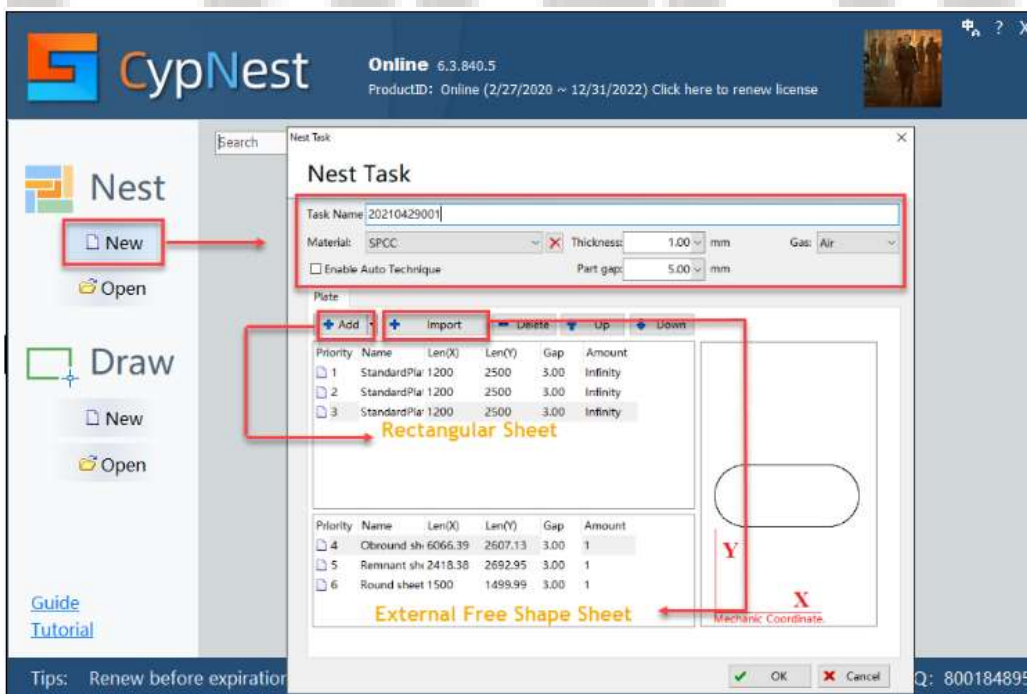
**Note: Do Not remove the Dongle for the license.**

CypNest is designed for providing nesting solutions for laser cutting industry, especially for Friendless HypCut and CypCut users to meet the automation requirements of drawing processing, nesting, tool path generation and remote task transmission etc.

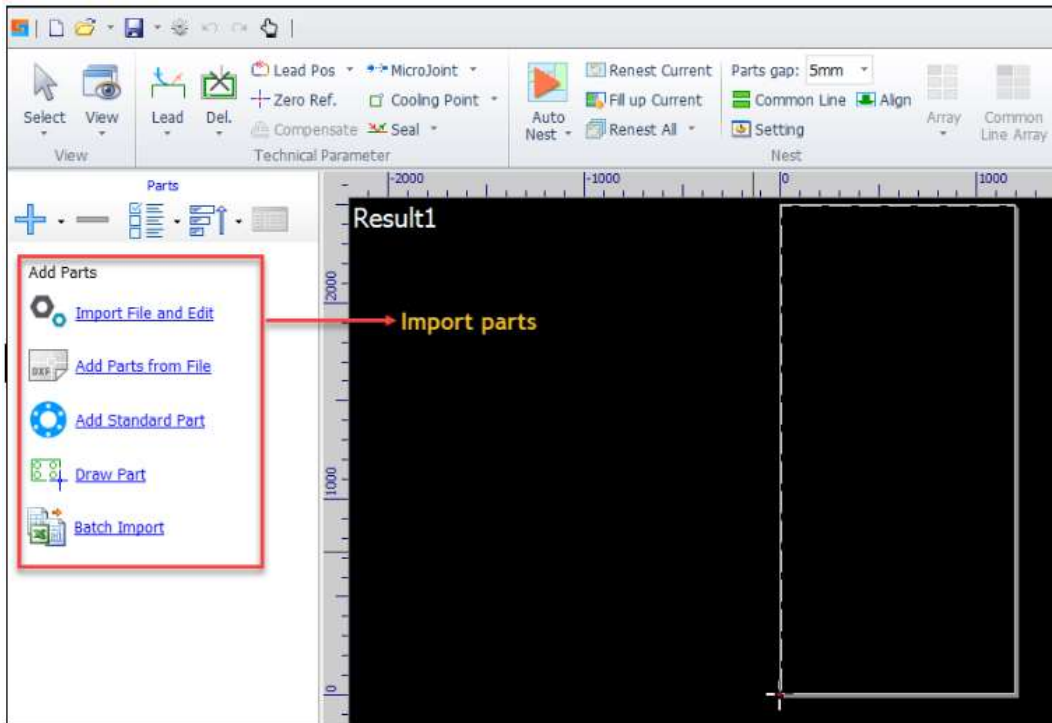
### CypNest Quick Start Guide:

Full CypNest reference below the Quick Start Guide.

- Create **New** task and finish some basic settings.
- Click **OK** enter to nest workspace.

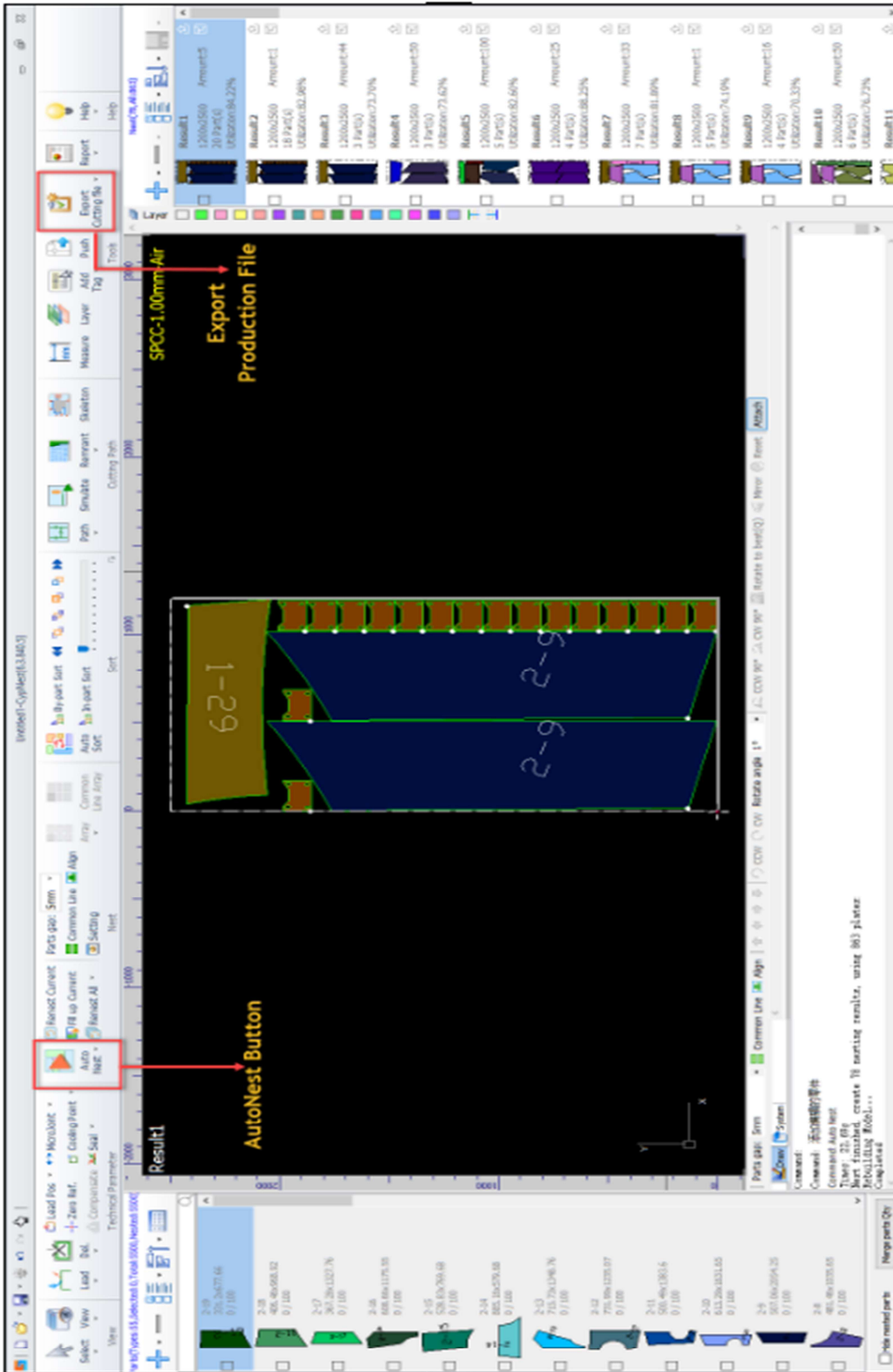


- **Import** part drawing or **create** part in CypNest.



- *Import File and Edit*: import parts drawing and modify drawing error, this is the recommended entrance for beginners.
- *Add Parts from File*: import parts drawing directly to parts library. Invalid parts drawing will be rejected by program.
- *Add Standard Part*: create parts from standard shapes.
- *Draw Part*: draw a part in CypNest with integrated CAD tools.
- *Batch Import*: import parts file by excel table. The excel template is under C:\Program Files (x86)\Friendess\CypNest\BatchImport.

• Export finished nesting file for production.



## CypNest, Full Reference:



## Create Nest Task

Create a nest job, config sheet material and technique setup.

Click **New** on CypNest main page will open Nest Task window. Config nest task of material, thickness, gas and part gap which can modify later.

Create rectangular sheet with X/Y length in regard with machine coordinate or import external file of free shape sheet.

The screenshot shows the CypNest software interface. The main window is titled 'Nest Task' and contains the following elements:

- Task Name:** 20210429001
- Material:** SPCC
- Thickness:** 1.00 mm
- Gas:** Air
- Part gap:** 5.00 mm
- Enable Auto Technique:** (unchecked)

Below the configuration fields is a 'Plate' section with a table of parts:

Priority	Name	Len(X)	Len(Y)	Gap	Amount
1	StandardPla	1200	2500	3.00	Infinity
2	StandardPla	1200	2500	3.00	Infinity
3	StandardPla	1200	2500	3.00	Infinity

Below the table are two options for creating a sheet:

- Rectangular Sheet:** Indicated by a red arrow pointing to the 'Add' button.
- External Free Shape Sheet:** Indicated by a red arrow pointing to the 'Import' button.

On the right side of the 'Plate' section, there is a diagram of a sheet with a rounded rectangular shape. The diagram is labeled 'Mechanic Coordinates' with 'Y' and 'X' axes.

The interface also shows a sidebar with 'Nest' and 'Draw' sections, each with 'New' and 'Open' buttons. The 'Nest' section is highlighted with a red box and an arrow pointing to the 'New' button. The 'Draw' section also has 'New' and 'Open' buttons.

At the bottom of the window, there is a 'Tips: Renew before expiration' message and a 'Q: 800184895' contact number.

Enable **Auto Technique** if needed. Click each technique entry to enable it and set parameters. The technique data will be saved to database and reused automatically to nest task of same group of material, thickness and gas.

Nest Task

Task Name: 20210429001

Material: SPCC Thickness: 2.00 mm Gas: Oxygen

Enable Auto Technique Part gap: 5.00 mm

Plate Auto Technique

- Lead
- Compensation
- CornerTech
- MicroJoint
- Cooling Point
- Auto Gap/Overcut

Auto lead  Distinguish inner and outer contour

Lead in

Type: Line Length: 3mm

Angle: 90° Radius: 1mm

Add hole at start point Hole radius: 0.5mm

Lead Out

Type: No Length: 3mm

Angle: 30° Radius: 1mm

Lead Position

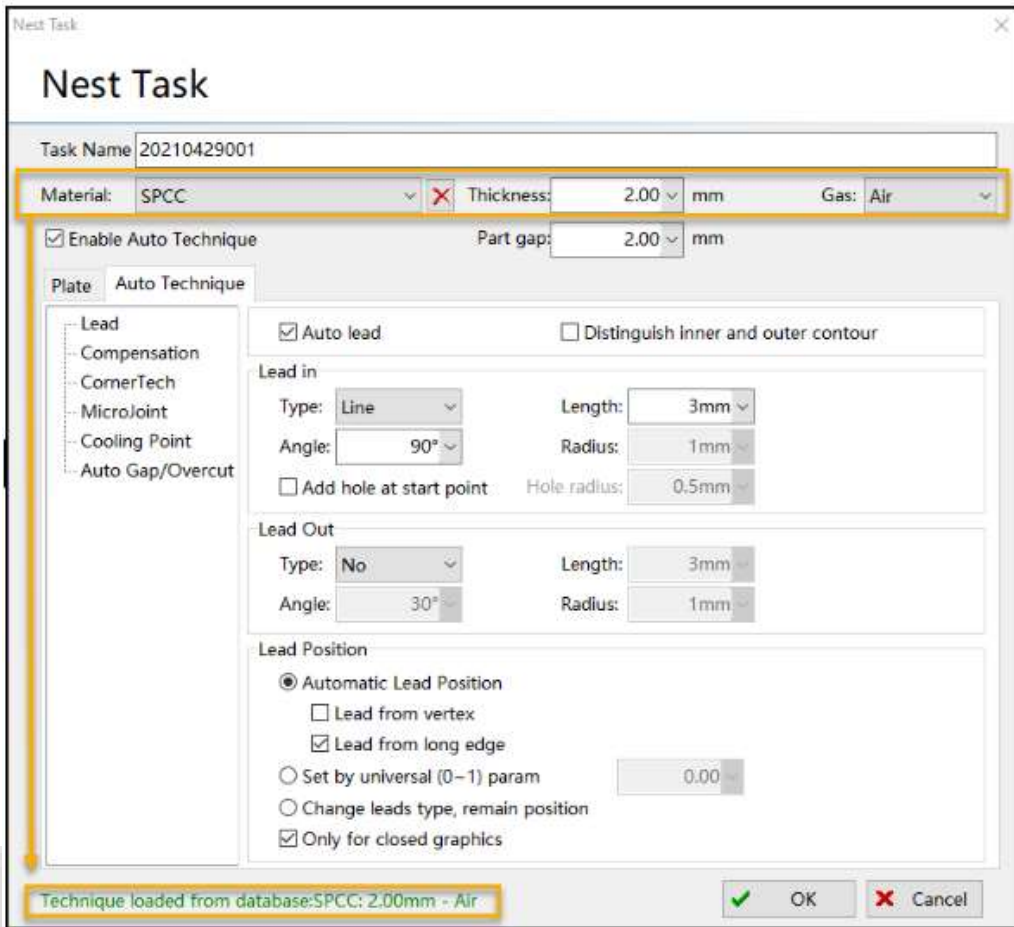
Automatic Lead Position

- Lead from vertex
- Lead from long edge
- Set by universal (0-1) param 0.00
- Change leads type, remain position
- Only for closed graphics

No matched technique in database. Click OK to save.

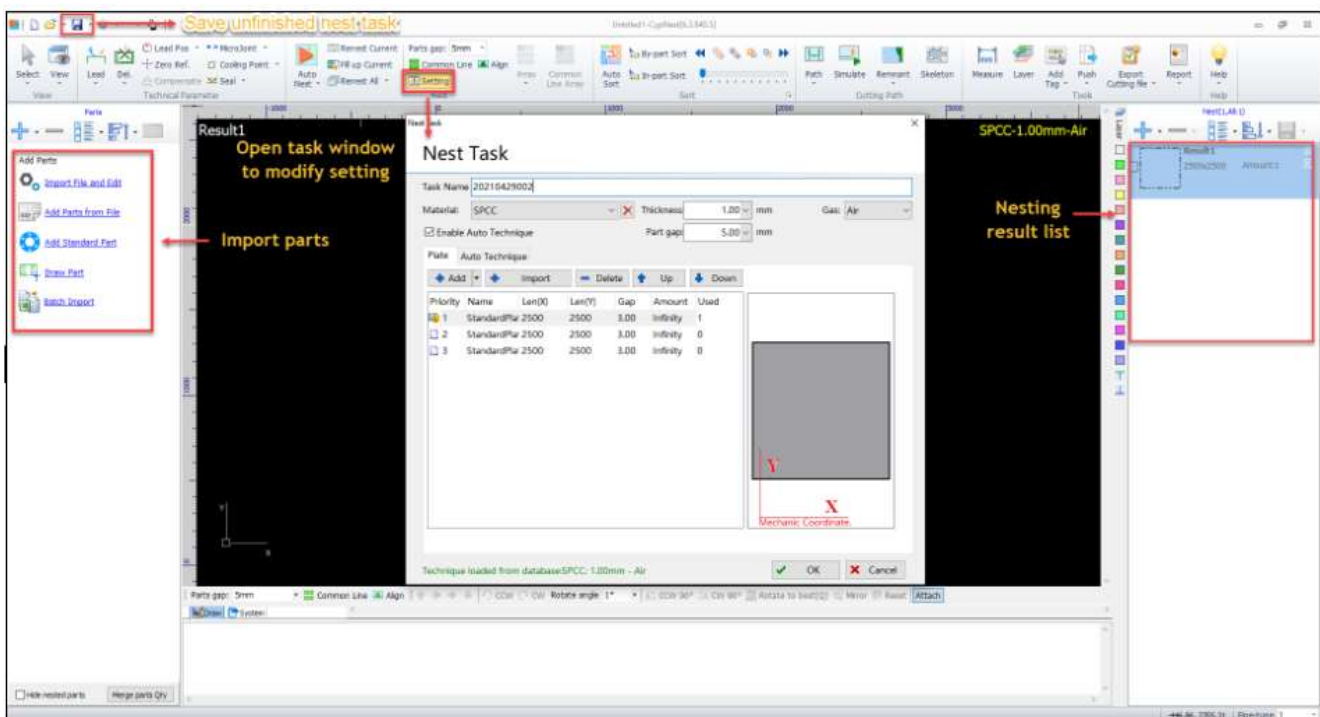
OK Cancel

**Saved auto technique applied to other nest tasks of same material, thickness and gas automatically.**

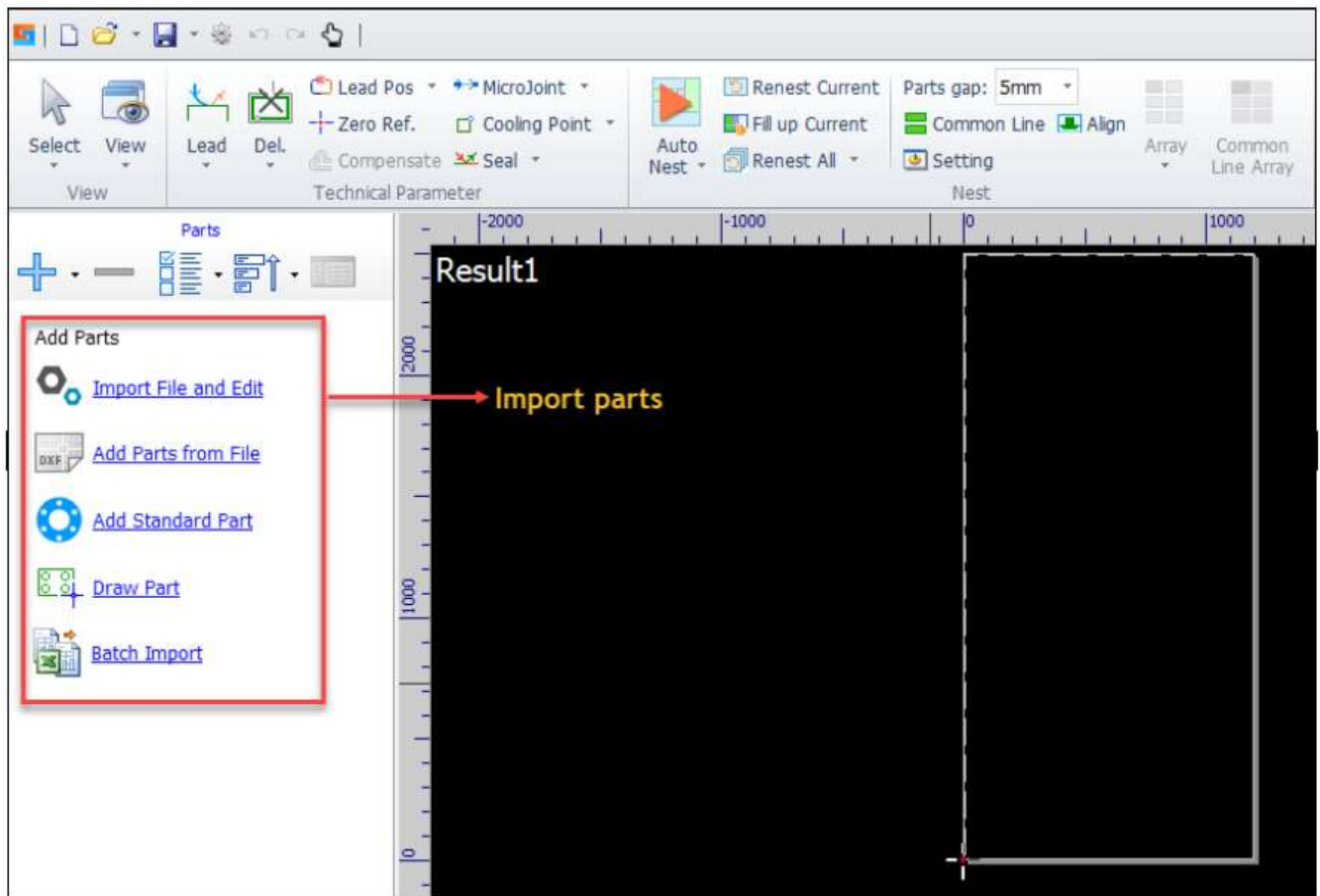


Click OK in nest task will go to nest workspace where to import part drawing and operate nesting. The unfinished nesting task which contains

the whole nest workspace of parts and nesting as \*.nsd file for editing later.

