User Manual

CY-WY300HZ

LASER WELDING MACHINE

FOR SIGN INDUSTRY

Preface

Thanks for choosing this laser welding machine.

We have made necessary precautions as much as possible to ensure operator's safety. Nonetheless, incorrect use/maintenance/transformation of the machine will still cause various damages to the operator or machine.

Please pay special attention to the following tips:

1、Please don't try to change any part inside the machine with power on.

2、Make sure this machine is well-grounded and regular checking is necessary.

3、Use one hand only to turn on/off the switch in order to avoid human body circuit.

4、If you have to touch the parts with high voltage, please use well-insulated tools for security.

CAUTION:

1、 This machine is Class 4 laser machine. Any direct exposure to laser flash or beam can be harmful to operator's eyes. When observing from microscope, please stop operation for 3 minutes every 30 minutes. When observing via CCD, don't stare at the LED screen for more than 1 minute continuously.

2、 There might be a fire accident or even explosion if laser beam shoot on flammable materials. Therefore, please don't put any flammable materials near by the laser path.

3、 Please don't operate this machine when the shield cover is open, unless you're permitted to do this by our technician for checking or repairing purpose.

4、 There's a danger of getting electrical shot when you try to fix any part inside the power unit or try to change the xenon lamp inside the laser chamber. Please turn off the power before any operation and try your best to operate with one hand only.

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Chapter 1 Machine Introduction

1-1 Prospect of AD metal letters/signage welding industry:

With the booming of global advertising industry, metal letters has been more and more popular because of its colorfulness, attractiveness, heating-proof, frozen-proof, no deformation, no fadedness (8-10 years color preservation), corrosion proof, rain-proof, and spontaneous combustion proof and some other good features. AD metal letters are made of stainless steel, aluminum, copper or other metal sheet being cut, polished, hemmed, and welded. The core feature of AD metal letters is being rustproof, with long life span and dimensional looks. It's widely used in LED illuminated billboard, exterior/interior signs, branding, door plate and etc.

Regular combination and fixing of metal letters are done via glue, rivets or soldering, but all of them have big defects. Metal letters combined by glue always get loose with time goes by, especially at outdoors. Fixing by rivets sounds good, but not good-looking. Soldering is never a green way of fixing metal letters because of the poisoning gas produced when processing.

However, laser welding technology makes two metal sheets become one only by a few melting spots. From any aspect, laser welding is the best solution and the greenest.

1-2 Application:

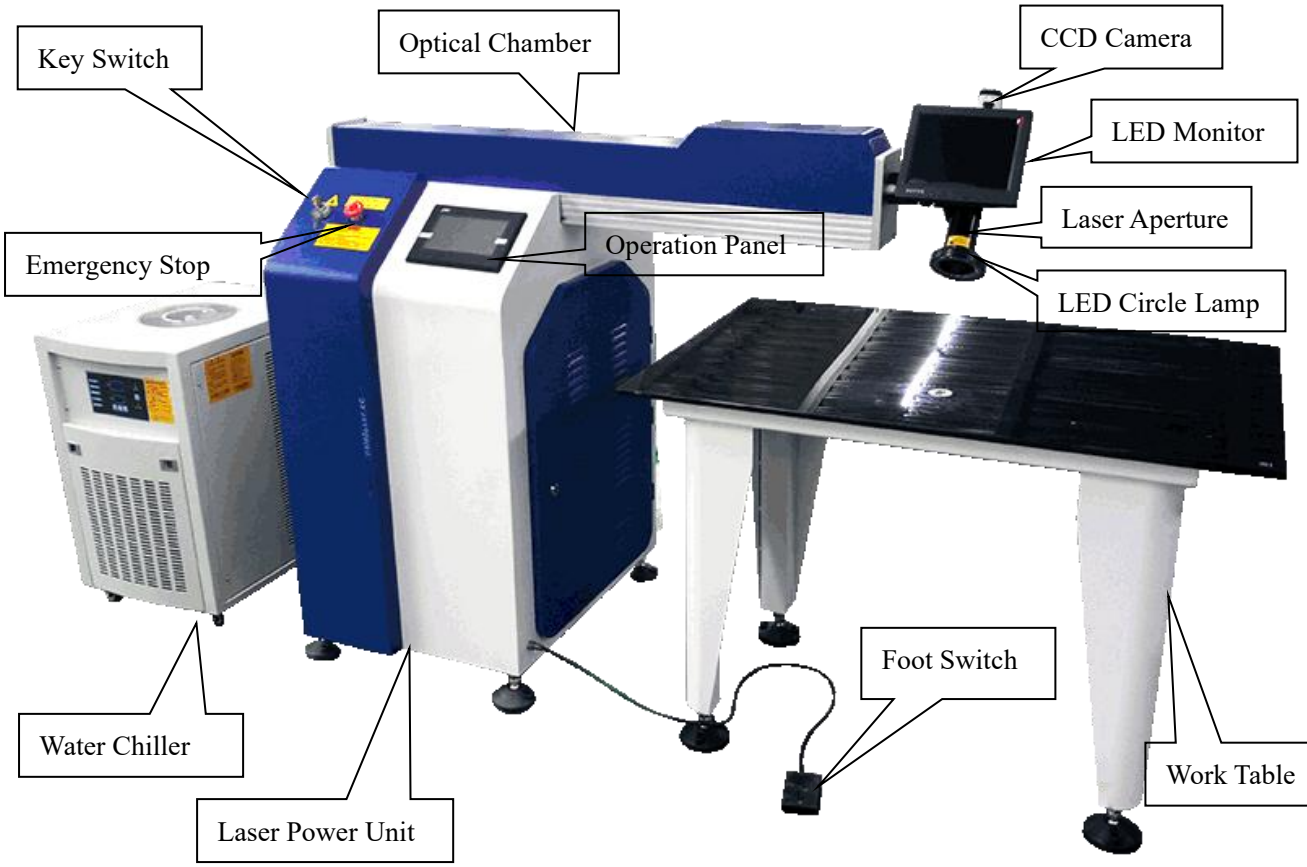
Applied for the welding of various metal letters, LED illuminated letters, customized metal signage, and exterior billboards.

