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Fiber Laser Cutting Machine

Maintenance Guide

Jinan Senfeng Laser Technology Co.,Ltd.

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Preface

Thanks for purchasing our products. SENFENG will wholeheartedly provide you with perfect service.

This high-tech laser cutting machine, combining laser, mechanical, and electrical technologies, is entirely developed and produced by SENFENG. The machine has compact structure, high precision, long life span, beautiful appearance and excellent cost performance. Please read this manual and the other accompanying instructions carefully before operating the fiber laser cutting machine.

Please thoroughly familiarize yourself with the machine's principles, structure, performance, daily maintenance, safety guidelines, and proper operating procedures. Please develop the ability to handle failures in emergency situations to ensure the safety of people and machines.

If you have any questions, please contact SENFENG promptly. Do not operate the machine until the issue is resolved.

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1 Safety

Neglecting basic safety precautions during the operation, inspection, and maintenance of the laser cutting machine can easily lead to malfunctions. Therefore, it is essential to read and understand the safety precautions described in this manual before starting any operation, inspection, or maintenance to avoid harm to both operators and the machine. To ensure proper understanding of the warning information on the equipment nameplate, the safety precautions in this manual will be categorized as follows:

 Danger	Failures in Avoiding Potential Hazards may result in serious injury or death.
 Warning	Failures related to the Warning may result in moderate injury or death.
 Caution	Failures related to the Caution warning may result in minor injury or performance damage.
 Notice	Failures related to the Notice warning may cause performance issues or shorten the lifespan of the fiber laser cutting machine.

The terms 'safety' and 'safely' used in this manual do not imply that there are no hazards at any given time. With different operating conditions, methods, and environments, any step could be considered 'unsafe'. Therefore, the methods and procedures in this manual are intended as general guidelines and may vary depending on changes in the environment.

1.1 Laser Safety Classification

Laser products are classified into four categories (as detailed in GB7247–2001) based on safety considerations and laser power, classified according to the Accessible Emission Limit (AEL). The classification is briefly described as follows:

Class 1: Laser products that are inherently safe and will not exceed the maximum permissible exposure under any circumstances.

Class 2: Laser products that emit visible light and are usually safe due to the eye's natural aversion response to light.

Class 3A: Laser products that are harmful when the beam is directly observed through optical instruments.

Class 3B: Laser products that can be hazardous to the eyes when exposed directly to the laser beam.

Class 4: Laser products that are hazardous to the eyes or skin, whether exposed directly, diffusely, or by scattered reflection.

1.2 Dangers during Operation

1.2.1 Mechanical Hazards

Mechanical moving parts may pose a risk of collision or crushing due to human negligence or component failure.

1.2.2 Thermal Hazards

A large amount of heat is generated during the laser cutting process. If flammable organic solvents or particles are present in the surrounding area, there is a risk of fire.

1.2.3 Combustion Hazards

The fiber laser beam has strong thermal energy. If it irradiates or radiates onto flammable materials (such as wood, paper, clothing, etc.), it may cause a fire. Therefore, a fire extinguisher should be available around the fiber laser cutting machine.

Additionally, it is strictly prohibited to store or leave flammable materials in the laser control area. Special attention should be given to fire prevention, especially when cutting materials with a low ignition point.

1.2.4 Radiation Hazards

1. Direct, reflected, or scattered laser beams may cause severe eye or skin burns.
2. Staring directly at the laser's red dot indicator is strictly prohibited, as it may cause eye burns.
3. The risk of fire or explosion caused by laser radiation.
4. The risk of ionizing radiation.

1.3 Safe Operation

1.3.1 Basic Safe Operation Rules



Warning

Before operating the laser cutting machine, please read and understand this manual. Ignoring this warning may result in serious personal injury.

1. Do not turn on any power or switches before reading this manual. The equipment should be operated according to the steps described in this manual. It is strictly prohibited to operate any items not specified, and any content not mentioned in this manual is considered "forbidden."
2. Identify potential hazards and take steps to avoid them.
3. During operation, avoid making incorrect conclusions based on subjective judgment, as this may lead to accidents.
4. If you have any questions about this manual or the equipment operation steps, please consult your supervisor or contact SENFENG.



Warning

This laser cutting machine should only be operated by experienced personnel with safety knowledge, and all operations must be reviewed by a supervisor. Unauthorized personnel are strictly prohibited from operating the equipment. Ignoring this warning may result in serious personal injury!

This laser cutting machine should be operated only by personnel who have received complete safety training and are authorized by a supervisor. Unauthorized personnel are

prohibited from operating the equipment.

1. Do not operate the equipment while under the influence of any medication, sedatives, or alcohol.
2. Maintenance of optical components and electronic devices should be performed by qualified electrical engineers.



Warning

This manual should be stored in a designated location near the fiber laser cutting machine for easy access.

1. Please designate a responsible person to manage this manual to prevent loss or damage.
2. If the manual is lost or damaged, please provide the equipment model and serial number, and contact SENFENG for a paid replacement.

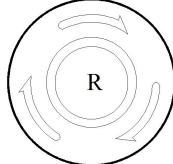


Warning

In the event of any personal injury or signs of a fiber laser cutting machine malfunction, the EMERGENCY STOP button should be pressed immediately.

All relevant operators must be familiar with the function and location of the EMERGENCY STOP button to ensure quick action in case of an emergency.

EMERGENCY STOP



Relevant operators must be familiar with the location and operation of the EMERGENCY STOP button on the fiber laser cutting machine to prevent potential dangers

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in emergency situations. If non-operators need to press the EMERGENCY STOP button, your company should establish clear emergency procedures in advance.