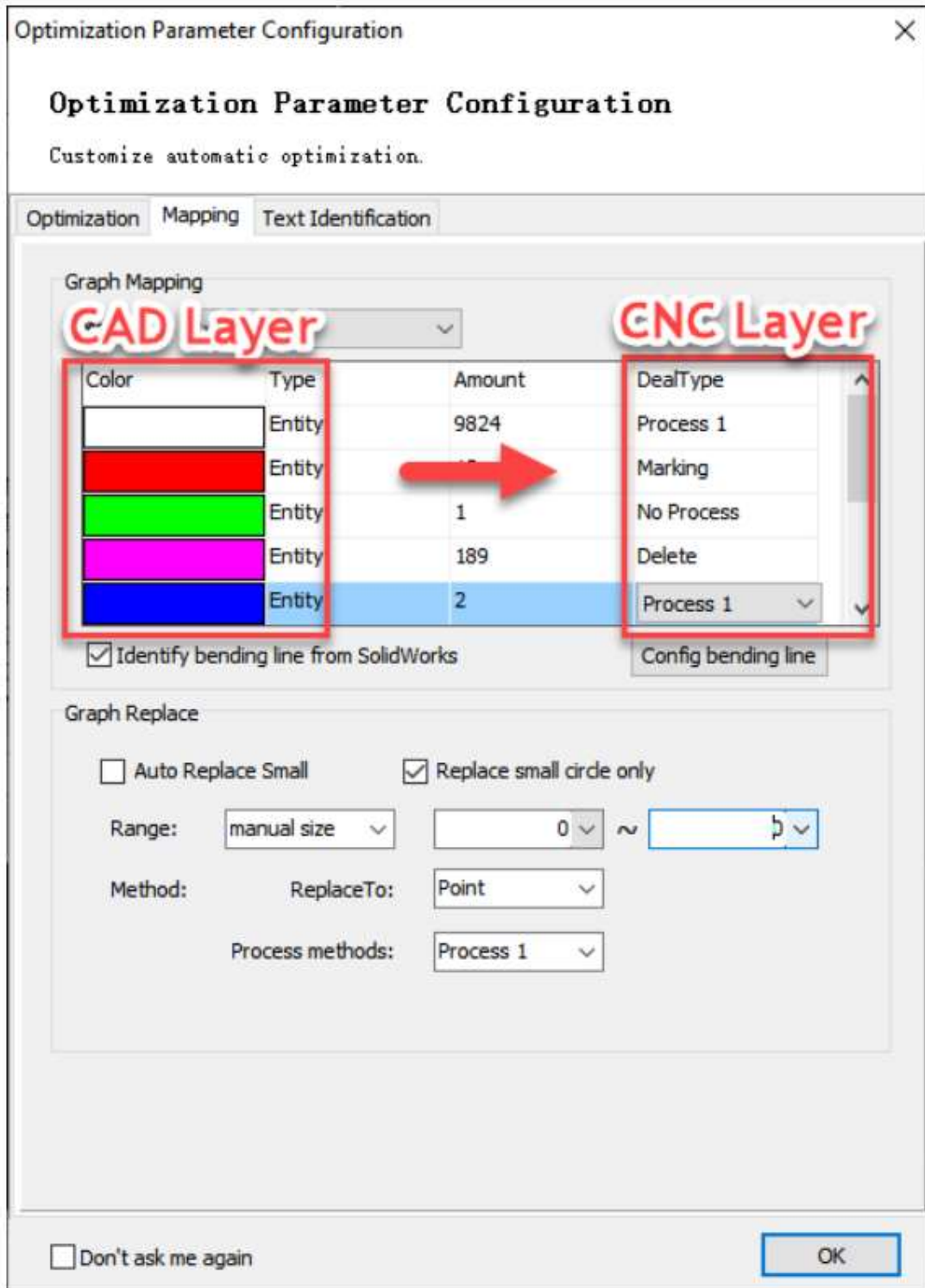


**Import part entrance:** to import or create parts from a different file location.

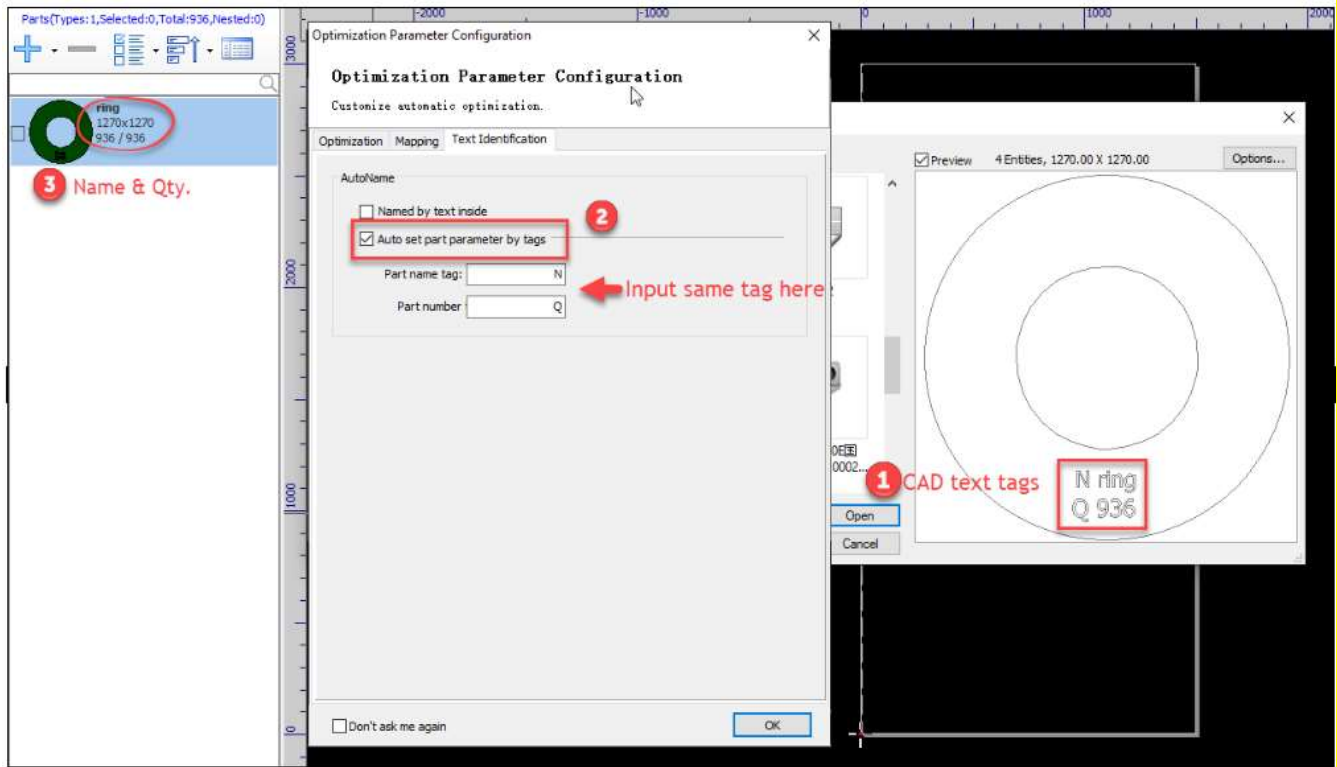


- **Import File and Edit:** This is recommended entrance to import parts file for beginners; invalid parts drawing must be corrected before imported into parts library.
- **Add Parts from File ;** Import parts drawing directly to parts library. Do notice that parts drawing cannot be
- **Add Standard Part:** Create parts from standard shapes.
- **Draw Part:** Draw a part via integrated CAD tools.
- **Batch Import:** Import parts file by excel table. The excel template is under C:\Program Files (x86)\Friendess\CypNest\BatchImport.

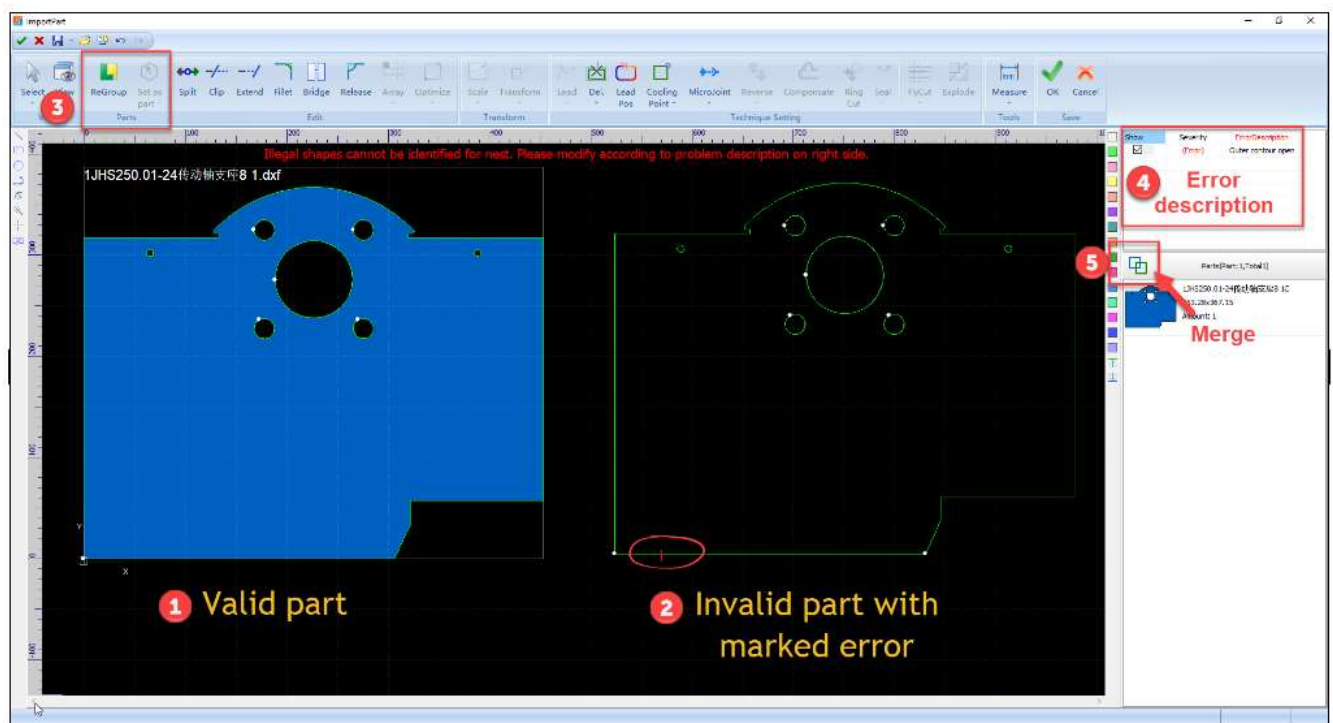
**Layer Mapping:** to differentiate CAD layers to marking, cutting, or non-process layers for CNC production via 'Optimization Config' window





**Text Identification:** to recognize text tags in CAD drawing for automatic parts naming and quantity setup in CypNest.



**Import Part editor.** Through 'Import file and edit' will open an editor window to modify drawing error which all be red marked and labeled with error description.



1. **Valid part:** the drawing with no deficiency will be identified as a valid part.
2. **Invalid part:** the drawing with deficiency like open contour and crossed lines will be red marked
3. **Error description:** explain which type the error is that helps to correct the error with suited tools.
4. **ReGroup:** after correcting the error, click (REGROUP)  to refresh the drawing for program to identify the modified drawing to valid part. Click (SET AS PART)  to deliberately set drawing with deficiency to valid part.
5. **Merge:** merge different parts of same geometry to same type in part list.

Notice: unfinished drawing in Import Part editor can be saved as \*.cpe file to resume editing. The invalid part cannot be imported to parts library.

# Technique Setting

**Auto Technique** applied to all parts automatically if function activated when create nest task. Each technique in the menu can be turned on or off separately. The technique will be saved in database and load in to nest task of same config of material, thickness and gas.

Nest Task

Task Name: 20210429001

Material: SPCC Thickness: 2.00 mm Gas: Air

Enable Auto Technique Part gap: 2.00 mm

Plate Auto Technique

- Lead
- Compensation
- CornerTech
- MicroJoint
- Cooling Point
- Auto Gap/Overcut

Auto lead  Distinguish inner and outer contour

Lead in

Type: Line Length: 3mm

Angle: 90° Radius: 1mm

Add hole at start point Hole radius: 0.5mm

Lead Out

Type: No Length: 3mm

Angle: 30° Radius: 1mm

Lead Position

Automatic Lead Position

Lead from vertex

Lead from long edge

Set by universal (0~1) param 0.00

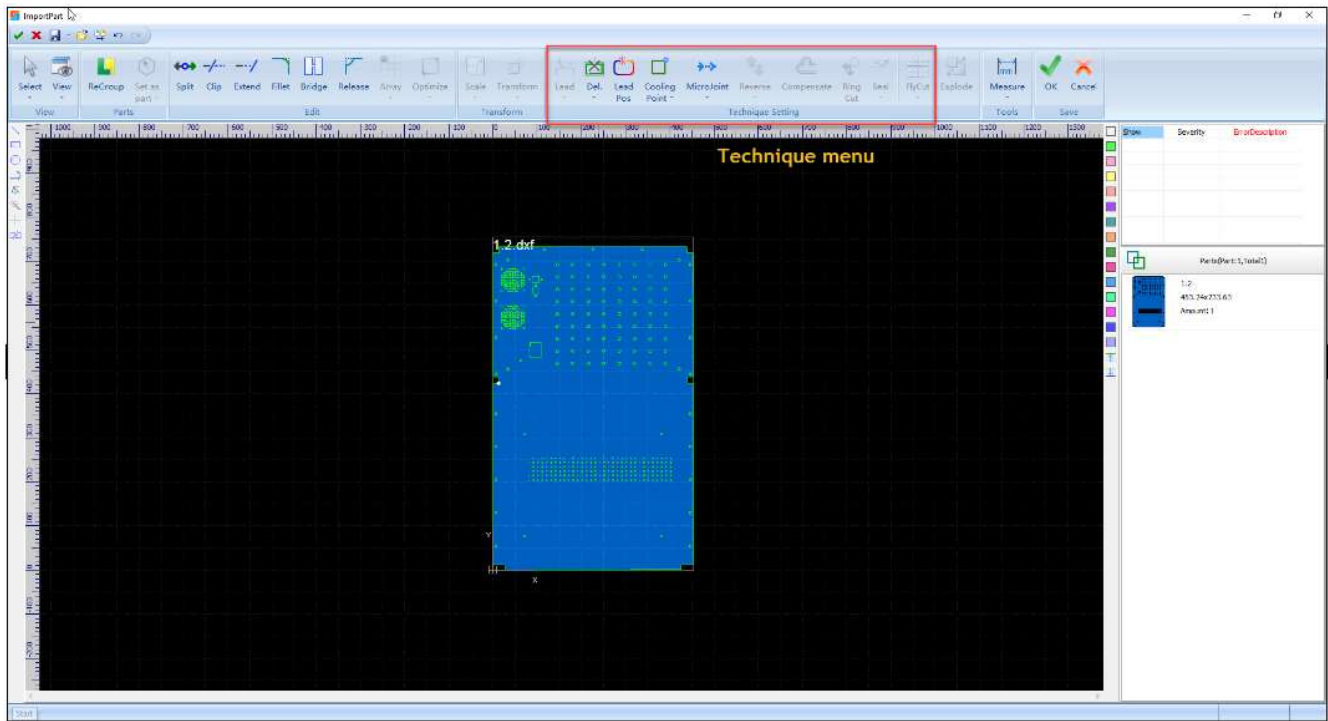
Change leads type, remain position

Only for closed graphics

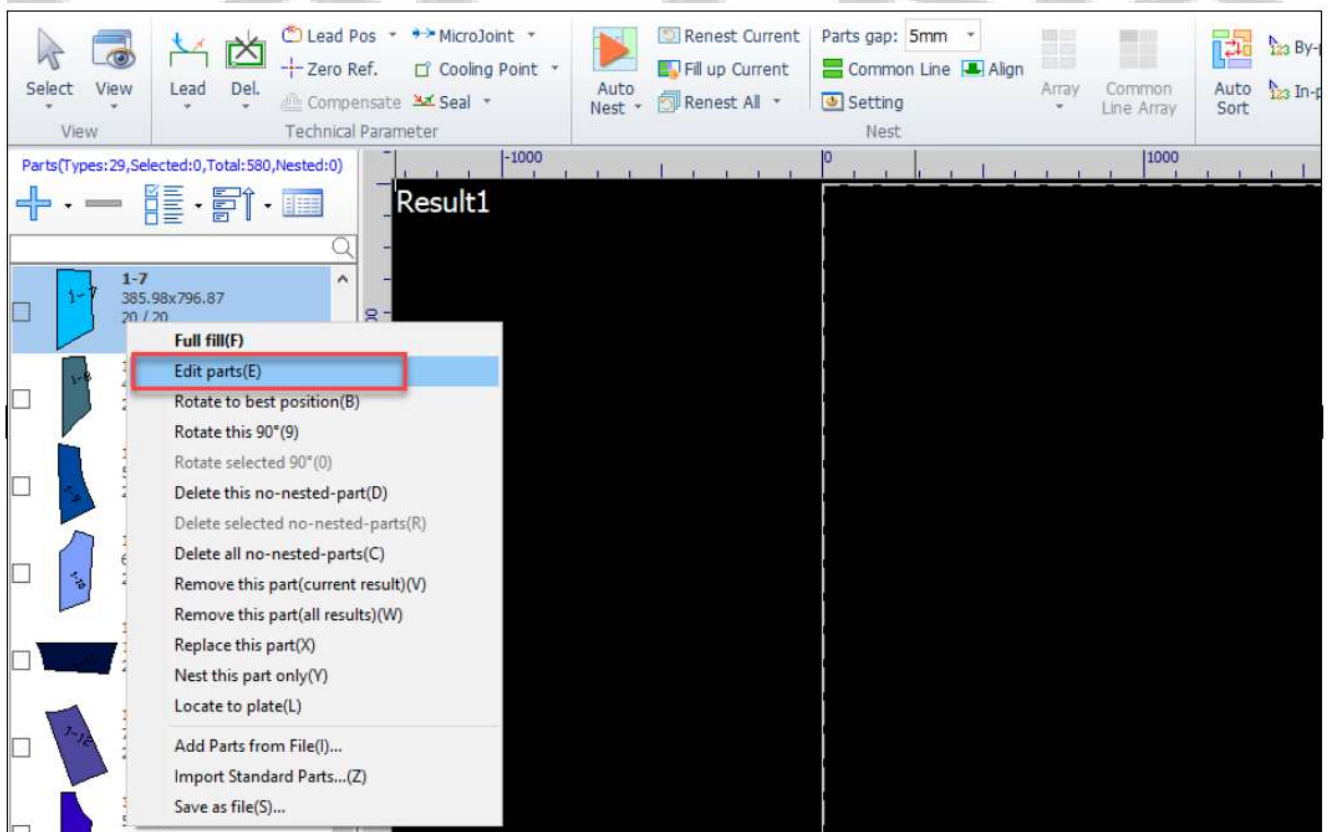
Technique loaded from database:SPCC: 2.00mm - Air

OK Cancel

The technique setting is also available in **Import Part Editor** when import part drawing



After import the part, technique setting is still available in **part editor**. You can edit the technique of part separately

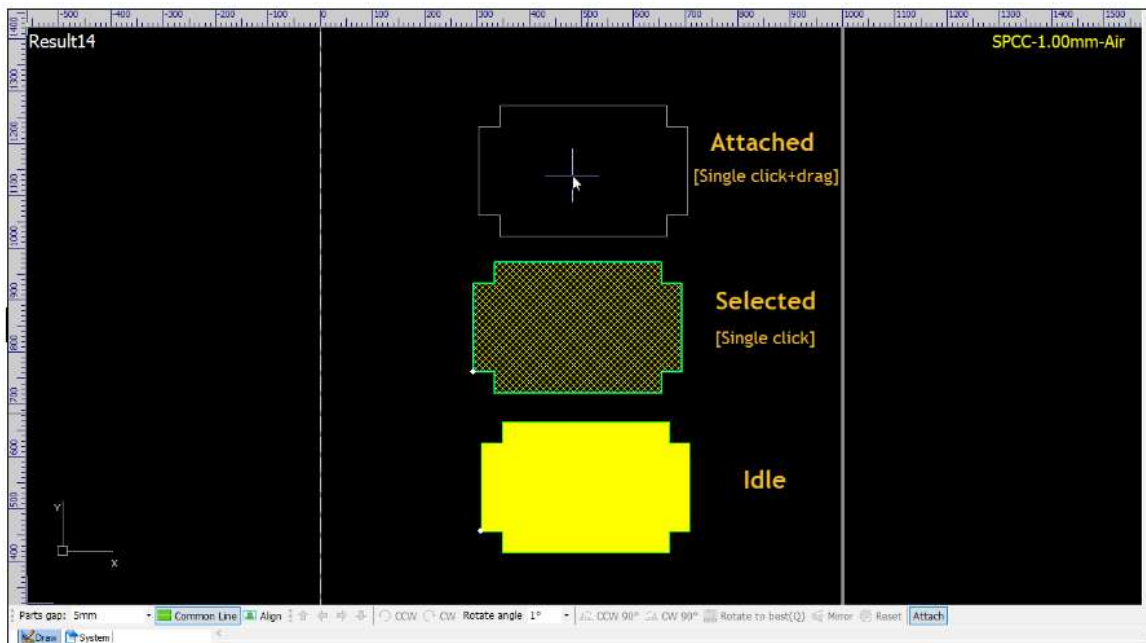


# Manual Nest

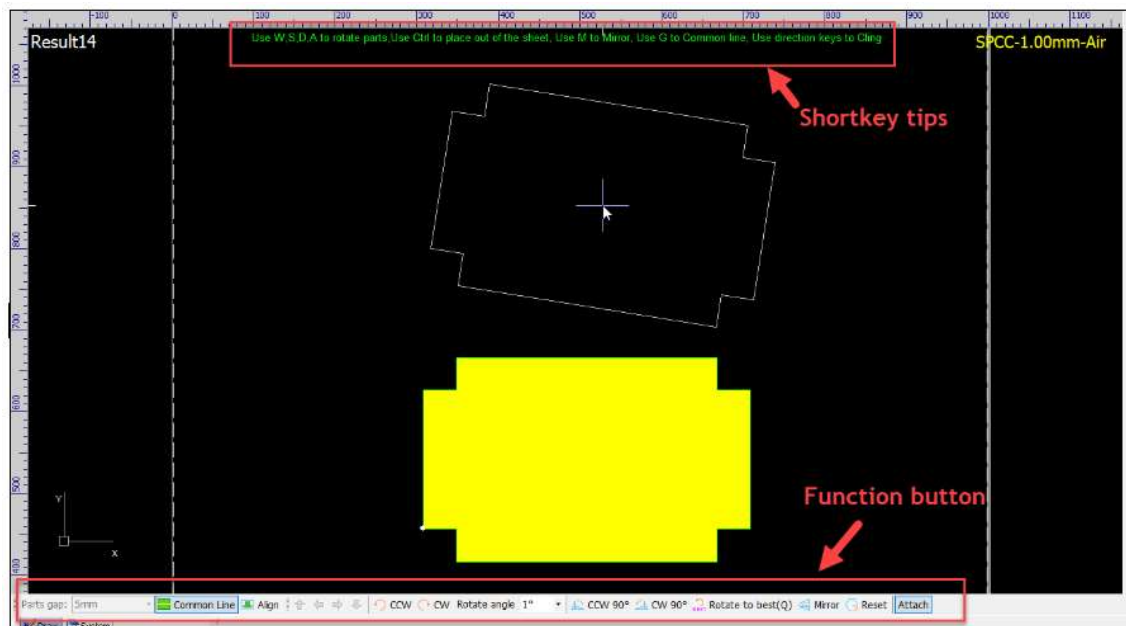
Operate parts on nesting sheet freely---automatic key point snap and optimal part placement, rotate and align parts in flexible ways, turn on/off

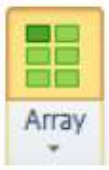
common line effect as wanted, quick array part in parametric method or press-drag style.

Three **operation status** of a part in nesting: **idle** status, **selected** and **attached** on cursor. When a part is attached on cursor, user is able to move the part in nesting sheet, and activate the function buttons of rotation, flip, align and attach etc.

