

Laser Pipe Cutting Machine Wattsan Uniq Plus Manual



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Dear customer!

Thank you for purchasing our equipment. We hope that his work will delight you for a long time.

The machines are manufactured in accordance with global standards. Each piece of equipment undergoes pre-sale preparation.

First of all, we strongly recommend that this manual be read carefully and completely before using the equipment. Failure to comply with certain points of the Operating Manual may result in injury to personnel and/or damage to equipment!

Follow the instructions in this instruction. This will not only make the work easier but also make the use of the equipment safe and long-term. Please follow these instructions carefully.

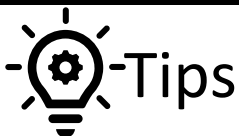
This document is intended to provide an overview of the basic technical data and requirements for the use of the Wattsan machine.

In the event that the equipment is transferred to another customer, this document shall be transferred with it.

The manufacturer reserves the right to make changes and improvements to the design that do not impair the declared characteristics of the equipment.

Information about signs and symbols

In this operating manual and on the equipment, the following designations, signs and symbols are used to transmit especially important information:

	This indicates a hazardous situation that could result in serious injury or death if the specified instructions are not strictly followed.
	Indicates a potential hazard that could result in minor injury or damage to the product.
	It contains important information about the safe and correct handling of the product.
	This component is energized by an electric current. In these places, strictly follow the safety rules when working with electricity.
	Caution: Laser beam hazard.

Read the instructions carefully before starting.

Note!

The equipment you directly purchased may differ from the equipment shown in the figures.

	Untrained personnel should not be allowed to work with this equipment and install it.
	The equipment complies with safety class 4. The use of this equipment may lead to the following consequences: • Ignition of nearby materials • Materials exposed to laser radiation can become sources of dangerous gases • Laser beams can cause direct harm to humans
 MUST-DO	The location of the equipment must be equipped with fire extinguishing equipment. It is forbidden to store flammable and explosive substances near the device.
 MUST-DO	The user must ensure that the material to be processed is suitable for laser processing in order to avoid risks to the life and operation of the equipment.
 FORBIDDER	The operator must not leave the equipment unattended while it is in operation. The equipment must be turned off at the end of operation.
	The use of highly reflective materials is prohibited to avoid the reflection of the laser beam on a person.
	The equipment must be located in a dry, uncontaminated place. The temperature inside the room should be 10-40 Co. Humidity should be in the range of 5-70% (provided there is no condensation).
	The equipment operates from an alternating power supply of 220 / 380 V with a frequency of 50 / 60 Hz. It is forbidden to use the equipment without a voltage stabilizer.

Attention!

The seller is not responsible for the improper use of the equipment and if the user fails to take precautions.

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Specifications

Model	Uniq Plus
Max length of the pipe, mm	6000
Round pipe diameter, mm	20-220
Cross section of square pipe, mm	20-220
Max pipe weight, kg	220
Laser Type	Ytterbium Fiber
Laser Source Model	Raycus RFL-C6000S-CE
Laser power, W	6000
Laser wavelength, nm	1080+/-5
Power adjustment range (%)	10~100
Max. Modulation Frequency (Hz)	50-5000
Laser Head Model	Raytools BM06K
Focusing System	Automatic
Guides	Hiwin
Motor and driver	Yaskawa and Innovance Servo Motors
Power Electronics	Siemens
Control system	FSCUT 5000B
Lubricant	Automatic centralized
Supply voltage, V	380
Supply voltage frequency, Hz	50
Emitter cooling method	Water
Coolant temperature (°C)	22±1
Maximum Fluid Pressure in Cooling System (MPa)	0.5
Ambient temperature range (°C)	+10...+40
Ambient humidity value (%)	<70
Gas pressure for cutting in the system (MPa)	2,5
Cooling pressure in the system (MPa)	0,5
Dimensions without packaging, mm	11230x2020x2133
Weight, kg	5800

Chapter 1. Prelude

1.1. The main purpose and scope of the equipment

The Wattsan Uniq Plus fiber laser pipe cutter is a "standard+" grade machine designed to handle a broad spectrum of pipe-cutting tasks, from simple to complex profiles. It delivers high-precision cutting for round, square, and elliptical pipes, as well as channels and I-beams.

The laser machine is equipped with a high-power fiber optic laser radiation source, equipped with high-precision transmission mechanisms, as well as a high-quality laser head and user-friendly interface.

This equipment can be used to make ship hulls, metal parts, precision machinery, auto parts and other fields.

1.2. Basic requirements for operation

- 1) Connected Ground: Ground resistance $<5 \Omega$.
- 2) Voltage Stabilizer: A mains voltage stabilizer is required to stabilize the voltage of the machine and all associated devices.
- 3) Good ventilation is required to prevent dust accumulation and corrosion.
- 4) Installation of the equipment is possible without the use of a pillow, since there will be no strong vibrations during operation.
- 5) The chiller is used to cool the laser source and the laser head. It is a specialized piece of equipment that cools circulating water and requires the use of distilled water only.
- 6) To prevent fire, the workplace must be equipped with a suitable fire extinguisher.
- 7) The left and rear parts of the machine should be at a distance of more than 1.2 m from the wall. There should be a distance of at least 1 meter from the laser source to the walls.
- 8) The control box, servo, display and control panel are the main parts of the machine. They have certain requirements for the environment and must be protected from mechanical effects and electromagnetic interference.

1.3. Impact on the environment and people

The laser machine belongs to the IV class of equipment. Its laser beam and reflected light can cause damage to the human body (especially the eyes). The operator and operating personnel should pay attention to eye protection and use special glasses (models SD-4 with a wavelength range of 1064 nm).

Chapter 2. Safety engineering

2.1. General safety requirements

1. Personnel working with this equipment must know and remember all safety requirements for working with laser engraving equipment and obey the safety requirements adopted at the enterprise, and the requirements for the management of the relevant equipment.
2. Neglect of control rules and safety requirements can lead to electric shock or fire, which threatens people with serious injury or death!

3. **Work with the equipment should be carried out only if the equipment is free of defects and fully operational.** Disconnect the equipment if there is a malfunction. For possible causes of equipment failure, consult your service staff or the supplier's service department.
4. It is forbidden to perform unauthorized modifications and disassembly of the equipment. This action is dangerous, and mechanical damage resulting from the result is not covered by the warranty. In case you need to disassemble the equipment, consult the supplier's service department beforehand.
5. Persons who have special education or have been trained to work with the equipment, have been briefed on safety, fire safety, on-the-job training, and testing of knowledge of occupational health and safety requirements are allowed to work independently on laser equipment.



It is not allowed to allow personnel who do not have the necessary qualifications to work with the equipment, otherwise the manufacturer is not responsible for the breakdown of the equipment.

6. The operator is not allowed to leave the workplace while the equipment is in operation. The material being processed may ignite and cause damage to equipment, personnel and the premises. The operator must observe the operation of the machine, in case of an emergency, it is necessary to turn off the power.
7. It is forbidden to open the covers of the equipment if it is connected to the mains supply. The voltage used to power the laser source may cause an electric shock.
8. It is forbidden to open the covers and doors of the machine during operation.
9. Avoid hands and other parts of the body in the equipment worktable area to avoid burns.
10. It is the operator's responsibility to inspect the equipment for visible external damage and defects before starting work. If this is observed, it is necessary to immediately inform the service personnel about it.
11. The operator must keep the equipment clean and turn off the equipment at the end of work.
12. During operation, ensure proper ventilation of the room, depending on the materials to be treated and the smoke and other harmful substances emitted by them.
13. The trajectory of the laser beam is not visible and has no explicit protection, so the operator must avoid the beam hitting any part of the body during operation; The laser beam is invisible and can have a negative impact and/or damage a person's vision
14. Never look directly at a laser beam!
15. Do not let the direct or scattered laser beam affect the eyes or skin!
16. Anyone approaching the equipment should wear safety glasses.
17. An employee who witnesses an accident must immediately inform his immediate supervisor about any accident that occurred at work, a situation that poses a threat to the life and health of people.
18. The machine must be used according to the instructions in this manual. In no event will the supplier be liable for any damages caused in whole or in part by the customer, or for any economic loss, personal injury, loss of revenue, loss of profits, loss of savings, or other indirect, incidental, or consequential damages suffered by anyone, even if the company has been advised of the possibility of such losses or claims.

Safety should be an integral part of your work!

2.2. Requirements for the workplace

Working conditions must meet the following requirements: Failure to use suitable operating conditions may result in improper operation or damage to the equipment.

1. The temperature inside the room should be between 10-40°C. When the ambient temperature is higher than the maximum stipulated, the equipment will overheat, which will damage it. If the ambient temperature is below the minimum stipulated temperature, the electronic or electrical components of the equipment, as well as the optical elements, may fail.

2. Humidity should not exceed 70%. The formation of condensate will damage the electronic components of the equipment and can threaten the safety of the operator.
3. ***Never place flammable substances (alcohol-containing, gasoline, etc.) on the equipment or store them near the equipment.***
4. ***Provide the workplace with a CO2 fire extinguisher. Do not use dry powder fire extinguishers, as they can severely damage the parts of the device.***
5. ***Install suitable ventilation equipment to eliminate smoke and dust.***
6. Maintain free airflow around the equipment. Never cover the equipment with film or cloth during operation.
7. The room in which the equipment is installed shall also be equipped with fire extinguishing systems and fire alarms.
8. It is forbidden to store combustible and explosive substances in the same room with the equipment.
9. Do not store flammable materials inside or in the immediate vicinity of the equipment. In particular, debris or residues of used material to prevent the risk of fire.
10. The equipment must be placed quite freely. On the front side of the control panels, it is necessary to leave a free space of 1.5 meters in the case of a single-row arrangement of equipment and 2.0 meters in the case of a two-row arrangement.
11. Ventilate the room daily.
12. Before starting work, make sure that the equipment worktable is free of dirt and foreign objects. Make sure that the ventilation system of the equipment is in good working order.
13. Clean the work surface and mechanics of the equipment daily from debris and material residues after they have been processed.

