BESCUTTER
Powered by Laser

Accu Star

Fiber Laser Cutting Machine Series
Product Manual

Copyright Statement

Disclaimer and Responsibility Statement

Whole using the machine from our company, users are required to ensure integrity and independence of the product including but not limited to: mechanical, electrical, optical, control software and accessories. Unauthorized modification is strictly prohibited. It is a must to satisfy operating environment and operating specifications specified in the owner's manual. For the followings:

1. Machine modified with no authorization (including but not limited to: add, remove, modify, unauthorized disassembly, replacing parts);
2. Use the machine in the environment failing to satisfy the operating requirements;
3. Operate disobeying the specifications of our company;
4. Unauthorized use the machine parts, accessories and auxiliaries on to other machine or in other places;
5. Viciously disassemble, destroy, decode hardware and software of the machine from our company.

Our company shall not undertake any direct, indirect or joint responsibility. Our company reserves the rights to ascertain legal responsibility for the serious consequences or economic losses or reputation losses caused by what mentioned above.

Foreword

Thank you for choosing our laser equipment!

Before operating, please read this manual carefully to ensure proper use of your equipment.

Please keep this manual properly for future reference.

Due to different configurations, certain models might not have certain features listed in this manual. The actual product shall prevail.

Due to constant improvement, certain content of this manual might be inconsistent with the actual product, which shall prevail.

The symbol conventions in this manual:

Attention	The content requires special attention and the user must abide by, or else it will cause error or serious problems.

 Tip	Prompt the user to pay attention or suggest the user to abide by, which will be more convenient and efficient.

 Alarm	For a particular case there is no dedicated staff to guide the operation could lead to catastrophic happens.

Safety Precautions

Attention	Before using the machine, users are required to carefully read this manual and other operating requirements, strictly abide by the operating specifications. Professional are required for operating the machine.
 Alarm	The machine uses class 4 laser (strong laser radiation). The laser radiation may possibly cause the following accidents: ◆ Emblaze the surrounded flammable materials; ◆ Generate other radiations and toxic or hazardous gas by processed objects during laser processing; ◆ Direct irradiation of laser radiation cause harm to human body. Therefore, firefighting devices are required in the operating place of the machine. Stacking flammable or explosive objects near the machine is strictly prohibited. Good ventilation is a must. Only the qualified personnel are authorized to approach the machine.
 Tip	The processed objects and discharged materials are required to satisfy requirements as per local laws and regulations.
 Alarm	◆ Laser processing is with potential risks. Users should carefully make sure if the processed objects are suitable for laser processing; ◆ There is high voltage and potential risk in the laser machine. Unauthorized disassembly by unqualified personnel is prohibited; ◆ Reliable earthing is required for the machine and related other machine before power-on; ◆ During operating, removing any cover of the machine is strictly prohibited; ◆ During operating, the operators are required to observe working status of the machine all the time. In case of any abnormality, it is immediately to disconnect power supply and take active and corresponding measures. ◆ After power-on, special personnel are required for monitoring. Unauthorized leaving is strictly prohibited; ◆ It is a must to disconnect the power supply before leaving.
 Alarm	It is strictly prohibited to placing any unrelated all-reflective or diffusion reflective objects in the machine to prevent laser reflecting to human body or flammable materials.
Attention	◆ The environment for the machine should be dry, free of interference and influences from pollution, vibration, high voltage and strong magnet. The operating ambient temperature ranges 5-40℃, and the humidity ranges 5-85% (no dew); ◆ The machine should be far from electric appliances sensitive to electromagnetic interference; ◆ Operating voltage: Three-phase AC380V/60Hz. Three-phase five-wire, 380V and 220V loads exist simultaneously. Power-on is strictly prohibited in case of unstable voltage of the power grid or unspecified voltage; ◆ Voltage regulator should be provided by the customer.

Attention	Chapter of this manual for Safety Rules. Please refer to the chapter more details concerning safe operation of the machine. Users are required to carefully read and abide by all the requirements of safety.

Chapter1 Product Introduction

1.1 Summary

Accu Star fiber laser cutting machine is a professional equipment for metal plate processing. It can be used with 1000W, 1500W, 2000W, 3000W and 4000W fiber laser for different customer's needs. This equipment has the characteristics of high machining precision, high efficiency and smooth incision. It can completely replace the traditional processing method of punching machine. This equipment adopts imported well-known laser and moving parts. The frame is welded and annealed by steel frame, which ensures high efficiency, high precision and high stability in the process of machining

1.2 Product specifications

Working Area:	60" x 120 " (1525 mm x 3050 mm)
Laser Power:	1000 W / 1500 W / 2000 W
Laser Wavelength:	1.07 um
Beam Quality:	<0.373 mrad
Laser Head:	RayTools (Auto Focus)
Control System:	CypCut BCS 100
Cooling System:	CWFL-1000, CWFL-1500, CWFL-2000 or Comparable
Driving System:	Pinion and Rack
XYZ Servo Motors:	Schneider Y 2x1500W, X 1x1000W, Z 1x400W
Max Speed:	39.4in/s - 2362in/min - 60m/min
Power Supply:	Three phase 208V/ 240V/ 480V (transformer included)
Overall Size:	197"L X 92"W x 70"H
Weight:	6614 lbs
Format supported:	DXF, LXD, PLT, AI, G-CODE (NC) etc.

1.3 Operating environment

Temperature:	41 – 104 °F (5 – 40 °C)
Humidity	5 – 85%, no dew
Grounding	Grounding resistance should be less than 5Ω
Shop air pressure	90 – 110 psi
Environment of the equipment	Dry, smoke-free, dust-free, pollution-free and vibrate free

Chapter2 Safety Rules

This chapter mainly introduces safety warnings for protecting personnel and the machine, and makes an introduction to signs used in the owner's manual. The machine is already equipped with sufficient safety guarantee, yet it is still with certain risk. All the operators are required to carefully read through and well understand the safety rules.

2.1 Safety overview

- Be aware of safety knowledge of fiber lasers and focus on safety precautions.
- Be aware of the possible danger.
- Operators are required to wear protective clothing and gloves when necessary. The requirement is mainly applied when taking out the thermal workpiece by using suitable tools in this situation. It is necessary to wear appropriate laser protective glasses by principle under the maintenance service operation mode (level-4 laser device). Wear a dust mask that clings to the face by principle (anti-toxic-particle and dust-proof mask with filter grade P3) when operating the dust collector.
- Responsibilities of operation, maintenance, overhaul, etc. should be clearly defined to avoid unclear definition of safety issues.
- Read the technical literature of the equipment. We recommend that the user should require for a written confirmation of reading and understanding the technical literature from the operator each time.
- Be aware of the safety knowledge of optical fiber lasers and pay attention to safety precautions.
- Master the necessary safety skills for the machine operation.

2.2 Master the necessary safety skills for the machine operation

Statement: the company is not liable for any losses if the equipment is not used according to the safety regulations!

Notes: properly use the equipment. Laser cutting of plastics, modification and refitting of equipment conducted by users and operators voluntarily, and unsafe working methods are strictly prohibited.

Only authorized, trained and guided personnel can operate, repair and maintain the machine.

Only specially trained professionals can use electrical, pneumatic, hydraulic and laser equipment.

In addition, following measures must be performed before the operator can work on the equipment:

2.3 Overview of dangers of machine

All types of important potential accidents caused by the equipment and endanger life and health are listed by the following hazard overview. Refer to the danger overview below to find out appropriate measures if the user can take additional measures to avoid other possible dangers.

Danger types	Dangerous position	Danger	Measures and suggestions
Mechanical danger			
Danger caused by extrusion, shear, or collision	Movements of X, Y, Z axis and exchange pallets, and conveyor belt.	Life-threatening danger	
High pressure gas blow-out danger	Cutting gas.	Danger of injury	
Cutting and severing danger	Workpiece with a sharp edge.	Danger of injury	
Electric shock danger			
Through contact with electrified objects	Direct contact with electrified parts under normal conditions. Indirect contact with an electrically conductive part in an abnormal state. Contact with electrified parts.	Life-threatening danger	
Scalding danger			
Through the contact	Hot workpiece or splattered slag.	Danger of injury	Wear protective clothing and gloves, and use tools to take workpiece.
Flame and explosion	Combustion or explosion due to the high level of oxygen in the working environment.	Danger of injury	Ventilate and take dust-removal measures.
Radiation danger			
Laser	The laser is reflected during cutting process for the open laser protection chamber.	Danger of injury	Wear protective clothing and laser protective glasses.
Dangers caused by materials			
Dangers caused by exposure to or inhalation of toxic liquid, gas, fume, vapor, and dust	Cutting gas, dust, polyethylene-coating board, high temperature decomposition lens.	Danger to health	Ensure adequate ventilation at the work place and proper use of dust-removal equipment.
Fire danger	Burning of a combustible object due to the laser reflection	Danger of injury	Prepare a carbon dioxide fire extinguisher.
Dangers caused by failure or malfunction			
Power failure	Drive device or control system voltage failure	Danger of injury	

2.4 Safety sign

When using the equipment, some operations that may cause danger maybe conducted. In this instruction manual, warning tips are firstly illustrated before introducing how to perform the operation. In addition, there are corresponding danger signs on the device.

Tips

Please pay attention to warning tips!

Please follow the instructions and prohibitions indicated by warning tips. They protect your safety.

These warning tips include: a symbol, a warning, tips about danger sources and danger types, and illustration on avoiding danger.

The symbol in the left column, indicating the danger type, is the complement of warning tips.

Sign	Meaning
 **High voltage sign**	Electric shock danger: operating electrified parts, or handling electrical equipment inappropriately or not carefully, can cause dangerous burns and electric shocks. Electrical equipment or devices must be operated by maintenance personnel alone or under their supervision. Unless otherwise specified, electrical parts must be disconnected from the power supply during maintenance, and measures shall be taken to prevent it from being turned on again without authorization. Check that if the disconnected part is electrified. Insulate the electrified parts nearby.
 **Laser danger**	Laser radiation danger: undefined invisible laser radiation may be emitted due to the damage of shell safety cover or the working optical fiber, and the part of the cutting head, modified or missing. Direct laser beams, laser-bounce or stray radiation can be harmful to the eyes and skin. Burns, eye injuries and skin injuries. Do not remove or modify the safety cover of the machine. Only the maintenance tasks specified in the instructions can be performed. Any maintenance or repair works beyond specified requirements for the parts mentioned above can only be performed by the manufacturer's personnel. After maintenance and repair, all dis-assembled safety covers must be re-installed properly. Do not disconnect the working optical fiber from the laser module or the cutting head. Replacement or re-installation of the working optical fiber can only be performed by the manufacturer's personnel.
 **Prohibition of trampling**	This symbol warns danger and the machine part cannot bear a human body. Otherwise, it may result in personnel injury or machine damage.
 **Beware of mechanical hand-pinch**	This symbol warns mechanical hand-pinch danger.

2.5 Precautions when operating the machine

- The machine is allowed for operation only when the appropriate safety device can ensure the safety in the dangerous area.
- It is strictly prohibited to remove or disable the safety devices. It should be re-installed and used immediately after the completion of overhaul work when there is necessity for maintenance and overhaul.
- It is strictly prohibited to extend the foot or hand into the lifting platform to prevent personal injury during lifting.
- The work performance of the safety door lock and the emergency stop button should be checked once per shift (better before usage).
- The operator must confirm that there are no personnel staying in the dangerous area before start every time.