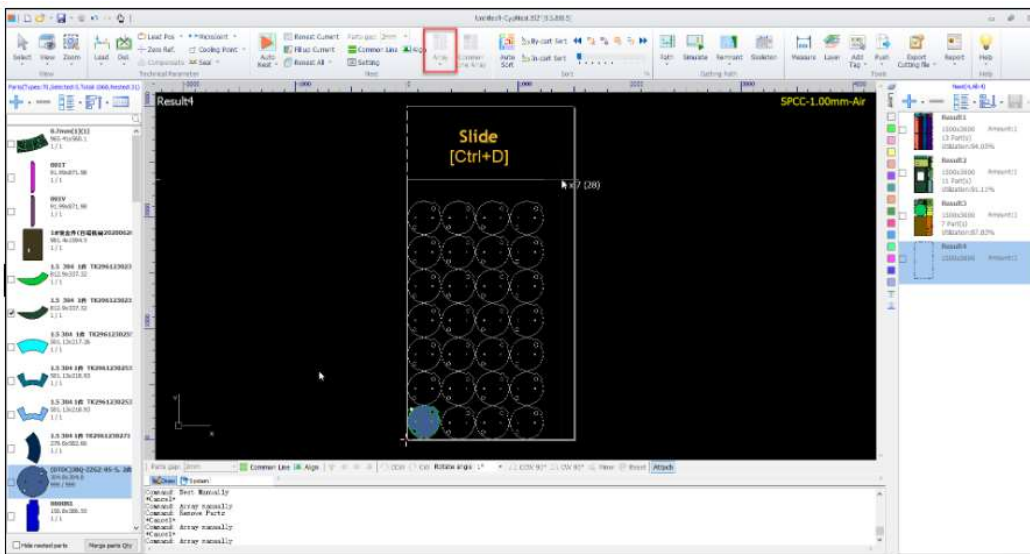


The **parts operations** are rotation, flip, attach and align etc., which can be activated by both short key and function button.

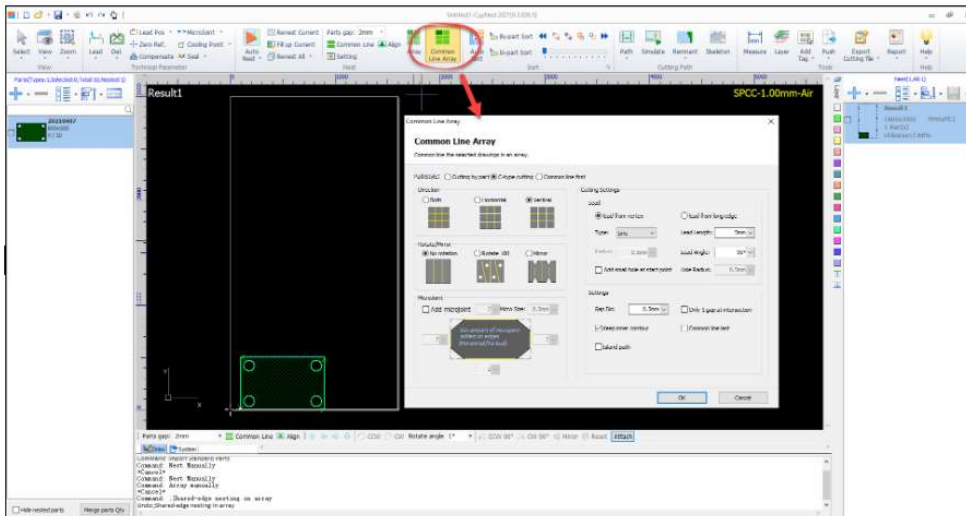




**Array [Ctrl+D]:** select a part first, click function button or short key to activate the array function meanwhile open a parametric window, then slide on the sheet to array the parts.



**Common Line Array [Ctrl+G]:** select a part first, click function button or shortcut to activate the function and meanwhile open a parametric window to setup common line toolpath, then slide on the sheet to array parts in common line style.

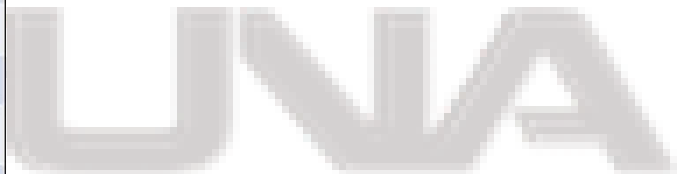


## CypNest Shortcut Keys

Open, Save, Select and Display	
Ctrl + O	Open a nest task file
Ctrl + S	Save a nest task file
Ctrl + A	Select all parts
F7	Display parts toolpath
F8	Display travel path
F9	Render parts with color
F3	View all



Ctrl + C	Copy
Ctrl + X	Cut
Ctrl + V	Paste
Delete	Delete
Ctrl + D	Quick array
Ctrl + G	Quick array in common line
W	Rotate 90° CW
S	Rotate 90° CCW
D	Rotate in minimal degree CW (Editable value)
A	Rotate in minimal degree CCW (Editable value)
Press Alt	Turn off snap function; select one part from group of common line
1	Rotate 1° CCW
2	Rotate 10° CCW
3	Rotate 30° CCW
4	Rotate 45° CCW
6	Rotate 60° CCW
9	Rotate 90° CCW
0	Reset part to original rotation
M	Vertical flip
G	Press to turn on common line effect; release to turn off common line effect
↑ ↓ ← →	Align to top/bottom/left/right



# Co-edge Toolpath

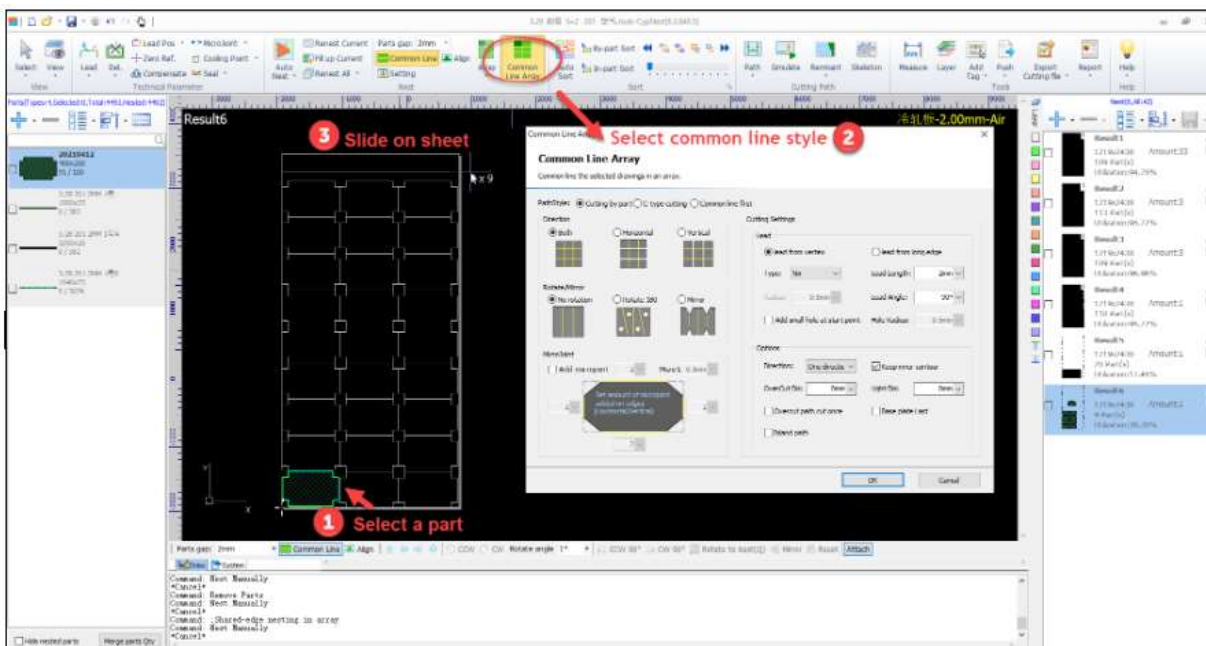
Select practical common line toolpath style to fit production need, learn how to modify the common line tool path for advanced production scenario.

There are three methods to create common-line toolpath: **Auto Nest**, **Co-edge Array** and **Manual Nest**.

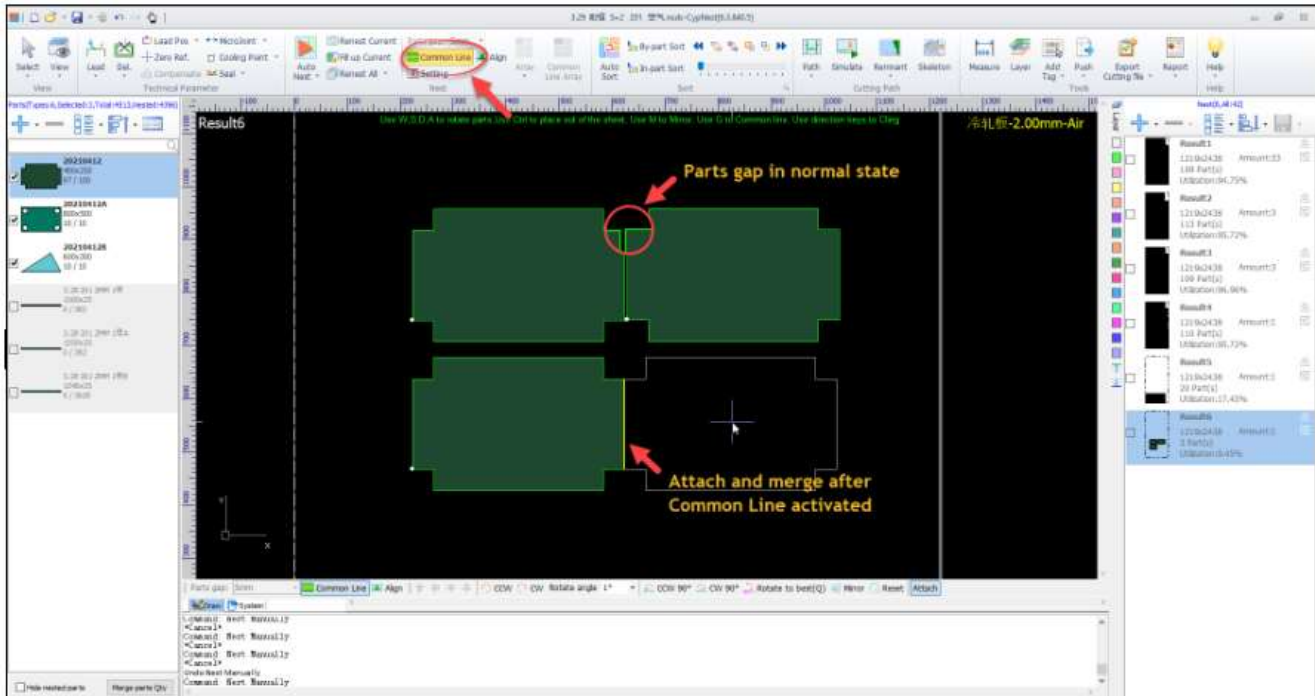
**Auto Nest:** activate common line option in Auto Nest setup window. Program will merge the parts edges that meet the user-defined conditions to common line toolpath.



**Co-edge Array:** to array the parts in specified common line toolpath.



**Manual Nest:** click function button (COMMON LINE) to activate common line effect, A yellow (COMMON LINE) button means common line effect is activated. Drag a part attach to another one, it will merge the shared edges into common line. When common line effect is not activated, the Edges between parts keep a minimal space.



**Depart** the parts of common line to separate parts

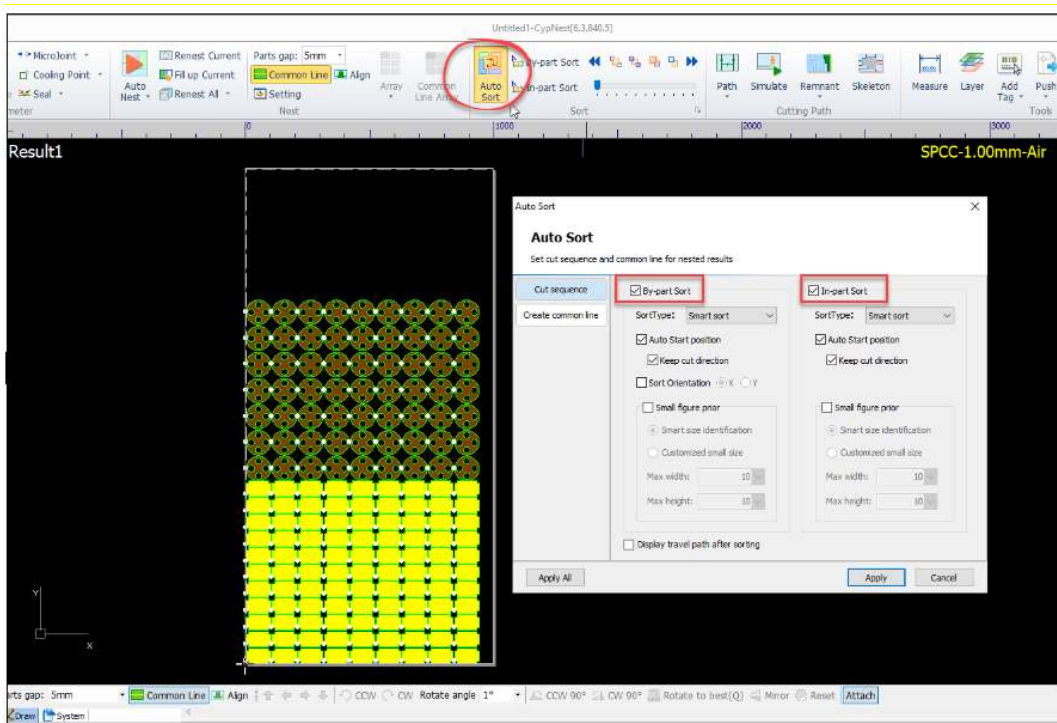




# Sort Parts

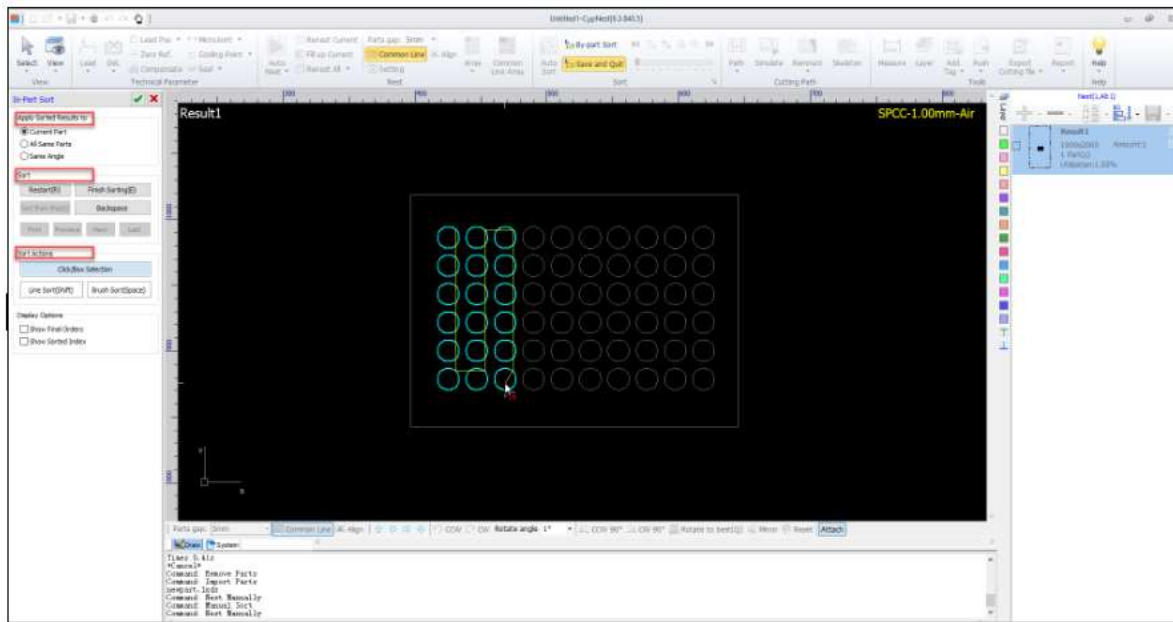
Smart Sort the toolpath to use flexible sort methods and define sequence of toolpath inside parts and between parts

**Auto Sort:** click "Auto Sort" button to open the parameter window, setup the by-part and in-part sorting rules, and co-edge toolpath style



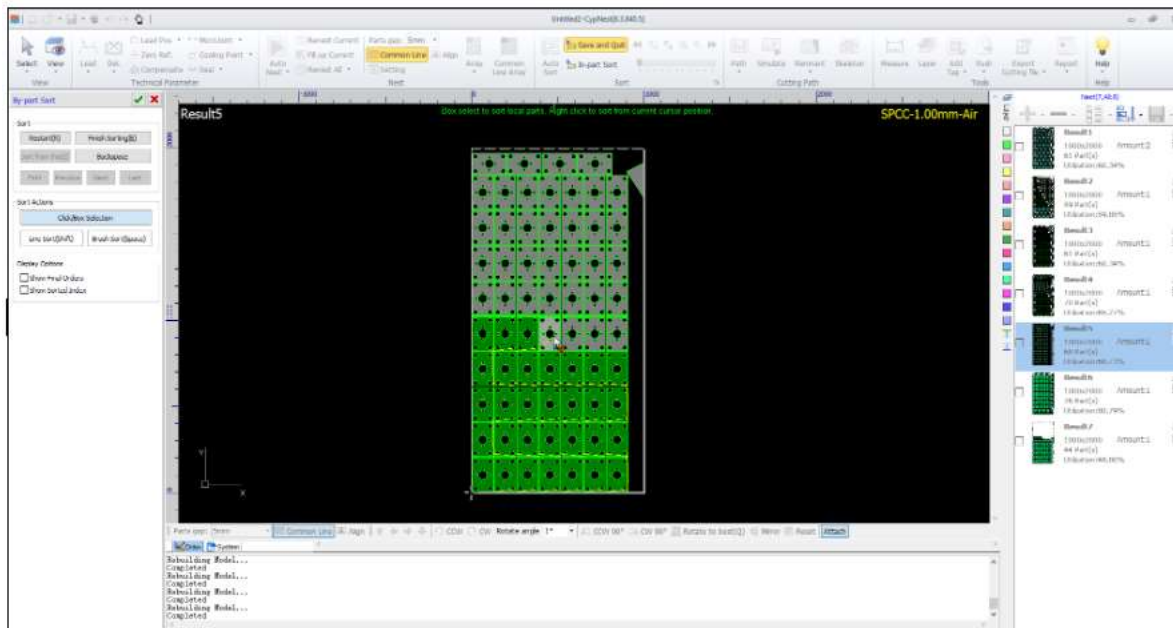
**Manual Sort** parts sequence. The cutting sequence of a whole sheet nesting is defined by internal sequence of a part(In-part Sort) and external sequence between parts(By-part Sort).

Click **(In-part sorting)** to define the toolpath sequence inside a part.



- Apply to save the modification to all parts of same type/only current part/all parts of same type and same rotation angle.
- Sort options: define which is the first one/the last one; bring one contour a step forward/backward to another one.
- Sort actions: 3 ways to define sequence---click one by one/ Shift + click/ Spacebar+ scroll.

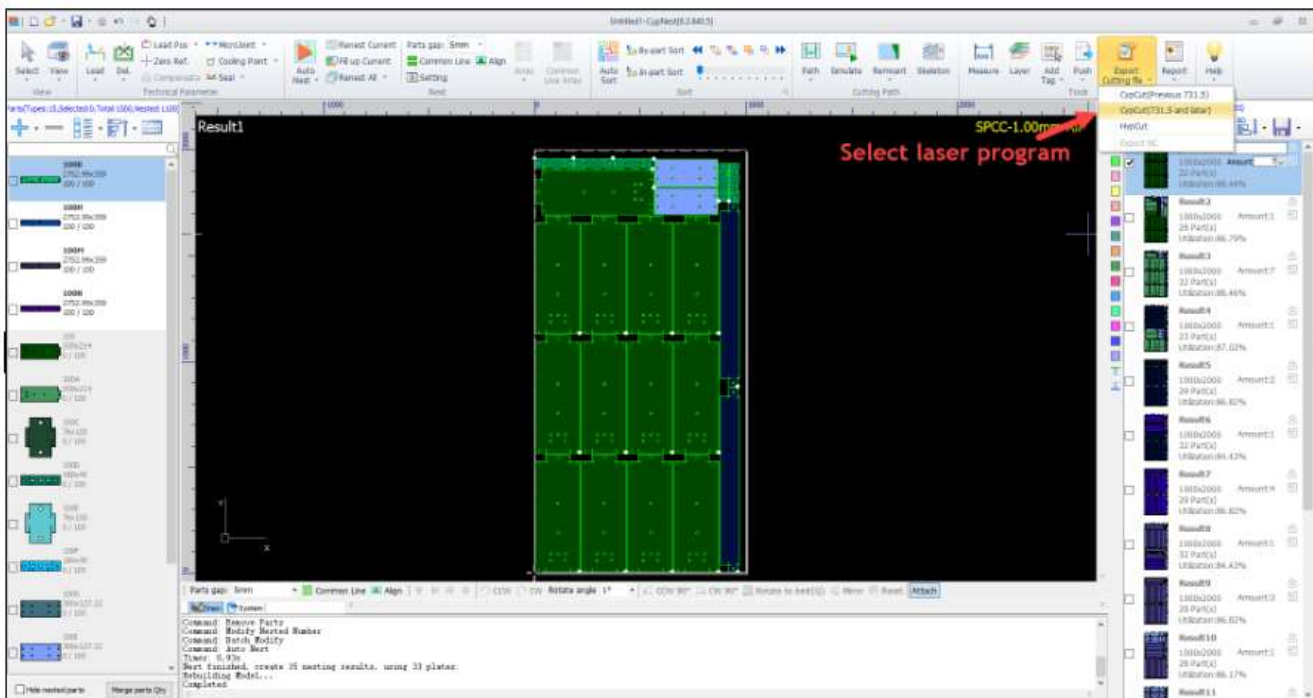
Click (**Part-to-part sorting**): define the toolpath sequence between parts:



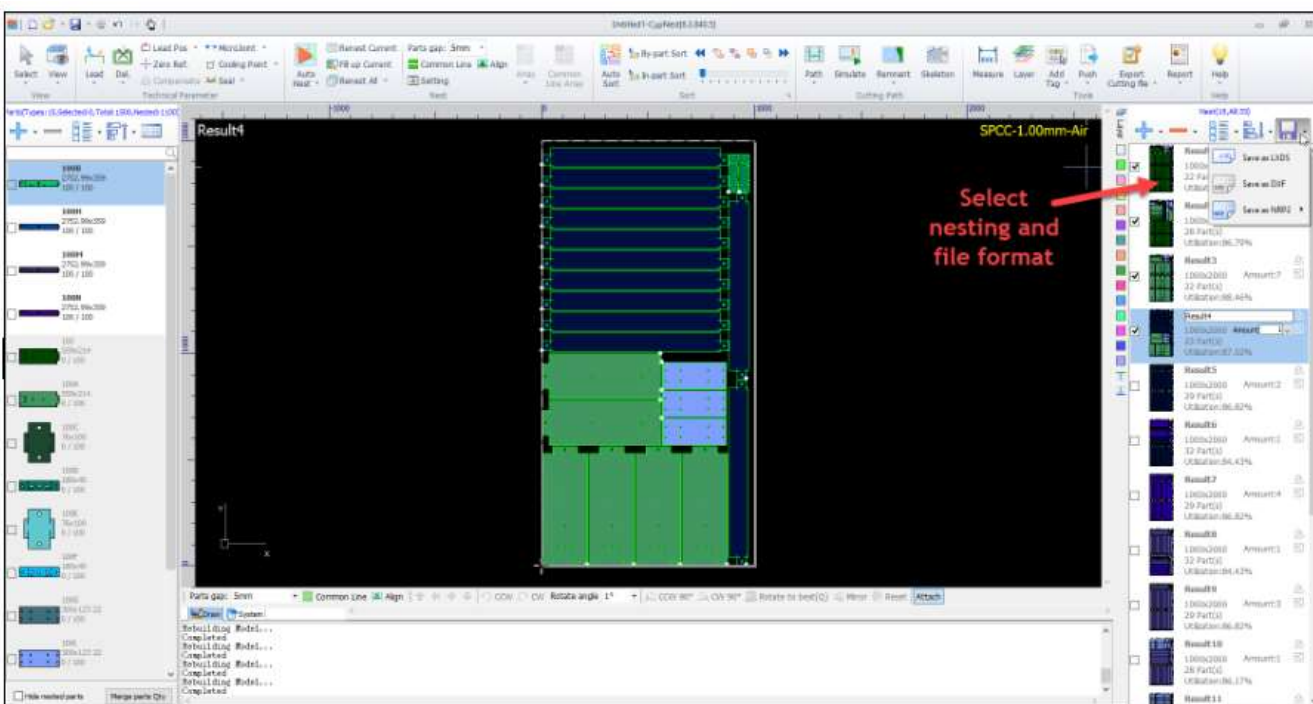
- Sort options: define which is the first one/the last one; bring one part a step forward/backward another one.
- Sort actions: 3 ways to define the sequence---click one by one/ press Shift + click / press Spacebar+ scroll.