2.3. Electrical safety

	<i>After turning off the power to the machine, you must wait at least 5 minutes, and only then you can touch the electrical circuit of the machine. For a period of time after the power is turned off, there may be a high voltage in the machine's electrical system, which can cause harm to people and equipment.</i>
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1. The equipment includes a large number of high-precision and high-tech components that are sensitive to the characteristics of the supply voltage.

The equipment should work without sudden power surges. If the voltage fluctuates, the equipment will not work properly.

To prevent the above factors, **it is necessary to install a voltage stabilizer** that is suitable in power for the configuration of your equipment.

2. The equipment **must be properly grounded**. Poor grounding shortens the service life of the equipment, and a high voltage discharge is destructive to the equipment electronics and life-threatening.

3. Proper grounding of the CNC machine and what it is for.

The use of this equipment imposes certain obligations on the owner for connection, in particular:

1. **The presence of a working grounding in the socket is mandatory.**
2. **Additional protective grounding of the equipment body and all related electrical appliances (chiller, PC, exhaust system, etc.).**

The lack of grounding affects the electronics of the machine and there is a risk of interference and electrical interference, as well as leading to the failure of the equipment electronics.

Do not forget about the need to ground peripheral devices connected to the machine, such as a computer, smoke extraction system, etc.

To ground the enclosure, the equipment has an additional grounding terminal.

Correct grounding can be organized by means of a wire with a cross-section of at least 4 mm and a triangle design.

	Before you begin, make sure that the wires are connected and that the equipment is grounded correctly.
	The machine works under high voltage, take all precautions.

2.4. Laser Safety

This equipment belongs to safety class 4

1. In accordance with the regulations CFR 1040.10 and IEC/EN 60825-1, laser systems are classified into 4 safety classes to assess the potential hazards. Without safety regulations, direct radiation or even scattered reflected radiation is dangerous!

Class IV lasers include those whose diffusely reflected radiation poses a hazard to the eyes and skin at a distance of 10 cm from the reflective surface.

Laser sources are classified by the manufacturer according to the output characteristics of radiation by the calculation method.

	The parts can be very hot even after the cutting process is complete. Take steps to prevent skin damage by wearing protective clothing such as flame retardant gloves, caps, leather apron, and other flame retardant clothing. Sleeves and collars should be buttoned.
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2. Without observing precautions when exposed to laser radiation, there are the following risks:

- Burns of the eyes or cornea;
- Burns of the skin;
- Risk of fire from clothing or flammable materials located in the vicinity of the machine in operation;
- Emission of harmful gases during the processing of materials.

	To avoid the effects of radiation, it is necessary to wear special protective glasses.
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3. Never attempt to modify or disassemble the laser emitter!

2.5. Fire safety

2.5.1 Sources of fire hazard

Like any other high-tech equipment, laser equipment requires careful operation in compliance with labor protection rules and standards, including fire and explosion hazard requirements.

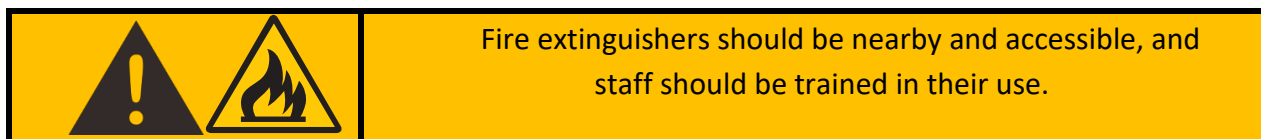
Ignition of machines is dangerous in any case, whether it is caused by internal malfunctions of the mechanism or is associated with the external effect of flame on the equipment.

Such violations in the operation of the machine as:

- short circuits;
- lack of grounding;
- violation of electrical circuits;
- erroneous choice of processing mode, etc.

can lead to the appearance of fires on the equipment worktable. The presence of flammable materials (scraps, debris, dust, etc.) in the desktop area can further aggravate the situation and lead to a fire.

The impact of flame on the machine from the outside is no less dangerous and unprofitable. Machine parts are not able to withstand high temperatures. In addition to the fact that repairing equipment after a fire will not be cheap, the burning of mechanisms can intensify the fire, increase the total burning area and damage property or personnel in the room.



2.5.2. Protection of equipment from fire

To prevent the ignition of the machines, their operation should be treated as carefully and carefully as possible. The equipment must be grounded, as well as protected from the ingress of gas, vapors, liquids, dust, dirt and other substances that are used or emitted during operation of the device.

Guaranteed fire safety can be increased by installing a specialized automatic fire extinguishing system. Such systems usually have a modular design, which allows them to be successfully used on various types of equipment

A simpler fire extinguishing system should be made in the form of a 5-10 liter cylinder with a fire extinguisher. The fire extinguisher must be carbon dioxide or halon. The location of the fire extinguisher should be within 10 meters of where your equipment is installed.

We do not recommend using dry powder fire extinguishers, since due to the excessively detrimental effect of their fire extinguishers on the equipment, it is often no longer possible to restore it after fire extinguishing.

The correct approach to ensuring the fire safety of CNC machines, their careful operation and compliance with labor protection requirements is the key to a long and fruitful operation of the equipment, as well as the safety of others.

2.6. Obligations of the Operator

- The operator must undergo special training in order to start working on the machine.
- Follow the instructions for regular maintenance of the appliance to keep it operational and

prevent accidents.



Each employee who is near the laser during its operation must wear appropriate laser safety goggles and protective clothing.

Chapter 3. Installation and connection

3.1. Delivery

Content Checking:

- 1) After opening the package, check the complete set.
- 2) Check the equipment for damage in transit.

3.2. Requirements for the premises

3.2.1 Environmental requirements

- 1) Ambient temperature

When operating the machine, the ambient temperature should be between +10 °C and +40 °C. When the equipment is switched off, the ambient temperature should not be lower than + 4 °C. If the ambient temperature is above 40 °C, a device that lowers the temperature (e.g. air conditioner) must be installed in the room.

- 2) HumidityFor the correct operation of the equipment, it is recommended to use it at a relative humidity of <70%. A wet room is not suitable for the operation of the machine, as it corrodes it, which leads to the failure of the electrical and mechanical systems of the machine.



It is forbidden to use the equipment at a relative humidity of more than 70%.

Do not use the equipment at temperatures below the dew point.

Temperature	Humidity															
	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
16°C				0	2	4	5	7	8	9	10	11	12	13	14	15
18°C			1	3	4	6	8	9	11	12	13	14	15	16	17	18
21°C		1	3	5	7	9	11	12	13	14	16	17	18	18	19	21
27°C	2	5	8	10	12	13	16	17	18	19	21	22	23	24	25	26
29°C	4	7	10	12	14	16	18	19	21	22	23	24	26	27	28	28
32°C	7	10	12	15	17	19	21	22	23	25	26	27	28	29	31	31
35°C	9	12	15	17	19	21	23	24	26	27	29	30	31	32	33	34
38°C	11	14	17	20	22	24	26	27	29	30	31	33	34	35	36	37

3) Equipment Cooling

The equipment is cooled by air circulation inside the cabinet. Therefore, it is important that the parts inside the cabinet are not contaminated with dust and dirt.

A wet room is not suitable for the operation of the machine, as it corrodes it, which leads to the failure of the electrical and mechanical systems of the machine.

3.2.2. Vibration requirements

Equipment can be adversely affected by:

- 1) Forklift, ground transport.
- 2) Equipment and machines that will cause vibration, e.g. punching machine, bending machine, shears, etc.

3.2.4. Gas requirements.

1) Cutting Gas

Cleanliness requirements:

Cutting Gas	Purity	Maximum Content of Water Vapor (ppm)	Maximum Content of Hydrocarbon (ppm)
Oxygen	> 99.5%	<5 ppm	<1 ppm
Nitrogen	> 99.9995%	<5 ppm	<1 ppm

2) The level of gas consumption is influenced by:

- Nozzle Diameter
- Gas pressure
- Laser Cutting Time

Cutting Gas Consumption Estimate: The following is a list of gas consumption when cutting at standard pressure and high pressure. To estimate gas consumption, use the machine to accumulate data and evaluate the determination of material varieties and material thickness.

Standard cutting: the nozzle outlet pressure is less than 6 bar. For cutting, oxygen or nitrogen is needed as a cutting gas. Using O₂ for cutting under standard pressure conditions, the pressure will be at least 8 bar (with a gas flow rate of 10 Nm³/h, a nozzle diameter of Ø 1.7 mm and a cutting pressure of 6 bar).

High pressure: the nozzle outlet pressure is more than 6 bar. Nitrogen is used as a cutting gas, and oxygen can also be used.

Gas supply hoses should be located at least 150 mm from the ground, hoses should have an area of at least 1 m for freedom of movement, so that the tube can be bent when replacing the filter.

A shut-off valve should be installed on each hose so that you can stop the gas supply if necessary.

	The temperature of the gas should not exceed 50 °C.
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3) Gas cylinder

The pressure reducer used in cylinders is the simplest way to supply gas, but requires a lot of manual work.

When replacing a gas cylinder, first check the label on the cylinder to ensure that it meets the requirements for laser cutting gas (e.g., N₂ or O₂ gas purity requirements and pressure requirements). The gas level cannot be lower than the recommended gas level. Next, connect the hoses to the equipment in the correct direction, open the cylinder of the connecting valve, check the gas path for damage to the hoses.

	Do not use gas cylinders until the cylinder is completely depleted. The pressure in the cylinder used must be higher than atmospheric pressure.
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Pressure: not less than 1.5 kgf/cm², not more than 3 kgf/cm².

The difference between the inlet and outlet water pressure: not less than 2kgf/cm².

Temperature range: 20 ± 2 ° - 22 ± 2 C°.

Cooling water: distilled, free of mineral impurities.

Valve and pipe: all stainless steel or high-pressure rubber hose, do not use galvanized material; clamp to connect stainless steel pipes.