Warning

When operating the fiber laser cutting machine, wear appropriate clothing to prevent serious personal injury.

1. When operating the equipment, minimize skin exposure by wearing appropriate clothing and long pants, with heat-resistant protective clothing being ideal.
2. Wear specialized safety goggles to protect against potential damage from the fiber laser.
3. Long hair should be tied back, and a protective helmet must be worn to prevent it from getting caught in the moving parts of the fiber laser cutting machine. Do not wear any jewelry (e.g., bracelets) that could be caught by the moving parts.
4. To protect your feet, safety shoes must be worn.

1.3.2 Equipment Control

1.3.2.1 Equipment Supervisor Appointment

The equipment supervisor should have knowledge and experience in mechanics, optics (particularly the laser beam), and electronic circuits (especially high-voltage discharges).

The supervisor's main responsibilities include:

1. Preparing and implementing plans and measures to prevent damage from mechanical movement and laser beams.

2. Setting up and managing the equipment control area, as well as controlling the operation buttons;
3. Inspecting, maintaining the equipment, and keeping service records;
4. Conducting safety training related to the equipment.

1.3.2.2 Operator Appointment

The operators should be assigned by the equipment monitoring personnel, possess basic knowledge in hazard handling, machinery, lasers, and high voltage safety, and have undergone complete equipment operation training.

1.3.2.3 Safety Education



Warning

Untrained personnel are prohibited from entering the laser control area due to the risk of serious injury.

Safety training should cover the following:

1. Characteristics and hazards of laser beams, potential risks to humans, preventive measures, and relevant regulations;
2. Dangers of high-voltage circuits and preventive measures for power handling.
3. Safety precautions during laser cutting and prevention of hazardous operations by other workers;
4. Emergency measures for handling dangers and troubleshooting.

1.3.2.4 Health Management

Workshop regulations should require equipment monitoring personnel and operators to undergo regular physical exams (as determined by local laws and practical circumstances).

1.3.2.5 Equipment Fault Log

Maintenance personnel should document the details of the fault, perform repairs in the specified manner, and notify the equipment monitoring personnel, who should maintain the fault log.

1.3.2.6 Pre-operation Inspection



Warning

To reduce the likelihood of faults and accidents with the fiber laser cutting machine, equipment monitoring personnel should perform relevant inspections before starting operation.

1.4 Security Settings

1.4.1 Equipment Control Area Setup



Warning

Monitoring personnel should supervise the laser control area to ensure that no personnel other than operators enter the area.

The equipment control area includes the following designated locations:

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1. Areas where equipment operators work with the laser beam.
2. Locations where the laser is installed, the laser beam is emitted, and the optical path passes through.
3. Areas that may be exposed to laser radiation due to uncontrolled movement.
4. Areas that may be endangered by mechanical components due to uncontrolled movement.

When setting up the equipment control area, ensure the following conditions:

1. Mark the area with yellow lines to distinguish the equipment control area.
2. Prepare a board to describe the status of the area.
3. Prepare a board to display the names of the equipment monitoring personnel and operators.
4. Prepare a safety board with safety precautions during cutting.
5. Install safety guards (doors, walls, screens, fences, etc.) to prevent unauthorized access, and install an interlock switch door if necessary.

The user should prepare safety guards and an interlock switch door:

1. Prepare an appropriate fire extinguisher.
2. Install ventilation, dust collection, deodorizing, and exhaust equipment.



Warning

The smoke and dust emission system should comply with local laws and regulations. It is strictly prohibited to store fire sources or leave flammable materials in the laser control area.

1.4.2 Safety Equipment

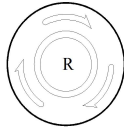
To ensure safe use, the fiber laser cutting machine is equipped with safety protective devices. Some of these devices are designed for specific functions and may not provide protection at all times. Therefore, it is important to understand the limitations and initial positions of these protective devices and to be highly aware of potential hazards that they cannot block. The user is responsible for preparing the outer protective covers and other safety settings.

Item	Qty	Location
EMERGENCY STOP button	1	Located on the control panel or in a separate electrical cabinet.
Main circuit breaker	1	Inside the electrical cabinet.
Power key switch	1	Located on the control panel
Follow-up protection	1	On the cutting head.
Limit switch	6	On the X, Y, and Z axes.
Soft limit	—	Configured through parameters in the CNC system.
Alarm message display	—	Displayed on the CNC system monitor.
Three-color warning light	1	Located on top of the control panel or the separate electrical cabinet.

Function details:

1. EMERGENCY STOP button

EMERGENCY STOP



Pressing this button will immediately stop the machine in an emergency stop state.

2. Main Circuit Breaker

The main circuit breaker automatically disconnects the power if the electrical circuit exceeds the allowed range, protecting the components from faults.

3. Power Key Switch



This switch is used to turn the cutting machine's power on or off. Insert the key and turn it to the "On" position to enable the circuit and activate the control power "On" button. Turn it to the "Off" position and remove the key to disconnect the power, making all operations on the machine ineffective.



Warning

The key should be kept by the equipment monitoring personnel or authorized personnel.

4. Follow-up Protection

Follow-up protection uses sensors to detect the distance between the workpiece and the cutting nozzle. It quickly adjusts for changes in distance caused by variations in the workpiece's flatness, ensuring a constant gap and preventing collisions or

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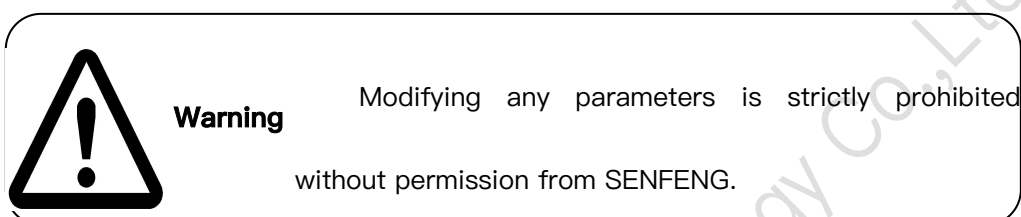
interference between the workpiece and the cutting nozzle.