## Export File for Laser Production:

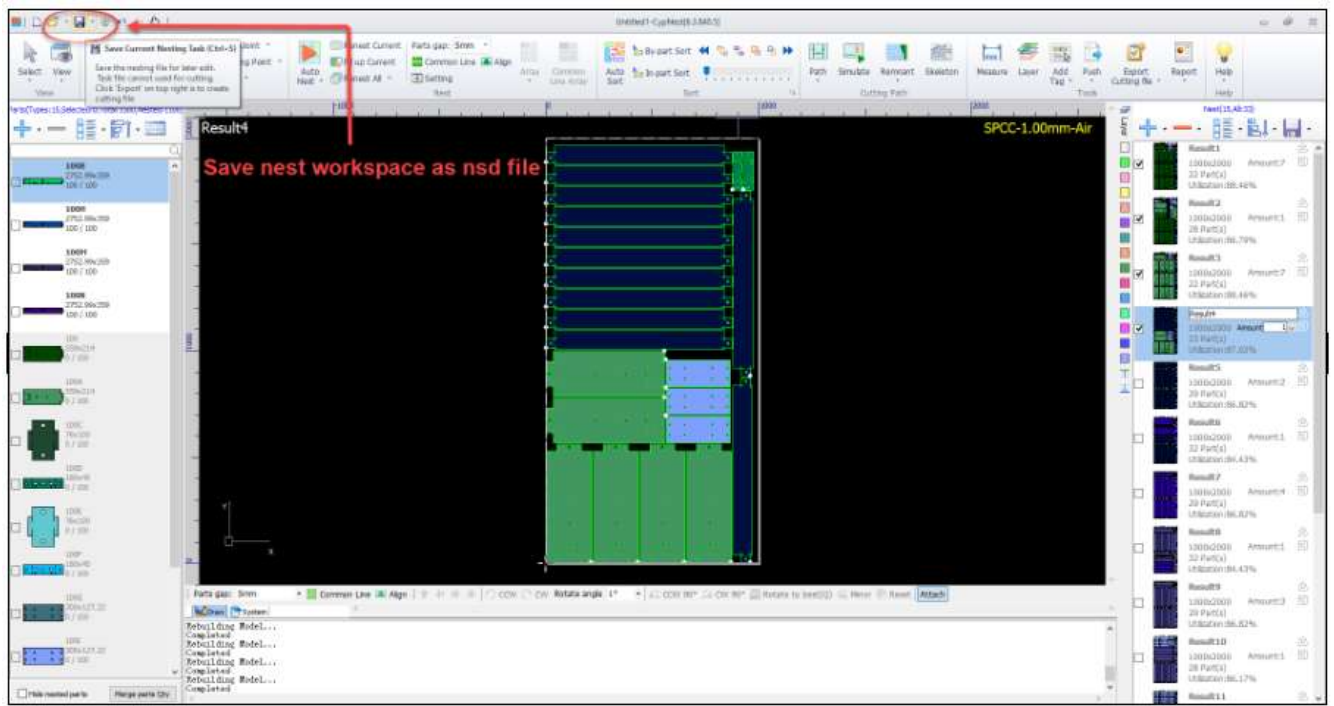
**Export cutting file:** export all nesting as \*.nrp/\*nrp2 file regard with the selected laser program. One nrp file contains all nesting sheets and cannot open in CypNest for editing again.



**Save as** lxds, dxf or nrp/nrp2 from selected nesting



**Save as nsd** file that contains nest workspace of parts library and nesting so that user can resume editing later or reuse it in other nest task.



# LAGUNA

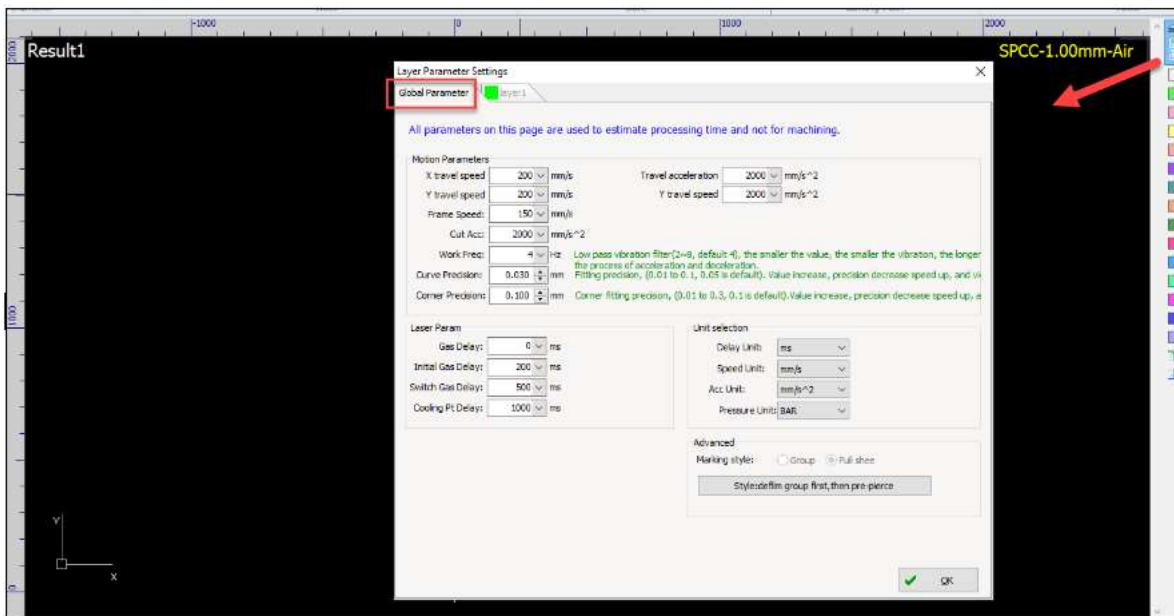
# Quote and Production Report

Create a report on pricing to your client and production schedule.

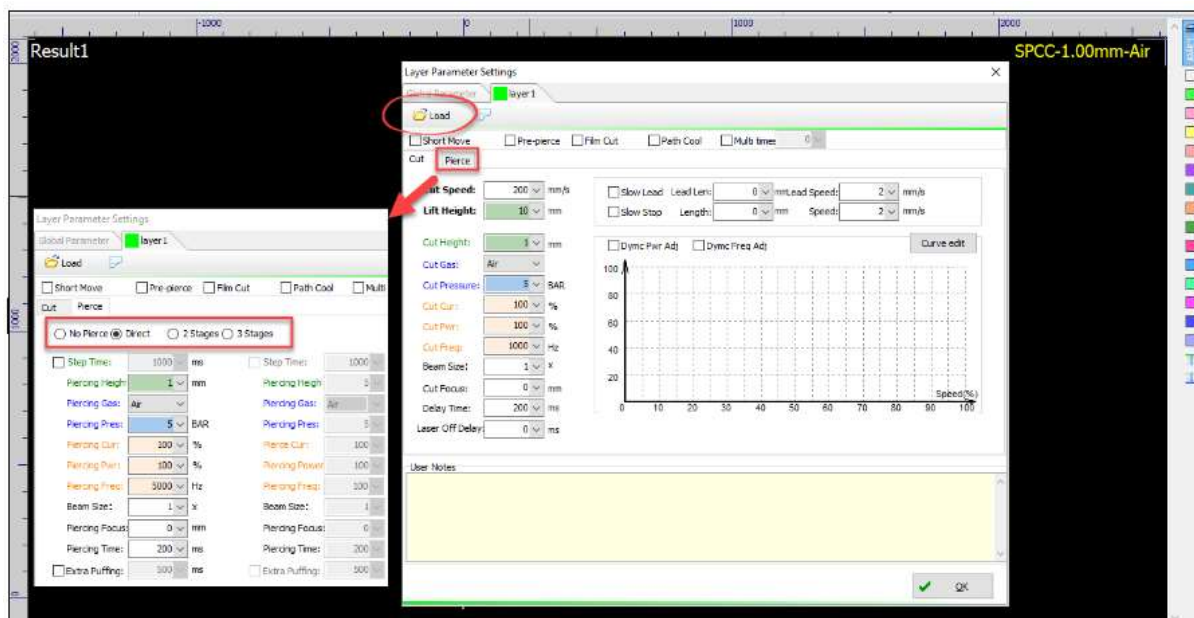
Set up CypNest in same machine config and production technique with laser machine before summarizing all the production data including time of

cutting time, marking time, pierce time, travel time and gas blow time, laser firing length of cutting length, marking length and pierce times etc.

**Machine config:** to set up the acceleration, speed and gas related parameters same with laser machine in Layer > Global Parameter.



**Layer technique:** to setup the production technique which can be loaded from CypCut \*.fsm file directly. For pierce times calculation, it has to activate the pierce function first.



**Generate report:** it's available in Excel and PDF format. Besides preset template, users can edit the custom report template of wanted data item and table arrangement.

The screenshot displays the 'Nest Report' software interface. The main window shows a report for task '20210427001'. The interface includes a toolbar at the top with a 'Report' button highlighted in red. On the left, a 'Template' panel lists options: 'Common', 'Price template', 'PriceReport', 'Report', 'WorkReport', and 'User template'. A red arrow points to 'Price template' with the text 'Select template'. On the right, a 'Price setting' panel is visible, containing a table for price parameters.

**Task Info**

TaskName	Customer	Materials	Thickness	ProcessTime	PartCount
20210427001	Customer X	SPCC	1.00mm	0.2s	0

**Plate Info**

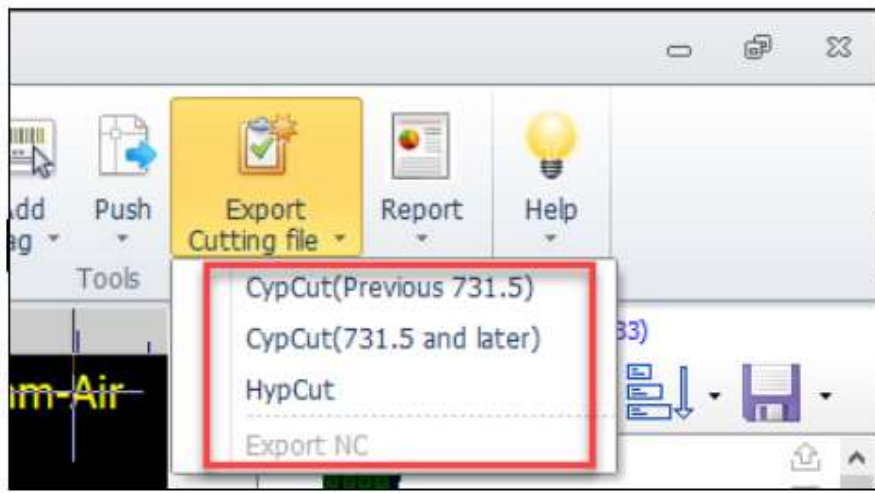
ID	Thumbnail	PartName	Size(mm*mm)	Parts	Utilization	ProcessTime	CutLength(m)	Amount
1		Result1	1000*2000	0	0.00%	0.2s	0	1

**Price setting**

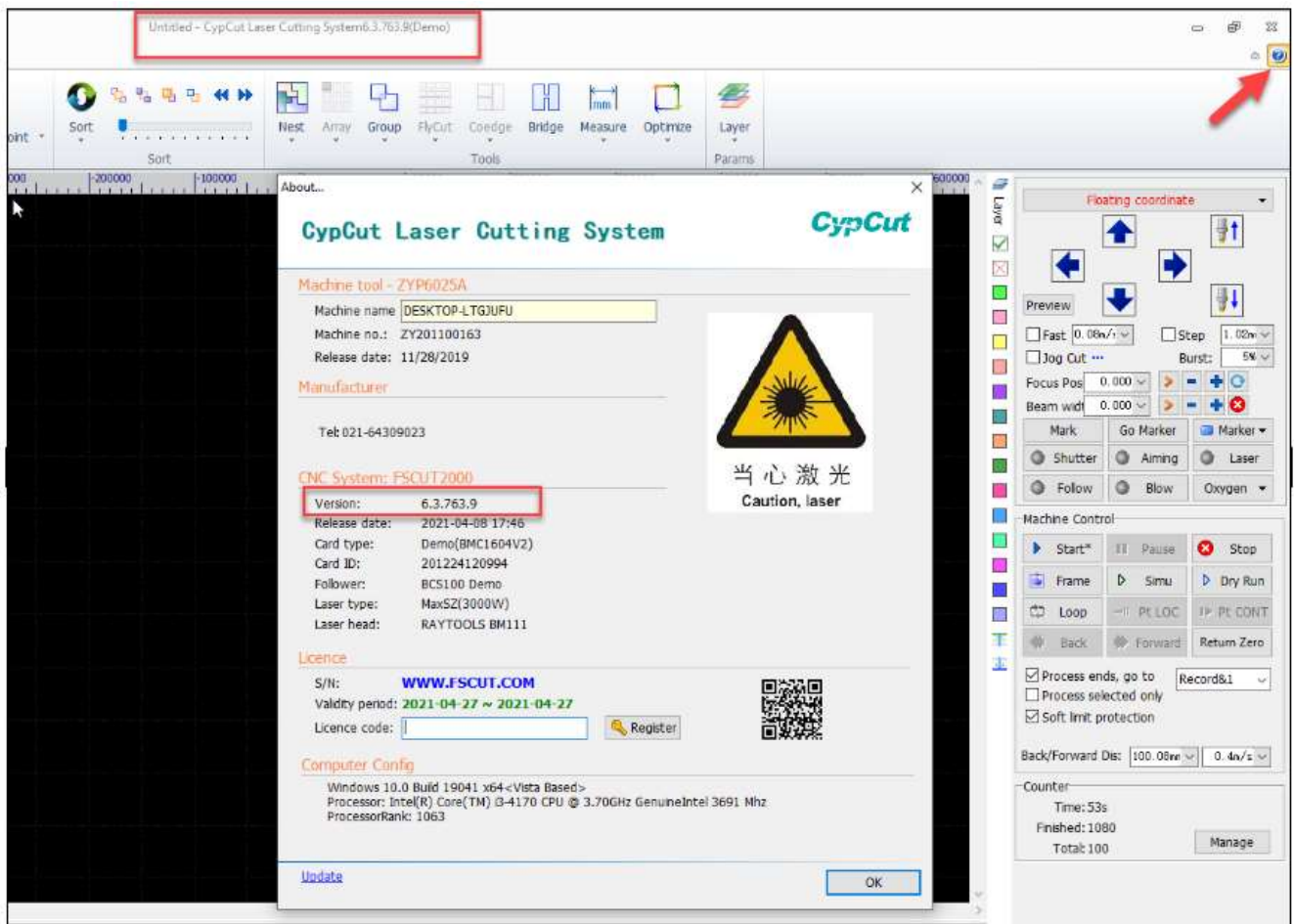
Price param	use the default data
SheetDensity:	2800 kg/m <sup>2</sup>
MaterialPrice:	100 USD/kg
PiecePrice:	0.1 USD/PCS
CutPrice:	1 USD/m
Sheet Price:	500 USD

## Why My LXDS/NRP2 File Cannot Open in CypCut?

The format of exported file must match with CypCut laser cutting software on laser machine.



How to check CypCut version: the larger number indicates a newer version, for example CypCut 763.9 is newer than CypCut 731.5. The [CypCut download](#) is free on our website.



Join CypNest Whatsapp group to get instant support.



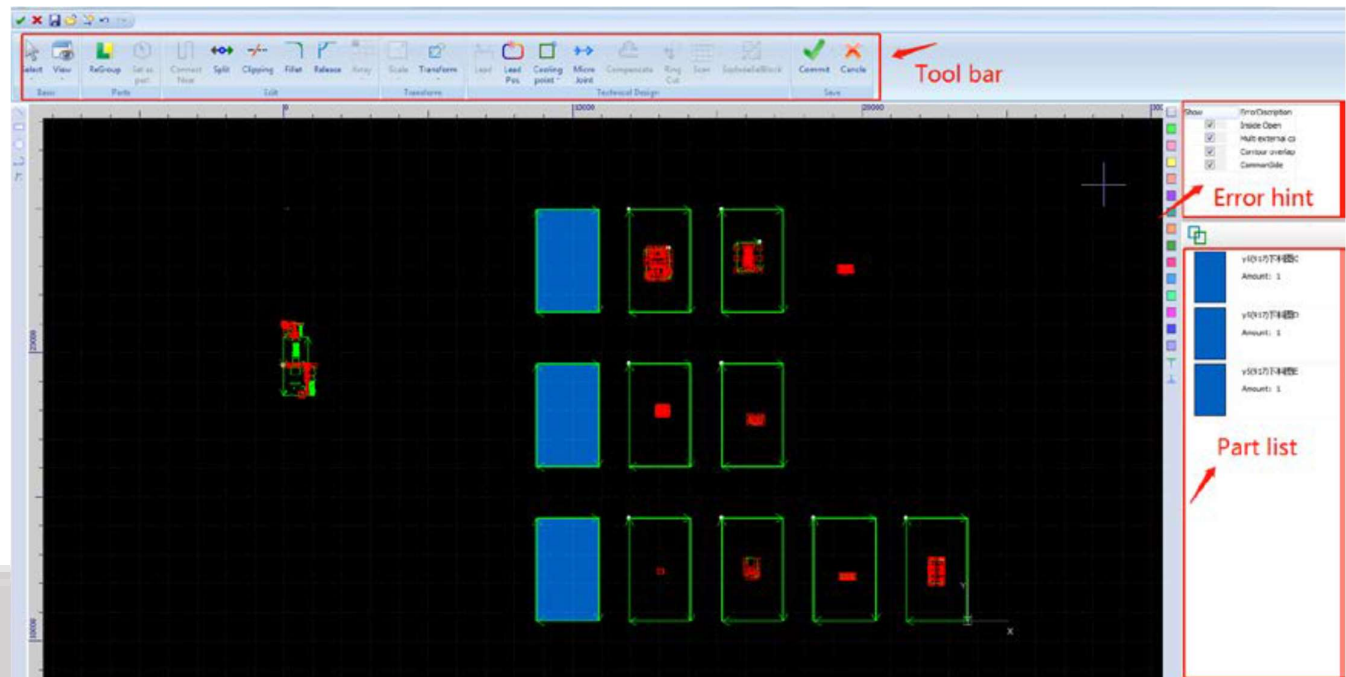
**Laguna Support Line: 1(877)844-8314**

**You can also make a support case at:**

**<https://lagunatools.com/resources/customer-service/>**

## Graphic Handling Notes:

Useable graphics are automatically identified as parts and filled in blue. The problem drawings are marked with red highlights and red boxes.



On the top right area shows the error hint. You can check or uncheck each option to show or hide related error area. All types of errors are highlighted in red.

When the drawing is set as a part, it will be displayed in the part list on the right side. Click each part and input number to modify the part quantity. You can modify the part name in this part list.

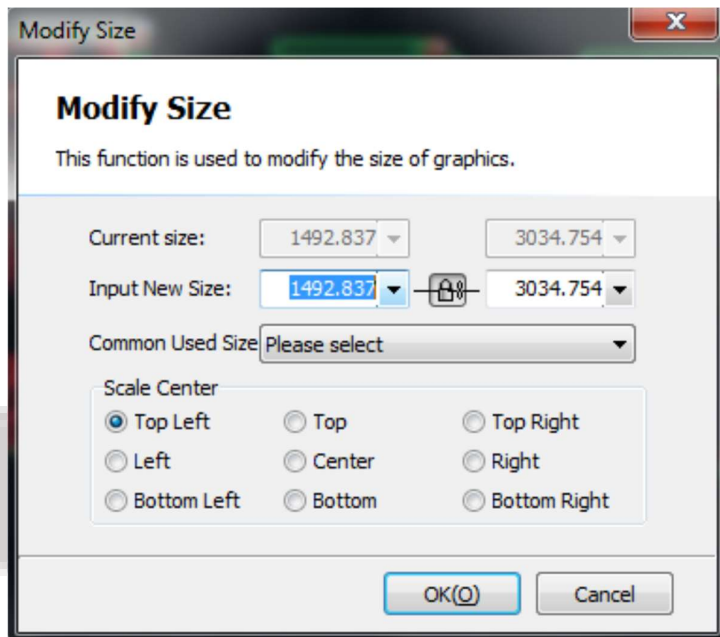
The ribbon toolbar provides tools for modifying and editing error drawings.

### Edit toolbar:

- **Connect Near:** Select the edges to connect and input max distance(unclosed lines within this distance will snap as one)
- **Split:** Click the split point will divide the closed curve to 2 curves. The split function will be activated until press ESC to disable the function or switch to other command.
- **Clipping:** The selected entity will be clipped from the near entity.
- **Fillet:** Add fillet corner to the graph entity.
- **Release:** Add a release corner to the specified position.
- **Array:** Array the selected graphic entities.

**Transform toolbar:**

- **Scale:** Select graph entity and click scale will prompt modify size dialog box. If the lock icon in this state, the scale of length and width is coupled, if you want to modify the length and width separately click the icon turn to state. "Scale center" specify the position between new graph and the original one. For example, "Top left" indicates the graph in new scale at the top left of the original one. Click the small triangle on the scale button will open a drop-down menu so you can modify the graph scale as fixed ratio.



- **Transform:** Transform the graph entity as specified rules. Transform the graph entity by rotate. Click mouse to create a rotate base line to modify the graph entity.

## BOCI cutting head:

Machine tool debugging requires professionals and must be strictly implemented in accordance with relevant regulations. Please understand the performance of the machine tool and read the relevant random technical information before debugging. Correct debugging is the basis for ensuring the normal operation of the machine tool. If you have any questions, please contact us. We will give you a satisfactory answer as soon as possible.

**Note: This debugging method includes the debugging method after the machine tool is online and powered on normally.**

The fiber laser equipped with this machine is free of optical path debugging, but the operating fiber must be strictly placed in the drag chain of each axis, and the bending radius must be greater than 200mm. The moving radius is prohibited to be less than 200mm, and the fixed radius is prohibited to be less than 100mm.