Make sure that the equipment is in perfect normal condition

- Users or their authorized personnel are allowed to operate the equipment only when it under completely normal condition.
- The user must install the equipment according to the installation drawing and conditions.
- Users must ensure that the equipment work place is clean and organized through appropriate regulations and inspections.
- Users must provide plenty of fresh air to the workplace.
- The operator must immediately report to the operating party the changes of the equipment which affect the safety (including operating performance). Therefore, each shift must check equipment and find defects and damages that can be distinguished externally.

Follow the shutdown procedure

As for transportation, installation, commissioning, handling, operation, maintenance and repair, it is necessary to comply with the prescribed shutdown procedures. When the laser processing machine is not used, the switch key of the equipment should be removed (if the laser is equipped with the key separately, it should be taken together) to prevent the misuse of other unauthorized personnel.

Operation on the pneumatic system:

- Close the compressed air supply and drain off the water from air storage tank.
- Check whether the working pressure has been reduced to 0 bar. So, current working pressure of the corresponding pressure gauge on the instrument board should be checked.
- When the air pressure drops to 0 bar, turn off the refrigeration dryer.

Hoisting and moving of equipment

When carrying out the work involved in transportation, positioning and installation, it is necessary to carry out fixation, hoisting installation and transportation of equipment under the guidance of the manufacturer's engineering personnel. Avoid equipment damage and personnel injury due to improper operation during the process of hoisting.

2.6 Use predetermined spare parts and working parts

Original parts and accessories are specially designed for this equipment. original spare parts and accessories not supplied by machine manufacturer should not be inspected and approved by the manufacturer. The installation or use of such products may, in some cases, change the original characteristics of the equipment in the design and imperil the safety.

Warns

The manufacturer shall not be liable for any loss caused by the use, incorrect installation or replacement of non- original parts and accessories.

2.7 Fire prevention

Make sure the normal use of portable fire extinguisher

Two portable fire extinguishers mentioned below should be prepared for fire prevention:

- The portable fire extinguisher for combustion of metal is used to eliminate the ignition danger caused by the fall of hot slag during the laser processing process.
- CO_2 portable fire extinguisher is used to eliminate the combustion in the compact dust collector.

2.8 Classification and hazards of laser products

2.8.1 Categories of laser product

Category of laser products	Definition
Class1	The laser is safe under the reasonable and predictable working conditions. The reasonable and predictable working conditions refer to that the silo door of the laser is completely closed, the machine housing cover is in good condition, and the safety door is closed.
Class 2	For the visible light laser with a wavelength of 400nm to 700nm, avoidance reactions including blinking can protect eyes. The indicating red light belongs to this kind of laser, and direct eye contact is strictly prohibited.
Class 3A	It is safe to observe with the naked eyes. For the laser with emission wavelength of 400nm-700nm, the protection shall be provided for the avoidance reaction including

	the blinking disaster. A laser with the hazard of other wavelength to the naked eyes is not more than Class 1. It may be dangerous to make the direct internal view observation of light beam of Class 3A by optical devices (e.g., binocular eyepiece, telescope microscope).
Class 3B	The direct internal view observation of light beam is dangerous, while observing the diffuse reflection is safe. The safety conditions for observing the diffuse reflection of such visible laser are: the longest observation time is 10s for the laser when the shortest distance from the optical screen to the cornea is 13cm.
Class 4	The diffuse reflections which can produce danger may cause skin burns and fires. Such laser products should be used with special care. The laser should be handled with special care if it is emitted when the machine housing is removed, and the safety door or the laser silo door is opened.

2.8.2 Irradiation time and damage mechanism

CIE spectral range	Eyes	Skin	Notes
Ultraviolet radiation C (180nm-280nm)	Photoinduced keratitis	Erythema (sun burn), acceleration of the skin aging process	
Ultraviolet radiation B (280nm-315nm)	Photoinduced keratitis	Hyperpigmentation Dark color and light sensitization Skin burns	
Ultraviolet radiation A (315nm-400nm)	Photochemical reaction	Dark color and light sensitization Skin burns	
Visible light (400nm-780nm)	Retinal damage caused by photochemical and thermal effects.	Dark color and light sensitization Skin burns	It is forbidden to look directly at the light source of the indicating red light of this machine which belongs to this kind of light.
Infrared radiation A (780nm-1400nm)	Cataract, retinal damage	Skin burns	It is forbidden to look directly at the light source because the laser wave of this machine belongs to this Class.
Infrared radiation B (1.4μm-3.0μm)	Cataract, water evaporation Corneal burns	Skin burns	
Infrared radiation C	Corneal burns	Skin burns	

(3.0μm-1mm)			

Precautions:

Operations of the machine are strictly prohibited under the following conditions:

1. The chamber door of the laser is opened.
2. The machine housing is removed or incomplete.
3. The machine safety door is opened.
4. The laser protection glass is damaged.
5. The scrap trolley is not placed in the designated position.

2.9 Electric power system

The following points must be noted when the power equipment is operated or installed:

1. A fuse with the specified current strength provided by the factory must be used.
2. If the power failure occurs, turn off the machine immediately.
3. Unless otherwise specified, electrical parts must be disconnected from the power supply during repair.
4. Isolated parts should be checked first whether they are electrified, then treated for grounding and short-circuit, and nearby electrified (charged) parts should be insulated.
5. Check electrical equipment regularly. Failure should be corrected immediately, such as loose connection or charred cable.
6. A second person must be present in order to control the emergency stop button or power switch in case of emergency when operating an electrified part. The working area should be isolated with red and white barrier belt and warning signs.
7. Be sure to use insulating tools.

2.10 Gas supply

Gas leaked from the gas supply system can cause an explosion once being exposed to oxygen and fire. Please ensure that the gas supply pipe is connected correctly.

The room should be ventilated per shift when the circulating air is used. Prevent the accumulation of air in the enclosed area.

Choose a fire extinguisher that is suitable for the combustibles in the room. Indicate

the location of the fire extinguisher and the escape route.

Conduct the regular vacuum leak testing. Leave the room immediately if a significant leakage accident or equipment failure is found; breathing apparatus must be worn when re-entering the room. In this case, at least two people must be present.

The gas container must be stored far away from open fire and heat source (> 50° C). The direct sunlight should be prevented if the gas containers are kept outside.

Gas container must be equipped with a safety helmet during transportation. The gas container should be tightened to prevent falling. The gas container should be prevented from leakage during storage and usage. Gas containers should be kept in a well-ventilated area away from the flammable. It shall not be stored along the escape route or in the working area and adjacent areas. Do not store the gas containers in the storage room. Only the original gas container supplied by the manufacturer can be used. The valve on the container should be checked for air leaks when replacing gas container. The safety valve shall not be adjusted. The gas should not be released in the enclosed space.

The repair must be operated by professionals. Protective clothing and gloves made of leather or thick material should be worn. If the gas escapes into the enclosed space, an independent breathing apparatus should be worn.

Comply with other national regulations (for example, vehicle labels in the transport process), and conduct regular personnel training, etc.

Comply with the country's regulations on the permit and test cycle of the gas container.

2.10.1 Nitrogen (N_2)

Chemical and physical properties and instructions for use.

Only at room temperature can nitrogen react with a few substances, such as lithium and calcium to generate nitrides. The nitrogen is not prone to reaction with others even at high temperatures. So, it is used as an inert gas and for technical process, transportation and storing flammable liquids.

Warning in case of fire or accident

The nitrogen is un-inflammable. The fire hazard may cause the increase of pressure and explosion of the gas container. In case of fire, the water spray, gas or powder fire extinguisher should be used. If the gas escapes, do not spill water on the gas container. Use cold water to fully cool the surrounding containers and gas container. The cold fog heavier than the air is formed when a large amount of escaping gas mixes with the damp air. Wear independent breathing apparatus and protective clothing to protect the whole body. The nitrogen does not cause water pollution.

Health precautions

Utility and toxicity: the nitrogen does not cause the physiological effect, but cause breathing difficulties and even suffocation when the concentration exceeds 88%. It doesn't cause restlessness or warning symptoms.

Emergency

If inhaling the nitrogen, the victim must be evacuated from the danger zone and provided with plenty of fresh air. In enclosed spaces, the first-aid personnel must wear

independent breathing apparatus. Victims need rest, warmth and even artificial respiration. Keep the respiratory tract unimpeded, monitor the blood circulation, and perform heart massage if necessary. If being unconscious, the patient should be kept in a lateral position when being placed or moved, waiting for the diagnosis of doctor.

2.10.2 Oxygen (O_2)

Chemical and physical properties and instructions for use.

Though being un-flammable, the oxygen can contribute to the combustion. Although the oxygen is 11% heavier than the air under the environmental temperature, the concentration of the oxygen close to the ground will not increase as the air does not separate. The temperature of the liquid oxygen is very low (-183 ° C under the atmospheric pressure). The skin will be damaged by the "cold burning" phenomenon quickly if being contacted with the oxygen at such temperature. Some materials will be likely to become fragile under low temperatures.

Warning in case of fire or accident

The increase of oxygen content in the air will significantly increase the fire risk (even if increased by a very low percentage). Materials which are nonflammable in air (including insulated flame-resistant materials) will burn fiercely or even cause spontaneous combustion in oxygen-enriched air. In such condition, flame temperature will be higher and the fire will spread quickly.

Health precautions

The volume ratio of oxygen in air is 21% under the natural condition. Therefore, oxygen escaping into the air will not incur pollution. In most cases, harmful effects will not be caused to the human body if pure oxygen or air with high oxygen content is inhaled. Good ventilation should be guaranteed for clothes to be dressed in environments with possibly high oxygen content. Oxygen shows a strong adsorption capacity to clothes. Fire sources including cigarettes may fire the clothes. Low-temperature liquid oxygen will not pollute the floor when it spills by accident, because it will evaporate instead of penetrating into the ground, or will penetrate in a small volume at most. Temporary local freezing of the ground will not cause any continued damage.

2.10.3 Compressed air

General safety pre-warning

1. Operators should follow safe operating mode and all relevant local occupational safety regulations and rules.

2. If the following instructions are inconsistent with relevant local regulations, the stricter one’s hall prevail.

3. Installation, operation, maintenance and repair should be conducted by skilled personnel authorized and properly trained only.

4. The air generated by the compressor is not the air can be inhaled. The compressed air must be filtered in accordance with local laws and standards to generate the air can be inhaled.

5. The compressor should be stopped before performing any maintenance, repair and adjustment or any other routine inspections, so press the Emergency Stop button, power off and decompress the compressor. Then turn off the circuit breaker and fix it on the OFF position.

Do not fiddle with compressed air. Do not blow directly to the skin or toward a third party with compressed air flow. It is strictly prohibited to remove dust from the surface of clothes with compressed air. Always maintain heightened alertness when using compressed air to clean the equipment, and wear protective glasses.

2.11 Refer to safety standards

Laser processing equipment and operations shall be in accordance with both two national standards, which are GB7247-87 Radiation safety of laser products, equipment classification, requirements and user guide, and GB10320-88 electrical safety of laser equipment and facilities.