5. Limit Switch

This switch prevents overtravel of the axes.

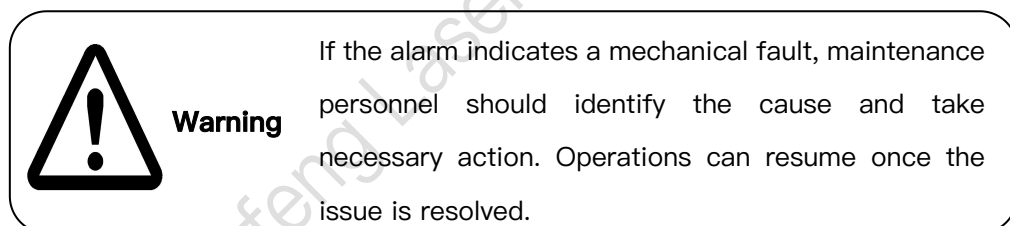
6. Soft Limit

Soft limit prevents overtravel of the axes by setting parameters in the system.



7. Alarm Message Display


If a fault occurs with the fiber laser cutting machine, relevant information will be displayed on the CNC system screen.



8. Three-color Warning Light

The warning light is red when there is an alarm, green when the machine is operating normally, and yellow when the machine is in a standby state.

1.5 Safety Precautions



Warning

Both the fiber laser cutting machine and laser source carry lethal voltages and require special caution. Only qualified electrical engineers should operate them.

Do not touch any areas marked with this warning symbol, and never operate switches or keys with wet or dirty hands!

1.5.1 Overview

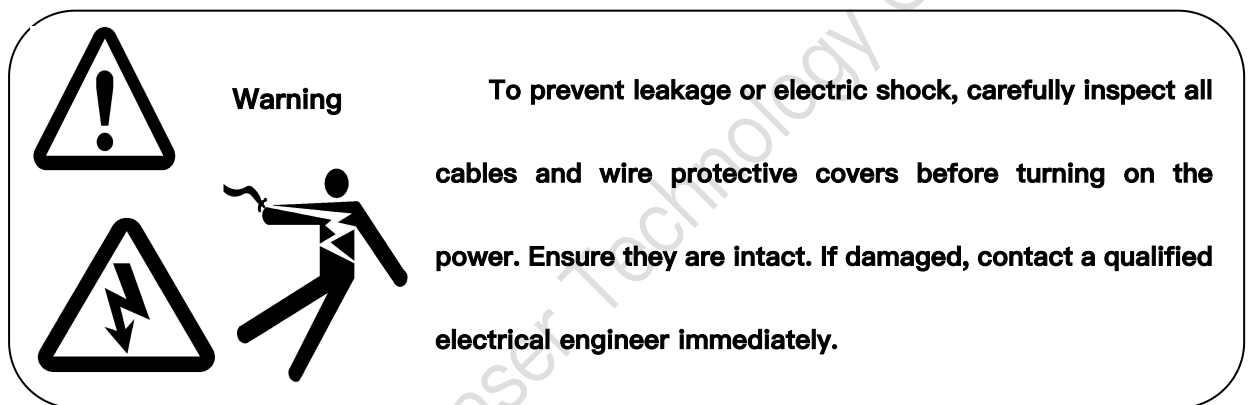
1. If there is a power failure, immediately disconnect the main circuit breaker.
2. Use gentle pressure when operating the control panel.
3. Keep all tools and materials clean and organized at all times. Please follow these points:
 - 1) Place items in a secure location to prevent them from falling.
 - 2) When storing tools or parts vertically, ensure safety measures are in place to prevent them from falling.
 - 3) When stacking items, ensure safety measures are in place to prevent them from toppling.

1.5.2 Precautions during Installation

1. Cranes and forklifts must be operated by qualified personnel. Unauthorized personnel are prohibited from operating them.
2. Under no circumstances should any part of the body be positioned under the crane at any time.
3. Electrical connections must be made by qualified personnel. To avoid electric shock, ensure proper grounding. The main circuit breaker must be off during grounding and should not be turned on until grounding is complete.
4. During electrical connections, warning signs must be posted to alert others that work is in progress.
5. For equipment relocation or installation, please contact SENFENG.
6. When multiple people are working, a supervisor must be designated to give instructions to others.
7. When wiring on the ground, use a secure and sturdy protective shield to fully cover the cables and prevent damage.
8. When lifting equipment, use steel ropes and lifting devices at the designated points, ensuring they can fully support the weight of the fiber laser cutting machine.
9. The leveling of the equipment should be done according to the provided adjustment method. Using any other methods (e.g., prying with a steel bar) is strictly prohibited.
10. After the equipment installation is complete, the following checks must be performed before powering on.