3.3. Installation

3.3.1. Installation of the voltage stabilizer and connection of the machine.

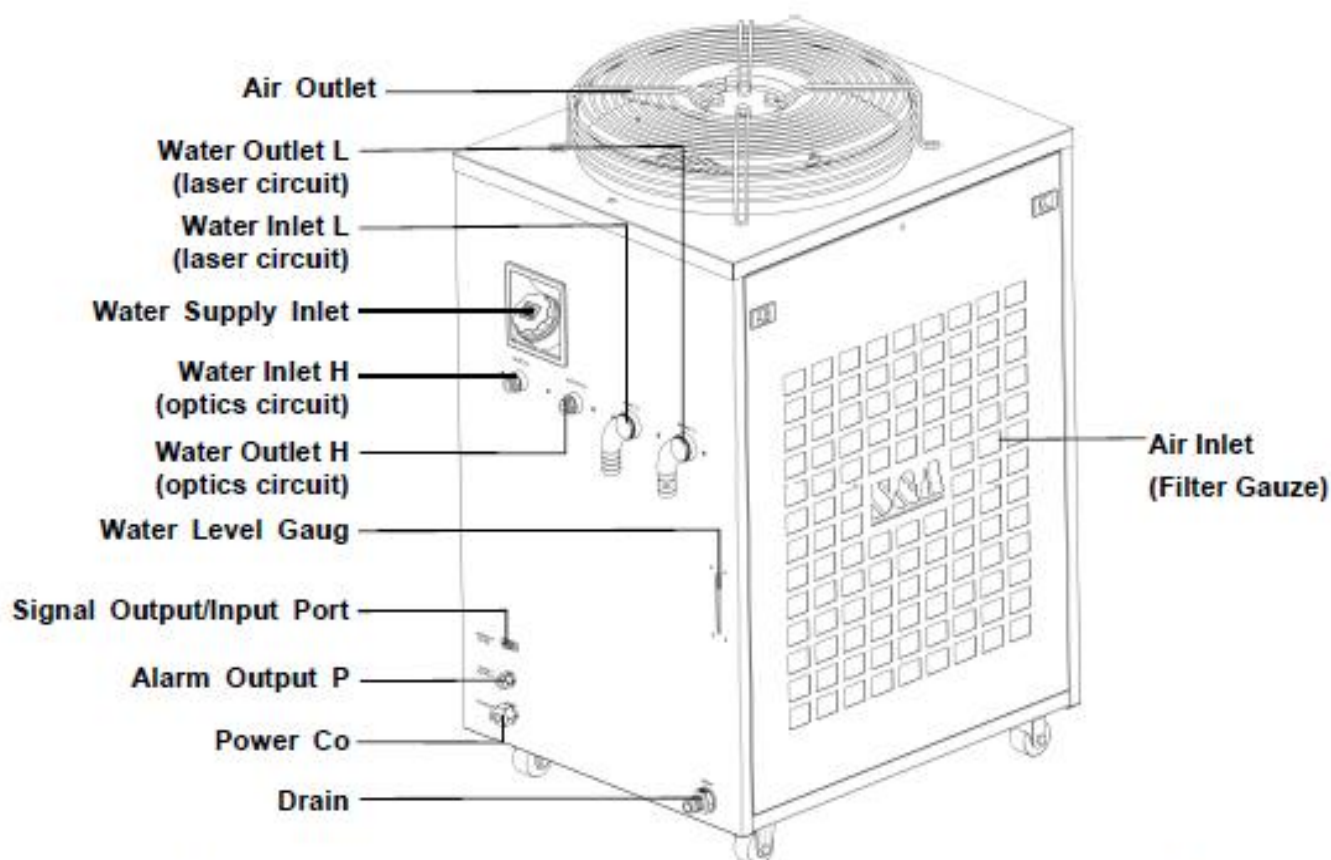
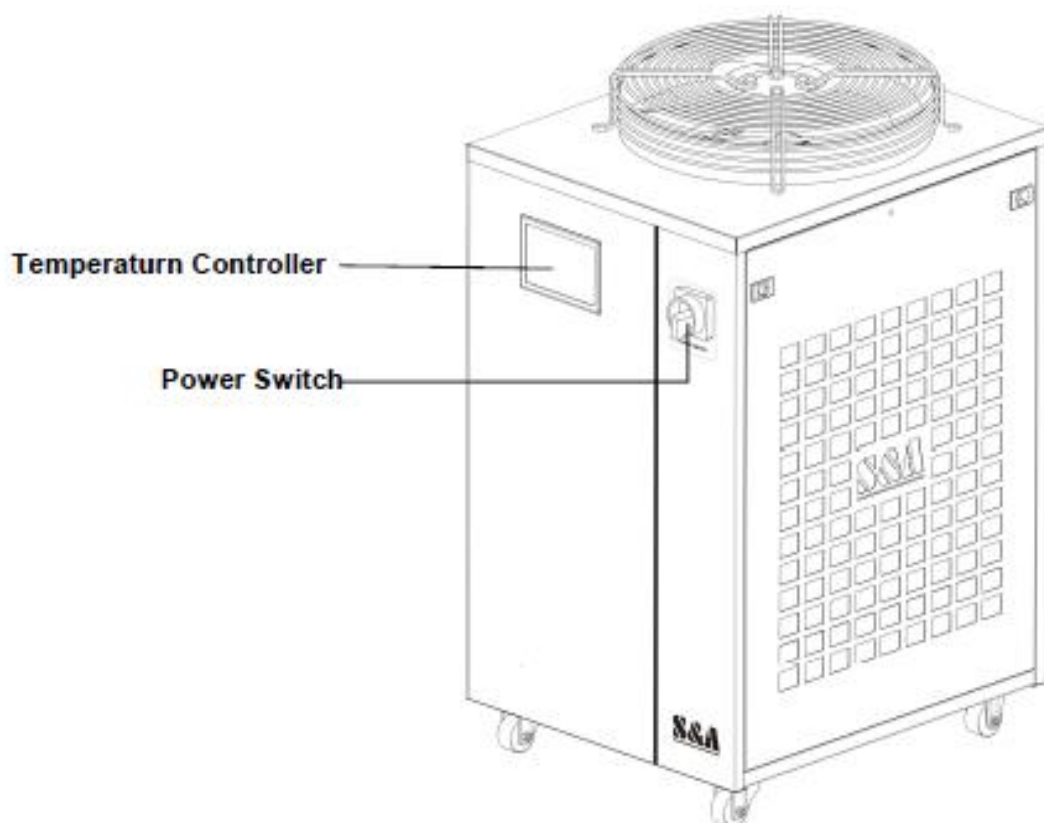
To ensure the proper operation of your equipment, it and all peripherals must be connected through a voltage stabilizer.

1. The voltage stabilizer must be suitable in power for your equipment (including PCs and other peripheral equipment).
2. Install and connect the voltage regulator to your power supply according to the instructions that came with it.
3. Don't forget to connect your gimbal to the ground.
4. Turn on the voltage regulator and check that it is working and converting the voltage correctly.
5. Connect the machine and peripheral equipment to the voltage stabilizer.

3.3.2. Chiller Installation

	Only distilled water is allowed to be filled into the chiller.
	Before connecting the tubes, make sure that the hoses inside are not dirty and do not have foreign objects (debris and fasteners), and the hoses are not bent along the entire route of laying.
	The water cooling system must be equipped with filters with a cleaning accuracy of 100 µm

Installation of a water chiller should be carried out in a room without corrosive gases, at an ambient temperature of 2 to 40 ° °CC. There must be enough air to enter and exit the chiller ventilation space. The top of the device should be more than 2.5 meters away from other objects and at least 1.5 meters away from the device. It is forbidden to install the device in ventilation mode in an enclosed room, the room must guarantee the condition under which hot air from the chiller will not return back to the device.



Note: The above-mentioned product outlines and part names are only for one of the models. The outlines and parts installation may be slightly different in different models.

1) Chiller Inspection

Clean the chiller's water tank to make sure the water tank is clean and free of contaminants. Next, check the connection of the cooling hoses for breaks.

2) Hose connection

Next, connect the water outlet and inlet to the laser light source and the laser head. Pay attention to the direction of entry and exit to avoid the wrong one. Before connecting the pipe, make sure that the hoses inside are not dirty and do not have foreign objects (debris and fasteners), and the hoses are not bent along the entire route of laying.

3) Water quality

Open the inlet valve and add water to the water tank. The water level should be in the green area on the water level indicator to prevent the water in the tank from overflowing. Do not fill the chiller with tap water, and only use distilled water for cooling, otherwise it may damage the chiller and the laser source. **It is forbidden to add any aggressive liquids and antifreezes to the water.**

4) Power Test

Connect the machine to a power source, make sure the lights are green. When reusing after prolonged inactivity, the chiller should be turned on 2 hours in advance so that the oil heater automatically heats the oil inside the chiller compressor (preheating is turned on on the chiller display). After preheating the chiller, you can start working.

5) Trial Run

Make sure the direction of the water pump and fan is correct and the chiller display is working accordingly. Check the tightness of the hoses and the compliance of the water pressure in the circuit with the required pressure for your equipment. If there is not enough cooling water in the tank, it should be added, also check that the chiller's water cooling temperature limits meet the requirements of the equipment.

6) Use

Please avoid unnecessary contact with water. All parts of the water cooling system, such as the pump, hose, etc., should be used only for the water system.

Before filling, visually check that the water does not contain mineral water, is colorless, cloudless and odorless.

7) Color/Opacity

The presence of any opacity (for example, suspension, filamentous, flaky, particles, etc.) indicates water pollution, so it is forbidden to use such water in a water cooling system.

3.3.2. Compressed air connection

Connect the compressor to the air supply system in the machine. Before connecting, make sure that the hoses inside are not dirty and do not have foreign objects), and the hoses are not kinked throughout the laying route.

1) When the water temperature reaches the set temperature, the chiller will start regulating the temperature automatically, while the water pump inside the chiller will continue to operate normally.

2) Before starting the equipment for the first time, it is necessary to open the drain valve of the gas pump to ventilate the air, otherwise the pump may be damaged, at the same time, adjust the opening of the valve in the water supply system well.

Try not to touch the valve of the water supply system afterwards.

3) After the water temperature in the cooling system and the water pressure difference reach the required value, the laser can be turned on.

4) When the room temperature is below freezing, for example, the equipment is not used for a long time, it is very important to drain all hoses to avoid rupture.

5) When working for a long time, always keep an eye on the level of cooling water. The water level should be checked in a timely manner and the hoses should be checked for leaks.

6) If water filters are dirty, they must be replaced in time.