2.12 Product safety

The following conditions are required to be satisfied to ensure safe work:
Abide by operation manual and instruction signs;
Operators and maintenance personnel have received training held by machine manufacture;
In case of operation by couples of people at the same time, division of responsibility should be made and followed;
No admission to the working area for the unauthorized personnel;
Avoid any working method breaking the safety rules;
Timely eliminate all the failures possibly causing lower safety coefficient;
Abide by maintenance regulations of the machine.

2.13 Safe equipment

Safety machines are used for protecting personnel, and unauthorized disassembly, bridge-group or by-pass connection are strictly prohibited; in case of failure with the safety machine, professional is required for repair. If part replacement is needed, the product with same model, specification and from the same manufacture is required; otherwise, written consent from the manufacturer is required.

2.14 Safety awareness

The machine can be operated only by skilled personnel or under supervision of them. Improper use or operation may possibly be very dangerous and cause damage to the machine. Therefore, the followings are strictly prohibited:
Placing heavy objects or stepping on the working table of the machine;
Used for processing the materials unapproved by manufacturer;
Staying of unauthorized personnel in the dangerous area (It is the responsibility of operators to ensure keeping unauthorized personnel away from the working area.);
Block of using emergency stop button (Regular check is required to ensure a good condition for the emergency stop button).

2.15 Requirements for personnel

After trail operation, maintenance personnel from the manufacturer may perform training on the operators.
It is the responsibility of machine owner to have operators trained at corresponding level.
We have prepared ready a series of training course for your option. Please make phone call to our Customer Training Center for details.

2.15.1 Definition of terms

All the personnel using or operating the machine are called User in the manual.
Different requirements are for different users. Users are classified into the followings:
Owner;
Owner means the authorized person or representative to sign contract with the manufacturer. With authorization, the owner has rights to sign the agreement with binding force of law.
Operator;
Operator means the personnel trained for operating the machine. Training of the operator includes participation of training held by the manufacturer.
Maintenance personnel;
Maintenance personnel mean the technicians having received formal training for machine and electric engineering. The maintenance personnel are responsible for daily maintenance of the machine, and repair at low level if needed. Training on the maintenance personnel contains participation training held by manufacturer.
Qualifications
The operator is required to accept guidance and training of the owner, and the operator is responsible for the safety of a third party in the working area; the personnel required for further training and guidance are required work or operate the machine under supervision of the operators.

2.15.2 Responsibility

It is a must to clarify the related responsibilities of each performance (operation, maintenance, parameter setting), and carry it out. Unclarified responsibilities will cause safety hidden risks. Owner is required to provide operation manual for the operators and maintenance personnel, and ensure that they have read and understood the operation manual.

2.15.3 Personal protective devices

When Group or measures fail to absolutely avoid risk of health, the owner is required to provide personal protective devices for operator and maintenance personnel. For example: steel toe boots, protective gloves, laser-proof goggles.

Chapter3 Basic operating instructions

On/off

There are certain requirements for the start-up and shutdown of the machine when using the optical fiber laser cutting machine, so as to ensure better operation and running of the machine, and attention should be paid to the following operation steps.

- **Boot order**

1. Turn on the main switch of the power distribution cabinet, turn on the voltage-stabilized switch after the start-up and wait for 10s to allow the voltage stabilizer to output a stable voltage normally.
2. Turn on the main switch of the machine control cabinet after the machine is power on.
3. Turn on the water chiller switch and then turn on the laser switch. (Note: don't close laser and water chiller at room temperature below 5 °C)
4. start the refrigeration dryer, then start air compressor and open air valve after waiting the fully warmed-up of the refrigeration dryer for 5 min.
5. Turn on power switch of dust removal fan.
6. Turn on the cutting gas.
7. the machine performs the operation of Zero Return and calibrates the cutting head.
8. open the computer programming software and input the cutting program to conduct the cutting (note that the cutting area of machine is completely closed when cutting).

- **Shutdown order**

1. Turn off the water chiller.
2. Turn off the laser.
3. Turn the cutting gas and dust removal fan.
4. Turn off the air compressor, turn off air valve after the air compressor has stopped running, and close the refrigeration dryer.
5. Shutdown the programming computer and CNC system.
6. make sure that the main power of laser is turned off after closing the laser system. The power switch of laser and the switch power of electrical cabinet should be turned off after closing CNC system (display of machine is off).
7. Turn off voltage-stabilized power source.
8. Disconnect the main switch of the power distribution cabinet finally.

Description of Operation Panel

- Emergency stop button [EMERGENCY]: Press this button to activate the emergency stop function. When the button is pressed down, the power will be cut off, and the equipment enters “Stop” state; to release emergency stop, rotate the button clockwise.
- Key switch [LOCK]: When the key switch is activated, the computer starts, and other power supplies can be turned on; rotate to the right to unlock, and rotate to the left to lock. If the equipment won’t be used,it is recommended to remove the key switch and keep it properly to prevent personnel without permission from operating the equipment.
- Main power switch [POWER ON/OFF]: The button is a self-locking illuminated pushbutton switch; press it to turn on the chiller and electric motors of each axis, and the indicator turns on; press the button againto turn off the chiller and electric motors of each axis, and the indicator turns off.
- Laser power switch [LASER POWER]: The button is a self-locking illuminated pushbutton switch; press it to turn on the laser power, and the indicator turns on; press the button again to turn off the laser power, and the indicator turns off.
- USB interface [USB]: The interface is connected to the USB interface of the computer, and is used by USB disk.

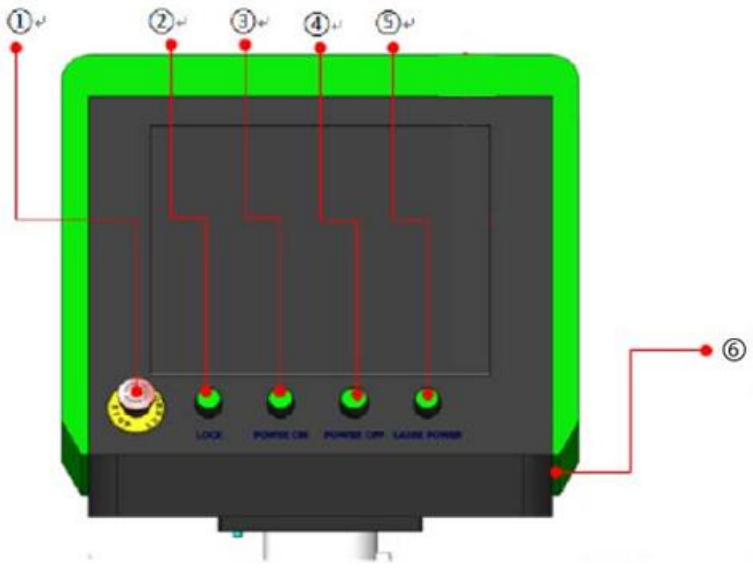


Fig.3-9 Operation Panel Diagram

①	Emergency	⑤	Laser power
②	Lock	⑥	USB port
③	Power on		
④	Power off		

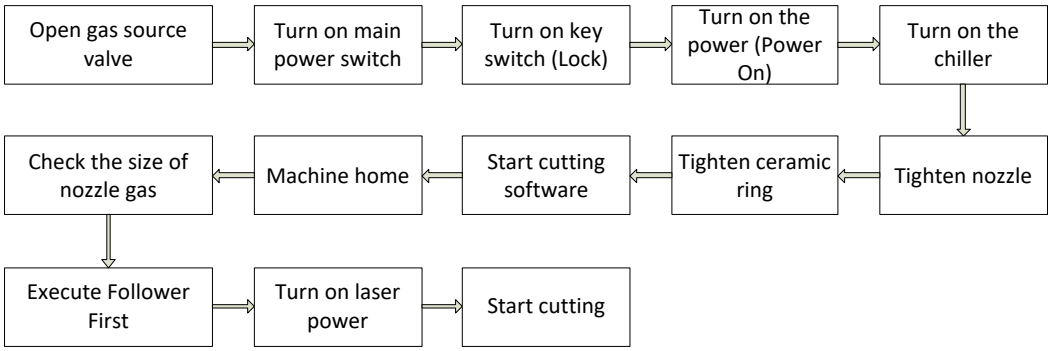
Tip	When the emergency is eliminated, rotate the emergency stop button clockwise to reset it naturally and release the emergency stop state; Other buttons are available only after the key switch is activated; Cylinder lift button is only used for loading and unloading; Cylinder lift is jointly controlled by the cylinder lift button and in-position sensor, and the cylinder rises only when both are effective.

Equipment debugging

After installation, the equipment needs debugging and processing test. Equipment debugging mainly completes state detection of each module of the machine, including motion module, laser module and electrical I/O module.

Switching sequence

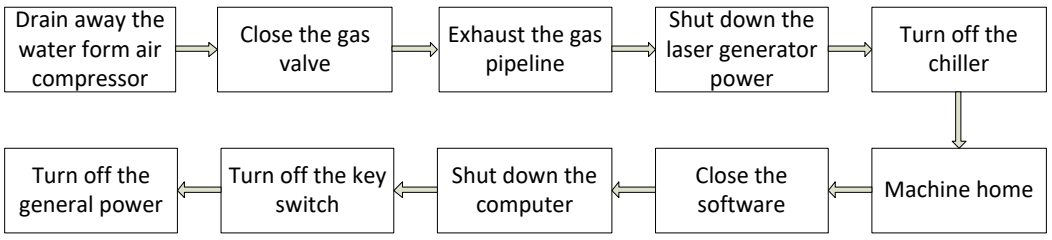
Switching on sequence



Reminder:

- Execute Follower First after replacing materials of different thickness every time!
- After turn off the machine, please ensure no high pressure air sealed in the air pipe, otherwise, the air pipe may be broken by the high pressure air, leak the high pressure air please.

Switching off sequence



Attention	Please turn on/off the equipment as required, or else it may cause equipment malfunction.

Movement debugging

Stroke, limit and reset

Setting stroke of each shaft of the machine will play the function of breadth protection (equals to software limit). The travel parameters for each axis have been set up. Improper travel settings may cause the equipment unable to work in full breadth or cutting head over-limit and collision.

Limit switch is the hardware sensor equipped on limit position of the two ends of each shaft. After detecting limit triggering signal, the movement shaft will perform emergency stop to avoid “overreaching”. Minimum one limit switch is needed for each shaft to indicate limit position of the current shaft. The installation position of limit switch may differ due to different types of machines, so the triggering signal. Therefore, configuration is needed.

Zero point of the machine is a referential point of a certain hardware fixed in processing breadth. Generally, after power-on, “reset” is needed for the machine to create coordinate of lathe. The machines from our company generally take the limit switch position of each movement shaft as the zero point of the machine.

Attention	At ex-factory, configuration of parameters for stroke, limit and reset has been already performed. Unauthorized change of parameters by user before making clear its meaning is prohibited. Otherwise, failure of the equipment may possibly be caused.