- 1) All electrical connections and lubrication oil additions have been completed.
- 2) All pipes are correctly installed and securely fixed.
- 3) All screws and plug connections are tight and reliable.
- 4) Water and dust on the equipment have been wiped clean
- 5) Ensure there are no water or oil leaks around the equipment

1.5.3 Precautions before Operation



To prevent equipment failure, the equipment monitor should check the following items before starting operation:

1. Ensure the work area and movable parts of the machine are free of obstructions
2. Check for water or oil on the floor to prevent slipping
3. Strictly follow the steps in this manual to turn the power on/off
4. Ensure all doors and protective covers are securely closed
5. Check all safety devices to ensure they are functioning properly and free of damage
6. After turning on the power, check the following:
 - 1) No error messages or alarms on the display

- 2) No abnormal sounds from motors or gears
 - 3) Cooling fan in the electrical cabinet is functioning properly
 - 4) All axes and guide rails are properly lubricated
 - 5) Preheat the fiber laser cutting machine (excluding the laser source)
7. Never leave flammable materials inside the laser control area

1.5.4 Precautions during Operation

1. Never damage, remove, or relocate any safety devices or interlocks
2. During operation, follow these rules:
 - 1) Do not open the safety guard of the laser cutter.
 - 2) Do not enter the movable parts of the equipment
 - 3) Do not tighten, measure workpieces, remove debris, or perform any cleaning around the equipment during operation
3. During external optical path adjustments, follow these rules:
 - 1) Never place any part of your body under the sensor base (i.e., the cutting head)
 - 2) Before starting axis movement, verify the direction.
 - 3) Never direct the laser beam at a person's body
 - 4) Never look directly at or touch the Indicator red light, laser beam, or its scattered light, as it may cause serious injuries (including blindness and burns)
 - 5) Wear the specified protective clothing and goggles during laser cutting to prevent serious injury.

- 6) Ensure proper ventilation, smoke and gas extraction, and dust collection before operation to avoid severe lung damage.
4. If the equipment suddenly stops during operation, identify the cause of the fault and follow the proper steps to restore operation. Do not operate again before resolving the issue.
 - 1) Do not touch materials with bare hands after cutting to avoid injury from burrs or heat.
 - 2) Do not wear gloves when operating any switches, keys, or buttons.
 - 3) Do not leave any tools or parts on the fiber laser cutting machine, workbench, or surrounding area to avoid accidental activation, worker injury, or movement of the workpiece.
 - 4) During operation, never lean any part of your body on the fiber laser cutting machine to avoid accidentally activating switches or keys.
 - 5) If the fiber laser cutting machine is not functioning properly, displays an error message, or shows any signs of malfunction, immediately notify the equipment monitoring and maintenance personnel.

1.5.5 Precautions during Maintenance

1. The main power supply of the equipment must be turned off before starting any maintenance.
2. Maintenance work must be carried out by qualified personnel, especially electrical

- maintenance, which should only be performed by individuals with an operation certificate.
3. Both the laser source and control units contain lethal voltage, and any contact may lead to serious accidents. Before inspecting these units, ensure the power is turned off, and wait for more than five minutes before opening the doors (refer to the laser source manual for details).
 4. To prevent others from turning on the main power supply or accidentally touching the control panel, a warning sign reading "Under Maintenance, Do Not Touch!" must be hung in a visible location.
 5. Do not remove or modify any limit switches or proximity switches without authorization from SENFENG.
 6. Do not modify the control circuit to prevent malfunction or personal injury caused by incorrect operation of the fiber laser cutting machine.
 7. When replacing electronic components (including lighting, fuses, or mechanical parts), only use parts provided or specified by SENFENG.
 8. When working at heights, use a sturdy ladder or platform and wear a safety helmet to ensure personnel safety.
 9. If the protective cover of the fiber laser cutting machine is temporarily removed for maintenance, ensure it is returned to its original position after maintenance.
 10. When cleaning the fiber laser cutting machine and surrounding equipment, stop all operations, turn off the power, and hang a warning sign.

11. Do not use an air gun when cleaning the equipment to avoid the risk of cutting debris and metal slag splashing, which could cause personal injury.
12. Gloves must be worn when cleaning cutting debris and metal slag.
13. Perform the periodic inspections as described in this manual.

2 Maintenance

2.1 Overview

Regular maintenance is essential to ensure the reliable operation of the fiber laser cutting machine. Since the equipment consists of high-precision components, special caution must be taken during routine maintenance. Designated personnel must strictly follow the operating procedures for each unit and avoid rough handling to prevent damage to components. Operators and maintenance personnel must receive specialized training, reach a certain level of proficiency, and obtain approval from the safety supervisor before operating the machine.

Personnel working near the laser during operation should wear appropriate laser safety glasses. The area where protective glasses are required must also be well-lit to ensure safe and effective operation.

To ensure better use and maintenance of the equipment, users should familiarize themselves with the basics of daily upkeep and follow the correct maintenance procedures.

2.2 Maintenance Cycle

1. The laser source, chiller, and air compressor should be maintained according to the maintenance intervals specified in their respective user manuals.
2. For the fiber laser cutting machine, the first inspection should be carried out after 24 hours of initial use, followed by another inspection after 100 hours. A full maintenance check should be conducted after six months, and then regularly every six months or annually, depending on actual usage conditions.

2.3 Daily Maintenance and Care

1. Before starting the machine each day, carefully check the laser source, chiller unit, water levels, and pipelines for any leaks.
2. Check the laser ready status button for any damage (inspect the indicator light), and ensure the emergency stop button is functioning properly.
3. Check the limit switches and mounting screws for the X, Y, and Z axes to ensure they are not loose, and verify that the limit switches on each axis are functioning properly.
4. Check the limit switches on the exchange table to ensure they are functioning properly (ignore this step if the machine does not have an exchange table).
5. Inspect the focusing lens and protective lens for any damage.
6. After finishing the work, clean up the cutting debris and tidy the area. Ensure the equipment is clean and free of dirt or stains, and avoid placing any items on the laser cutting machine.

7. After daily work is completed, open the drainage valve at the bottom of the air compressor's air tank to drain the water. Once the wastewater has been fully drained, close the valve (if using compressed air).
8. After finishing work, follow the shutdown procedure and then turn off the main power supply of the fiber laser cutting machine.