Before starting the machine, ensure that all water and air pipes are connected normally without leakage!

the head, make sure it is clean. If there is any foreign matter, clean it as follows:

- Use a special microscope component to observe the head and use special compressed air or professional cleaning agent (ethylene propylene alcohol) and cleaning tools such as fiber optic cotton swabs and special lens paper to clean the dust and other dirt on the head! Make sure the head is clean and pollution-free before inserting it into the cutting head beam expansion tube!
- Adjust the coaxially and focus of the cutting head lens and then try cutting! Adjust repeatedly to the best position!
- **The installation of optical fiber must be done by trained professionals, and non-professionals are strictly prohibited from plugging and unplugging the fiber optic cable.**
- **NEVER remove the tape on the optic connection to the head.**
- **NEVER remove the Optic cable unless asked to do so by technical support.**

## • Precautions for using lenses

- 1) Do not touch the focusing lens, protective lens, head and other optical lens surfaces directly with your hands, as this may easily cause scratches or corrosion on the mirror surface.
- 2) If there is oil stain or dust on the mirror surface, it will seriously affect the use of the lens, and the lens should be cleaned in time.
- 3) It is strictly forbidden to use water, detergent, etc. to clean the surface of the optical lens. The surface of the lens is coated with a special film. If you use these to clean the lens, it will damage the surface of the lens.
- 4) Do not place the lens in a dark and humid place, as this will cause the lens surface to age.
- 5) The lens surface must be clean. If there is dust, dirt, or moisture on it, it will easily absorb the laser and cause damage to the lens coating. This will affect the quality of the laser beam at the very least or even prevent the laser beam from passing through or reflecting.
- 6) When installing or replacing the reflector or focusing lens, do not use too much pressure, otherwise it will cause the lens to deform and affect the quality of the light beam.

## • How to install or replace optical lenses

- 1) Before installing optical lenses, please pay attention to the following: Wear clean clothes, clean your hands with soap or detergent, and wear thin, clean white gloves; It is strictly forbidden to touch the lens with any part of your hands; When taking the lens, take it from the side of the lens and do not touch the lens coating surface directly.
- 2) When assembling the lens, do not blow air at the lens with your mouth; the lens should be placed stably on a clean table with a few lens professional papers underneath. Be as careful as possible when taking the lens to prevent it from being bumped or dropped, and do not apply any force to the coated surface of the lens; the lens seat where the lens is installed should be clean, and use a clean air spray gun to clean the dust and dirt in the lens seat , and then gently put the lens into the lens seat.
- 3) When installing the lens to the lens holder, do not use too much force to fix the lens to avoid deformation of the lens, which will affect the quality of the light beam.

## • Steps for cleaning lenses

The cleaning methods for different lenses are different. For example, the specific steps for focusing lens or collimating lens are as follows:

1) Steps to clean the lens with lens paper: Use a clean air spray gun to blow away the dust on the lens surface; Use alcohol or lens paper to clean the lens surface. Place the smooth side of the lens paper flat on the lens surface, drip 2-3 drops of high-purity alcohol or high-purity acetone and slowly pull the lens paper out horizontally toward the operator. Repeat the above steps several times until the mirror surface is clean. Do not apply pressure on the lens paper to prevent scratches. If the mirror surface is very dirty, fold the lens paper in half 2-3 times and repeat the above steps until the mirror surface is clean. Do not drag the dry lens paper directly on the mirror surface.

2)Steps for cleaning the lens with a cotton swab: First, use a spray gun to blow away the dust on the mirror surface; then use a clean cotton swab to remove the dirt; use a new cotton swab dipped in high-purity alcohol or acetone to move in a circular motion from the center of the lens to clean the lens. After each circle of wiping, use another clean cotton swab and repeat the above steps until the lens is clean; take the cleaned lens to a well-lit place for observation. If the reflection of the lens is good, it means that the lens has been cleaned. If the reflection of the lens is not good, continue to clean the lens; place the cleaned lens on the lens holder according to the method described above. It is forbidden to use used cotton swabs for operation.

## • Storage of optical lenses:

1) Proper storage of optical lenses can maintain the quality of the lenses.

2) The storage environment temperature is 10 ~ 30 °C, {10-90 degrees Fahrenheit}. The lenses should not be placed in a freezer or similar environment, otherwise condensation and frost will form when the lenses are taken out, which may easily damage the lenses. The storage environment temperature should not be higher than 30°C, otherwise it will affect the coating on the lens surface.

3) Store the lens in the box in a non-vibrating environment, otherwise it is easy to cause the lens to deform, thus affecting the performance of the lens.

## • Focal focusing method:

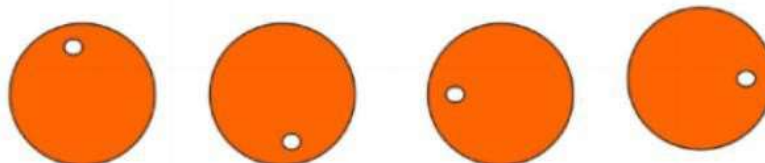
The focusing mechanism of the focusing mirror adopts a precision screw to pull the focusing box to achieve Z -axis focusing, which has good self-locking performance and fine focusing function. The focus is electrically adjustable, and the vertical movement of the focusing lens is determined by the laser head model. 0 scale means the focus is near the nozzle, and +3 scale means the focus is out of the nozzle. 3 mm, -7 means the focus is retracted into the nozzle by 7

mm.

- **Nozzle function and center adjustment:**

The nozzle and the jet flow directly affect the cutting quality; manufacturing accuracy of the nozzle is closely related to the cutting quality.

The main functions of the nozzle are to prevent debris such as cutting molten stains from rebounding upwards into the cutting head and damaging the focusing lens. The nozzle can change the state of the cutting gas spray and can control the area and size of gas diffusion, thereby affecting the cutting quality. The steps to adjust the nozzle so that the laser passes through the center of the nozzle are when adjusting the light, first stick transparent tape on the nozzle, and press the "shoot" button on the handle to make "⊙" appear on the tape. If it is not in the center of the nozzle, adjust the two knobs on the cutting head to make the light spot in the center of the nozzle.



Adjust the XY centering knob to make the focal point in the center of the nozzle by low-power dotting.

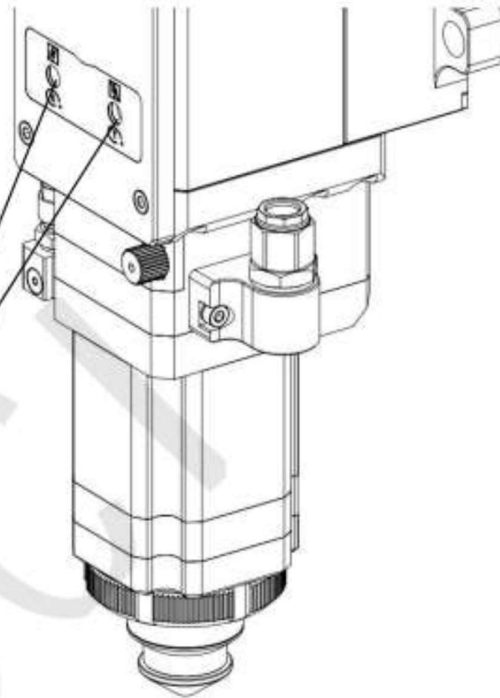


The conditioned laser beam must be in the center of the nozzle.

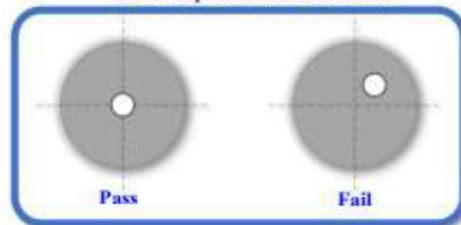
X/Y adjustment screw



Tape



Relative position of laser beam



### Manual alignment operation:

1. Make sure the laser beam is turned off.
2. Place scotch tape under the nozzle.
3. Click to trigger a low-power laser pulse and assess the position of the laser beam relative to the nozzle through the penetration of the tape.
4. Adjust the X/Y centering screws to center the laser beam on the nozzle.

- 1) Move the nozzle to approximately the cutting height.
- 2) to the end of the nozzle and stick the transparent tape on it. Note: The toolbox comes with transparent tape.
- 3) Adjust the laser output power to 20W ~ 100W. After the laser stops emitting light, take off the white sticker, being careful not to rotate its relative position. If the nozzle position is too far away from the laser center, the center hole cannot be punched on the sticker; since the laser center is fixed, the center of the focusing mirror must be changed by adjusting the adjustment screw on the mirror cavity handle to make it correspond to the laser center. Repeat the above steps until the hole punched by the laser on the white sticker coincides with the center of the nozzle, thus confirming that the laser center coincides with the nozzle center.

- **Impact on cutting quality when the nozzle center and the laser center are not coaxial**

1) Affecting the cutting section. When the cutting gas is ejected, the gas volume is uneven, making it easier for the cutting section to have melt stains on one side and not on the other side, or the quality of the parts around the section is inconsistent, which sometimes causes failure to cut normally.

2) Affects the quality of sharp corners. When cutting workpieces with sharp corners or small angles, local over-melting is likely to occur, and when cutting thick plates, it may not be possible to cut.

3) It affects the perforation. The perforation is unstable, and the time is difficult to control. The penetration of thick plates will cause over-melting, and the penetration conditions are difficult to grasp. The perforation of thin plates has little effect.

In summary, the concentricity between the center of the nozzle and the laser is one of the important factors that affect the quality of cutting, especially when the workpiece is thicker, its influence is greater. Therefore, the concentricity between the center of the nozzle and the laser must be adjusted to obtain a better cutting section.

Note: When the nozzle is deformed or there are molten stains on the nozzle, the impact on the cutting quality is as described above. Therefore, the nozzle should be placed carefully and not damaged to avoid deformation; the molten stains on the nozzle should be cleaned in time. The

quality of the nozzle has high precision requirements during manufacturing, and the correct method is also required during installation. If the cutting conditions need to be changed due to poor nozzle quality, the nozzle should be replaced in time.

### • Selection of Nozzle Aperture:

The difference in nozzle aperture is shown in Table 4-1 below.

Nozzle aperture	Gas flow rate	Melt removal capability
Small	quick	powerful
big	slow	weak

The nozzle apertures are  $\varphi$  1.5mm,  $\varphi$  2.0mm,  $\varphi$  2.5mm,  $\varphi$  3.0mm, etc. For three-dimensional cutting of ordinary thin plates,  $\varphi$ 1.2mm and  $\varphi$ 1.5mm are sufficient. The differences between the two are:

- 1) For thin plates below 2mm: Use  $\varphi$ 1.2mm, the cutting surface will be finer; use  $\varphi$ 1.5mm, the cutting surface will be coarser.
- 2) Thick plates above 2mm: Due to the high cutting power, the relative heat dissipation time is longer, and the relative cutting time is also increased. When using  $\varphi$ 1.2mm, the gas diffusion area is small, so it is not very stable when used. When using  $\varphi$ 1.5mm, the gas diffusion area is large and the gas flow rate is slow, so it is more stable when cutting.

In summary, the size of the nozzle aperture has a serious impact on the cutting quality and the perforation quality. Currently, laser 3D cutting mostly uses nozzles with apertures of  $\varphi$  1.2mm and  $\varphi$ 1.5mm.

The larger the nozzle aperture, the worse the protection of the lens. Because the sparks of the melt are likely to splash and bounce upwards during cutting, the life of the lens will be shorter.

- **Adjustment of beam focus:**

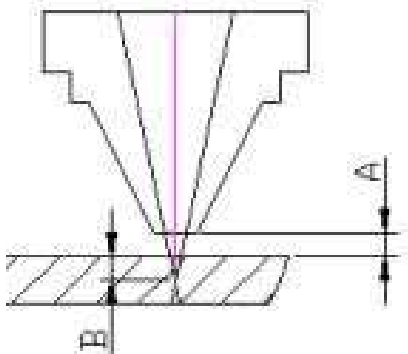
During the laser cutting process, the relative position between the beam focus and the surface of the cutting plate has a great influence on the cutting quality, so it is very important to adjust the focus position correctly. This laser system is equipped with an automatic height follow-up adjustment device. When the height of the plate changes, the CNC system will automatically adjust to ensure that the height between the nozzle and the plate surface is constant, and the focus position is stable.

Manual adjustment method: adjust the adjustment nut at the bottom of the laser cutting head to make the focus position meet the cutting needs, provided that the zero focus position is found. During the cutting process, you can also manually adjust the height adjustment button on the operation panel to slightly change the cutting height according to the situation. Only operators with sufficient experience can adjust the height during the cutting process.

Automatically adjust the focus. Equipment equipped with an automatic focusing cutting head can automatically adjust the focus position according to the parameter settings. The advantage is that it can improve processing efficiency, compensate for the change in focus position caused by changes in optical path, and improve the product yield.

- **Methods for finding zero focus:**

Place a flat stainless steel plate on the workbench, draw a straight line and set the cutting height to 1 mm. At this time, set the focus to 0.- 1.-2 -3 +1 +2+3, etc. The laser will be output in sequence with different focal points, and there will be traces of melting on the stainless steel plate. The thinnest line of melting is the 0 focus of the laser.



- **Process parameter debugging method:**

- **Laser cutting principle**

Laser cutting is cutting by focused optical fiber laser, which is transmitted through optical fiber. It has high flexibility, high speed, few failure points, low maintenance cost, convenient maintenance, high photoelectric conversion rate, and great cost-effectiveness in system matching. It is mainly used for cutting metal sheets within 20 mm. Laser beam is not easily absorbed by highly reflective materials, and the cutting effect on highly reflective materials is not very ideal. It cannot cut and process non-metallic materials.

- **Main process control of fiber laser cutting**

1) **Cutting power:** During laser cutting, the choice of laser power will affect the cutting quality. The cutting power needs to be determined according to the material and thickness of the plate being cut. Too much or too little power will not result in a good cutting section.

During laser cutting, if the laser power is too small, cutting will fail.

The laser power is set too high, the entire cutting surface will melt, the cutting seam will be too large, and good cutting quality will not be obtained.

When the laser power is set insufficiently, cutting stains will be produced and scars will be formed on the cut section.

Proper laser power setting, combined with appropriate cutting gas and pressure, can achieve good cutting quality without any melt marks.

**Cutting speed:** Too fast a speed may affect the cutting quality. It may cause the cutting to fail and sparks to fly. Some areas can be cut, but some areas cannot be cut. The entire cut section is rough, but no melted stains are produced. Too fast a speed may cause the sheet to fail to be cut in Time, and the cut section will show diagonal lines. And there are melt stains on the lower part, as shown in the right picture.

How do you judge the speed of cutting feed? The speed of cutting feed can be judged from the cutting sparks: Generally, cutting sparks spread from top to bottom. If the sparks are tilted, the feed speed is too fast; if the sparks do not spread and are few and condensed together, it means that the feed speed is too slow. As shown in the figure, the appropriate cutting speed is

As shown in Figure 3- 14. The cut surface presents relatively smooth lines, and there is no melting mark in the lower part.

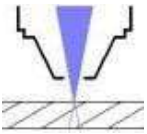



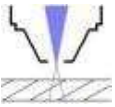
- 2) **Cutting height:** The cutting height has little effect on the cutting quality of the workpiece. If it is set too low, the auxiliary air pressure has a strong slag removal ability, but it is easy to return slag to the protective lens and damage the protective lens. If it is too high, the slag removal ability becomes poor, and the air pressure needs to be increased, which wastes air.

Generally, the cutting height is set between 0.5-1.5. The cutting height is too high, there is a small amount of beaded slag under the cut workpiece, and the cutting section texture is better.

- 3) **Focus:** The position of the focus has an important influence on laser cutting, how to choose the focus, and the impact of this focus on sheet drilling and cutting section. Nitrogen cutting of stainless steel generally uses a negative focus; oxygen cutting of carbon steel plates generally uses a positive focus.

Nitrogen cutting of stainless steel generally uses a negative focus; oxygen cutting of carbon steel plates generally uses a positive focus.

Name and focus position	Cutting materials and cross-section characteristics
<p data-bbox="657 472 803 604">  </p> <p data-bbox="207 640 625 829">Zero focal length: The laser focus is on the surface of the cutting workpiece</p>	<p data-bbox="829 577 1372 609">√ Suitable for thin carbon steel below 1.mm ;</p> <p data-bbox="829 682 1458 871">√ The focus is on the workpiece surface, the upper surface is cut smoothly, while the lower surface is not smooth.</p>
<p data-bbox="673 997 787 1123">  </p> <p data-bbox="207 1102 657 1291">Negative focal length: The laser focus is below the surface of the cutting workpiece</p>	<p data-bbox="829 976 1372 1008">√ Nitrogen cutting method for stainless steel.</p> <p data-bbox="829 1081 1458 1428">√ The focus is below the board surface, so the smooth surface range is larger, and the cutting seam is smaller than zero focus. The kerf is wide, the gas flow is larger during cutting, and the piercing time is longer than that of zero focal length.</p>

 <p>Positive focal length: The laser focus is above the surface of the cutting workpiece</p>	<p>√ Used for oxygen cutting of carbon steel.</p> <p>√ The surface is black, and the cross section is rough.</p>
---	--

4) **Nozzles:** Currently, the commonly used apertures of nozzles are  $\Phi 1.0$ ,  $\Phi 1.5$ ,  $\Phi 2.0$ ,  $\Phi 2.5$ . The differences in aperture sizes are:

① When cutting thin plates: Using a  $\Phi 1.5$  nozzle will result in a finer cut surface. Using a  $\Phi 2$  nozzle will result in a coarser cut surface, and there will be melt stains at the corners.

② When cutting thick plates: Due to the high cutting power, the relative heat dissipation time is longer, and the relative cutting time is also increased. When using a nozzle of  $\Phi 1.5$ , the gas diffusion area is small, so it is not very stable when used. When using a nozzle of  $\Phi 2$  or above, the gas diffusion area is large, the gas flow rate is slow, so it is more stable when cutting.

The nozzles are divided into double-layer nozzles ( $\Phi 1.5$ ,  $\Phi 2$ ) and single-layer nozzles ( $\Phi 1.5$ ,  $\Phi 2.0$ )

Oxygen cutting carbon steel nozzle selection: generally, use double-layer nozzles, within 3mm generally use  $\Phi$  single-layer 1.5; 3-12mm generally use double-layer  $\Phi 2.0$ ;

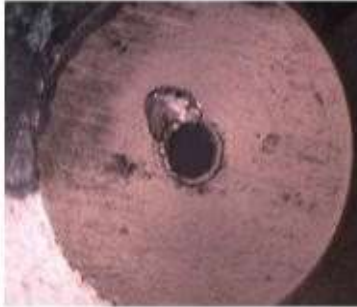
Selection of stainless steel nozzles for nitrogen cutting: Single-layer nozzles are generally used, single-layer 1.5 for less than 2mm, and single-layer 2.0 for more than 2mm. The size of the nozzle aperture has an absolute influence on the cutting quality and perforation quality. The larger the

nozzle aperture, the worse the protection of the focusing lens, because the sparks of the melt splash during cutting, and the probability of bouncing upward is very high, which shortens the life of the lens. At the same time, the quality of the nozzle is also an important factor affecting the cutting quality. The nozzle shape requirements are shown in the figure below.

Available



Unavailable



- 5) **Air Pressure:** The main functions of cutting gas are cooling and protection. Oxygen has the effect of supporting combustion and heat dissipation, blowing off the molten stains produced by cutting in time, preventing the cutting molten stains from rebounding upward into the nozzle, protecting the focusing lens and protective mirror, etc.

The influence of cutting gas and pressure on cutting quality: cutting gas helps to cool and dissipate heat and assists combustion, blows away molten stains, and thus obtains a better quality cut section. When the pressure of cutting gas is insufficient, it will cause the following effects: molten stains will be generated during cutting; the cutting speed cannot be increased, affecting production efficiency. When the pressure of cutting gas is too high, it will affect the cutting quality: when the pressure is high, the airflow is too large, the cut surface is rough, and the cut seam is wide; when the airflow is too large, it will also cause the cut section to partially melt, and a good cut section cannot be formed.

The effect of cutting gas pressure on perforation. When the gas pressure is too low, the laser cannot penetrate the plate easily, the perforation time increases, and the productivity is low.

When the gas pressure is too high, the penetration point melts, a hole appears, and a larger melting point is formed, which affects the cutting quality. When laser drilling, generally a higher gas pressure is used for thin plate drilling, and a lower gas pressure is used for thick plate drilling.

When cutting ordinary carbon steel with oxygen, the thicker the material, the lower the pressure of the cutting gas.

The thicker the material, the higher the gas pressure, but the cutting gas pressure is always at a high pressure state of 1.2 MPa

above.

- 6) **Lead-in line:** The line connecting the punching position and the workpiece contour is called the lead-in line or the lead-in line.


The benefits of wire insertion: It will reduce the scrap of workpieces caused by hole explosion. It can improve the quality of the first cutting surface.



It can improve the appearance of the cutting edge. It is easier to start cutting when cutting stainless steel.

For stainless steel within 2mm, straight lead wire can be used; for those above 2mm, a straight line of 3-5mm plus a small arc of about R0.2-R0.8 is generally used; for carbon steel, a straight

line of 3-5mm plus an arc of R0.5-R3 is generally used. The thicker the plate, the greater the R value. It is recommended not to add oxygen cutting for thick carbon steel plates above 5mm and cutting small holes.

- 7) **Direct perforation cutting** is generally suitable for perforation of carbon steel plates below 1.2mm and stainless steel, with small perforation diameter. Segmented perforation: generally suitable for perforation of carbon steel plates below 3mm and stainless steel above 1.5mm.
- 8) **Progressive perforation:** generally suitable for perforation of carbon steel plates above 3mm and stainless steel of 2mm-3mm, with faster perforation speed, larger perforation diameter ( $\Phi 2$ - $\Phi 3$ mm), perforation height  $> 3$ mm, and air pressure  $< 2$ bar. It is determined according to the actual situation.
- 9) **Level 3 perforation:** generally suitable for carbon steel plates with a thickness of more than 6mm and stainless steel plates with a thickness of more than 5mm. Thick carbon steel plates take a long time to perforate using ordinary perforation, and are prone to bursting. The minimum oxygen purity is 99.5%. The lens, protective mirror and nozzle are in good condition. The laser mode is distortion-free and wastes time, and is prone to collision alarms. After using progressive perforation, the perforation time is greatly shortened and the burst rate is reduced.

question	Possible causes	Workaround
The beginning of drilling 	Duty cycle is too high Punching power is too high Too much air pressure Wrong focus punching method	Reduce power by 10% at a time Reduce the duty cycle by 1%-2% each time Reduce air pressure, changing the focus by 0.1 bar . 0.1-0.2 mm each time Check the

		punching method, whether it is continuous wave punching, etc.
<p>Explosion during drilling</p> 	<p>Duty cycle is too low</p> <p>Low power</p> <p>Wrong focus</p> <p>Low air pressure</p>	<p>Reduce speed</p> <p>Checking the defocus amount</p> <p>Increase power by 5%-10% each time</p> <p>Increase the air pressure by 0.1-0.2 bar each time</p>
<p>Drilling is finished, and the hole is blasted before cutting begins</p> 	<p>Punching time</p> <p>Punching power is low</p>	<p>Increase the punching time, 0.5 sec each time</p> <p>Increase punching power by 5% each time</p> <p>Increase the duty cycle by 1%-2% each time</p> <p>Use slow knife</p>

## • Knife Testing

During the production process, before mass production, there is a test cutting process, which is called "test knife". Through the test knife, the process parameters required for plate cutting can be adjusted, but the test knife and the whole plate cutting process will be slightly different, so you need to pay attention. Test knife: First select a round square for cutting. The main purpose is to check whether the parameters can be cut normally, whether the cut section is qualified, and know the deviation between the actual size and the size after cutting, to compensate for the size during mass production, and then try to choose the most complex contour in the processing figure for test knife.