Chapter 4. Machine setup

Adjustment of the machine should be carried out by a specialist and carried out strictly in accordance with the rules set out in this manual. Correct setup is the basis for ensuring the normal operation of the machine.

4.1. Fiber Optic Cable

The bending radius of the fiber optic cable should be less than 200mm. The fiber optic cable must be routed through the flexible cable channels of the machine. Make sure that the water and gas pipes that are located next to the fiber optic cable do not leak!

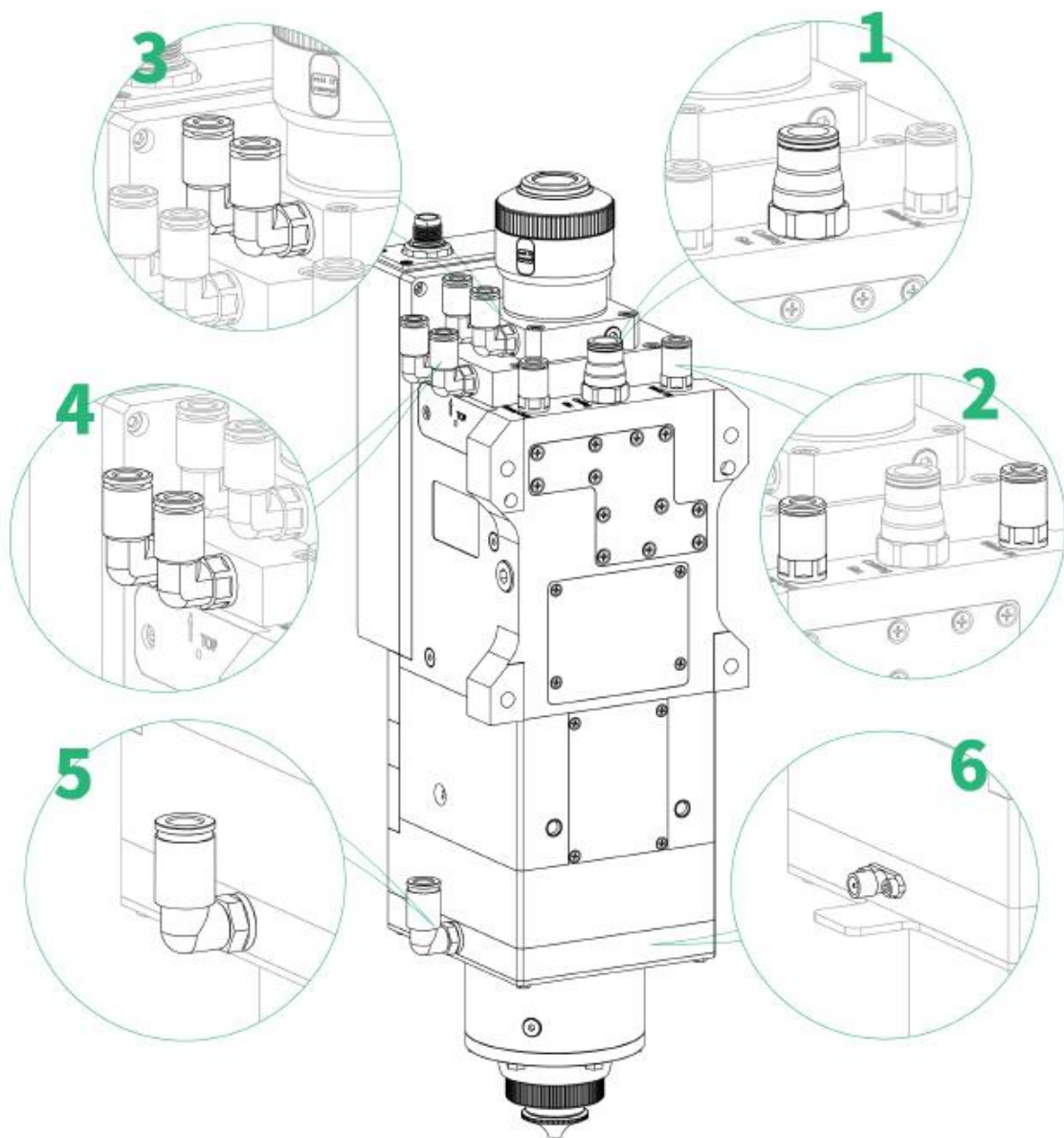
Before connecting the fiber optic cable to the laser head, it is necessary to ensure that the QD cable connector is clean, or clean it of dust using compressed dust blowing air or a professional cleaner (ethylene propylene glycol), as well as fiber cotton cleaning tools.



The installation of fiber optics should be carried out by trained specialists.

You need to make sure that the QD connector is not dirty, only then you can insert it into the hole of the laser head. After that, it is necessary to adjust (align) the optics of the laser head of the machine.

4.2. Laser head of the machine



No. 1	Cutting gas ($\Phi 10$)	No. 4	Cooling water ($\Phi 6$)
No. 2	Cooling water ($\Phi 6$)	No. 5	Nozzle cooling gas ($\Phi 8$)
No. 3	Cooling water ($\Phi 6$)	No. 6	Preamplifier interface (SMA)

4.2 Optical system

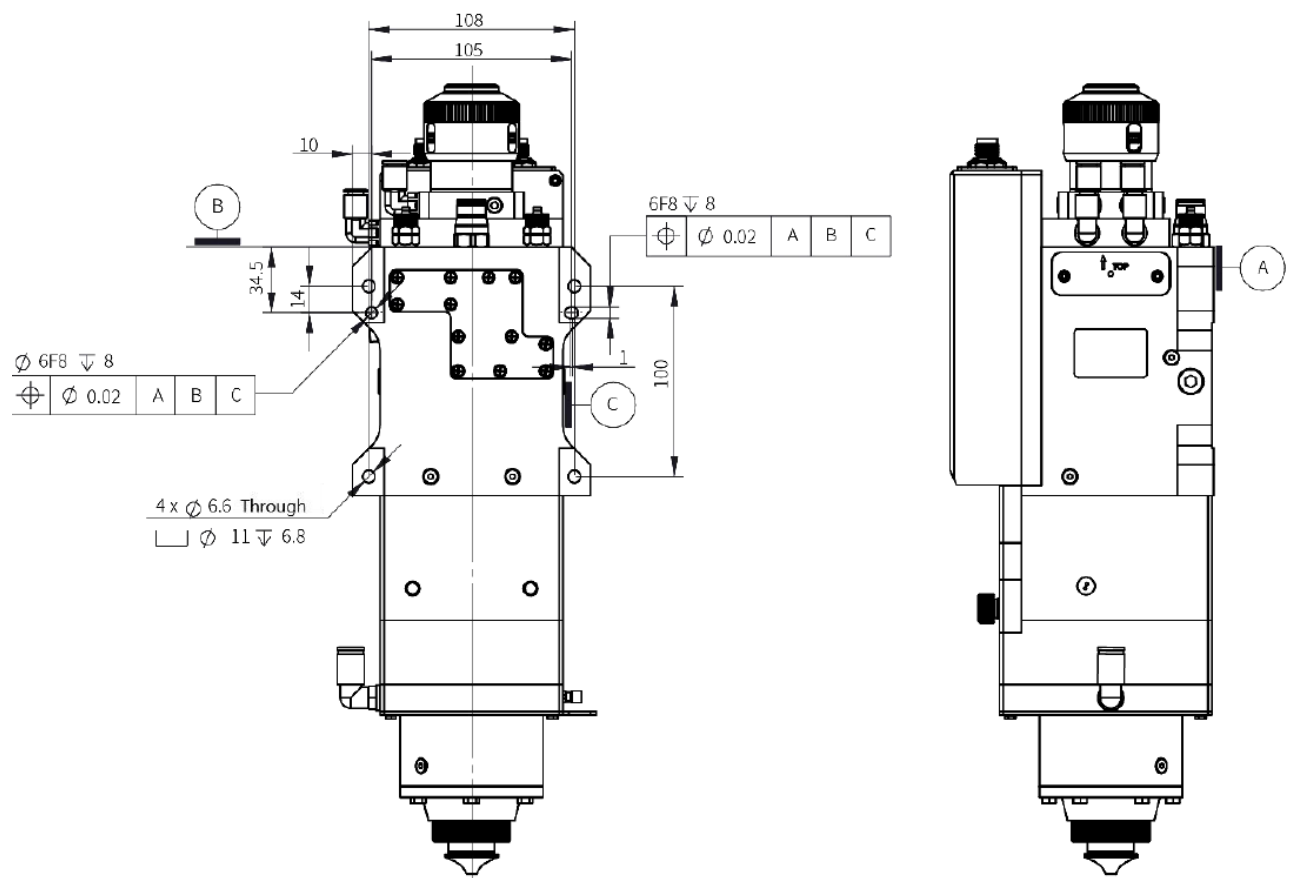
- 1) Focusing lenses, protective mirrors, and the optical surface of the QD connector must not be touched. These optics are easy to scratch. If there is grease or dust on the optics, it will affect the efficiency of the equipment.
- 2) It is strictly forbidden to wash the optical surface with water, detergents and other cleaning agents. The surface of the lenses is covered with a special layer, if you use standard optics cleaners, this will damage its surface.
- 3) Do not store the optics in places with high humidity, this will cause the surface of the optics to age.
- 4) The surface of the optics must be clean. If it is stained with dust, dirt or water vapor, you can easily damage the coating of the lens.

4.3. Installation and replacement of optical elements

- 1) Before installing the optics, put on clean clothes, wash your hands with soap or detergent, and wear white gloves. It is strictly forbidden to come into direct contact with any part of the optical element. When you pick up an optical element, try not to touch its surface.
- 2) When assembling/disassembling the optical system, do not breathe (do not blow) on the optical elements. When installing optical elements, make sure that the installation areas are not dusty or dirty.
- 3) Be extremely careful when you take the optical element out of the box in which it is stored. The optical element should be held only by its edges. Avoid dust on the optical element. After installing the optical element, blow it out with clean air from dust and other contaminants.