Motor shaft movement

When the equipment is powered on properly, start the computer and run the software CypCut. In standby mode, the six direction keys on the software interface control the motion of cross beam and the cutting head. If the four directions of X-axis and Y-axis and up/down motion of Z-axis are normal, then the motion of X-axis, Y-axis and Z-axis motor is normal. If the motor shaft has any problem in motion, please contact customer service staff.

Laser debugging

Laser debugging contains two aspects: light emitting test and light route adjustment. The followings are the details for them.

Light emitting test

After normal power up, press the laser power switch on the right side cover, and then set the light emitting energy and time directly on the control panel, and test if the laser emitting function is normal. If there is no laser emitting from the spot spray laser tube, it means that there are problems with the laser emitting, and check is required. In case of laser emitting found from the laser tube, but no laser emitting from the cutting head, it means improper position of the light route, and adjustment of light route is needed.

If there is no laser emitting, first check the setting of laser parameters. Improper laser parameters may cause equipment malfunction or laser power cannot be adjusted. If the laser parameters are determined correct and there is no emitting still, you need to check the hardware problem.

 Tips	The control panel of some types of machines is equipped with ammeter. With the ammeter, you can check if the power is normal.

Light route adjustment

As the center of the laser head is fixed, the nozzle center can be changed through adjustment screws on the cutting head to make it correspond to the laser center. Paste a layer of tape on the nozzle, then emit laser, and check if the hole punched on the tape by the laser coincides with the nozzle center; adjust the 4-faced screws repeatedly until the laser center coincides with the nozzle center.

Chapter6 equipment Operation

6.1 Preparing Graphics

- Save the graphics to be processed in a format supported by PLT, DXF, GBX or AI with graphics software;
- Run the cutting software CypCut, click [File] → [Import] in the top left corner, select the type of processing graphics to import the graphics into the software;
- Set up “Lead”, “Sort”, “Optimize”, “Group” and other processing parameters as required (see Optical Fiber Laser Cutter Software User Manual for specific settings).

6.1 Processing

- After setting the graphics, follow the power-on sequence and check if the laser power is turned on, if the gas supply is turned on, and if the cutting gas is proper;
- Position the cutting head to start working position by moving the four arrow keys of X-axis and Y-axis;
- Click [Frame] and check if the material under processing is placed in the format, and if the cut graphics exceed the processing format;
- Then click the [Start] button to start processing.

6.1 Description of metal cutting process

We backed up the [Sample Parameters], [Factory Parameters Backup], and [Worktable Blade Drawings] on the F disk of the computer. The user can open the [Sample Parameters] file, and the cutting parameters are automatically imported to your computer for reference.

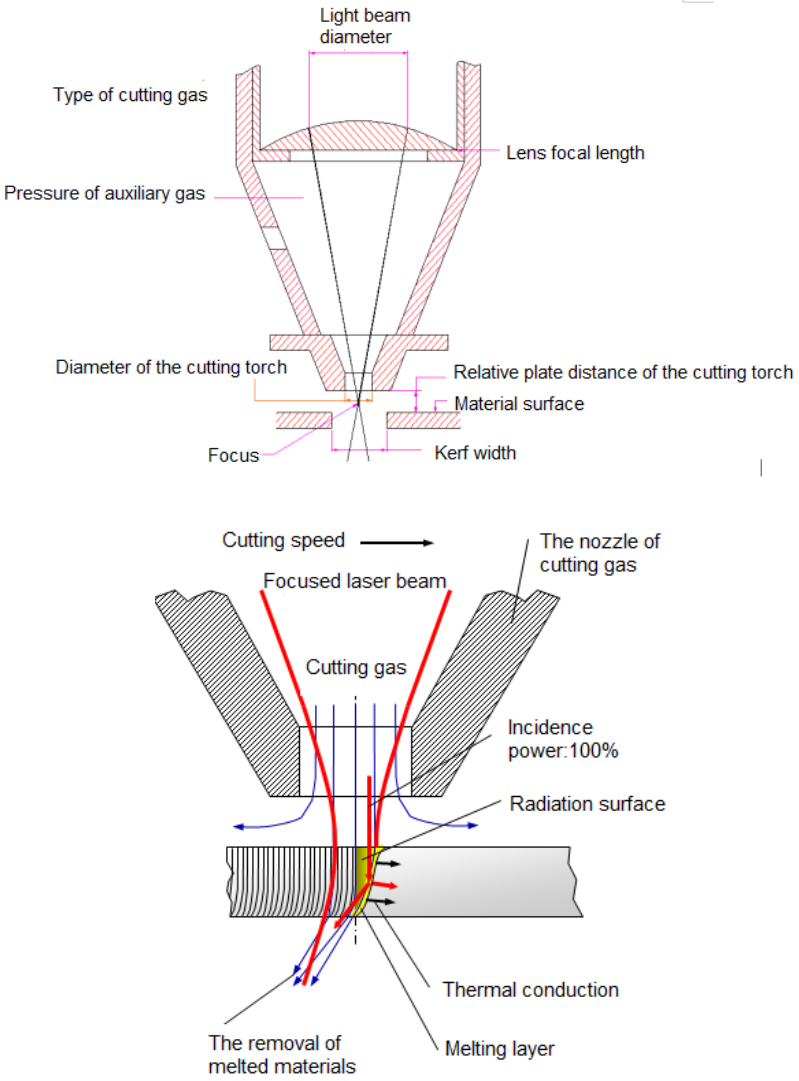
Chapter6 Startup and Cutting

Cutting process is closely related with the following elements:

- Laser power
- Focus position
- Height of the cutting torch
- Diameter of the cutting torch
- Type and quality of the cutting torch
- Auxiliary gas

- Purity of auxiliary gas
- Flow of auxiliary gas
- Pressure of auxiliary gas
- Cutting speed
- Material of board
- Surface quality of board

Process parameters related with cutting are shown in the figure below.

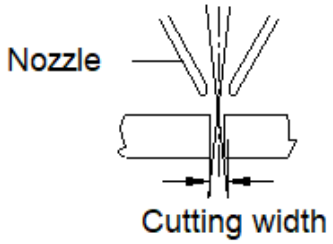
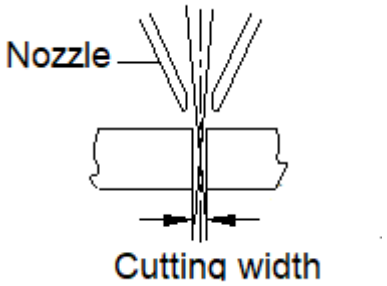
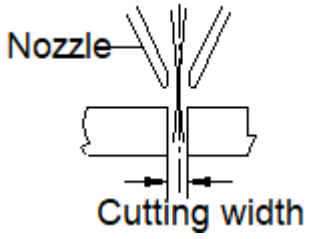


6.1 Laser power

The maximum power is applied when cutting thin carbon steel plate, stainless plate, aluminum plate and copper plate to obtain a fast cutting speed. Excessive power is not applicable to carbon steel plate.

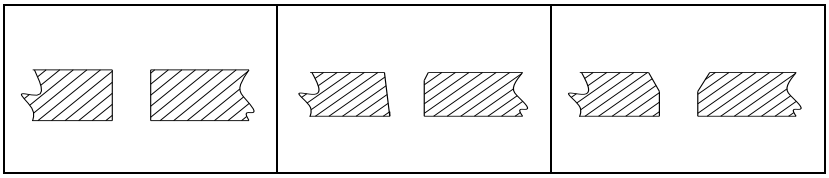
6.2 Focus position

Focus position is a key parameter, which shall be correctly adjusted.

Focus position	Schematic Diagram	Feature
Zero focal length Focus is on the workpiece surface		Applicable to thin plate. (Cut surface)  The focus is positioned on upper workpiece surface, so the cutting width is narrow and the cutting speed is faster.
Negative focal length Focus is under the workpiece surface		This method is applied in thick aluminum plate, stainless steel, copper plate and other workpieces. (Cut surface)  Comparing with the condition adopting zero focal length, with the focus located at the center, the cutting width, flow rate of cutting gas and the time of piercing is greater due to the wide range of smooth surface.
Positive focal length Focus is above the workpiece surface		Applied when cutting thick steel plate. When the thick steel plate is cut down, the oxidation of cutting oxygen shall thoroughly run from the upper surface to the bottom surface. Wider cutting width can be obtained on a plate due to its own needs. The cut surface is rough due to the oxygen, which is similar to the surface cut off by gas.

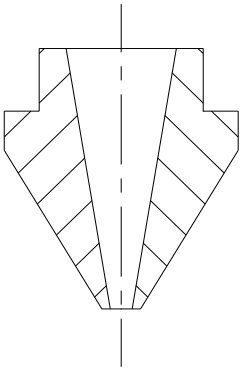
Influence of focus position on cutting section

Surface 1.5mm (upper)	Surface 0.5mm (upper)	Surface 2.5mm (upper)



6.3 Cutting torch

The shape, pore diameter and height (the distance between the cutting torch outlet and workpiece surface) of the cutting torch and other elements will impact on the cutting effect.



6.3.1 Function of the cutting torch

（1） Prevent melting stains and other foreign objects from bouncing back and passing the cutting torch to pollute focus lens.

（2） Control the gas diffusion area and degree to guarantee cutting quality.

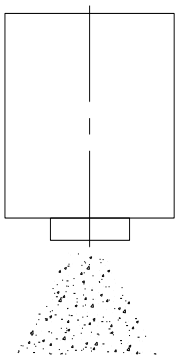


Figure 1 The Condition of Gas Spraying without a Cutting Torch

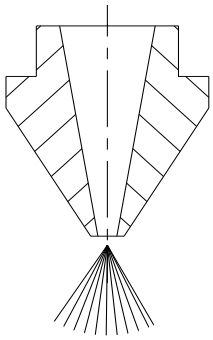


Figure 2 The Condition of Gas Spraying with a Cutting Torch

6.3.2 The relationship between the cutting torch and cutting quality

1. The coaxiality between the outlet hole center of the cutting torch and laser beam is one of the key factors affecting cutting quality. The thicker the workpiece is, the greater the effect will be.
2. The coaxiality will be affected when there is any deformation or melting stain on the cutting torch.
3. A careful preservation of cutting torch is required in case of deformation due to bump injuries. Mount correctly considering the high manufacturing precision of the cutting torch shape and dimension.
4. If the cutting torch is in poor condition and cutting parameters have to be changed accordingly, the replacement of a brand-new cutting torch is preferred.
5. If the cutting torch is not same with laser in coaxiality, it will have the following effects on the cutting quality.
6. Effect on cut surface
7. Shown as "Figure 3", when auxiliary gas sprays out from the cutting torch, the air flow is uneven, and the phenomena occurs with one side melt stained and the other side not. There is a little effect when cutting thin plate with thickness less than 3mm, while there is a severe effect with thickness greater than 3mm and sometimes the plate cannot be cut through.

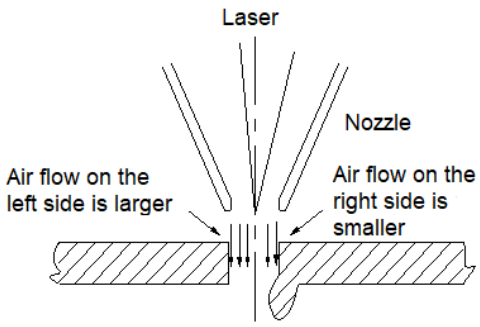


Figure 3 Coaxiality Influence on Cutting Section

6.3.2.1 Influence on sharp corner

It is easy to cause super fusion if there is sharp corner or smaller angle on workpiece, and thick plate may not be cut.