### Notes on mass production after knife testing:

- (1) Pay attention to the machine tool limit, the plate should not be too close to the edge and pay attention to the starting position of the cutting head.
- (2) Pay attention to whether the graphics direction during programming is consistent with the direction of the plate during cutting. The dimensional deviation during the trial cutter must be compensated in the graphics for mass production.
- (3) It is best to simulate the program once before cutting it to ensure the correctness of the program.
- (4) The speed during mass production is 80% of the speed during trial cutting.
- (5) The first part cut during mass production must be measured to ensure that it is foolproof. If necessary, random inspections should be conducted on the parts during the cutting process.

(6) If parts flip during batch production, they are likely to hit the cutting head, generating an alarm and requiring cutting to be suspended. Otherwise, collisions are likely to occur, and in severe cases, the plate may move. The solution is to set a micro-joint for the cutting workpiece. If the laser head is hit, recalibration is required.

(7) Before cutting, manually check whether the air blowing is normal. During the cutting process, pay more attention to the air usage to prevent air shortage in the middle, which may cause the parts to be scrapped.

(8) During the cutting process, the operator is not allowed to leave the operating table to avoid emergencies.

(9) The cutting starting point is set at the lower right of the part to reduce the error caused by deformation during the cutting process.

(10) The parts should be at least .400" away from the edge of the plate.

(11) Cutting with film: Face the film upwards. If there is film on both sides, the film on the lower surface must be torn off, otherwise there will be residue. Depending on the film condition of the board, if the film is firmly attached, it can be cut normally. If the film is not firmly attached, it must be cut after removing the film with some scissors.

(Recommended: high viscosity, black and white film with a viscosity of 120 and a thickness of less than 0.05 mm);

(12) Film removal cutting: The cutting path is marked first and then cut. Simply put, the same path is cut twice, once with low power to mark and cut off the film, and once with high power to cut the metal. The film removal height can be adjusted by adjusting the cutting degree in the

film removal parameters. The wider the height, the smaller the chance of the film being blown out.



# LAGUNA

## \* Overview of different materials and methods

### ★ Carbon steel cutting process

This material will give better results when cut with oxygen. When oxygen is used as the processing gas, the cut edge will oxidize slightly. For plates up to 1 mm thick, high pressure cutting can be performed with nitrogen as the processing gas. In this case, the cut edge will not oxidize. For plates over 10 mm thick, better results can be obtained by oiling the workpiece surface during processing.

★ Stainless steel cutting process, oxygen can be used when oxidation of the cut end surface is acceptable.

Use high pressure nitrogen to get an edge without oxidation and burrs, and no further processing is needed. Applying an oil film on the surface of the plate will get a better perforation effect without reducing the processing quality. As shown in the figure, a stainless steel part cut with high pressure nitrogen has a small burr under the workpiece, and the nitrogen pressure can be increased.

★ Aluminum cutting process, despite its high reflectivity and thermal conductivity, aluminum with a thickness of less than 6mm can be cut, depending on the alloy type and laser capability. When cutting with oxygen, the cut surface is rough and hard. When using nitrogen, the cut surface is smooth. Pure aluminum is very difficult to cut because of its high purity.

★ Brass and copper cutting process, both materials have high reflectivity and very good thermal conductivity. Brass can be cut with nitrogen; copper can be cut; the processing gas must be oxygen.

### ★ Special process with film cutting

a. With the film facing upwards, if there is film on both sides, the film on the lower surface must be torn off, otherwise there will be residue; according to the film condition of the board, if the film is firmly attached, it can be cut normally; if the film is not firmly attached, it must be cut after removing the film with a scissors (it is recommended to choose: high viscosity, black and white film with a viscosity of 120 and a thickness of less than 0.05 mm);

b Film removal cutting: The cutting path is marked first and then cut. Simply put, the same path is cut twice, one time with low power to mark and cut the film, and the other time with high power to cut the metal. The film removal width can be adjusted by adjusting the cutting degree in the film removal parameters.

The wider the width, the smaller the chance of the film being blown up.

#### ★Special process layered cutting

The contours of each workpiece are not the same. Some are easy to cut, but some are difficult to cut, such as small holes, sharp corners, etc. To ensure the cutting quality and cutting efficiency of the entire workpiece, we adopt a layered cutting method, so that we can use different process parameters to control the cutting of different contours, which can not only ensure the cutting quality of difficult-to-cut contours but also improve the cutting efficiency of easy-to-cut contours. Layered cutting is mainly divided into continuous wave cutting layer and pulse cutting layer.

★Characteristics of pulse cutting small heat input, small deformation of workpiece, slow cutting speed, high air pressure, and rougher cutting section than continuous wave cutting.

Application: Processing of sharp corners, fine contours, irregular lines (especially lines decomposed from spline curves) and precision parts requiring less thermal deformation.

Pulse cutting is not used for carbon steel with a thickness of more than 4MM, stainless steel with a thickness of no more than 3MM, and pulse cutting is generally not used for aluminum alloys.

LAGUNA

## Maintenance

To ensure the normal use of the laser cutting machine, the equipment must be maintained daily. Since the entire machine tool is composed of high-precision components, special care must be taken during daily maintenance, and the operation procedures of each part must be strictly followed. Maintenance must be performed by a dedicated person, and rough operation is prohibited to avoid damage to components.

### • General Guidelines:

Professional lubrication with the most suitable lubricant is the prerequisite for maintaining the quality of machine tools. This can avoid operating failures and their consequences. In this sense, the following precautions should be observed.

Before putting the machine into operation: Before putting the machine into operation, the machine must be carefully lubricated according to the lubrication instructions. If the machine has not been used for a long time (such as ocean transportation), the lubrication condition of the entire machine must be checked.

### • Lubrication precautions:

The lubrication of the machine tool is carried out according to the lubrication diagram and the description of the lubrication diagram. It is recommended that you also pay attention to the following points:

- ① Do not open the refueling and drain ports for longer than the specified time and keep them always clean.
- ② When cleaning the oil tank and lubrication points, only use a cloth without fiber debris. Do not use waste wool, kerosene, or gasoline. You can use a thin liquid spindle lubricant ("Lubricant recommended model: 32#, 46#, 68# or high-quality guide rail lubricant").

③ It is not allowed to mix synthetic lubricating oil with mineral oil or synthetic oil produced by other manufacturers. This is also true for synthetic oils with the same characteristics produced by other manufacturers.

### • **Cleaning precautions:**

The entire device must be thoroughly cleaned at regular intervals. Visible dirt can be scrubbed or removed with an industrial vacuum cleaner.

### • **Safety Tips:**

① When performing maintenance work, the machine tool must be turned off by the main switch.

② Safety regulations must be strictly observed to avoid accidents.

③ Maintenance supplies that users should always have are as follows:

- Acetone: purity 99.5%, water less than 0.3%, capacity 500ml per bottle.

- Cotton wool: 5 packs.

- Alcohol: 500ml, purity above 99.5%.

- Lens paper: 5 pieces.

- Inflatable ball: one.

- Dropper needle: one (medical use).

- Plexiglass: 200×300×20.

- Inkstone (red): one piece.

- Cotton swabs: two packs.

- Multimeter: one.

- **Daily maintenance and care of peripheral equipment:**

For daily maintenance of peripheral equipment such as chillers, voltage stabilizers and lasers, please refer to the corresponding instruction manuals. The following is only a brief description.

The main function of a high-power chiller is to cool the laser and keep it in a constant temperature working state, so good and regular maintenance is the key to ensure the normal operation of the machine.

At the same time, the circulating water of the chiller must use distilled water, but due to water quality problems, there are still certain impurities such as minerals and dust in the circulating water, and dust in the environment may also enter the circulating water in certain operating links.

The deposition of these impurities will cause the water system and cutting machine parts (such as metal filters, heat exchanger heads in the cutting machine) to be blocked, which will seriously affect the cutting effect and even burn the optical components. Dust and other debris in the environment accumulate on the radiator and water pump of the chiller, which will cause poor heat dissipation of the radiator and water pump, resulting in poor refrigeration, burning of the compressor and water pump, which will also directly affect the cutting effect; therefore, the daily maintenance of the chiller is particularly important; the daily maintenance of various types of chillers must be strictly carried out in accordance with their respective chiller maintenance instructions (see the attached table for details).

LAGUNATOOLS

## Fiber laser cutting machine maintenance

Fiber laser cutting machine needs to do the basic daily maintenance and maintenance to ensure the normal operation of the equipment, reduce possible failures, and prolong the service life of the equipment.

1	Clean the cutting head, protect lens, nozzle.	Clean x, y-axis rack rails and z-axis screw guides	Check the connection of the cutting head	Check that the components in the cabinet are working properly and clean the dust.	Clean water pipe or replace	Replace air filter	Check if ball screw guide rail needs to be replaced
2	make sure machine go to origin	Check if the exchange workbench chain is loose	adjust the temperature of the chiller water (winter 20,25°C, summer 25,28°C)	Check the dustproof cloth of each shaft for damage.	Check relay usage if needed and replace	Replace Chiller Water Filter	Check if you need to change the chain
3	Check laser and nozzle concentricity	Check the filter for undischarged water	check the connection of the servo driver cables	Check whether there is looseness in the rear door panel fixing screw of the exchange table	Cleaning the dust in the electrical cabinet	Replace the aging pipe pipe	Check if you need to change the gear
4	Check operation panel button, emergency stop button	Check the exchange table proximity switch and bracket impact block	Check the air compressor is working properly	If you need an air compressor for maintenance	Clean laser	Check if ball screw guide rail needs to be replaced	Check whether it is necessary to replace the high-pressure gas pipe

5	Check the cutting pressure	Check the surface of each proximity switch for foreign objects	change the chiller water and the filter	Check if the air filter needs to be replaced	Check the cable contact of each line and it is not tight	Check whether the photoelectric switch and proximity switch need to be replaced	Check if safety relay needs to be replaced	
6	check the gas supply, Check for gas leaks and pressure	Clean up slag drawer		Check focus lens, collimate lens if you need to replace	Check cutting blade if needed and replace		Check if you need to replace the computer host	
7	check the chiller system, check for water leaks	Clean up foreign objects on the exchange guide and machine tool			Check focus lens, collimate lens if you need to replace			
8	Check for water leakage	In summer, the chiller is replaced with pure water in time						
9	check the machine for abnormal noise							
10	Z axis screw guide manual oil injection 2 times							
Service engineer :			Signature : ( stamp )			Date:		

## • Laser and laser head maintenance:

The laser is the core equipment in the laser cutting machine. It provides the cutting light source for the laser cutting machine. For your laser cutting machine to work normally and with high quality, and at the same time ensure the reliable operation of your laser and extend the service life of the laser, you are reminded to check and maintain your laser regularly.

Fiber lasers are basically maintenance-free. Daily inspections mainly focus on whether the cooling water and cooling air conditioner are normal, whether the voltage is normal! If there is an abnormal alarm, please contact Laguna Tools service personnel immediately!

## • Precautions for using air compressors:

- 1) The air compressor filter must be clean. If the filter is not clean, the air blown out will contain moisture and oil, which will damage the optical lenses in the laser head, such as the protective lens, focusing lens, collimating lens, etc. In severe cases, the output crystal of the fiber optic device will be damaged.
- 2) Choose branded, high-quality air compressors. Equipped with high-quality cold dryers and 5-stage filtration systems.
- 3) Clean the filter elements of the air compressor every month and replace them with new ones no more than once every six months.

**Warning again: The air filter must be free of oil and moisture,**

**so as not to damage the optical lens.**

## • Protective Lens Maintenance:

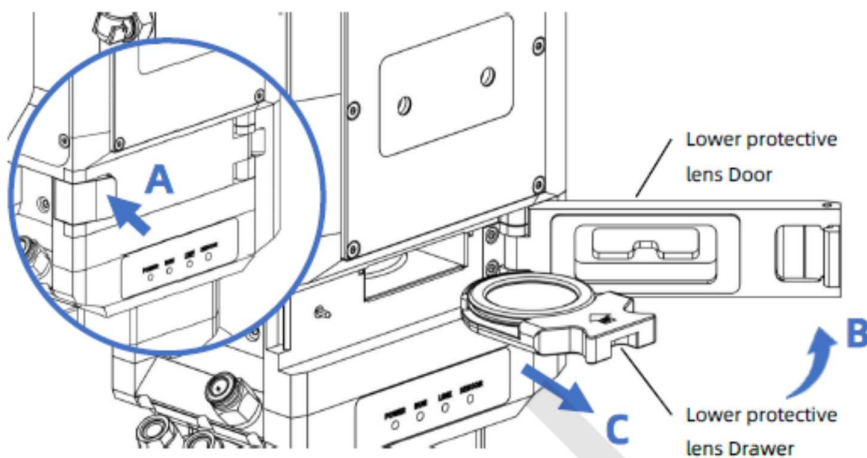
The protective lens is located at the bottom of the centering mold and is easily contaminated by smoke and dust. It is recommended to clean it once a week.

Removal of the protective lens box: Hold the drawer handle of the protective lens box with your thumb, slowly pull out the protective lens box, and then seal the drawer opening with adhesive tape to prevent dust from contaminating the focusing lens.

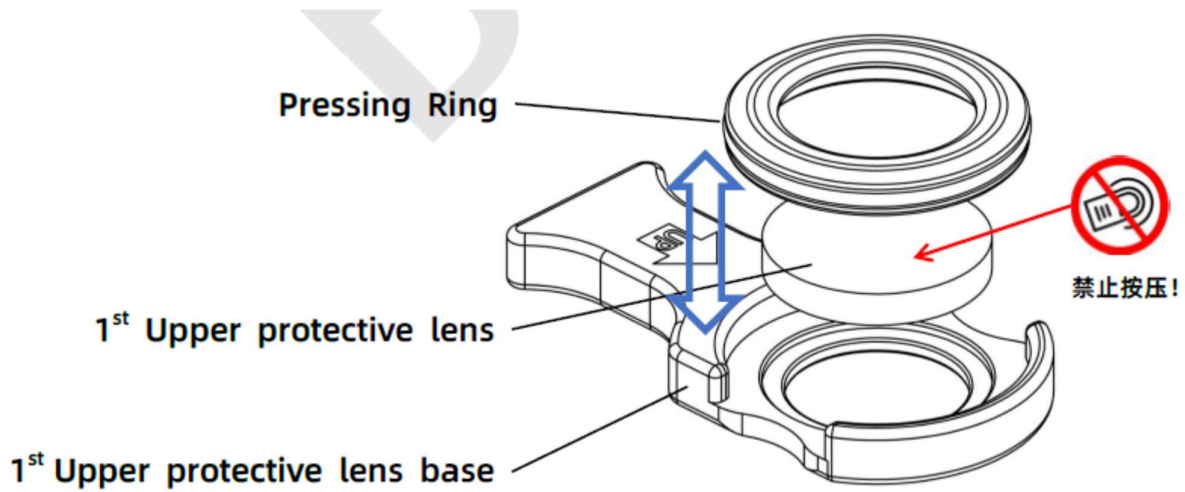
Installation of the protective lens box:

The protective lens is a flat mirror and can be directly placed in the lens box. The order of steps for installing the lens is the opposite of that for removing it. Press the locking button on the drawer handle with your finger, insert it into the drawer box, and the assembly is completed after the locking button pops up.

### 3. Replace Lower protective lens



1. Press the buckle to open the protective door of the lower protective mirror drawer;
2. Pull out the lower protective mirror drawer;
3. Close the protective door of the lower protective mirror drawer to prevent dust from entering;
4. Remove the pressure ring on the protective lens;
5. Replace the lower protective lens;
6. Open the protective door of the lower protective mirror drawer;
7. Insert the lower protective mirror drawer with lens into the inside of the cutting head.



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#### • **Cleaning of lenses:**

A. Tools used: dust-proof gloves/finger required, long-fiber cotton swabs, isopropyl alcohol, and rubber air blower or canned air.

B. Cleaning method:

1. Put finger gloves on the thumb and index finger of your left hand.
2. Spray isopropyl alcohol onto a cotton swab.
3. Use your left thumb and index finger to gently pinch the side edge of the protective lens. Note that the fingertip cannot touch the surface of the lens to avoid leaving marks.
4. Place the lens directly in front of your eyes, hold the cotton swab in your right hand, and gently wipe the lens from bottom to top or from left to right in a single direction (do not wipe back and forth to avoid secondary contamination of the lens), and blow the surface of the lens with a rubber air blower. Clean both sides, and after cleaning, confirm again that there are no residues

of the following: detergent, cotton wool, foreign matter, or impurities.

After cleaning, the lens must not be exposed to the air and should be installed as soon as possible or temporarily stored in a clean sealed container.

- **Replacement of bottom kit:**

1. Unscrew the mechanical part of the sensor and remove it.
2. Replace the new bottom kit and tighten it.
3. Adjust the bottom kit to the desired position.

#### 6.1.1 Nozzle replacement

Unscrew the nozzle by hand, as shown in Figure 9

Replace the new nozzle and tighten it again with appropriate force. The floating head capacitance calibration must be redone after replacement.

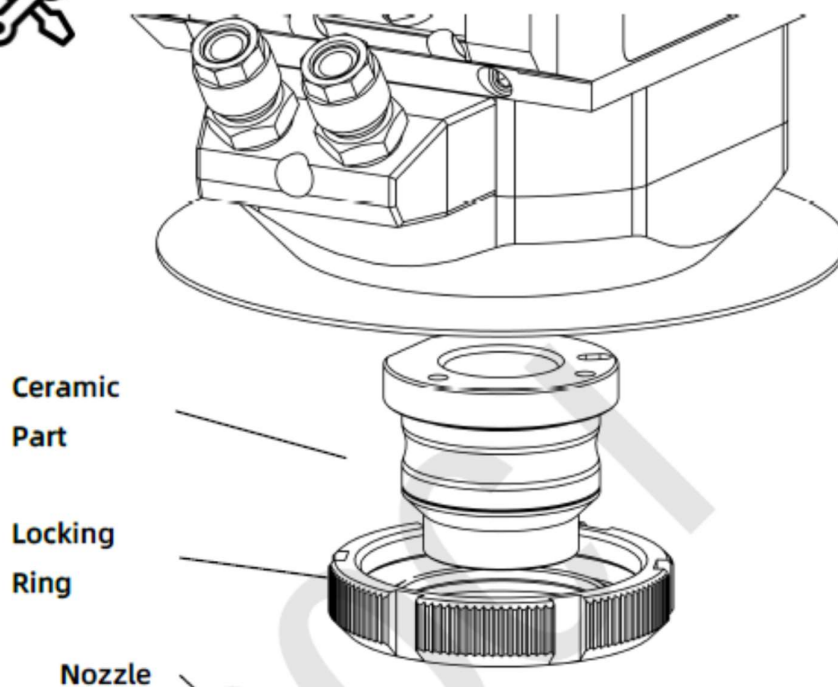
LAGUNA

- **Replacement of ceramic body:**

1. Remove the short cable, take down the mechanical part of the cutting head, and remove the nozzle.
2. Unscrew the ceramic body fastening nut and take out the ceramic body, as shown in Figure 9.
3. Replace the new ceramic body and install it facing the two positioning columns on the mechanical part of the cutting head.
4. Tighten the compression nut firmly and reassemble it on the connector.

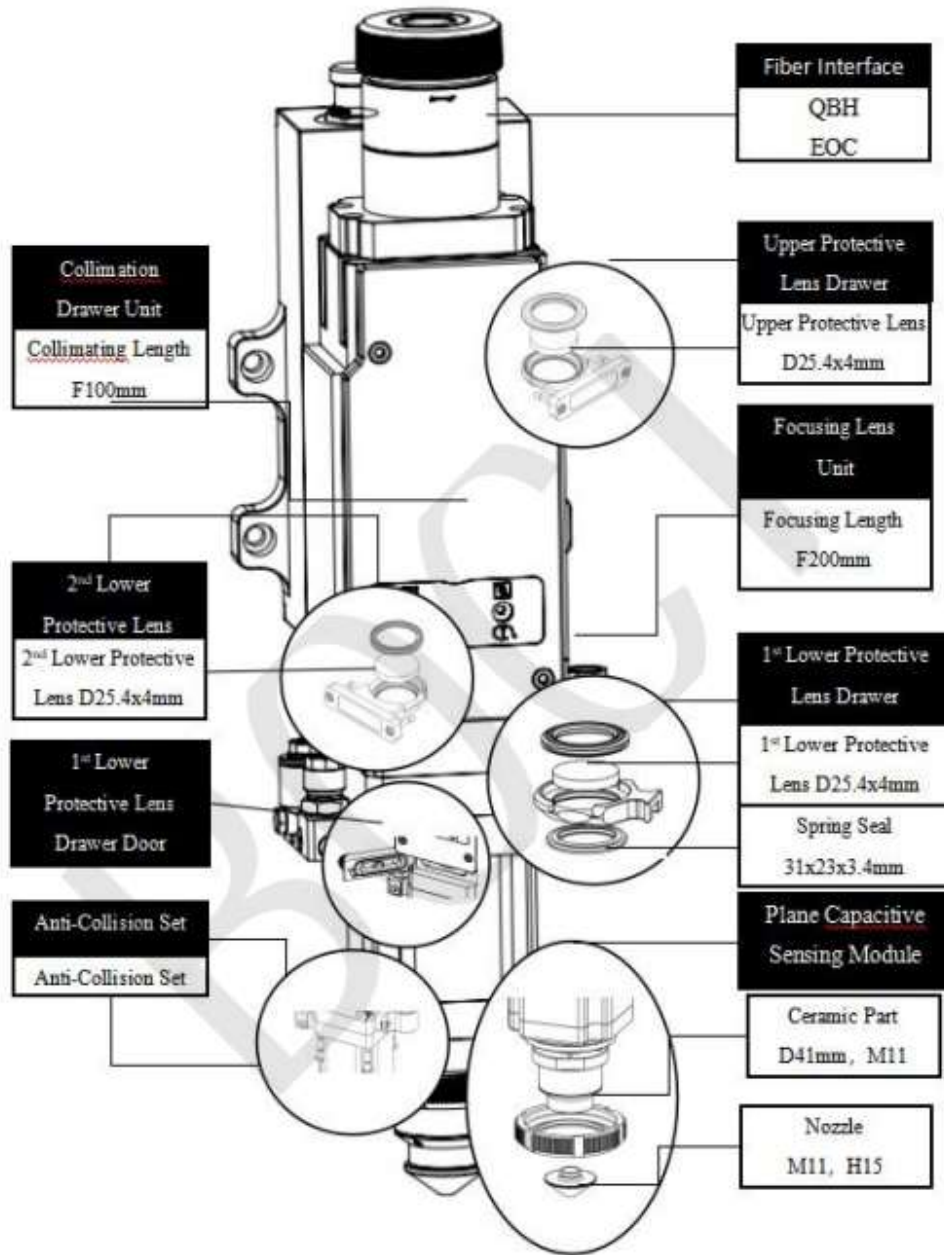


Install the ceramic body and secure with the locking ring, then install the nozzle.