2.4 Maintenance and Care during Operation

Before operating the fiber laser cutting machine, please perform the daily inspection. If any unusual noises occur during operation, stop the machine immediately and inspect it. After operation, follow the shutdown procedure, clean the worktable and surrounding area, and avoid placing unrelated items on the worktable or control panel.

1. Regularly check the oil level of the centralized lubrication pump in the cutting unit (add lubricant if it's low), and adjust the oiling schedule as needed to ensure proper lubrication of the X, Y, and Z axis rails, as well as the lead screws. This will help maintain the precision of the fiber laser cutting machine and ensure the lubrication of moving parts, thus extending their lifespan. If the machine produces louder sounds during operation, check the lubrication of the gear racks and add lubricant as necessary.
2. Clean the dust and debris from the air conditioner filter mesh every week.
3. Clean the dust from the dust collector filter every week.
4. Check the coolant water level inside the laser source every week, and add coolant

promptly if it's low.

5. Check the contamination on the surfaces of the protective lens and focusing lens every two weeks, and clean the optical lenses promptly to ensure their longevity.
6. Check the filters in the air system once a month, and remove any accumulated water and debris.
7. Regularly check the external cables for any damage and inspect the wiring connections inside the distribution cabinet for looseness.
8. After the fiber laser cutting machine has been installed and used for six months, its level should be re-adjusted to ensure cutting accuracy.

3 Long-term Maintenance

3.1 Inspection and Maintenance of Water and Gas Systems

1. The water cooling system of the laser cutting machine consists of two parts: one part of the cooling water flows out of the chiller, enters the laser source, cools the unit through its internal radiator, and then returns to the chiller. The other part of the cooling water cools the cutting head of the optical system.
 - 1) Check the circulating water pipeline for damage or blockages caused by animal bites, compression, or impact from other objects
 - 2) Check the aging condition of the water circulation pipes and ensure there are no leaks at the connections
2. The gas system of the laser cutting machine consists of two parts. One part supplies

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cutting gas to the cutting head, which includes clean, dry compressed air, high-purity oxygen, and high-purity nitrogen. The other part supplies auxiliary gas, which is entirely clean, dry compressed air used for components such as the air gate and clamping table cylinders.



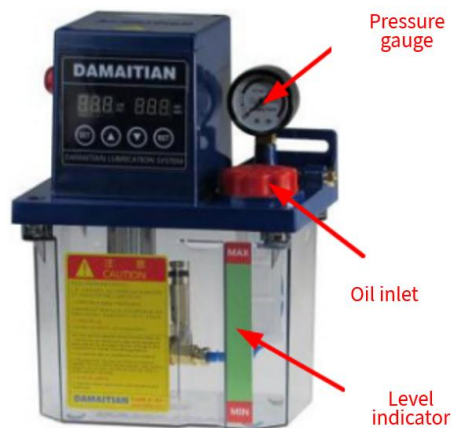
3. For compressed air, the gas from the compressor passes through the air tank and the refrigerated air dryer before entering the pneumatic control cabinet. It is then processed by a precision air treatment system to become clean and dry. The air is split into two paths: one serves as cutting gas to assist in the cutting process, and the other is used to drive cylinders, supplying air to the air gate and the clamping table.
 - 1) Check the high-pressure cutting gas pipelines for aging and ensure that all connections are free of leaks
 - 2) Inspect all gas handling components (such as gas purifiers, check valves, pressure regulators, and solenoid valves) for any damage or gas leakage
 - 3) Check both high- and low-pressure gas pipelines for damage or blockage caused by animal bites, physical compression, or impact
 - 4) Inspect the actuators in the auxiliary gas system (such as roller cylinders, clamping cylinders, and exhaust cylinders) for jamming or damage

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3.2 Repair and Maintenance of Oil Lubrication System

The lubrication system consists of an oil pump and pipelines. For manual oil pumps, lubrication should be done once every half month. For automatic oil pumps, lubrication occurs every 4 hours of operation for 10 seconds. When the oil level is low, the pump will trigger an alarm. At this point, standard lubricant should be added to the oil pump. Over time, dust can accumulate at the lubricated actuator ends, causing oil circuit blockages, reduced lubrication efficiency, increased pump pressure, and a shorter pump lifespan. Therefore, it is necessary to regularly clean the dust from the guide rails and racks of each axis and check for oil leaks or pipeline aging in the lubrication system.



Check if the oil level is at the appropriate position and add standard lubricating oil if necessary.

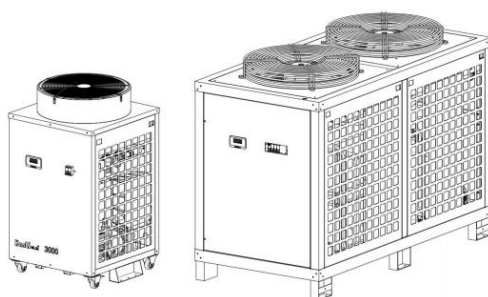
Inspect the oil lines for any damage or blockages caused by animal chewing, compression, or collisions, and clean them in a timely manner.

Check the oil pump's operating condition and power supply voltage to ensure proper

functioning.

3.3 Repair and Maintenance of Water Chiller

Maintenance and servicing of the equipment must be done after turning off the machine and disconnecting the power. Wait for at least 3 minutes before starting work to avoid the risk of electric shock. If the environment temperature is below 2°C and the machine is to be idle for an extended period, the internal water must be drained.



3.3.1 Summer Dust Prevention

In the summer, clean the condenser and dust filter every 15 days to prevent dust buildup.