6.3.2.2 Influence on piercing

Unstable piercing and time control difficulty may cause super fusion to thick plates, and it's difficult to control penetrating conditions. Influence on thin plates is relatively smaller.

6.3.3 Adjustment of cutting torch holes and laser beam coaxiality

Refer to the section about operation of automatic focusing cutting head.

6.3.4 Pore diameter of the cutting torch

Pore diameter size of cutting torch has critical influence on cutting quality and piercing quality.

If the pore diameter of cutting torch is too large, the slag spattering area is larger during cutting, and the cutting surface of thick plate is relatively coarse; on the contrary, if cutting torch diameter is too small and cutting speed is slow, it will easily generate adhering slag.

6.4 Adjustment of cutting torch height

Cutting torch height is the distance from cutting torch outlet to workpiece surface.

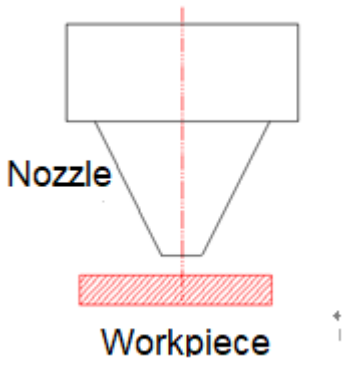


Figure 4 Height of the Cutting Torch

Capacitor box (BSC100)

After completing calibration, input appropriate piercing and cutting height into program parameter base.

➢ **Parameters of capacitive sensor**

Parameters of capacitive sensor have been set before delivery, and users cannot arbitrarily change.

6.5 Cutting speed

6.5.1 Too fast Cutting

If cutting speed is too fast, it may cause the following consequences.

1) It may be impossible to penetrate, with sparks spraying.
2) Some areas can be penetrated, but some cannot.
3) The entire section is relatively coarse, but it produces no melting stains.
4) Cutting section appears in slanted bars, with melting stains on the lower part.

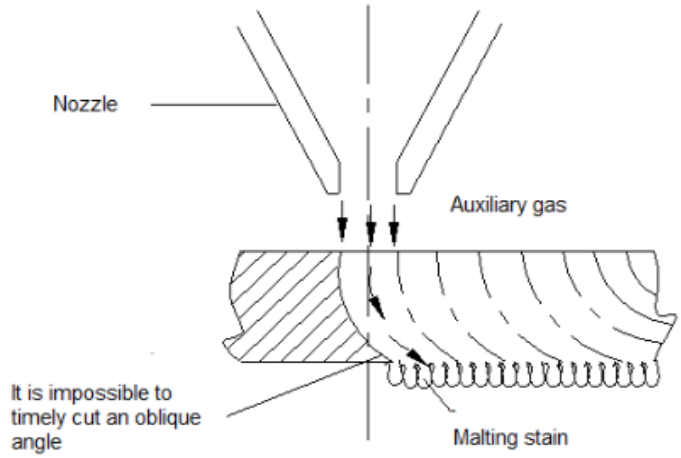


Figure 5 Too fast Cutting

6.5.2 Too slow cutting speed

1) It will cause super fusion, and the cut surface is relatively coarse.
2) Cutting joint gets widened, and the entire sharp corner is melted.
3) Cutting efficiency is influenced.

6.5.3 Confirm appropriate cutting speed

➢ **Determine whether to speed up or down feeding based on cutting sparks (targeted at cutting with low-pressure oxygen)**

1） Spark diffuses from up to down

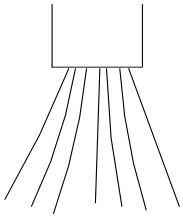


Figure 6 Normal Cutting Speed

2） The inclining backward of sparks indicates too high cutting speed.

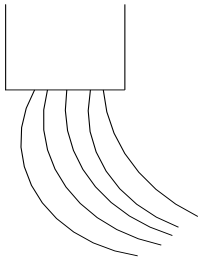


Figure 7 Too Fast Cutting Speed

3） Sparks are not dispersed and in a small number and gather together, which indicates too slow speed.

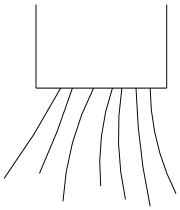


Figure 8 Too Slow Cutting Speed

- **Appropriate feeding speed**

As shown in the figure, the cutting surface appears with relatively stable lines and there is no melting stain on the lower part.

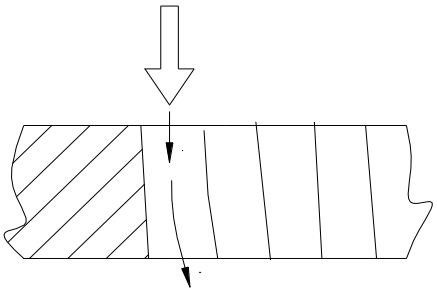


Figure 9 Normal Cutting Speed

6.6 Cutting auxiliary gas

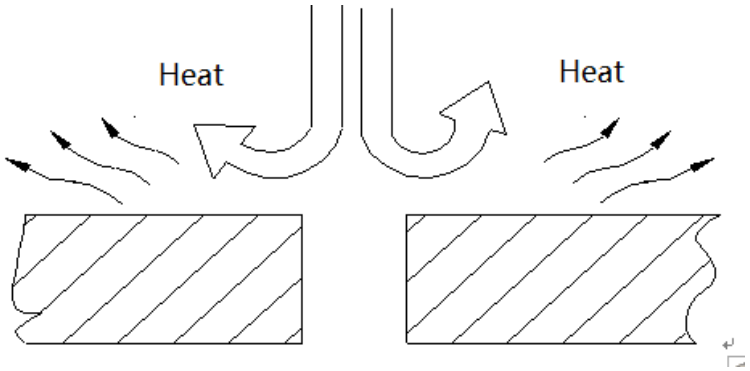
Consider from the following several aspects in the case of selecting type and pressure of cutting auxiliary gas:

1)Generally, oxygen is used to cut ordinary carbon steel and thick red copper.

2)Generally, air is used to cut thin plates of thickness less than 2mm.

3)Generally, nitrogen is used to cut stainless steel, red copper, brass, aluminum plate, etc.

4)The higher the gas purity is, the higher the cutting quality will be. Purity for cutting low-carbon steel plate shall be at least 99.6%, and recommended oxygen purity for cutting carbon steel plate of thickness more than 12mm is above 99.9. Oxygen purity for cutting stainless plate shall reach above 99.6%. The higher the oxygen purity is, the higher the quality of cutting section will be. If cutting gas purity cannot reach the regulated indicator, it will not only influence cutting quality, but also cause the pollution of lens.



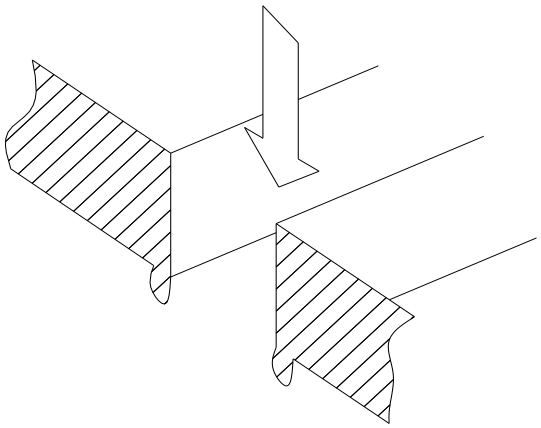
6.6.1 Influence on cutting quality from auxiliary gas

Gas is conducive to heat dissipation and combustion supporting, blowing off melting stains and improving quality of cutting surface.

- **Influence on cutting from insufficient gas pressure**

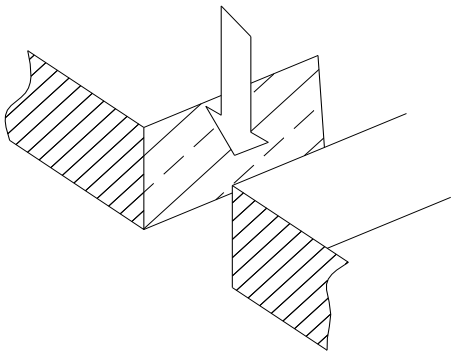
a. Melting stains on cutting surface.

b. Cutting speed cannot be increased, which influences efficiency.



➢ **Influence on cutting quality from over high gas pressure**

a. Too large air flow makes cutting surface relatively coarse and cutting seam wider.
b. Too large air flow causes melting to the cutting part, and influences cutting quality.



6.6.2 Influence on piercing from auxiliary gas

1) Laser can't easily cut through cutting board when gas pressure is too low, thus piercing time shall increase, which leads to low production rate.
2) The breakthrough point can be melted down with popping occurred when gas pressure is too high. Thus, larger melting point is formed, which influences the cutting quality.
3) During laser piercing, generally higher gas pressure is adopted for thin plate piercing and lower gas pressure is adopted for thick plate piercing.
4) In the case of cutting ordinary carbon steel with laser cutting machine, the thicker the material the lower the cutting gas pressure will be.

6.7 Laser power

Laser power has decisive influence on cutting process and quality.

a) Too small power cannot realize cutting

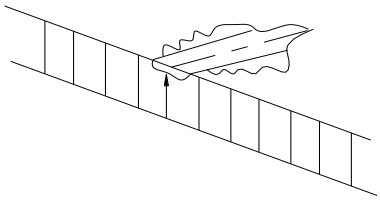


Figure 10 Too Small Power

b) Too large power will melt the entire cutting surface

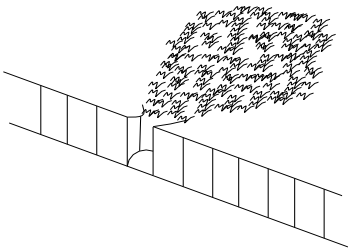


Figure 11 Too Large Power

c) Insufficient power will cause melting stains after cutting and slow down cutting

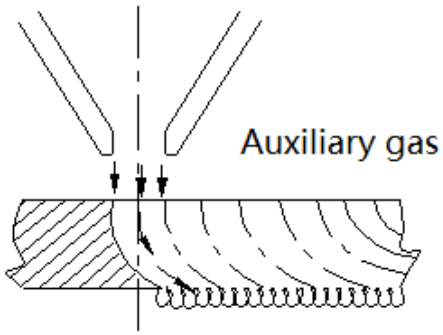


Figure 12 Insufficient Power

d) Appropriate power can gain good effects of cutting surface with no melting stain

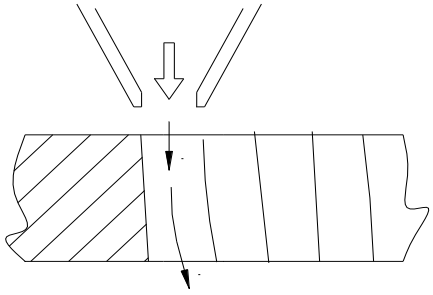


Figure 13 Appropriate Power

Chapter7 Maintenance and service

To ensure normal use of the laser machine it is necessary to perform routine care and maintenance on equipment. Since the whole machine tool is assembled with high-precision parts, be careful in the routine maintenance process, operate in strict accordance with the rules of each part, and perform maintenance by dedicated personnel to avoid damage to components.