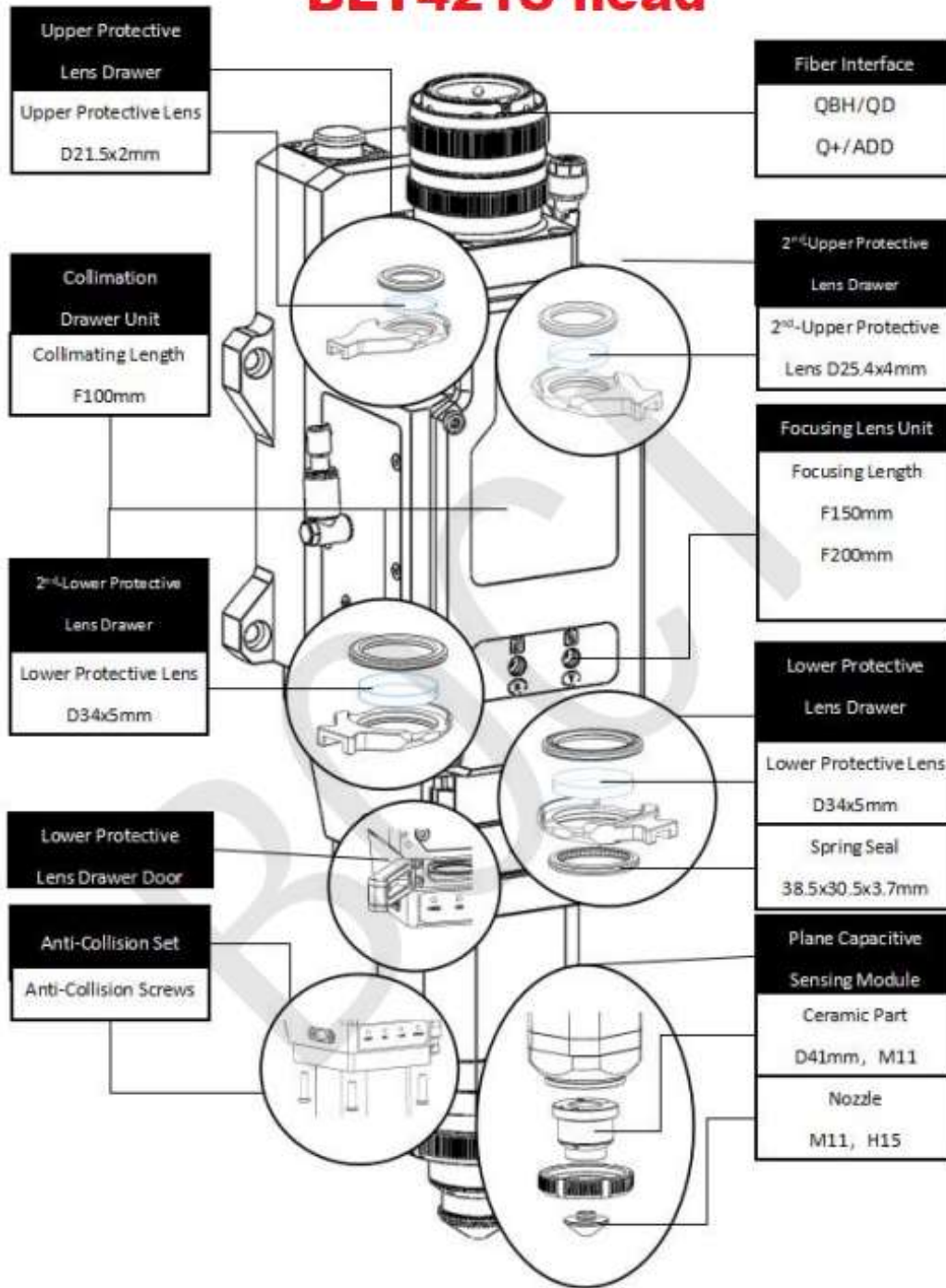
Tightening the nozzle on the ceramic body by hand, Tighten the ceramic locking ring using a wrench.

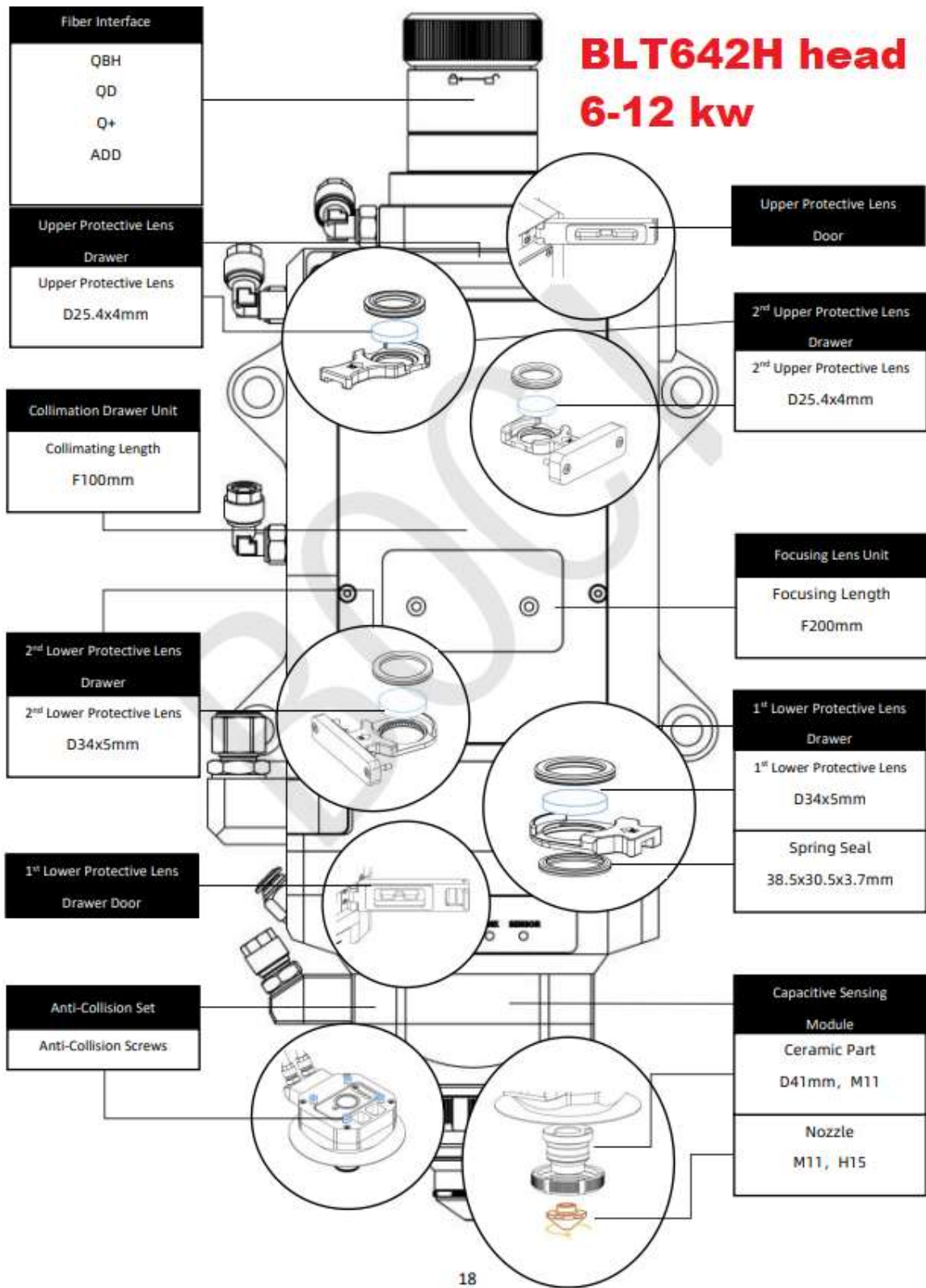
# BLT310 LENS REERENCE



1.1 Schematic diagram of product structure

**BLT421S head**





- Indicator lights on a BOCI Head:

## BLT642H Product Manual

## 1.3 Meaning of LED indicator

icon	state	meaning
<b>POWER</b> 	green	Power is normal.
	red	Under-voltage alarm: insufficient electrical power.
	not	No power supply: There is no power supply, the connection cable is broken, and the
	bright	interface is loose.
icon	state	meaning
<b>RUN</b> 	green	The system is operating normally.
	red	Abnormal motor: The current consumption of the motor is too large, and the mechanical components cannot run smoothly.
	not	The cable is broken, and the interface is loose.
	bright	
icon	state	meaning
<b>LINK</b> 	green	System communication is normal.
	red	System communication is abnormal.
	not	The cable is broken, and the interface is loose.
	bright	
icon	state	meaning
<b>SENSOR</b> 	green	The readings of each sensor are normal.
	red	There is an abnormal sensor reading.
	not	The cable is broken, and the interface is loose.
	bright	

- **Optical system inspection and cleaning:**

To ensure the normal use of the lens, the optical lens (protective lens, focusing lens, collimating lens, etc.) should be checked when parameters need adjusting. Do not touch the lens surface directly with your hands during the inspection, otherwise it will easily cause scratches on the mirror surface. If there is oil stains or dust on the mirror surface, please clean it. Replace if any imperfections persist

1) It is strictly forbidden to use water, detergent, etc. to clean optical lenses. The surface of the lens is coated with a special film. If these are used to clean the lens, the surface of the lens will be damaged.

2) Do not place the lens in a dark and humid place, as this will cause the lens surface to age.

3) The lens surface is stained with dust, dirt, or water vapor, which can easily absorb the laser and cause damage to the lens coating; at the very least, it will affect the quality of the laser beam, and at worst, no laser beam will be generated. Left unattended a damaged lens will destroy the head in production continues.

4) When installing or replacing optical lenses, do not use too much pressure, otherwise it will cause the lens to deform and affect the quality of the light beam.

- **Methods for installing or replacing optical lenses:**

1) Before installing optical lenses, please pay attention to the following: Wear clean clothes, clean your hands with soap or detergent, and wear clean and thin white gloves, or dust free latex gloves; It is strictly forbidden to touch the lenses with any part of your hands; When taking the lenses, you should wear gloves and take them from the side of the lenses, and do not touch the coated surface of the lenses directly.

2) When assembling the lens, do not blow air at the lens with your mouth; the lens should be placed stably on a clean table with a few lens papers underneath. Be as careful as possible when taking out the lens to prevent it from being bumped or dropped, and do not apply any force to the coated surface of the lens; the lens holder should be cleaned, and the dust and dirt in the holder should be cleaned with a clean air spray gun, then take out the lens and gently put it into the holder.

3) When installing the lens to the lens holder, do not use too much force to fix the lens to avoid deformation of the lens, which will affect the quality of the light beam.

4) Precautions when replacing optical lenses: Be very careful when taking out the lenses from the packaging box to avoid damaging the lenses; do not apply any pressure to the lenses before the packaging paper is opened; when taking out the reflector and focusing lens from the packaging box, wear clean gloves and take them from the side of the lens; when removing the packaging paper on the lens, avoid dust and other objects falling on the lens; after taking out the lens, use a spray gun to remove dust on the mirror surface, and then place the lens on special paper for optical lenses; remove dust and dirt from the lens support frame and fixing frame, and avoid other foreign objects falling on the lens during assembly; when installing the lens on the lens holder, do not use excessive force to avoid deformation of the lens; after the lens is assembled, use a clean air spray gun to remove dust and foreign objects from the lens again.

#### b. Steps for cleaning lenses

Different lenses require different cleaning methods. When the mirror surface is flat and has no lens mount, use lens paper to clean it, such as cleaning a reflector; when the mirror surface is

curved or has a lens mount, use a cotton swab to clean it, such as cleaning a focusing lens.

1) Steps to clean the lens with lens paper:

Use a clean air spray gun to blow away dust on the surface of the lens.

Use alcohol or lens paper to clean the surface of the lens. Do not drag the dry lens paper directly on the mirror surface. Instead, place the lens paper flat on the surface of the lens, drop 2 to 3 drops of high-purity alcohol or high-purity acetone, and slowly pull out the lens paper horizontally toward the operator. Repeat the above steps several times until the mirror surface is clean. If the mirror surface is very dirty, fold the lens paper in half 2 to 3 times and repeat the above steps until the mirror surface is clean.

2) Steps to clean the lens with a cotton swab: → Use a spray gun to blow away the dust on the mirror surface first; → Use a clean cotton swab to remove the dirt; → Use a new cotton swab dipped in high-purity alcohol or acetone to scrub the lens in a circular motion from the center of the lens. After each circle of scrubbing, use another clean cotton swab and repeat the above steps until the lens is clean. Never use a used cotton swab for the operation; → Use a clean cloth to clean the lens and remove any traces on the mirror surface. Be careful not to scratch the mirror surface; → Take the cleaned lens to a well-lit place for observation. If the reflection of the lens is good, it means that the lens has been cleaned. If the reflection of the lens is not good, continue to clean the lens; → Place the cleaned lens on the lens holder according to the method described above.

- Storage of optical lenses:

1) Proper storage of optical lenses can maintain the quality of the lenses.

2) The storage environment temperature is 10 ~ 30 °C . The lenses should not be placed in a freezer or similar environment, otherwise condensation and frost will form when the lenses are

taken out, which may easily damage the lenses. The storage environment temperature should not exceed 30°C, otherwise it will affect the coating on the lens surface.

3) Store the lens in the box in a non-vibrating environment, otherwise it is easy to cause the lens to deform, thus affecting the performance of the lens.










- **Maintenance and care during long-term storage:**

When the machine tool is not used for a long time, please apply grease to the moving parts of the machine tool and wrap them with anti-rust paper. For other parts, check whether there is rust regularly, and remove and prevent rust on the rusted parts (if conditions permit, add dust cover), and clean the machine tool regularly, check the linear guide rails and gear racks for maintenance:

Since the two rails use different types of lubricating oil, the equipment also uses two different lubrication methods. The guide rail uses an electric automatic refueling pump to automatically refuel. When the oil level of the automatic oil pump is too low, the system will automatically alarm and add SAE 30W automotive oil to the oil filling port. After the oil filling is completed, reset it. The rack needs to be refueled once every 7 days. The oil used is Mobil 00# lithium-based grease. If the linear slide rail is not properly lubricated, the friction of the rolling part will increase, which will become the main reason for shortening the life after long-term use.

The linear guide rail and sprocket chain grease is lithium-based grease, and Jinguang lithium-based grease MP-3 is recommended.




- Cleaning and maintenance of Chiller:**

Notice		Operation Guideline
 Must-do	The Operation should be carried out by professional technicians	Handling, installation of pipes, electrical, operation, maintenance, overhaul and other operations must be carried out by personnel with professional knowledge.
 Forbidden	It is forbidden to be used beyond the range of specification	It is forbidden to use the equipment beyond the range of manual specifications in order to avoid equipment damage, injury, fire, electric shock and other major accidents.
 Forbidden	It is forbidden to be used in the explosive environment	It cannot be installed in dangerous places with flammable gas.
 Must-do	Electrical connection	a) The power supply must conform to the standard indicated in the nameplate or the manual; b) Use the standard cable, and select the standard wire diameter; c) The grounding wire must be installed and the connection must be reliable; otherwise, it will cause an electric shock or fire.
	It is forbidden to operate the equipment without a cover	There are live parts inside the machine. It is forbidden to operate without a cover, as there is a risk of electric shock.
	Water-proof	Do not allow the equipment to be drenched or immersed in water, otherwise there may be a risk of short circuit and electric shock.
 Must-do	Maintenance and repair	The operation must be carried out after 3 minutes of cutting off the power supply, because the high-voltage charging part in the equipment is not discharged within 3 minutes. Working in a live state or working immediately after shutdown will cause the risk of electric shock.
	Danger High Voltage	Contact with live parts can cause serious personal injury or death.
	Danger Hot Surface	The human body or the heat-labile articles must keep away from this high temperature area. Otherwise, it will cause personal injury or property loss.



**DANGER** Failure to take safety measures will result in death or serious personal injury.

 Must-do	Electrical protection	The power cable terminal must be equipped with the electric leakage and overload protection device according to the rated current indicated on the equipment nameplate.
 Must-do	Stop running in abnormal state	When the equipment is abnormal, as long as the cause is not clear, it is forbidden to start. Otherwise, there is a danger of damage, electric shock, fire, and injury.
 Forbidden	Do not put fingers or other things into the gap of the equipment	There are rotating parts inside the device. Do not put fingers or other things into the gap of the equipment. Otherwise, it will cause personal injury.
 Must-do	Refrigerant leakage	<p>a) When the refrigerant leaks, please make sure that the ventilation is available. Otherwise, it may cause anesthesia and suffocation if a large amount of refrigerant fills the enclosed space;</p> <p>b) Avoid contacting with skin, or it will cause frostbite.</p>
 Must-do	Transport	<p>a) The equipment should be fixed firmly before transportation to prevent the equipment from moving due to vibration and external forces. If there is excessive vibration and external force, the internal equipment may be damaged.</p> <p>b) Tilt angle should be <math>\leq 45^\circ</math>. Otherwise, the refrigeration system will fail.</p>
 Forbidden	Operating environment	<p>a) It is forbidden to use in special environments such as high temperature, humidity, strong electromagnetic interference, etc.</p> <p>b) The equipment must be installed in a place where there is no direct sunlight and away from the fire sources.</p>
 Must-do	Installation	<p>a) The equipment must be installed on a horizontal surface. Otherwise, the refrigeration system will fail;</p> <p>b) It is forbidden to place objects within 1 meters around the air inlet and 1.5 meters around the air outlet. If the air inlet and</p>

 <b>Must-do</b>	<p>Clean the air filter regularly</p>	<p>Clean the air filter at least once a week. If it is blocked, the cooling ability will decrease and the power consumption will increase, and the alarm will not work properly.</p>
 <b>Must-do</b>	<p>Equipment surface cleaning</p>	<p>a) Please use cleaning agents that are non-corrosive to metals and plastics;  b) Please keep the cleaning agent properly after cleaning to prevent liquid leakage;  c) The container for storing the cleaning agent must be sealed completely to avoid danger.</p>
 <b>Forbidden</b>	<p>No air blowing at the water outlet</p>	<p>A temp sensor is installed inside the water inlet, and it is forbidden to blow air inside the device with an air gun.</p>

# LAGUNA

The main function of the water chiller is to protect the laser power supply and cutting head by controlling the water temperature and ensure the normal operation of the laser equipment. It is an important accessory, and attention must be paid to its cleaning and maintenance.

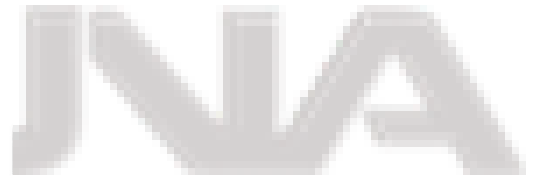
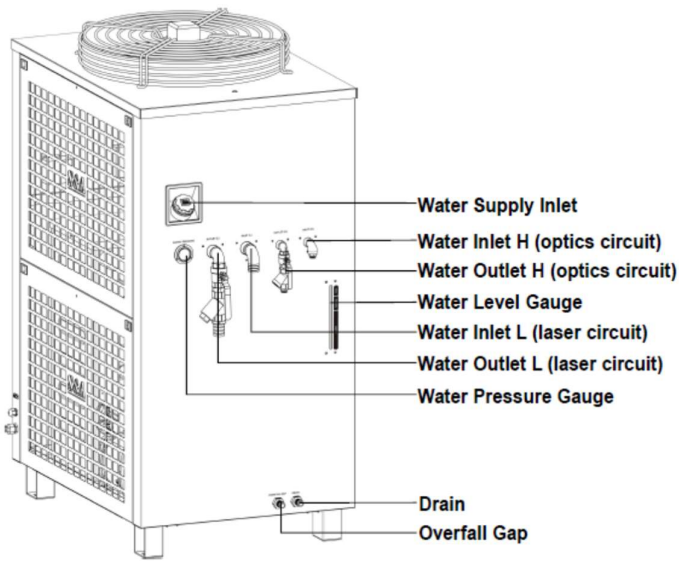
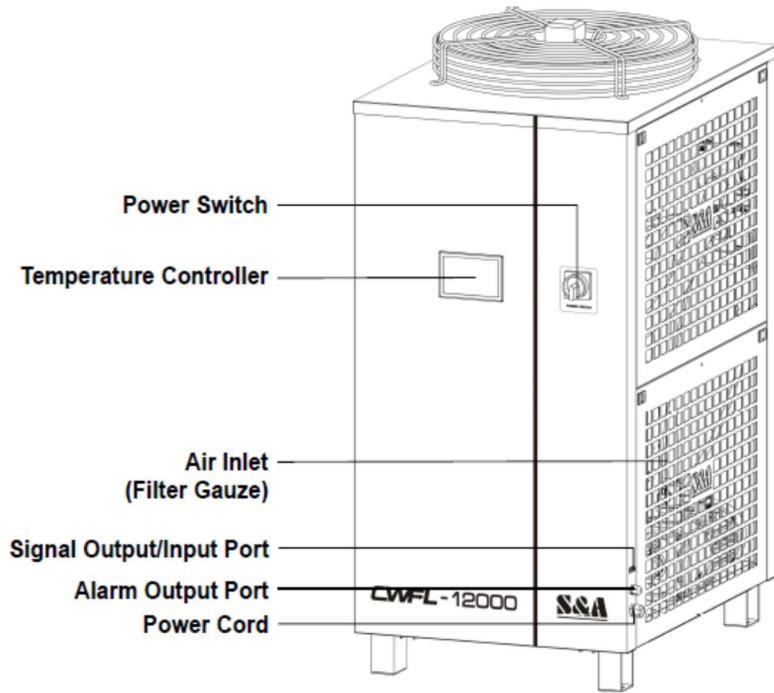
1. The filter needs to be cleaned every day to ensure good ventilation and heat dissipation to ensure normal water temperature.