3.3.2 Winter Frost Protection

When transporting or storing the laser cutting machine for an extended period, the water in the tank should be drained through the drain valve. Loosen the drainage plug beneath the water pump to drain any remaining water.

If the nighttime temperature is below 2°C, it is recommended to either keep the machine running or add antifreeze. The freezing point should be approximately 5°C below

the ambient temperature. When the average daily temperature exceeds 5°C, replace the antifreeze solution with softened water.

3.3.3 Daily Maintenance

The working environment of the chiller is harsh. To ensure optimal performance and extend its lifespan, regular maintenance is required. Maintenance should be performed weekly and includes, but is not limited to, the following tasks.

Check the cooling medium for foreign matter or microbial growth. The cooling medium must be clean water (such as distilled water, high-purity water, or deionized water). Replace the cooling medium regularly, typically every 30 days.

3.3.4 Inspection and Replacement of Cooling Water

1. Loosen the hose clamp and disconnect the water pipe, then move the chiller to an appropriate position
2. Open the drain valve at the bottom of the chiller to completely drain the water from the tank
3. Check the tank for any dirt or floating microorganisms, and thoroughly clean the inner walls of the tank
4. Close the drain valve and fill the tank with purified water (or distilled water, high-purity water, or deionized water). Monitor the water level gauge and fill the tank to 85%–95% of its total capacity

5. Return the chiller to its original position, reconnect the water pipes, and check for any leaks
6. Inspect the valves and piping: All components should be made of stainless steel or high-pressure rubber hoses. Galvanized materials are not permitted. Pipe connections must be secured with stainless steel clamps.

3.3.5 Laser Source External Water Pipe Inspection

Use pressure-resistant PVC pipes with an inner diameter of at least 6mm and outer diameter of 8mm (rubber, stainless steel, or copper pipes are also acceptable). If the chiller piping exceeds 10 meters, increase the pipe diameter to ensure the laser source receives the necessary pressure differential. Note that pipe specifications may vary depending on the brand and model of the laser source.

1. Check the external optical path cooling water pipe. PU tubing must withstand a pressure of at least 6 kgf/cm². Ensure all pipe joints are properly sealed.
2. Check the filter. The filter pore size should be 100 μm, preferably made of transparent plastic. The filter element installed between the chiller and the laser source must meet SENFENG's standard specifications.
3. Inspect and clean the heat sink and dust filter. Use a brush to clean the heat sink thoroughly, then blow it clean with compressed air.
4. Check the condenser and air duct for blockages. Clean regularly to remove dust and debris.

5. Check the water level in the chiller tank. If it's too low, refill with purified water (or distilled, high-purity, or deionized water) promptly.
6. Inspect electrical terminals and remove any dust.
7. Check for water leakage at pipe joints and aging of the pipelines in the water system. Replace any damaged components promptly.
8. Clean the impurities on the filter element every 7–10 days. If the element is damaged, replace it immediately with a standard filter element that meets SENFENG's specifications.
9. The chiller unit should be regularly maintained to ensure optimal performance. In case of a malfunction, repairs must be carried out by qualified technicians—do not disassemble the machine without authorization.

3.4 Electrical Connection Maintenance and Repair

1. Ensure the main power breaker, sub power breakers, and emergency stop breaker respond promptly.
2. Check if the power wiring of the laser cutting machine is correct. The workshop's 380VAC power supply should be connected to the input terminals of the main circuit breaker QF0.
3. Ensure the main and sub power breakers (e.g., for the main unit, laser, air compressor, etc.) meet the specified capacity.
4. The wire gauge for the power, ground, and neutral lines must meet the machine's

requirements.

5. Ensure the ground wire is properly connected.
6. Check all high-voltage wire terminals (especially at the input and output points of the transformer) for reliability and firmness, ensuring all plugs and sockets are securely connected.
7. Check the stability of the power supply voltage, keep the electrical cabinet clean, tidy, and well-ventilated. Inspect the integrity and safety of all wiring.

3.5 Optical System Inspection and Cleaning

3.5.1 Precautions

1. Avoid touching the surface of optical lenses (such as protective and focusing lenses) with bare hands to prevent scratches. If there are oil stains or dust on the lens surface, it can significantly affect performance, so the lenses should be cleaned promptly.



2. Do not use water, dish soap, or similar substances to clean optical lenses. The surface of the lens is coated with a special layer, and using such cleaners can damage it.
3. Avoid placing lenses in dark, damp areas, as this can cause the lens surface to

deteriorate over time.

4. The lens surface must be kept clean. Dust, dirt, or moisture can absorb the laser and damage the lens coating, which can degrade laser beam quality or even prevent the laser from being generated.
5. If the lens is damaged, replace it promptly.
6. When installing or replacing the protective lens or focusing lens, avoid using excessive pressure, as it may cause deformation of the lens, affecting beam quality.

3.5.2 Installation or Replacement of Optical Lenses

1. Before installing optical lenses, ensure to wear clean clothing and wash hands with soap or detergent. Never touch the top or bottom surface of the lens with any part of your hands. When handling the lens, take it from the sides, avoiding direct contact with the coated surface.
2. When assembling optical lenses, do not blow on the lens with your mouth. The lens should be placed steadily on a clean table with several sheets of professional lens tissue underneath. Handle the lens carefully to avoid scratches or drops, and do not apply any force to the coated surface. The lens mount should be clean; use a clean air gun to remove dust and debris from the mount. Then, gently place the lens into the mount.
3. When installing the lens into the mount, avoid applying excessive force when securing the lens, as this may cause deformation and negatively affect the beam quality.