7.1 Prepare the following accessories

- Cotton swab: 2 bags;
- Degreasing cotton: 5 bags;
- Alcohol: 500ml, purity > 99.5%;
- Acetone: purity > 99.5 %, water < 0.3%, capacity: 500ml;
- Lens cleaning wipes: 5pcs;
- Inflatable ball: 1pcs;
- Dropper needle: 1pcs (medical);
- Disposable latex gloves: 1 pair;
- Multimeter: 1pcs.

7.2 Daily maintenance requirements

1. Clean laser cutting machine to maintain a clean and tidy appearance.
2. Check output voltage of voltage-stabilized power source (required to be 380V-400V). If carbon brush acts frequently in voltage stabilizer, the external voltage may be unstable Shut down and stop production.
3. Each shift shall return to their original points after starting up the machine. If there is any problem, check whether the switch collision block at the original point is deviated.
4. Check cutting nozzle, timely replace if any defect, and adjust coaxiality if any part of cutting head is moved (such as cutting torch and even collision cutting head, etc.).
5. Calibrate the sensor while executing calibration procedures. It is necessary to re-calibrate every time nozzle or ceramic body is replaced or after a collision.
6. Check protective lens of cutting head, and clean it if necessary.
7. Check temperature and pressure of cooling water in water chiller. Temperature in water chiller is higher than 17°C and lower than 23°C. Temperature of circulating water in laser is about 28°C. Pressure at water intake is between 1 and 6bar.
8. Drain water out from air storage tank of air compressor.
9. Drain water out from filter of refrigeration dryer once every day, and pay attention to normal drainage of drain valve.
10. Clean waste tank at bottom of the machine.

7.3 Weekly maintenance requirements

1. Clean the part between cutting head and ceramic body, and timely replace and calibrate if any damage.
2. Check water level and quality in water chiller, and determine whether there is water leakage.
3. Check the refrigeration dryer for its status of operation and compressed air flow, and check whether the condensation indicator is in the green area.
4. Check and clean the air inlet filtering screen of air compressor, and take it out for cleaning if there is any dust.
5. Check deionized water level inside the laser (monitoring software may be used to check the water level).
6. Check hydraulic station and oil cylinder hose to see if there is any oil leakage.

7.4 Monthly maintenance requirements

1. Unnecessary c cutting programs inside the machine shall be timely deleted.
2. Check the tightness degree of workbench chains.
3. Lubricate guide rails of the laser cutting machine, and check the automatic lubricating device. It is necessary to add lubricating grease for the low oil level inside the device.
4. Check inner parts of the machine cabinet and the laser, and promptly clean up if any dust found (be sure to cut off power before cleaning).
5. Check PH value of water in water chiller, and timely replace if it is lower than 7.
6. Check air compressor for its operation conditions, and clean the cooling fin above the air compressor.
7. Blow off the dust on heat exchange film of water chiller with air gun or air pipe. Note: it is required to blow from the inside for cleaning.
8. Clean up dust on heat exchange film of the refrigeration dryer.
9. Check dust collector for its operating conditions, and clean the dust collection box of dust collector.

7.5 Requirements for semiannual maintenance

1. Clean up dust and stains on each part of voltage stabilizer
2. Check whether pressure regulating carbon brush of voltage stabilizer moves flexibly, and whether carbon brush is intact. If the voltage stabilizer is normal after inspection, add oil to chain wheel, adjust looseness of chains, check carbon chain's transmission system to see whether brush holder is inclined or jammed, and adjust if any found.
3. Disassemble and check drainage filter tap of the refrigeration dryer for cleaning.
4. Check water quality in water chiller, replace cooling water in it and clean the water tank. It is recommended to use N46# hydraulic oil.
5. Replace hydraulic oil, and clean inner parts of the oil tank.

6. Add No. 0 lithium-based lubricating grease to the lubrication hole on the vertical bearing seat of hydraulic lifting platform.

7.6 Annual maintenance requirements:

1. Check and replace filter element of refrigeration dryer.
2. Replace filter element at air inlet of air compressor, and replace oil filter (smaller) in air compressor in severe environment.
3. Check and replace air filter element in the gas circuit cabinet of the machine.
4. Replace deionized water for cooling and circulating in the laser.

7.7 Requirements for maintenance every 4,000 hours

1. Check oil level in forwarding and backwarding reducer on workbench, check oil level in lifting reducer, and replace gear case oil of forwarding and backwarding reducer and lifting reducer if necessary.
2. Replace air compressor oil.
3. Replace oil-gas separator of air compressor (larger).

Service Schedule of Laser Cutting Machine for Optical Fiber

<table>
<tr><th>Maintenance time</th><th>Maintenance items</th><th>Maintenance time</th><th>Maintenance items</th></tr>
<tr><td rowspan="10">Daily</td><td>Clean the environment around the machine</td><td rowspan="6">Monthly</td><td>Clean air overstock cooling fin</td></tr>
<tr><td>Check and stabilize voltage</td><td>Clean water chiller heat exchanger</td></tr>
<tr><td>The machine returns to the original point</td><td>Clean refrigeration dryer heat exchanger</td></tr>
<tr><td>Check cutting nozzle of the machine</td><td>Check operation state of refrigeration dryer</td></tr>
<tr><td>Calibrate cutting head</td><td>Clean dust collection box</td></tr>
<tr><td>Check protective lens</td><td>Check PH value of water chiller</td></tr>
<tr><td>Check pressure and temperature of water chiller</td><td rowspan="4">Semiannually</td><td>Check and clean voltage-stabilized power source</td></tr>
<tr><td>Drain water out from air storage tank of air compressor</td><td>Check electrical cabinet for laser and machine</td></tr>
<tr><td>Drain water out from filter of refrigeration dryer</td><td>Clean up filter element of water chiller</td></tr>
<tr><td>Clean waste tank of the machine</td><td>Replace cooling water in water chiller</td></tr>
</table>

Weekly	Check cutting head and ceramic body	Yearly	Check and replace filter element of refrigeration dryer
	Check water level and quality in water chiller		Check filter element of the machine
	Clean filter screen in air compressor		Replace deionized water in the laser
	Check deionized water level		Replace air compressor oil filter
Monthly	Check workbench chains	Every 4,000 hours	Check the workbench Click Oil Level
	Lubricate guide rail of the machine		Replace air compressor oil
	Add the lubricant		Replace oil-water separator of air compressor

7.8 Maintenance of the laser

1. Regular maintenance of the laser can effectively reduce failures, and keep the equipment in a good operating state at any time.
2. Usually, the laser does not need much maintenance. All functions and parameters are monitored by the control system at any time. If there is any abnormality or expiration of one maintenance item, the system will automatically send alarm information. Take corresponding measures or contact with us for maintenance in such a situation.
3. Regularly check equipment conditions, and please timely conduct maintenance if any sign of abnormality or pollution.
4. Regularly check laser cable conditions to protect the external protection layer from damage. Damaged protection layer of cable (if any) can only be replaced.

7.9 Maintenance of laser head

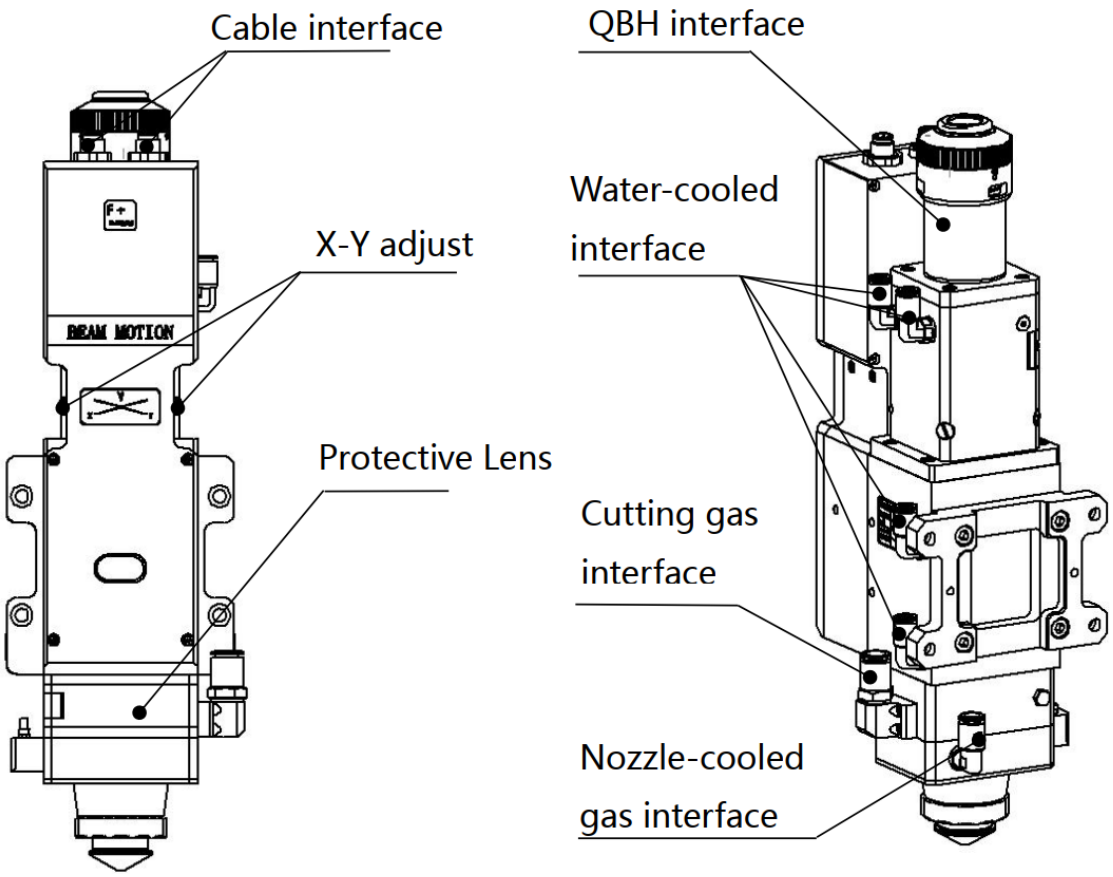
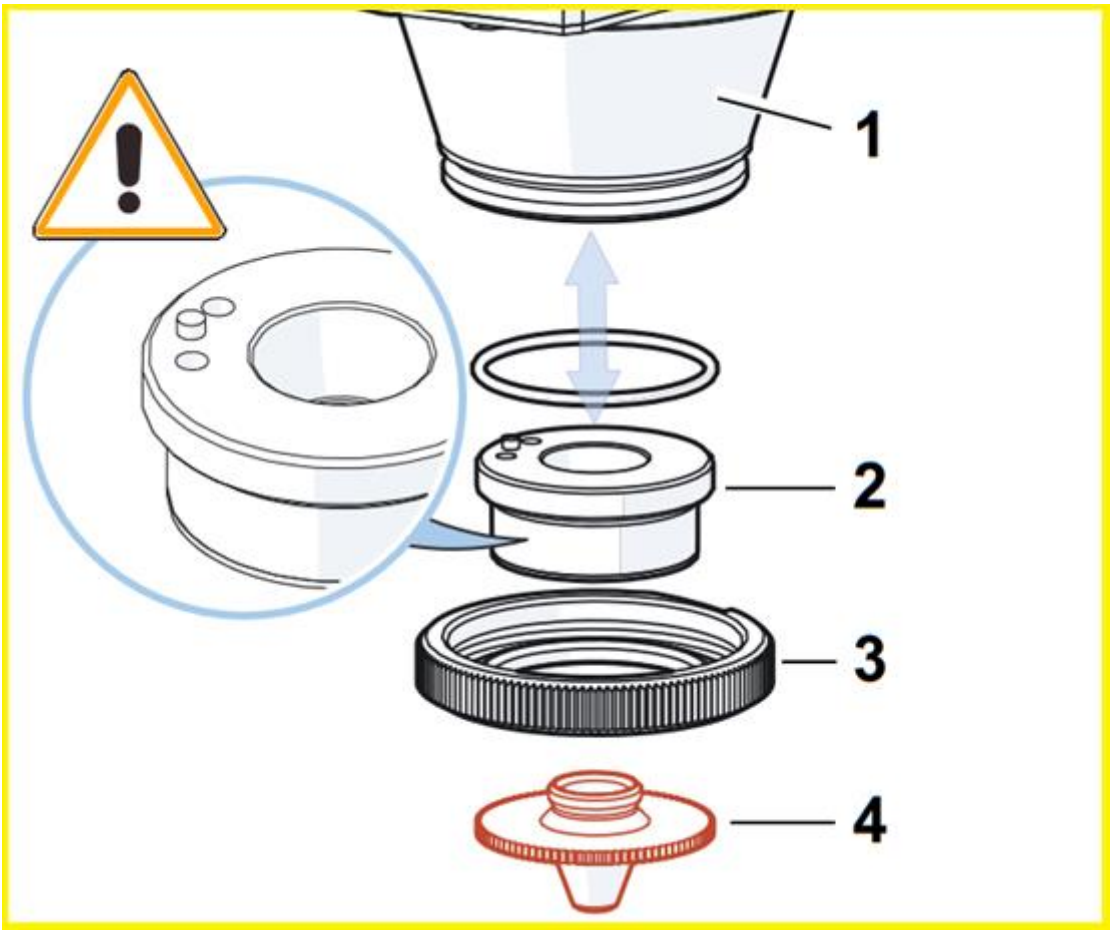