4.4. Installation of the laser head.

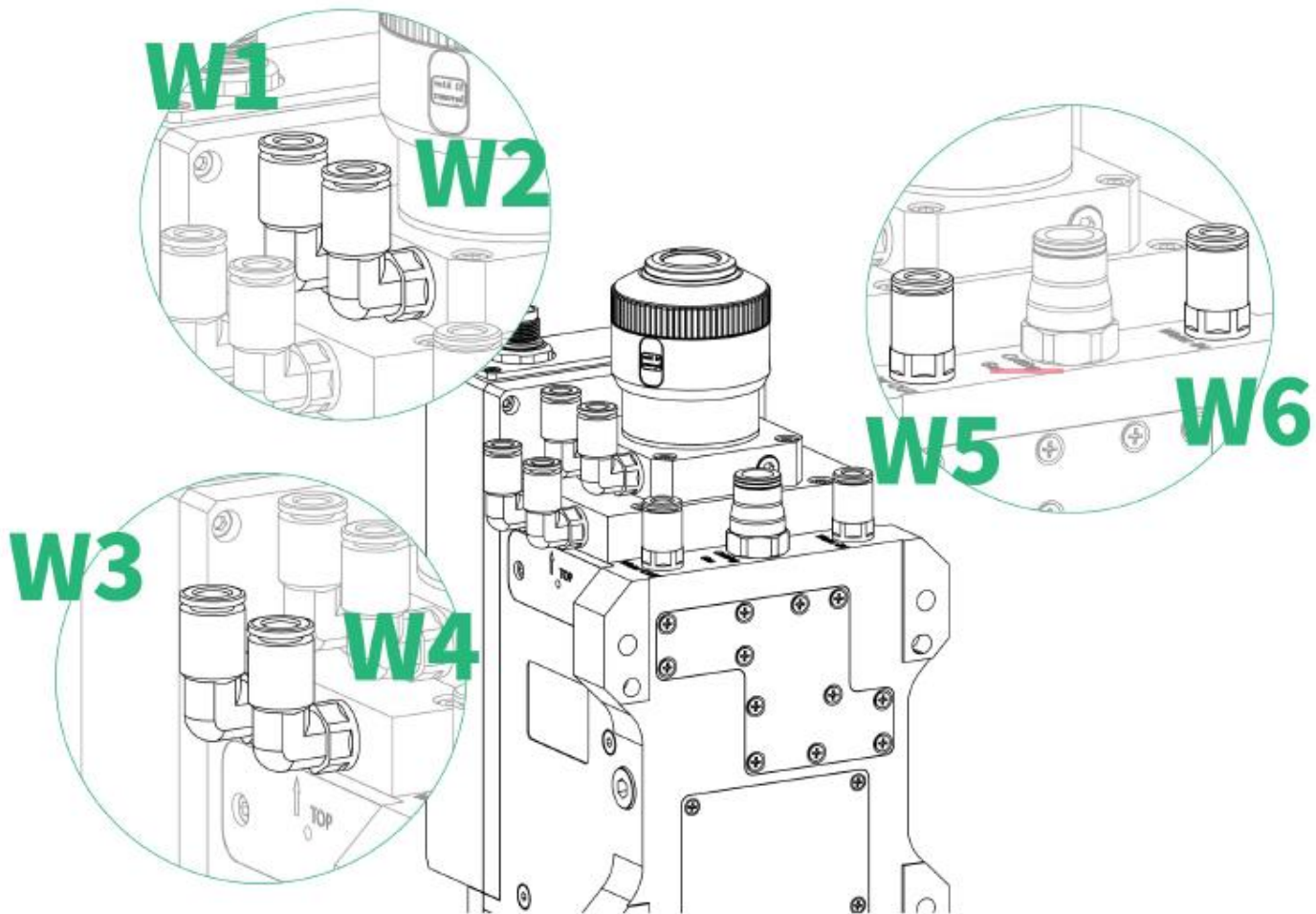
The laser head is mounted on the plate through 4 bolt holes.



4.4.1 Water cooling piping.

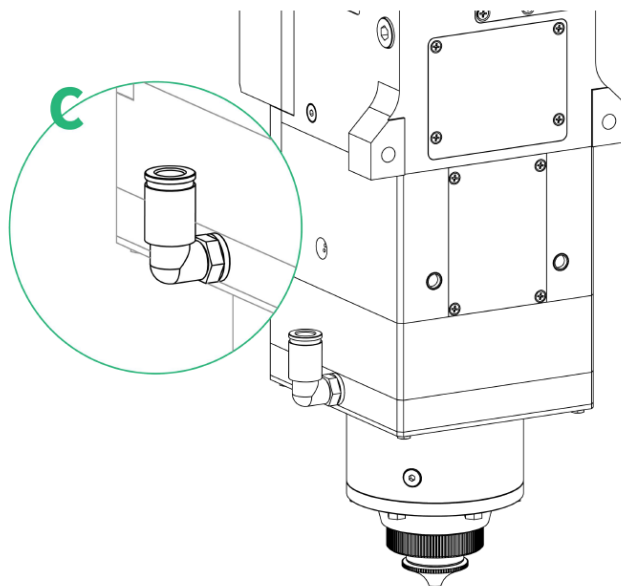
The recommended cooling water connection is shown in the above figure.

- Connect the cooling water to the $\Phi 6$ interface.
- Cooling pipeline of the fiber interface: W1, W2
- Cooling pipeline of the collimation module: W3, W4
- Cooling pipeline of the machine: W5, W6



4.4.2. Connection of cooling gas.

- The diameter of the nozzle cooling gas pipeline (external) is 8 mm.

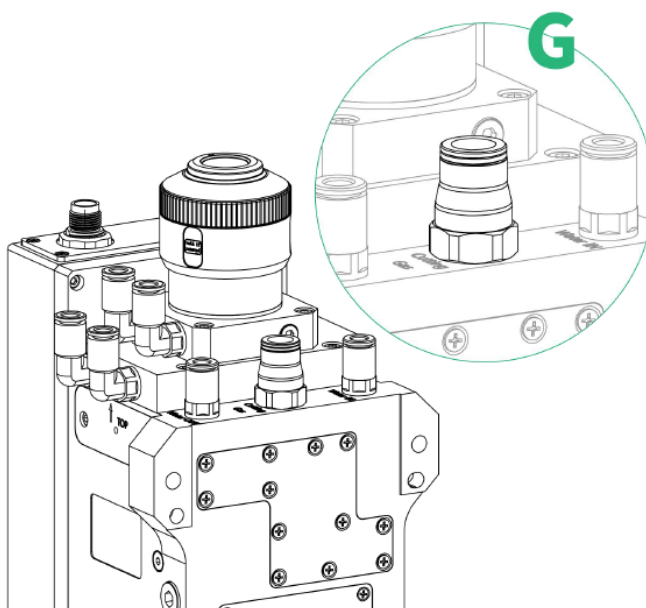


Dried nitrogen or fine-filtered air is recommended but oxygen is prohibited for nozzle cooling.

Maximum gas pressure: 5bar(0.5MPa)

4.4.3. Connection of cutting gas

- The diameter of the nozzle cutting gas pipeline (external) is 10 mm.





Only use clean and dry gas.

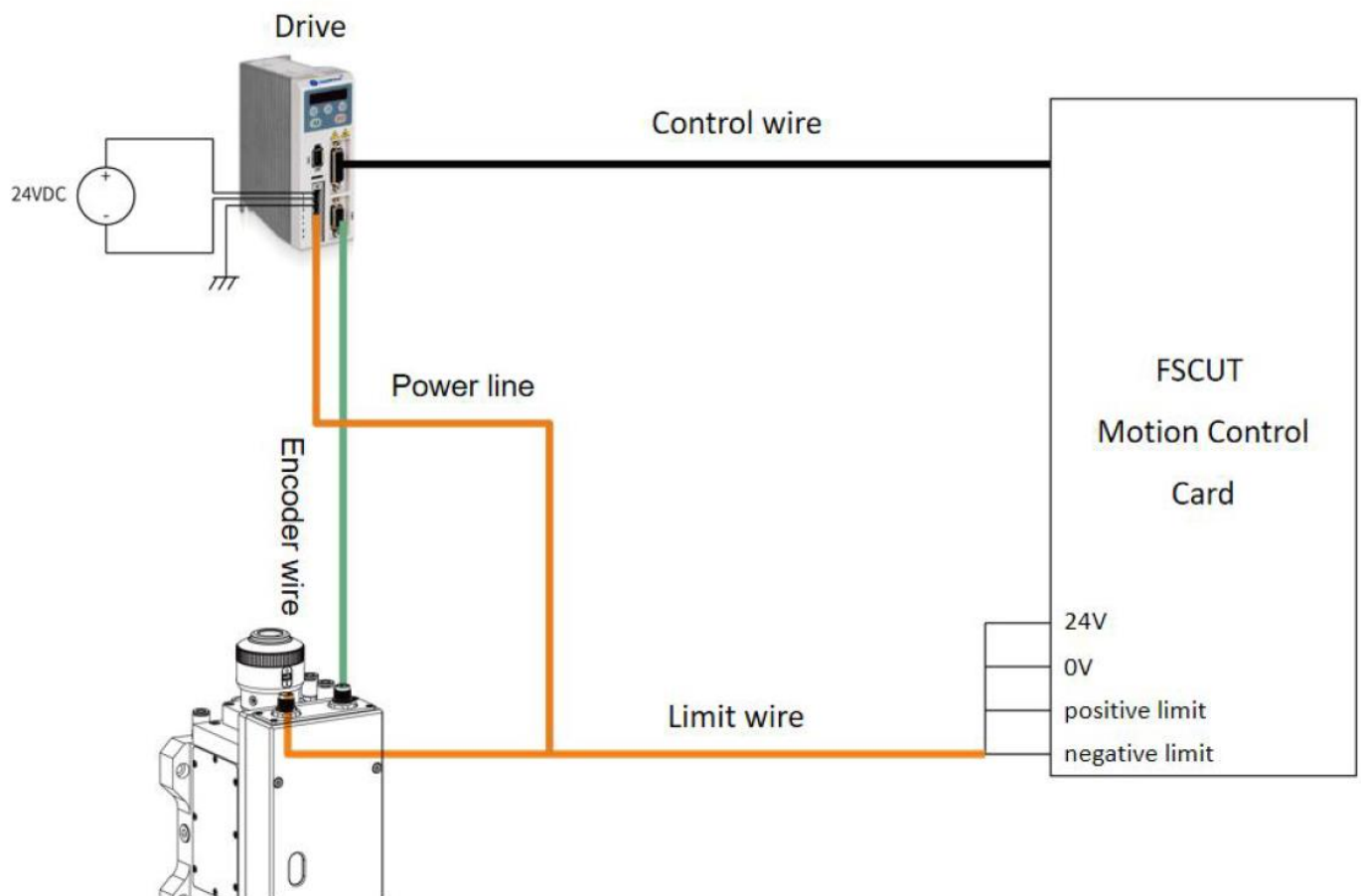
Maximum gas pressure: 25bar(2.5MPa)

4.4.4. Connecting the fiber optic cable to the laser head.

The sequence of operations:

- 1) Remove the connection block at the top of the plastic protective cover.
- 2) Insert the connector.
- 3) Tighten the connecting nuts clockwise.