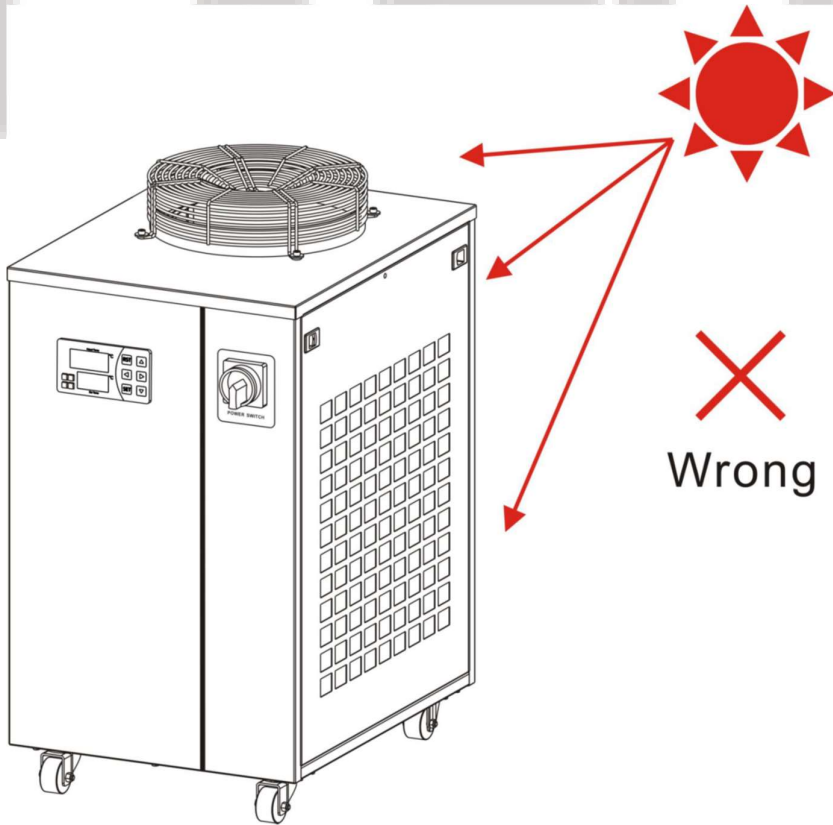
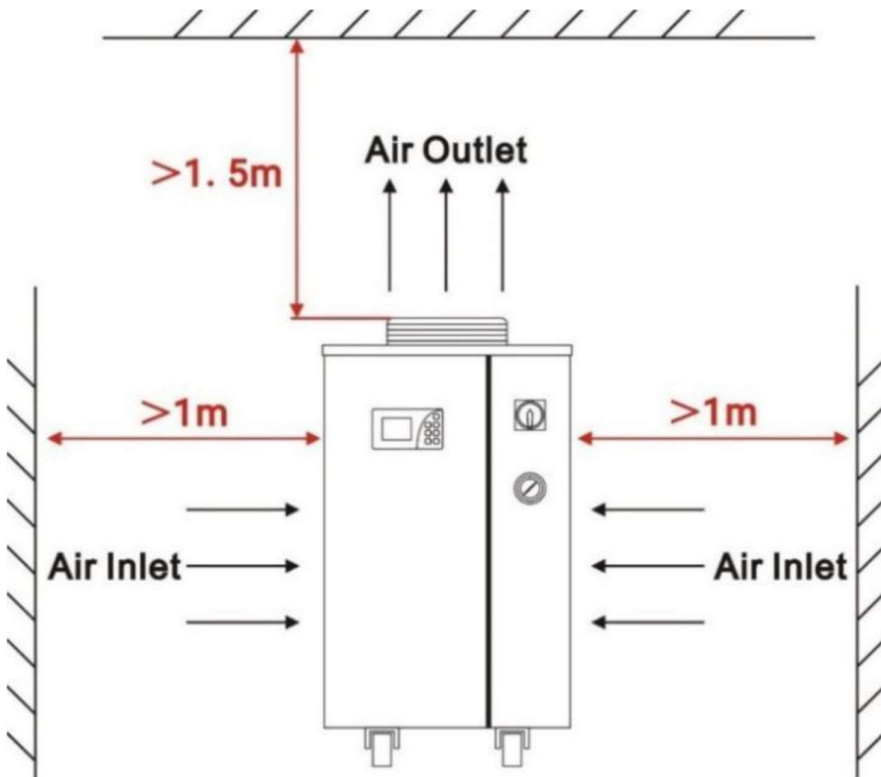
2. The temperature of the water tank is generally maintained at 22°C to 28°C (in summer, the high temperature is set to 28-35 °C, and the low temperature is set to 26-29 °C. Note that the temperature difference between the equipment temperature and the external environment temperature cannot be greater than 5°C. Please adjust it in time in summer, otherwise it will have a serious impact on the equipment). [As shown below]

3. Change the water every 3 months (note be sure to use distilled water, Watsons distilled water is recommended). Before changing the distilled water each time, clean the water tank, circulate the dirty water in the equipment with new distilled water, and then refill it with distilled water.

◆Cleaning and maintenance of electric cabinet:

1 Clean the filter of the electric cabinet every week. You can use compressed air or water to clean it. If the filter is too dirty, please replace it.





T-803A Alarm Code Table:

Working status	Display	Error code	Buzzer	OUT H1、H2	OUT H1、H3
Circulation pump works properly				Disconnection	Breakover
Ambient temp sensor failure		E01	Sounds	Breakover	Disconnection
Water temp sensor failure of laser circuit		E02	Sounds	Breakover	Disconnection
Water temp sensor failure of optics circuit		E03	Sounds	Breakover	Disconnection
Power phase loss alarm		E08	Sounds	Breakover	Disconnection
Power anti-phase alarm		E09	Sounds	Breakover	Disconnection
Liquid level alarm		E10	Sounds	Breakover	Disconnection
Compressor pressure switch alarm		E12	Sounds	Breakover	Disconnection
Switch type flow alarm of laser circuit		E13	Sounds	Breakover	Disconnection
Switch type flow alarm of optics circuit		E14	Sounds	Breakover	Disconnection
Pump overload alarm		E16	Sounds	Breakover	Disconnection
Sensor type flow alarm of laser circuit		E17	Sounds	Breakover	Disconnection
Sensor type flow alarm of optics circuit		E18	Sounds	Breakover	Disconnection
Compressor overload alarm		E19	Sounds	Breakover	Disconnection
Ultrahigh room temp alarm		E31	Sounds	Disconnection	Breakover
Ultrahigh water temp alarm of optics circuit		E35	Sounds	Breakover	Disconnection
Ultrahigh water temp alarm of laser circuit		E45	Sounds	Breakover	Disconnection
Ultralow water temp alarm of optics circuit		E53	Sounds	Breakover	Disconnection
Ultralow water temp alarm of laser circuit		E54	Sounds	Breakover	Disconnection

T-803B Alarm Code Table:

Working status	Display	Error code	Buzzer	OUT H1、H2	OUT H1、H3
Circulating pump works properly				Disconnection	Breakover
Ultrahigh room temp alarm		E01	Sounds	Breakover	Disconnection
Ultrahigh water temp alarm of laser circuit		E02	Sounds	Breakover	Disconnection
Ultralow water temp alarm of laser circuit		E03	Sounds	Breakover	Disconnection
Room temp sensor failure		E04	Sounds	Breakover	Disconnection
Water temp sensor failure of laser circuit		E05	Sounds	Breakover	Disconnection
Switch type flow alarm of laser circuit		E06	Sounds	Breakover	Disconnection
Sensor type flow alarm of laser circuit		E07	Sounds	Breakover	Disconnection

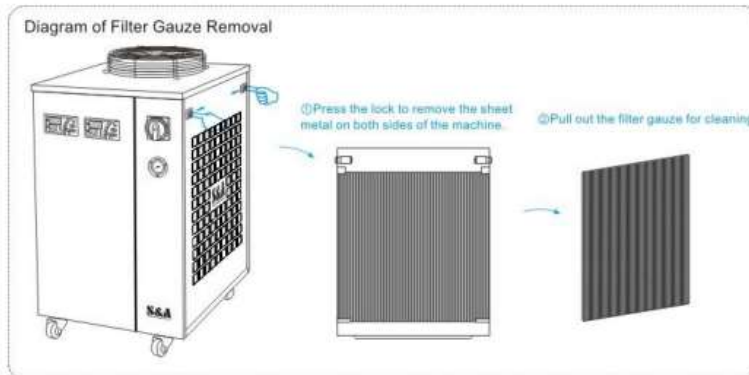
Ultrahigh water temp alarm of optics circuit	E08	Sounds	Breakover	Disconnection
Ultralow water temp alarm of optics circuit	E09	Sounds	Breakover	Disconnection
Water temp sensor failure of optics circuit	E10	Sounds	Breakover	Disconnection
Switch type flow alarm of optics circuit	E11	Sounds	Breakover	Disconnection
Sensor type flow alarm of optics circuit	E12	Sounds	Breakover	Disconnection
Power phase loss protection	E13	Sounds	Breakover	Disconnection
Power anti-phase protection	E14	Sounds	Breakover	Disconnection
Liquid level protection	E15	Sounds	Breakover	Disconnection
Compressor pressure switch alarm	E17	Sounds	Breakover	Disconnection
Compressor current overload	E19	Sounds	Breakover	Disconnection
Water pump overload alarm	E25	Sounds	Breakover	Disconnection

## VII. Maintenance

The equipment must be shut down for maintenance, and the power supply must be cut off. The operation can only be carried out after 3 minutes, otherwise there will be a risk of electric shock. When the room temperature is lower than 2°C, the internal water must be drained when the machine is shut down for a long time.

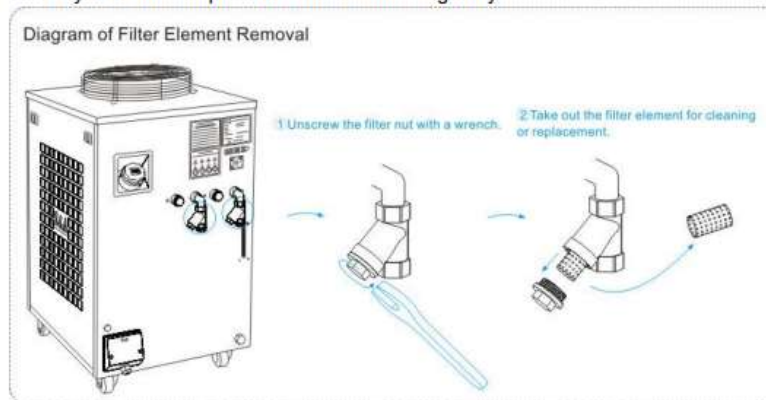
### 1. Remove Dust Regularly

Regularly disassemble the filter gauze for cleaning and use a compressed air gun to blow away the dust on the condenser (about 1 week is suggested and the air filter must not be missing for a long time).



### 2. Guarantee Water Quality

A certain amount of impurities will accumulate in the filter element over a period of time, which will cause a decrease in water flow, or even a secondary pollution. Therefore, it is necessary to clean or replace the filter element regularly.



2. Dust the cabinet every three months. If the environment is bad, dust once a month. When dusting, turn off all power and open the doors on both sides of the power supply chassis. Do not touch the electronic components in the cabinet directly. Use a vacuum cleaner to clean the dust in the cabinet (do not use compressed air).
3. cleaning. Please use clean dry cloth for cleaning.

## Common fault analysis

### • Cutting process issues:

Any thermal cutting technology, except for a few cases where it can start from the edge of the plate, generally requires a small hole to be punched in the plate. Previously, on the laser stamping composite machine, a punch was used to punch out a hole first, and then the laser was used to start cutting from the small hole. For laser cutting machines without stamping devices, there are two basic methods of perforation: blasting perforation - the material is irradiated with continuous laser to form a pit in the center, and then the oxygen flow coaxial with the laser beam quickly removes the molten material to form a hole. Generally, the size of the hole is related to the thickness of the plate. The average diameter of the blasting perforation is half the thickness of the plate. Therefore, the blasting perforation of thicker plates has a larger diameter and is not round. It is not suitable for parts with high processing accuracy requirements and can only be used for waste. In addition, since the oxygen pressure used for perforation is the same as that for cutting, the spatter is large. Pulse perforation - a pulsed laser with high peak power is used to melt or vaporize a small amount of material. Air or nitrogen is often used as an auxiliary gas to reduce the expansion of the hole due to exothermic oxidation. The gas pressure is lower than the oxygen pressure during cutting. Each pulse laser only produces a small particle jet, which gradually penetrates deeper, so it takes several seconds to perforate a thick plate. Once the perforation is completed, the auxiliary gas is immediately replaced with oxygen for cutting. In this way, the perforation diameter is smaller, and the perforation quality is better than that of blasting perforation. The laser used for this purpose should not only have a high output power; more importantly, the time and space characteristics of the beam, so general transverse flow

lasers cannot meet the requirements of laser cutting. In addition, pulse perforation also requires a more reliable gas path control system to achieve the switching of gas types, gas pressure and perforation time control. In the case of pulse perforation, to obtain high-quality incisions, the transition technology from pulse perforation when the workpiece is stationary to the constant speed continuous cutting of the workpiece should be paid attention to. In theory, the cutting conditions of the acceleration section can usually be changed, such as focal length, nozzle position, gas pressure, etc., but in fact, it is unlikely to change the above conditions because the time is too short. In industrial production, it is more realistic to mainly use the method of changing the average power of the laser. The specific methods are: changing the pulse width; changing the pulse frequency; changing the pulse width and frequency at the same time .

- **Analysis of deformation during cutting of small holes (small diameter and plate thickness)**

This is because the machine tool (only for high-power laser cutting machines) does not use the blasting perforation method when processing small holes but uses the pulse perforation (soft puncture) method, which makes the laser energy too concentrated in a small area, and burns the non-processing area, causing the hole to deform and affecting the processing quality. At this time, we should change the pulse perforation (soft puncture) method to the blasting perforation (ordinary puncture) method in the processing program to solve it. For lower-power laser cutting machines, it is just the opposite. When processing small holes, pulse perforation should be used to obtain better surface finish.

### • **Solution to burs on workpieces when laser cutting low carbon steel:**

- 1) According to the working and design principles of laser cutting, the following reasons are analyzed to be the main causes of burs on processed parts:
- 2) The upper and lower positions of the laser focus are incorrect, and a focus position test is required to adjust according to the focus offset.
- 3) The output power of the laser is not enough. You need to check whether the laser generator is working normally. If it is normal, observe whether the output value of the laser control button is correct and adjust it.
- 4) The cutting line speed is too slow, and the line speed needs to be increased during operation and control.
- 5) The purity of cutting gas is not enough, high-quality cutting working gas needs to be provided.
- 6) The laser focus is offset, so it is necessary to do a focus position test and adjust based on the focus offset.
- 7) The machine tool becomes unstable when it runs for too long and needs to be shut down and restarted.

### • **Analysis of burs on workpieces during laser cutting of stainless steel and galvanized steel:**

When the above situation occurs, the first thing to consider is the burr factor when cutting low-carbon steel, but you cannot simply increase the cutting speed, because increasing the speed sometimes causes the plate to not be cut through, which is particularly prominent when processing aluminum-zinc coated plates. At this time, other factors of the machine tool should

be considered comprehensively to solve the problem, such as replacement of the spray gun, unstable movement of the guide rail, etc.

### • **Analysis of the laser incomplete cutting state:**

After analysis, it can be found that the following situations are the main causes of unstable processing:

- 1) The selection of laser head nozzle does not match the thickness of the processed plate.
- 2) The laser cutting line speed is too fast, and the operator needs to control and reduce the line speed.
- 3) Inaccurate nozzle sensing leads to large errors in laser focus position, and the nozzle sensing data needs to be re-tested, which is most likely to occur when cutting aluminum.



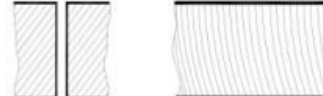
### • **Solution to abnormal sparks when cutting low carbon steel:**

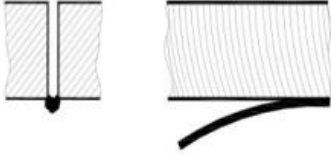
This situation will affect the quality of the cut section finish of the part. At this time, if other parameters are normal, the following situations should be considered:

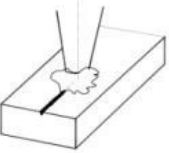


- ① the laser head Nozzle is worn out, and the nozzle should be replaced in time.
- ② If there is no new nozzle to replace, the cutting working gas pressure should be increased.
- ③ the thread connecting the nozzle and the laser head is loose. At this time, you should immediately stop cutting, check the connection status of the laser head, and re-thread it.



## • Summary of cutting process defects:

### Carbon steel oxygen cutting

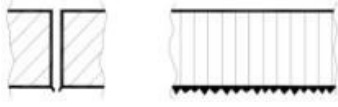

Phenomenon	reason	Workaround
<p>No burrs, good cutting</p> 	<p>Correct power</p> <p>Correct cutting speed</p>	
<p>The cut direction deviates at the bottom, and the cut bottom is wider</p> 	<p>Cutting speed is too high</p> <p>Laser power is too low</p> <p>Auxiliary gas is too low</p> <p>Focus position is high</p>	<p>Reduce cutting speed</p> <p>Increase laser power</p> <p>Increase gas pressure</p> <p>Lower the focus position</p>
<p>There are burrs similar to slag on both sides of the bottom of the cut, in the shape of water drops, which are easy to remove</p> 	<p>Cutting speed is too high</p> <p>Low air pressure</p> <p>Focus position is high</p>	<p>Adjust cutting speed</p> <p>Increase gas pressure</p>


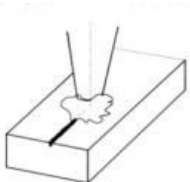
<p>The slag on both sides of the bottom of the cut sticks together</p>	<p>Focus position is high</p>	<p>Lower the focus position</p>
		
<p>The slag on both sides of the bottom of the kerf is difficult to remove</p>	<p>Cutting speed is too high</p> <p>Auxiliary pressure is too low</p> <p>Focus position is high</p> <p>Impurities in the gas</p>	<p>Reduce speed</p> <p>Increase gas pressure</p> <p>Adjust the focus position</p> <p>Use gases that meet purity requirements</p>
<p>Burr only on one side of the bottom of the kerf</p>	<p>Nozzle center is not good</p> <p>Nozzle hole is not round</p>	<p>Adjust the nozzle center</p> <p>Replace the nozzle</p>

<p>Blue plasma gas is generated, and the workpiece cannot be cut through</p> 	<p>Assist gas indirect</p> <p>Cutting speed is too high</p> <p>Power is too low</p>	<p>Use the required assist gas</p> <p>Reduce cutting speed</p> <p>Increase power</p>
<p>Irregular cutting surface</p> 	<p>Gas pressure is too high</p> <p>Nozzle damage</p> <p>Nozzle diameter is too large</p>	<p>Focus position</p>
<p>No burrs, the cut is tilted backwards, and the bottom of the cut is narrow</p> 	<p>Cutting speed is too high</p>	<p>Reduce cutting speed</p>

<p>There are pits on the cut surface</p> 	<p>Too much gas pressure</p> <p>Cutting speed is low</p> <p>High focus position</p> <p>Material surface corrosion</p> <p>Overheating of material</p> <p>Impurities in the material</p>	<p>Reduce other pressures</p> <p>Increase cutting speed</p> <p>Lower the focus position</p> <p>Use good materials</p>
<p>The cut surface is very rough</p> 	<p>Low focus position</p> <p>Higher gas pressure</p> <p>Cutting speed is too low</p> <p>Overheating of material</p>	<p>Improve the focus position</p> <p>Reduce gas pressure</p> <p>Increase cutting speed</p> <p>Material cooling</p>

- Stainless steel high pressure nitrogen cutting:

Phenomenon	reason	Workaround
<p>There are small regular burrs on both sides of the cut</p> 	<p>Focus position is too low</p> <p>Cutting speed is too high</p>	<p>Improve the focus position</p> <p>Reduce cutting speed</p>
<p>There are long, irregular burrs on both sides of the cut.</p> 	<p>Cutting speed is too low</p> <p>Focus position is too high</p> <p>Gas pressure too low</p> <p>Material is too hot</p>	<p>Increase cutting speed</p> <p>Lower the focus position</p> <p>Increase gas pressure</p>

		Cooling material
<p>There are only long irregular burs on both sides of the slit</p> 	<p>Nozzle not in center</p> <p>Focus position is too high</p> <p>Gas pressure too low</p> <p>Cutting speed is too low</p>	<p>Adjust the nozzle</p> <p>Lower the focus position</p> <p>Increase gas pressure</p> <p>Increase cutting speed</p>
<p>Cutting edge yellow</p>	<p>Nitrogen is impure and contains oxygen</p>	<p>Use high purity nitrogen</p>
<p>Plasma gas is generated, and the workpiece cannot be cut through</p> 	<p>Cutting speed is too high</p> <p>Laser power is too low</p> <p>Focus position is too low</p>	<p>Reduce cutting speed</p> <p>Increase laser power</p> <p>Improve the focus position</p>
<p>Beam interruption</p>	<p>Cutting speed is too high</p> <p>Laser power is too low</p>	<p>Reduce cutting speed</p> <p>Increase laser power</p> <p>Improve the focus</p>

	Focus position is too low	position
Rough cut	Nozzle damage Lens contamination	Replace the nozzle Clean or replace lenses

**ACTUAL FIBER IMAGE (CLEAN)**

1. Quartz Block  
2. Fiber Cladding  
3. Fiber Core

**POSSIBLE FIBER QUARTZ BLOCK DAMAGE**

<b>Surface Damage</b>	<b>Coating Damage</b>	<b>Scratches</b>



- **Back Reflection Error:**

Highly reflective material can be difficult to process for solid-state lasers including fiber lasers, since the typical emitted wavelength of commonly used industrial systems (in the range of 1,030 to 1,080 nm) is mostly reflected by the workpiece rather than absorbed. However, some energy is absorbed which generates a local hot spot which has increased absorption, allowing a greater proportion of the incident beam to be absorbed and a stable process to be established.

## Common alarms and potential solutions

Alarm Name	Possible Reason	Inspection and Solution
Capacity is 0	RF wire issue, such as a loose or damaged connection, or incorrect wire being used.	Check if the RF wire is the original one from the SIP card. If not, replace it. If it is, use a multimeter to test the wire's continuity and check for shorts between the inner core and outer casing.
Servo alarm	Servo is not turned on, or there is a problem with the servo wiring.	Check the servo's power and ensure all servo plugs are properly connected.
Limit alarm	A limit switch has been triggered (e.g., Y+ Limit or Z+ Limit).	Check the physical limit switch and the machine's positioning. The Z axis may have reached its highest or lowest point.
Communication timeout	Internet cable is not connected properly or the higher sensor did not open.	Re-set the higher sensor's IP address and check the internet cable connection.



## Yaskawa Servo Alarms.

1	oc1	Over Current 1
	oc2	Over Currant 2
2	o5	Over Speed
3	Hu	Over Voltage
4	Et1	Encoder Trouble 1
	Et2	Encoder Trouble 2
5	ct	Circuit Trouble
6	dE	Memory Error
7	cE	Motor Combination Error
8	tH	Braking Transistor Overheat
9	Ec	Encoder Communication Error
10	ctE	Control Signal Error
11	oL1	Overload 1
	Ol2	Overload 2
12	LuP	Main Power Umdr Voltage
13	rH1	Internal Braking Resistor Overheat
14	rH2	External Braking Resistor Overheat
15	oF	Braking Transistor Error
16	AH	Deviation Overflow
17	EH	Amplifier Overheat
18	dL1	Absolute Data Lost 1
19	dL2	Absolute Data Lost 2
	dL3	Absolute Data Lost 3
20	AF	Multi-turn Data Overflow
21	,E	Initial Error

# Laguna Tools Warranty Policies

## CNC Limited Warranty

New CNC machines sold by Laguna Tools carry a one-year warranty effective from the date of shipping. Laguna Tools guarantees all new machines 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 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. woodworking machine.
- Warranty may be 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 or licensing must be managed through the software provider.
- Normal user alignment, adjustment, tuning, and machine settings are not covered by this warranty. It is the responsibility of the user to understand basic woodworking machinery settings and procedures and to properly maintain the equipment in accordance with the standards provided by the manufacturer.
- Laguna Tools is not responsible for lost earnings due to a machine being inoperative or in need of repair.
- Spindles and bearings are not covered due to severe conditions or operating outside the duty cycle.
- 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](tel:1-800-332-4094).

**Laser warranty exclusions:**

- 1. Damage to head, or Optic cable due to lack of volume or contaminated assist gas.**
- 2. Damage to components from misuse or lack of maintenance and cleaning.**
- 3. Operation of the machine by untrained employees.**
- 4. Operating the machine outside of its capabilities or beyond its duty cycle.**
- 5. Failure to use Distilled or deionized water will void warranty of power supply, chiller, and head.**
- 6. Optic failure due to back reflection errors will void power supply and Optic warranty.**
- 7. The machine must be kept and operated in a proper environment to maintain warranty.**

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. woodworking machine. Warranty maybe voided upon the addition of such described tools and/or modifications, determined on a case-by-case basis. Normal user alignment, adjustment, tuning and machine settings are not covered by this warranty. It is the responsibility of the user to understand basic woodworking machinery 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.

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