4. Precautions when replacing optical lenses: Be extremely careful when removing the lens from its packaging to avoid damaging it. Do not apply any pressure to the lens before the protective wrapping is removed. When taking out the reflector or focusing lens from the box, wear clean gloves and handle the lens from the sides. When removing the protective paper from the lens, take care to prevent dust or other particles from falling onto the lens. After removing the lens, use an air gun to blow off any dust from the lens surface, then place it on specialized optical lens paper. Clean the dust and debris from the lens support and mounting brackets, and ensure no foreign objects fall onto the lens during assembly. When installing the lens into the holder, avoid applying excessive force to prevent deformation. After assembly, use a clean air gun again to remove any remaining dust or particles from the lens.

3.5.3 Lens Cleaning

1. **Steps for cleaning the lens with lens paper:** Use a blower to remove dust from the lens surface. Clean the lens surface with alcohol or lens paper—place the paper flat on the lens surface, apply 2–3 drops of high-purity alcohol or acetone, and slowly pull the paper horizontally toward the operator. Repeat the process several times until the lens surface is clean. If the lens is very dirty, fold the paper 2–3 times and repeat the steps until clean. Do not drag dry lens paper directly across the lens surface.



2. **Steps for cleaning the lens with a cotton swab:** First, use an air gun to blow off any dust from the lens surface. Then, use a clean cotton swab to remove any dirt.

Use a new cotton swab dipped in high-purity alcohol or acetone, and gently move it in a circular motion from the center of the lens outward to clean it. After completing one circle, switch to another clean cotton swab and repeat the process until the lens is clean. Use a clean cloth to wipe the lens and remove any residue, being careful not to scratch its surface.

Take the cleaned lens to a well-lit area and observe it. If the lens has a clear reflection, it's clean. If not, repeat the cleaning. After cleaning, place the lens in the lens holder as described above. Do not use a cotton swab that has already been used for cleaning.



3.5.4 Optical Lens Storage

1. Proper storage of optical lenses can maintain their quality.

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2. Store lenses at 10–30°C. Avoid freezing temperatures to prevent condensation and potential damage. Temperatures above 30°C may affect the lens coating.
3. Store lenses in a box in a vibration-free environment to prevent deformation and maintain their performance.

3.6 Laser Source and Optical Path Maintenance

1. Regularly inspect and maintain the laser source
2. Follow the specific maintenance instructions provided in the laser source manual
3. Check the power cable and ensure the laser source casing is properly grounded.

Before powering on, use a multimeter in continuity mode to verify effective grounding between the laser casing and the ground (PE yellow-green wire); poor grounding may lead to potential damage



4. All control lines and voltages of the laser source must meet technical specifications; otherwise, irreversible damage may occur. Therefore, check all voltage signals before

powering on the laser

5. Pay attention to the protection of the optical fiber and the fiber output head. Do not bend or apply force to them. These are fragile components and require proper protection and regular inspection
6. Keep the laser source, fiber output head, and lenses protected from dust. If dust is present, clean according to lens cleaning procedures:
 - 1) Use anhydrous ethanol with purity above 99.9%
 - 2) Use lint-free swabs—never use regular cotton swabs, as they may shed fibers and cause secondary contamination
7. During daily operation, follow the correct power-on/off sequence:
 - 1) Power-on sequence:

Chiller (ensure proper operation and water temperature around 25°C) → Power on the laser → Launch control software → Ensure gas system is working → Control system operational → Laser ready to emit → Safety protection in place → Cutting system starts working.
 - 2) Power-off sequence:

Shut down the control system → Turn off the laser control signal → Power off the laser → Stop the chiller.
8. Other precautions: During laser source operation, ensure that the water, gas, and electrical systems are functioning properly. If any issue arises, power off the system and check for the cause of the malfunction.

9. If any malfunction occurs during laser operation, first record the time, issue, and system status during the fault. Then identify the cause. If you have any questions, please contact SENFENG.
10. For long-term laser use, clean the cooling water system, keep the laser clean and well-maintained, and regularly replace the cooling water in the chiller.

3.7 Repair and Maintenance of Air Compressor

3.7.1 Daily Maintenance



1. Record the air compressor's operating status daily.
2. Clean the air filter dust bag or intake silencer. Never operate the machine without an air filter. If the differential pressure switch triggers an alarm, maintain the filter element promptly.
3. Check whether the oil level is within the specified range
4. If the intelligent controller alarms due to a clogged oil filter, replace the filter

3.7.2 Weekly Maintenance

1. Check if the safety valve is clogged or damaged

2. Check the oil filter after the first 50 hours of operation on a new machine and replace the filter element if necessary
3. Clean the orifice and filter mesh (if equipped) on the secondary oil return pipeline after the first 50 hours of operation on a new machine

3.7.3 Quarterly Maintenance

1. Remove dust from the machine's air inlet;
2. Remove the air filter and inspect and maintain the filter element;
3. Remove the intake pipe, clean it, and let it dry;
4. Replace the oil filter during initial use.
5. Replace the lubricating oil during initial use;
6. Check the tension of the belt and adjust if necessary;
7. Check and clean the orifice and filter mesh (if equipped) on the secondary oil return line.

3.7.4 Annual Maintenance

1. Replace the air filter element;
2. Check the spring valve plate inside the check valve to ensure it works properly, and replace it if necessary;
3. Replace the lubricating oil.
4. Check and calibrate the pressure gauges and sensors;

5. Check the regulating (loading) solenoid valve (two-position, three-way normally closed solenoid valve), and replace the internal seal ring if necessary;
6. Review the machine's operating condition records to determine if the cooler needs cleaning, and it is recommended to use chemical agents to clean its interior.
7. Replace the oil filter
8. Replace the oil-air separator element

3.7.5 Long-term Air Compressor Shutdown Preparation

If the shutdown is prolonged, manually open the (electronic) drain valve for at least 5 minutes to remove moisture, and drain any accumulated water from the oil separator and air receiver.