4.4.5. Wiring the laser head.



4.4.5. Beam centering (Alignment).

It is performed by adjusting the collimation lens in the X-Y directions.

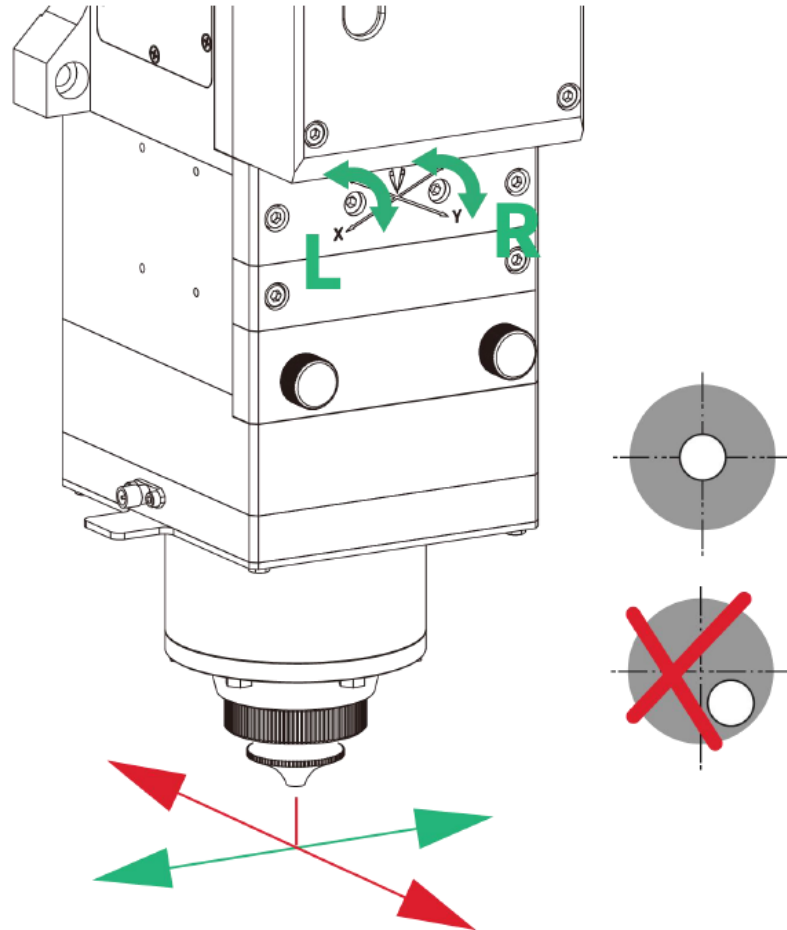
Use the adjustment screws located on the front of the laser head.

1. Make sure the laser beam is turned off.

2. Place adhesive tape under the nozzle.

3. Turn on a low-power laser pulse and evaluate the position of the laser beam relative to the nozzle by penetrating through the tape.

4. Adjust the alignment screws in the X/Y axes to center the laser beam relative to the nozzle.



4.5. Nozzle function and its adjustment.

4.5.1. Nozzle function.

The design and precision of the nozzle directly affects the cutting quality.

The main functions of the nozzle are:

- 1) Prevents melting and damage to the focusing lens and prevents cutting debris from entering the laser head.
- 2) The nozzle can control the size of the gas supply area and thus affect the cutting quality.

4.5.2 Adjusting the laser and nozzle.

It is necessary to adjust the nozzle so that the laser beam passes strictly along its center:

- 1) Move the nozzle to the cutting height
- 2) Clean the surface of the nozzle. Then, put white adhesive tape on it.
- 3) Set the laser power to 20 watts – 30 watts. Run the laser light briefly. After the laser turns off, remove the tape from the nozzle. Check on the tape that the laser beam hits the center of the nozzle. If this is not the case, then it is necessary to adjust this with the adjustment bolts on the laser head.



Tips

The center of the nozzle and its concentricity relative to the laser beam is one of the important factors that affect the quality of the cut, especially when cutting thick materials.

4.5.3. Selection of nozzle diameter.

Nozzle Diameter	Gas flow rate	Actual Cutting Ability
Small	Fast	High
Big	Slow	Low

Nozzle diameters are usually 1.5mm, 2.0mm, 2.5mm, 3.0mm, etc.

The difference is as follows:

- 1) For material up to 2 mm thick, a nozzle with a diameter of 1.2 mm is used, resulting in a thin cutting surface. When using a nozzle with a diameter of 1.5 mm, the cutting surface is thicker.
- 2) For material thicker than 2mm: Due to the high cutting power, it takes a long time for all parts of the laser head to cool down, which also increases the cutting time. With a nozzle with a diameter of 1.2 mm, the gas spread area is relatively small, resulting in low cutting efficiency. With a 1.5 mm nozzle, and a correspondingly larger gas distribution area, cutting is more efficient.

The larger the nozzle size, the lower the protection of the optical elements of the laser head of the machine, because sparks, combustion products and residues from the material to be cut can get into the laser head.

4.6. Laser Cutting Speed Selection

The choice of laser cutting speed is determined according to the material and its thickness. Different cutting speeds can have a big impact on the quality of the cut.

4.6.1. Determination of the optimal cutting speed.

The cutting speed can be determined by the sparks, if the speed is too high, then the sparks will fly in different directions. If there are very few or no sparks, then the speed is too low. The suitable cutting

speed is shown below in the figure: the cut surface should have a smooth line, and the bottom of the material will be slightly melted.

4.6.2. Effect of Too High Cutting Speed on Cut Quality

1) It is possible that the material will not cut through or will not cut completely.

2) The cut will be uneven and have traces of melting.

4.6.3. Effect of Too Low Speed on Cutting Quality

1) Melting of the upper part of the material, the edge of the cut will be coarser.

2) The cutting width of rounded or pointed elements will expand, this will lead to the fact that the entire area will melt and you will not get a perfect cutting result. 3) Low cutting speed affects productivity

4.7. Selection of gas and its pressure for laser cutting.

Depending on the cutting material, a special gas must be used.

Gas supply is necessary for combustion and heat dissipation, as well as for extruding molten metal during cutting and protecting against sparks from entering the nozzle protecting the focusing lens.

4.7.2 Effects of Cutting Gas and Pressure on Cutting Quality

1) The cutting gas helps to heat and melt the cutting material to get the best cut quality.

2) Due to insufficient gas pressure, the cutting quality may be reduced due to material melting and slow cutting speed, which greatly reduces the processing efficiency.

3) When the cutting gas pressure is too high, the impact on the cutting quality will be as follows:

The cutting surface will be rough and the cutting seam will be wide. At the same time, it can cause the material in the cutting area to melt, which will degrade the quality of the cut.

4.7.3 Effect of Pressure on Material Burning

1) When the gas pressure is too low, it is difficult for the laser to cut through the material, the cutting time is longer, resulting in low productivity.

2) Too high a gas pressure causes melting at the penetration point, forming a larger melting point, which affects the quality of the cut.

3) When piercing the material, as a rule, high gas pressure is used.

4) When cutting ordinary carbon steel, the thicker the material, the lower the cutting gas pressure. And when cutting stainless steel, the pressure of the cutting gas increases relative to the thickness of the material.

The choice of gas pressure should be made according to the material and the specific application of the machine.

4.7.4. Influence of laser cutting power on cutting quality

The choice of laser power also affects the quality of the cut, the laser power can be determined according to the thickness of the material and the cutting speed. Too much or too little power does not allow you to get a good cut.

- 1) Too little power will not be able to cut through the material.
- 2) If the laser power is too high, the melting of the cutting surface will be too great, which will not give a good cut quality.
- 3) When the laser power is not enough, the machine will both cut and melt the material at the same time.

Therefore, setting the appropriate laser power at the appropriate gas pressure can ensure good cutting quality, without molten spots.

Chapter 5. Start-up and operation

5.1. Startup sequence

1. Connect a shared power supply.
2. Starting the chiller: Check the water supply and no leaks.
3. Starting the Laser Source: Check the cooling of the laser head.



- 1) Insert the key, turn to the "on" position.
 - 2) Power indicator. Green light - the power is on.
 - 3) Laser power button. This is a button with a ring LED indicator (red color). In Hyper terminal mode and AD mode, when this button is pressed, the machine is ready to deliver laser radiation and the LED lights up. Press again to release the button and turn off the laser light.
 - 4) Signalling. If there are errors or malfunctions, it lights up yellow.
 - 5) Emergency stop button. When pressed, the power stops and disconnects. You can turn off the button clockwise, but to turn on the laser source, you will have to turn the power key of the laser source again (p.1).
4. Gas Supply Equipment: Connect the oxygen or nitrogen cylinder to the machine.

5.2. Procedure for working in the software

The procedure for working in the software can be found in the enclosed user manual.

5.3. Machine shutdown procedure

- 1) Once the treatment is complete, turn off the gas supply from the gas cylinder. Blow all the gas out of the machine system. Move the laser head along the X and Y axes to the middle of the desktop.
- 2) Turn off the laser source.

- 3) Disconnect the power to the chiller.
- 4) Turn off the air compressor valve.
- 5) Turn off the external master switch.