Diagram of the laser head

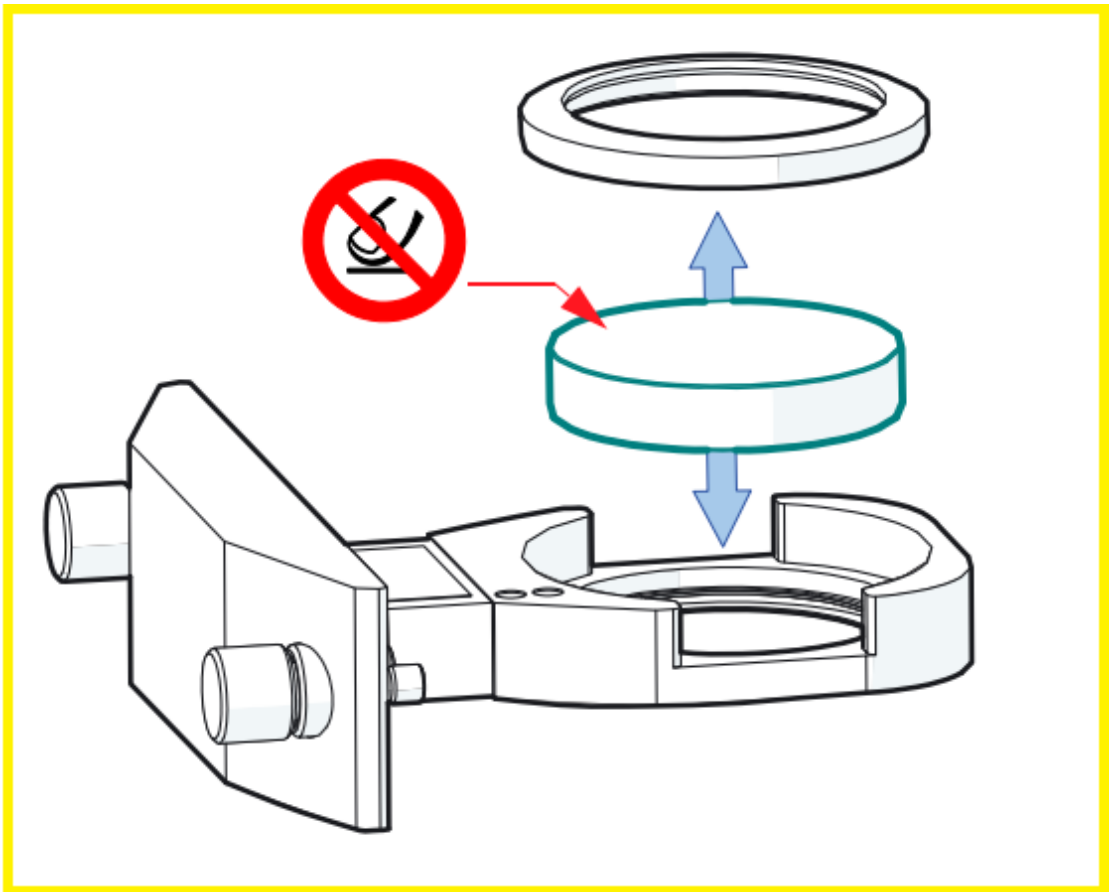
1. Check operation conditions of cutting torch and ceramic body every 8 hours, and timely clean up if there is any welding slag;



Ceramic Body and Cutting tip

Notes: pay attention to preventing electric shock and ensuring in-place installation while installing ceramic body. The incorrect installation is prohibited.

2. Check whether cutting torch and ceramic body are damaged every 24 hours, and timely replace if they are damaged and cannot operate normally;
3. Clean surface of the laser head every 24 hours;
4. Check protective lens for its operation conditions every 72 hours, use dedicated cleaning tools to clean if there are somewhat dirt and welding slag, and timely replace if it influences cutting effect;



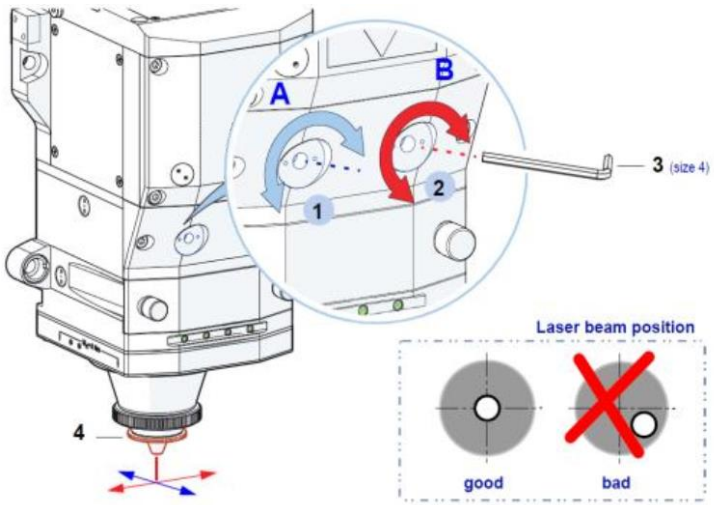
Installation of Protective Lens

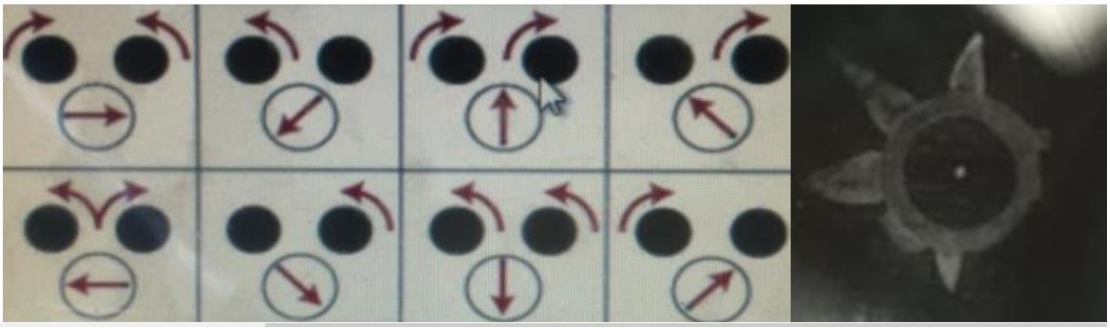
Notes: conduct dust-prevention of cutting head after withdrawing lens holder. It is strictly prohibited to touch the up and down sides of protective lens while replacing it (fingerstalls or gloves are available)

5. Check whether follow-up height is normal every 72 hours, and please re-calibrate if abnormal;
6. Check whether the lateral blowing system of cutting head works normally every day

7.10 Beam alignment

1. Tool preparation, 3 mm (or 4 mm) Allen wrench and transparent tape.
2. Reset the focus to 0.
3. Stick the transparent tape on the cutting nozzle, then adjust (1,2) two screws with the Allen wrench to align the beam at the center of the cutting nozzle.
4. When the tape is not penetrated by the laser beam, this is because the laser beam is too off-center. So please remove the cutting nozzle and stick the tape to the ceramic ring for beam correction. After preliminary correction, install the upper cutting nozzle for accurate correction. Start from a bigger nozzle (like a 4.0 mm single nozzle) then change to a smaller one until you can see it centered with a 1.0 mm or 1.2 mm nozzle.





7.10 Maintenance to dust removal fan

It is necessary to frequently check operation conditions of each part of dust collector during operation, maintain each part, and pay special attention to checking the following critical parts to ensure good operating conditions of equipment.

1. Check pressure difference change at air inlet and outlet of dust collector, and if there is any abnormal decrease or increase of pressure difference, further inspection may be conducted from damage of filter element or blocking.
2. Periodically check integrity of case to reduce air leakage rate of equipment.
3. Check pressure change conditions of compressed air for blowing. Air pressure shall be controlled within 0.4-0.6MPa, which shall not be too low or too high, for its influence on dust removal effects and service life of pulse valve.
4. Cable: check all conduits, cables and connection points for wearing and fracture.
5. Frequently check whether the pulse dust removal system of dust collector works normally. If not, focus on checking whether the pressure regulating valve, control device, pulse valve, solenoid valve and others on air bags are out of order or damaged, and timely repair or replace them.
6. Check whether air fan and motor operate normally.
7. Check whether the dust discharge system is blocked.
8. Regularly clean up dust in the dust collecting car.