1. Shutdown for less than one month:
 - 1) Start the machine once a week and let it run unloaded for 10 minutes.
 - 2) Turn the coupling by hand once a week.
2. Shutdown for more than one month:
 - 1) Pre-shutdown:

Run the machine with continuous load for 10 minutes to expel air from the system.

After shutdown, turn the coupling by hand.

Drain accumulated water from components like the cooler and air tank.
 - 2) During downtime

Repeat item (A) every three months.

3) Before restarting

Replace the lubricating oil, oil filter, and oil-gas separator inside the oil tank.

Manually rotate the connecting parts (couplings, belts) of the motor and the main

unit to ensure they rotate smoothly.

3.8 Repair and Maintenance of Cold Dryer



1. Ensure the ambient temperature of the air dryer is not lower than 10°C to prevent oil condensation and shortage, which could damage the compressor.
2. Monitor the inlet temperature of the dryer to ensure it does not exceed the rated value.
Check the indicators on the control panel daily to ensure they are functioning properly.
3. Check the automatic drain daily to avoid clogging. If clogged, close the ball valve before the solenoid valve and clean the solenoid valve.
4. Check the air-cooled condenser fins for dirt monthly and clean them regularly.
5. Listen for any abnormal noise or instability during compressor operation.

6. Keep the air bypass valve fully closed during normal use.
7. Check all electrical connections for looseness every month.

4 Long-term Storage Maintenance and Care

When the fiber laser cutting machine is not in use for long periods, apply grease to all moving parts and wrap them in anti-rust paper. Regularly check for signs of rust on other parts and perform rust removal and anti-rust treatments if necessary (consider adding dust covers if possible). Additionally, periodically clean and inspect the fiber laser cutting machine.

4.1 Winter Maintenance for Chiller

1. To protect the laser cutting machine, please follow the below requirements during use:
 - 1) Install air conditioning or heating to maintain an environment temperature around 10°C.
 - 2) Run the chiller 24/7 to prevent water from freezing (ensure the factory has continuous power supply).
 - 3) Add ethylene glycol antifreeze to the chiller, as its freezing point varies with the concentration in the water solution.

Ethylene Glycol Concentration and Freezing Point	
Concentration of Ethylene Glycol (%)	Freezing Point (° C)
26	-10

32	-15
37	-20
40	-25
45	-30
50	-35



It is recommended to use Clariant's Antifrogen N antifreeze, with a mixing ratio of 3:7 (3 parts antifreeze to 7 parts water), which can resist freezing at -20°C .

2. If the ambient temperature around the laser is between 10°C and 40°C , no antifreeze is required. Additionally, in summer, please drain the antifreeze from the chiller and fill it with distilled water.
3. Before a cold start, please check the water status.
4. If the equipment is not in use for a long period or during power outages, be sure to drain the water from the chiller water tank and the laser source. (For holiday shutdowns, ensure proper antifreeze and drainage work is done.)

Draining Method:

- 1) Turn off the equipment power, open the drain valve at the back of the chiller, and empty the water from the water tank.
- 2) Open the filter element inside the chiller to drain the water from the filter.
Unscrew the drain screw under the water pump to drain the water from the pump.
- 3) Remove the water pipe at the back of the water tank and mark it. Connect a 0.2

MPa (2 kg) air supply to one end of the water pipe ($\phi 12$) to drain the water from the laser source. (For low-temperature areas)

- 4) Connect a 0.2 MPa (2 kg) air supply to one end of the water pipe ($\phi 8$) to drain the water from the fiber optic head.

Note: Excessive gas pressure used for draining may damage the laser source. A high concentration of antifreeze can increase water circulation resistance.

Special Reminder:

If the customer does not follow our antifreeze instructions, they will be responsible for any resulting damage and repair costs. We urge all customers to take antifreeze precautions promptly!

5 Maintenance System

5.1 Purpose

To keep the laser cutting machine in top condition and ensure it meets production needs, make sure it's kept clean, well-organized, properly lubricated, and safe to use.

5.2 Scope of Application

Applicable to the maintenance and upkeep of fiber laser cutting machines.

5.3 Requirements

5.3.1 First Level Maintenance

Before each shift, operators must perform daily checks on the laser cutting machine (according to the maintenance checklist) and keep proper records. During the shift, strictly follow operational procedures and address any issues promptly. After the shift, clean and wipe down the equipment, and document any abnormal conditions.

Generally, simple adjustments should be handled by the operator. For more complex faults or potential issues, promptly report them for repairs and contact SENFENG.

5.3.2 Secondary Maintenance

Thoroughly clean and inspect the exterior of the laser cutting machine and each unit. Pay special attention to lubrication and oil levels. Ensure the surrounding area of the equipment is thoroughly organized and cleaned.

6 Repair System

6.1 Purpose

To address laser cutting machine faults promptly, ensure faults are fully recorded and analyzed.

6.2 Scope of Application

Applicable to the maintenance of fiber laser cutting machines.

6.3 Requirements

1. In case of a fault, the operator must immediately stop production, fill out a maintenance request, describe the fault, and report it to the maintenance department.
2. Maintenance personnel will arrive on-site to repair the laser cutting machine and address the issue promptly.
3. Maintenance personnel can contact SENFENG for online guidance. If the issue cannot be resolved, on-site guidance and repair can be requested.

★ **Please follow the maintenance manual for regular upkeep to ensure your laser cutting machine stays in good working condition.**

Appendix 1 Contact Us

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