Chapter 6. Maintenance

In order to ensure the normal operation of the laser machine, it must undergo daily maintenance. Due to the fact that the machine uses components manufactured with high processing precision, maintenance must be carried out in strict accordance with the operating rules of each part of the machine so as not to damage its components.

6.1. General Rules

Use the most appropriate oils to lubricate machine tool systems. At the same time, you should pay attention to the following:

- 1) Before the initial commissioning of the machine (or after a long downtime), it is necessary to check the lubrication condition of all equipment.
- 2) Do not use woolen, fiber, woolen rags to lubricate the machine. Do not use kerosene and gasoline.
- 3) Do not mix synthetic and mineral lubricants.

6.2. Maintenance of peripheral equipment

Only distilled water should be used in the chiller. The presence of problems with water quality can seriously affect the cutting effect and even the burn-in of optical elements. The presence of dust and debris in the chiller radiator can lead to a lack of effective cooling of the equipment, which will also directly affect the cutting effect. Thus, the daily maintenance of the chiller is especially important.

Maintenance period	Maintenance content	Purpose
Once a year	1. Check that the water temperature in the chiller is set to $22 \pm 1^{\circ}\text{C}$.	For normal cooling of equipment
	2. Check the water pressure in the chiller.	To prevent water leaks
	3. Clean the chiller body with soap and water (do not use gasoline, acids, metal brushes).	For long-term operation of the chiller
Once a month	1. Check that the chiller body is dry, clean and well ventilated.	For long-term operation of the chiller

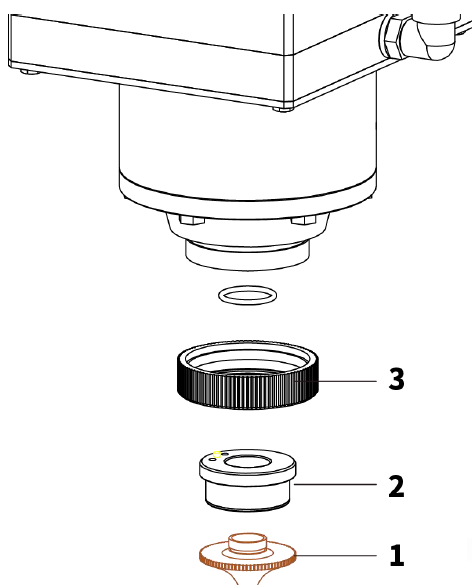
	2. Check the chiller condenser for dirt or dust buildup. If necessary, blow it out.	To ensure the normal operation of the chiller
	4. Replace the water in the chiller	To ensure the normal operation of the laser
	5. Check for gaps in the pipelines	Make sure there are no leaks
Once every 15 days	1. Check the electrical parts (such as switches, screen, etc.). Wipe them with a dry, clean cloth.	To ensure the cleanliness of the surface of electrical parts
	2. Clean the chiller air filter. Use a vacuum cleaner, air guns and brushes for this.	To ensure efficient water cooling
	3. Check the water quality.	Good water quality is essential for the normal operation of laser equipment



If an alarm comes on at the laser source, contact your equipment supplier immediately!

6.3. Cleaning and maintenance of the optical system of the machine

6.3.1 Replace ceramic body and nozzle



The nozzle must be replaced if it crashes or is damaged by the laser beam. Dirt on the ceramic body is required to be

cleaned or to replace the ceramic body if it gets crashes.

1. Unscrew the nozzle (1).
2. Press the ceramic body (3) upward by hand to make it fixed without deflection and then unscrew the lock nut (2).
3. Align the pinhole of the new ceramic body with the locating pin. Press the ceramic body (3) upward by hand and
tighten the lock nut (2).
4. Screw the new nozzle (1) and get it properly tightened.
5. Do the capacitance calibration once again after replacing the nozzle or ceramic body.

	Tighten the nozzle and lock the nut only by hand (without tools). Otherwise, the ceramic body might be damaged.
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6.3.2 Installation and replacement of the optical element:

	If the optical element is damaged, it must be replaced as soon as possible, do not operate the machine with damaged optics.
	The whole process shall be done in a clean place. Must wear the clean gloves or finger-cots to remove and install the lens. It is not allowed to pull out the edge of seal ring directly as it is very easy to be damaged.

- 1) Before installing the optical element, wear clean clothes, wash your hands with soap and water, and wear clean white thin gloves. During any procedures, try not to touch the surface of the optical element.
- 2) When assembling/disassembling the optical system, do not blow on the optical elements. When installing optical elements, make sure that the installation area is not dusty or dirty.
- 3) When installing/replacing the optical element, do not apply too much pressure to it, as this may cause damage.

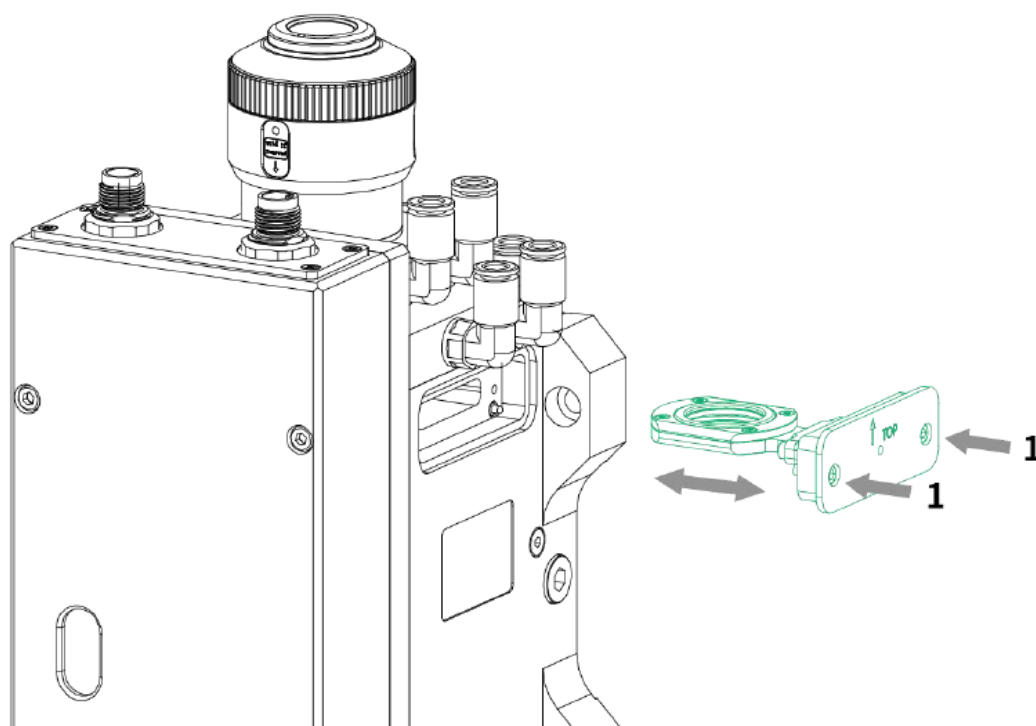
Be extremely careful when removing the optical element from the box in which it is stored. The optical element should be held only by its edges. Avoid dust on the optical element. After installing the optical element, blow it out with clean air from dust and other contaminants. If dirt or dust has accumulated on the optical element, they should be cleaned immediately.

6.3.3. Replacement of the upper protective lens

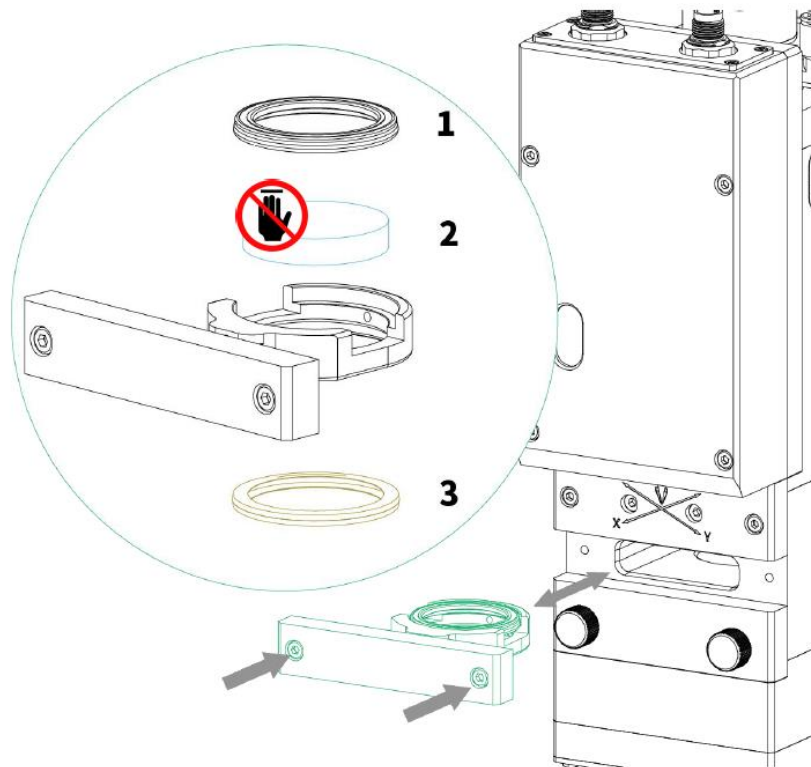
- Loose bolts (item 1), and the drawer of glass holder will pop up automatically. Pull out the glass holder until the glass can be seen completely.
- Check if there is any contamination on the glass and blow off the dust on cover glass with clean air if it's needed till the glass surface is clean.



The cover glass shall be replaced if it cannot be cleaned or damage happens.