7.11 Maintenance of water chiller

1. Water chiller cannot be exposed to water swash or rain;
2. It is forbidden to stretch hands or foreign object into the machine;
3. Laser water chiller which has not been used for a long time may cause water pump starting difficulty at the first starting. Please lightly toggle engine Aaron;
4. It is forbidden to operate without cover if there are any live, operating and high-temperature parts inside;
5. By no means is the machine allowed to operate with no water, for it will cause damage to the machine;
6. The water tank used in this machine cannot be fully filled to prevent liquid spoiling during operation;
7. Make sure to operate in a well-ventilated environment;
8. Be sure to cut off power before maintenance, and operate five minutes after cutting off the power;
9. Wipe machine surface with neutral detergent;
10. Clean filter screen of the condenser every week;
11. Check water quality in water tank every month;
12. Check the filter in laser water chiller every two months, and timely clean up if there is any foreign matter;

13. It is recommended to clean finned condenser every 3 months. In the case of using finned condenser in high-temperature, high-humidity or greasy environment, please shorten the cleaning period based on actual filth blockage conditions.
14. If there is just little dust and batting in finned condenser, use compressed air to blow out dust and batting, and pay attention to not touching fins.
15. If there is much oil dirt or it is seriously scaled on surface of finned condenser, please clean with cleaning agent dedicated for air conditioner.
16. If water chiller has not been used for a long time or stopped in an environment lower than 2° C for a long time, drain out water inside the equipment based on the following steps and ensure machine dryness.

a) Make sure that the water chiller has been stopped and deenergized, close the water inlet and outlet ball valve, and dismantle water pipes connecting air chiller and the host machine;
b) Open drain valve and water inlet and outlet valves at bottom of water tank of water chiller to drain water in the water tank;
c) Screw off drainage plugs at bottom of water pump with spanner to drain out water in the water pump;
d) Blow in compressed air from the water outlet of water chiller and maintain a certain pressure, screw on the plugs after there is no water flowing out from the drainage plug, then respectively blow in compressed air from water inlet and outlet and maintain a certain pressure for 1 minutes to make sure that water in hose has been blown to the water tank;
e) For water chiller with water filter, disassemble water filter and take out the filter element, and install back the element after drying the element and inside of water filter with compressed air;
f) Close the drainage ball valve and water inlet and outlet ball valves after there is no water draining out from the water drainage outlet of the water tank;
g) If water chiller is equipped with internal circulating pump, it is necessary to screw off the drainage plug at bottom of circulating water pump with spanner, drain out all water in the internal circulating pump, and screw back the plug.

17. Water chiller shall be replaced at least every 6 months, which cannot use tap water, but purified water or distilled water. Add some anticorrosive agent and agitate if possible;
18. Water pump has to be operated after draining out air every time the water is replaced. Operation before drainage is strictly prohibited;

7.12 Maintenance of voltage-stabilized power source

Regularly check operation conditions of voltage-stabilized power source, which may be conducted from the several following aspects:

1. Check whether temperature rise of compensation transformer and voltage regulating transformer work normally, and whether the load exceeds the rated value;
2. Whether input voltage goes beyond the regulated range;
3. Whether the voltage regulating system and transmission system (including transmission chains) operate normally;

4. Whether carbon brush holder is loose, and whether carbon brush is on the same plane and the same straight line and is well contacted;
5. None of the above example issues is allowed. It is necessary to timely solve if any found.

It is recommended to maintain voltage-stabilized power source every year, and maintenance items include:

1. Clean up dust and stains on each part of voltage stabilizer;
2. Check whether electrical components are damaged, and if any, timely replace;
3. Whether chain transmission mechanism and other parts of the voltage regulating system operate normally. These parts shall be well lubricated and chain looseness shall be calibrated;
4. Replace damaged or seriously worn carbon brushes, and wipe clean column-type voltage regulator coil with carbon tetroxide and cotton to make it smooth as new;
5. If there is any burning point, timely polish smooth with No. 0 fine sandpaper.

7.13 Maintenance of refrigeration dryer

Notes: refrigeration dryer has to be started before air compressor operates. It is strictly prohibited to blow compressed air into refrigeration dryer when the refrigeration dryer stops operating.

- **Start up**

1. Press down ON/OFF button and wait for 5 minutes if there is no abnormality until the refrigeration dryer operates at correct working pressure and temperature.
2. Slowly open air inlet valve of refrigeration dryer to increase the air inlet pressure of refrigeration dryer to the system pressure.
3. Slowly open the drainage valve of refrigeration dryer until the dryer starts to operate normally.

- **Shutdown**

1. Close the air inlet valve of the refrigeration dryer after the air compressor stops operating
2. Press the ON/OFF button.
3. Maintenance and service
4. Daily inspection items for maintenance:
5. Check whether the power indicator light is on.
6. Check whether dew point indicating instrument is in the green area

- **Monthly inspection items for maintenance:**

1. Check drain valve
2. Check maintenance items every 4 months:
3. Clean condenser fins
4. Check power consumption
5. Check whether there is refrigerant leakage
6. Check maintenance items every 12 months:
7. Turn off the unit, and completely maintain the drain valve
8. Turn off the unit and replace elements of the front and rear filters

Chapter8 Installation and acceptance

8.1 Site conditions and requirements

8.1.1 Personnel requirements

- Programming operators shall have obtained college degree for CNC or electromechanics (including vocational school);
- Understand general G codes for machine, be proficient in computer operating, and have certain knowledge about machine industry;
- Able to operate office software and AutoCAD on computer. Provide one set of programming computer for machine.

8.1.2 Electrical requirements

Specifications for electricity consumption of the whole machine (including host machine, laser, water chiller, dust collector)		
1	Power connection	**3-Phase & PE**
2	Frequency	**60Hz**
3	Rated voltage	**3x400V**
4	Allowable voltage fluctuation	**± 10%**
5	Maximum power	**10 kW**
6	Installed capacity	**30 KVA**
7	Power factor	**0.7-0.9**
8	Protection grade	**IP54**
✧ No snap of power voltage or sudden power outage is allowed, for it will easily cause damage to the laser; ✧ It shall be well grounded (grounding resistance less than 4Ω)		

8.1.3 Gas requirements

Cutting auxiliary gas: Oxygen O_2		
1	Gas purity	**≥ 99.95** Vol.%
2	Dynamic pressure at the machine inlet	**10** Bar
3	The maximum dynamic flow	**600** L/Min

4	Diameter of connecting hose	**Φ12 (Outer diameter)**
Cutting auxiliary gas: Nitrogen N_2		
1	Gas purity	**≥ 99.999** Vol.%
2	Dynamic pressure at the machine entrance	**25** Bar
3	The maximum dynamic flow	**1600** L/Min
4	Diameter of connecting hose	**Φ12 (Outer diameter)**
Cutting auxiliary gas: Compressed air (Air)		
1	Quality standards for compressed air	**GB/T 13277-1991**
2	Maximum particle dimension	**0.1um**（Class 1）
3	Maximum particle density	**0.1mg/m³**（Class 1）
4	Maximum pressure dew point	**-40°** C（Class 2）
5	Maximum oil content	**0.01mg/m³**（Class 1）
6	Dynamic pressure at the machine entrance	**10** Bar
7	The maximum dynamic flow	**40** m³/h
8	Diameter of connecting hose	**Φ12 (Outer diameter)**

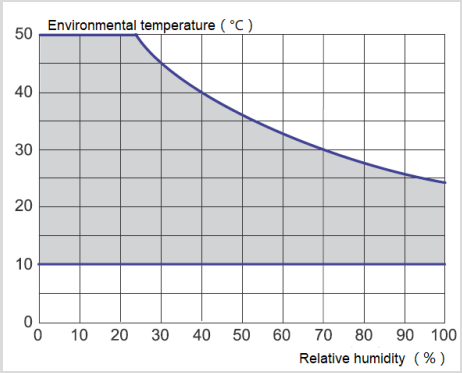
- ✧ Cut pipes of auxiliary gas (oxygen, nitrogen and air) from gas source to machine, which shall be provided and installed by users;
- ✧ Refer to the table for requirements for dimension and pressure of gas pipes;

8.1.4 Cooling water requirements

Cooling water	
1kW	➢ Circulating water in water chiller: distilled water 30L (electric conductivity <10uS/cm)
1.5kW	➢ Circulating water in water chiller: distilled water 40L (electric conductivity <10uS/cm)
2kW	➢ Circulating water in water chiller: distilled water 40L (electric conductivity <10uS/cm)
3kW	➢ Circulating water in water chiller: distilled water 60L (electric conductivity <10uS/cm)
4kW	➢ Circulating water in water chiller: distilled water 60L (electric conductivity <10uS/cm)

8.1.5 Environmental requirements

Requirements for temperature and humidity		
1	Environmental temperature for machine operation	+5°C-45°C
2	Environmental temperature for laser operation	+10°C-45°C

3	Environmental temperature for laser shutdown	+5°C-45°C
4	Environmental humidity for laser operation	
✧ It is recommended to place the laser in the air conditioning room		

8.1.6 Site requirements

Site requirements		
1	Indoor site is required, site size	Refer to the attached Foundation Drawing
2	Thickness of foundation concrete	≥ 200mm
3	Concrete quality	Intensity grade C25/30
4	Ground levelness	±5mm/5m
5	Maximum amplitude	1mm/s2

8.2 On-site installation

- After the machine arriving at the site, our company will send engineers to the user's site for equipment installation and linkage commissioning;
- Enable the machine to operate officially and meet the acceptance requirements within 5 working days (the user's on-site conditions shall meet the above Chapter5 8.1installation and relevant requirements in 7.1)
- After official operation of the machine, the two parties shall organize acceptance of machine according to the contract technical requirements and main configurations;
- After acceptance, our service engineers shall organize guidance and training for actual production for the user's operation engineers on the user's site. Refer to Chapter 5: Training for training contents.

Chapter9 Service and quality warranty

- Our warranty period of equipment (including the laser and main machine) lasts for 1 year for customer (12 months) from the equipment acceptance date;
- In case of equipment failure during normal operation within the warranty period, reply within 2 hours after receiving user's notice, respond within 24 hours and go to the customer's site for repair;
- In case of damage to spare parts or components due to inappropriate use of user within the warranty period, our company provides free labor service, and only charges for spare parts and elements;
- Wearing parts and consumables are not included in the company's warranty range; (Refer to the attachment for list of wearing parts)
- The implementation of after-sales service of auxiliary equipment should be according to the after-sales service standards of the manufacturer, and our company will assist the requiring party in coordinating after-sales service of auxiliary equipment;
- Out of the warranty period, our company provides lifelong service within the service life of the equipment.

Chapter10 Safety

10.1 Employee instruction

- Only authorized, trained and guided personnel are allowed to operate, repair and maintain the machine.
- Only specially trained professionals can use electrical, pneumatic, hydraulic and laser equipment.

In addition, following measures must be performed before the operator works on the equipment:

1. Understand the possible danger.
2. Operators are required to wear protective clothing and gloves by users if necessary. The stipulation is mainly applied when taking out the thermal workpiece and suitable tools should be used if necessary. It is necessary to wear appropriate laser protective glasses by principle under the maintenance service operation mode (level-4 laser device). Wear a dust mask that clings to the face by principle (anti-toxic-particle and dust-proof mask with filter grade P3) when operating the dust collector.
3. Responsibilities of operation, maintenance, overhaul, etc. should be clearly defined to avoid unclear definition of function and power.
4. Read the technical literature of the equipment. We recommend that the user should require for a written confirmation of reading and understanding the technical literature from the operator each time.

Layout Attachment