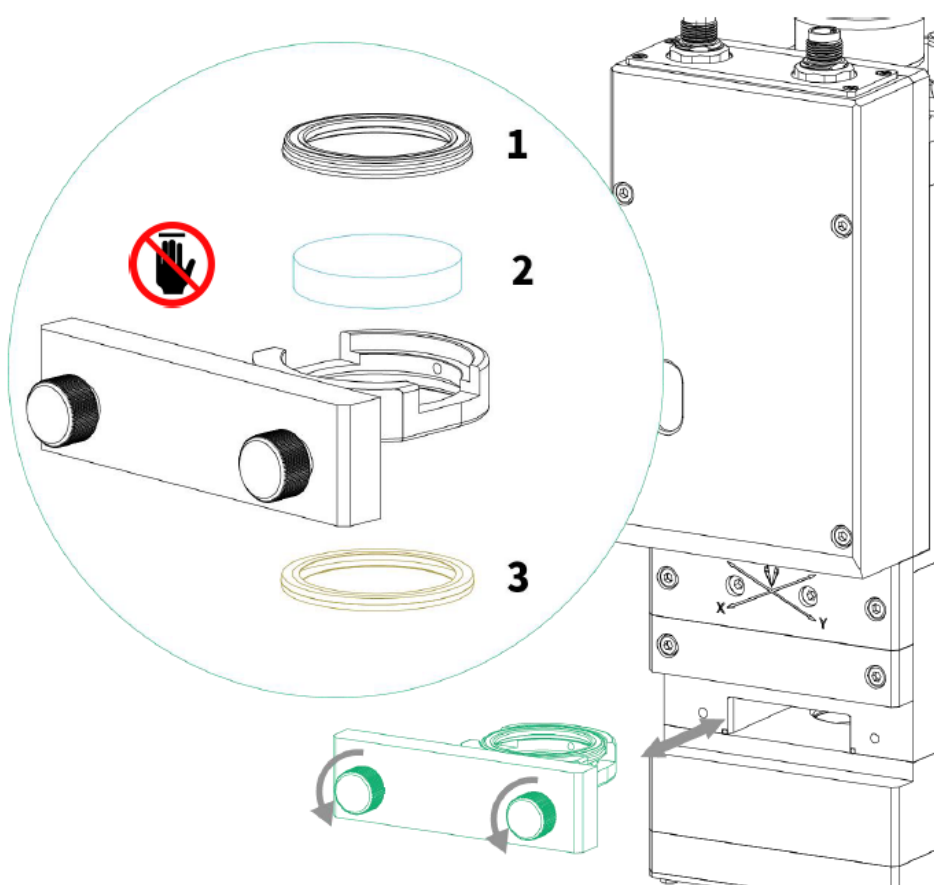


6.3.4. Replacement of the middle protective lens



1. As shown above, loose the 2 bolts to pull out the cover glass holder by pinching 2 edges of drawer type holder.
2. Seal the mounting openings with textured tape immediately.
3. Remove the pressing ring (1) and cover glass (2) after wearing finger-cots.
4. Clean the cover glass holder and seal ring (3). The elastic seal ring (3) should be replaced if damaged.
5. Install the cleaned or new cover glass (regardless of the front or back surface) into the cover glass holder.
6. Install the pressing ring. Insert the cover glass holder back into the laser head and tighten the bolts.

6.3.5. Replacement of the lower protective lens



1. As shown above, loose the 2 bolts to pull out the cover glass holder by pinching 2 edges of drawer type holder.
2. Seal the mounting openings with textured tape immediately.
3. Remove the pressing ring (1) and cover glass (2) after wearing finger-cots.
4. Clean the cover glass holder and seal ring (3). The elastic seal ring (3) should be replaced if damaged.
5. Install the cleaned or new cover glass (regardless of the front or back surface) into the cover glass holder.
6. Install the pressing ring. Insert the cover glass holder back into the laser head and tighten the bolts.

6.3.4 Steps for cleaning optical elements.

	Work on cleaning and replacing optical elements must be carried out in a clean room!
	Optical elements must not be rinsed with water or detergents.

There are different cleaning methods for different optical elements. If the surface of the optical element is flat and does not have a frame, then you can use special paper for cleaning the optics. If the surface of the optical element is curved or has a frame, and it is not possible to use special cleaning paper to clean it, then clean lint-free sticks should be used.

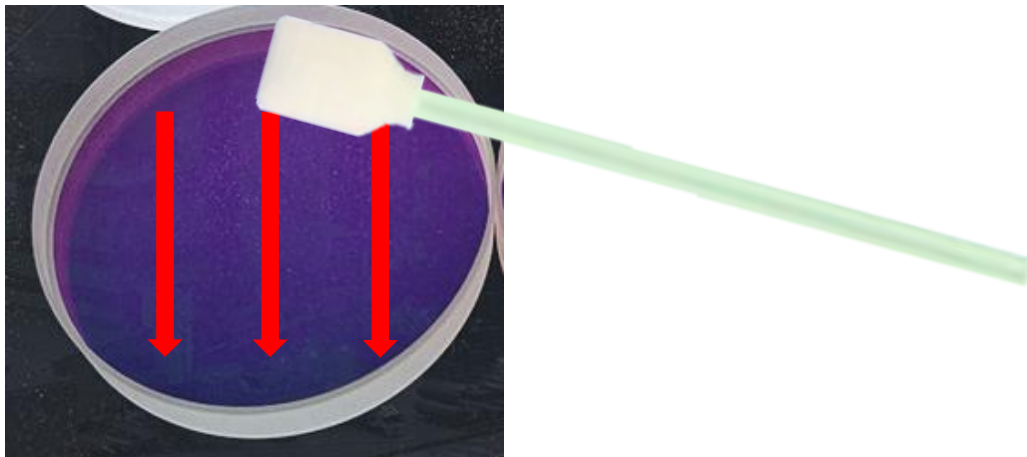
Cleaning methods:

- 1) Using special paper for cleaning optics.

Use clean air to blow the dust off the surface of the optical element. Use alcohol and special cleaning paper. Position the optical element horizontally on the special cleaning paper. Pour 2~3 drops of high-purity isopropyl alcohol or acetone onto the optical element and rub slowly, in the direction of the operator, with special cleaning paper on the surface of the optical element until the surface of the optical element is cleaned. Do not press the optical element and try not to scratch it. In no case rub dry on the surface of the optical element, use alcohol or acetone of high purity!

- 2) Using a special lint-free stick for cleaning optics.

Use clean air to blow the dust off the surface of the optical element. Pour 2~3 drops of isopropyl alcohol or high-purity acetone onto the optical element. Gently pinch the optical element at the edges. Wipe the surfaces of the optical element with a lint-free wand in one-way motions. **Do not allow backward movements on the surface of the optical element!** Do not use used wipes or lint-free sticks!



6.3.4 Storage of optical elements:

- 1) The storage condition of the optical element affects its quality.
- 2) The ambient temperature should be 10~40C. Do not freeze the optics!
- 3) Optical elements must be stored in a separate box, must not be subject to vibration, otherwise they can be damaged.

6.4. Machine conservation

If you want to suspend the use of the machine for a long time, then it is necessary to carry out anti-corrosion treatment of all mechanical parts and components of the machine, cover them with impermeable bags.

6.5. Lubrication of the machine

6.5.1. Lubrication of machine tool guides and mechanical transmissions

1. Use WD-40 or equivalent to clean guide rails and mechanical transmissions.

2. Use spray oil to lubricate guide rails and mechanical transmissions.
3. Using a grease gun (R-301), fill the lithium base grease (MP-3) into the centralized lubrication system.

Chapter 7. Troubleshooting.

Issue	Cause	Troubleshooting method
No auxiliary gas output generated at par processing	1.Insufficient air pressure; 2.Damage of solenoid valve or circuit; 3.Damage of cylinder sealing ring	1.Check the air pressure; 2.Check the electrical circuit and solenoid valves of solenoid valve; 3.Replacement of cylinder sealing ring
Abnormal noise at axis running	1.No lubricating oil on axis moving parts; 2.Interference between moving parts and fixed parts;	1.Add lubricating oil; 2.Check the safety of running path of moving parts
Lack of or insufficient laser power on the cutting head	1.Numerical control signal delivery failure; 2.Laser damage; 3.Nozzle damage or blocking; 4.Incorrect laser optical path: 5.Insufficient working air pressure or gas purity	1.Check whether the CNC operation bench is correctly connected to the laser machine; 2.Check the laser; 3.Replace the nozzle; 4.Adjust the laser light pathway 5.Replace the purity and pressure gas
Discrepancy between cutting graphic and drawing dimensions	1.Program input error; 2.Influence of positioning accuracy; 3.Damage to servo motor; 4.Damage to servo driver	1.Check the program according to the drawing; 2.Check the machine accuracy; 3.Servo motor and servo driver delivered shall be replaced in case of any damage.

Chapter 8. Transport, unloading and storage

8.1. Transportation of the machine

- 1) A hydraulic crane with a lifting capacity of at least 80

If according to the situation, it is necessary to use a large boom, the truck crane should have a large gravitational force.

- 2) The lifting capacity of the forklift should be at least 2.5 tons.
- 3) The lifting capacity of the overhead crane should be at least 10 tons.
- 4) The machine can be transported at a height of at least 100 mm from the ground.

8.2. Features during the transportation and delivery of the machine

1) When transporting the machine, it is necessary to avoid rain, moisture, strong inclinations, rodents, potholes on the roads. The ambient temperature should be in the range from -10 °C to + 40 °C, relative humidity should not exceed 70%. It is forbidden to store the machine in the open air for a long time.

- 2) Do not put other loads on the machine during transportation.
- 3) When transporting the machine, do not use cables that are tied directly to the machine.
- 4) The packaging of the machine should protect from moisture and sunlight.

Chapter 9. Warranty

9.1. During the warranty period

In case of equipment breakdown during its warranty period due to a defect caused by the manufacturer, repair is carried out by the supplier's company free of charge.

However, consumable parts such as optical parts (focusing lens, protective lens, reflective mirrors, etc.) are not eligible for warranty service.

For free repair or replacement of accessories, the buyer bears the cost of delivering new components from the place of their storage to the buyer's address, and, if necessary, the buyer bears the cost of the specialist's visit to the place of work.

If the equipment failure is caused by a defective part or assembly of the equipment, this part or assembly is repaired or replaced free of charge.

Defective components and parts must be returned to the supplier.

If the malfunction is not caused by the quality of parts or components of the equipment, the buyer will have to pay the cost of repair as well.

Warranty service is also not subject to malfunctions due to improper use of equipment, non-compliance with maintenance rules, operating conditions, as well as warnings specified in manuals and on warning plates that have arisen during the warranty period.

It is also a prerequisite that your equipment and peripheral devices are grounded and operated through a voltage stabilizer.