1-3 Features:

1. Red light fast positioning, CCD display
2. 100 different programs can be saved and quick selected
3. Adjustable work table allows welding from small size to big size of work piece
4. Fast working speed; professional jig ensures the focus fixed and makes welding easier without using CCD or microscope
5. Slight distortion and affect by heating.
6. Capable of partial heating process.
7. Able to deal with complex, profiled, or tiny letters.
8. Low noise and no pollution.
9. Ultra fine locating rod makes corner welding easier without changing spot position
10. Latest adapted 7' touch screen control panel makes operation more convenient

Chapter 2 Basic Operation

2-1 2017 NEW MODEL PREVIEW:



◆This laser welder requires 220V 50HZ power supply which means 6 square meter wires and 30A air switch/safety fuse. And water chiller also requires 220V 50HZ power supply. Any damage caused by disconnection is not obliged by the seller.

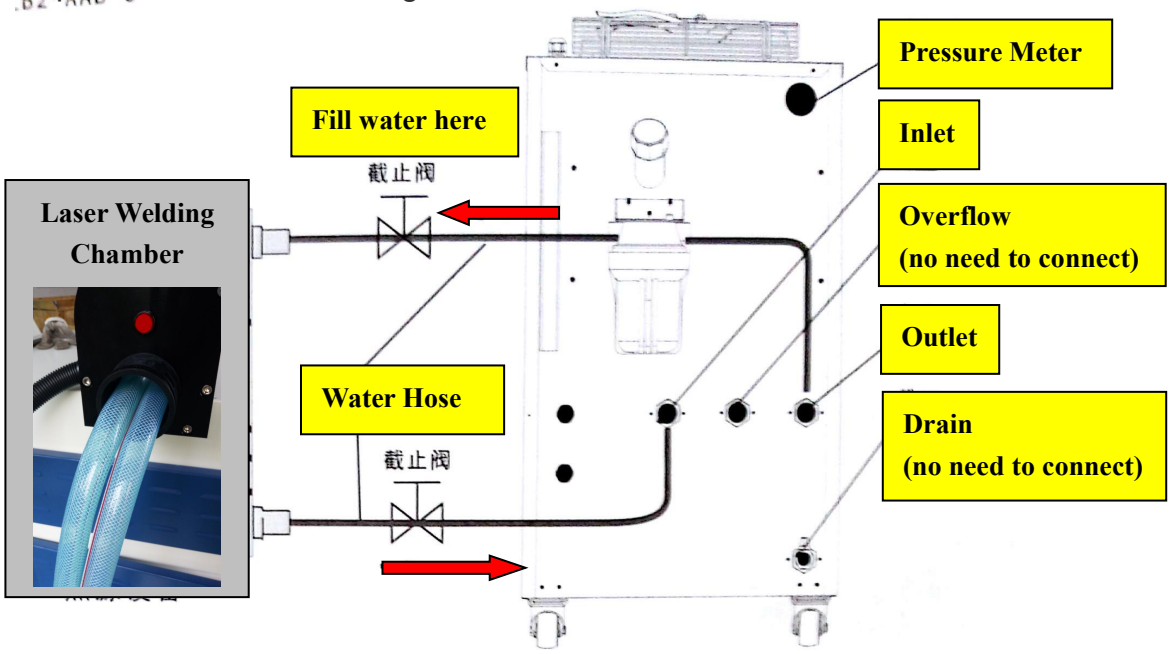
◆Work current ranges from 50-200A, and work pulse width ranges from 1ms-5ms. Suggested pulse frequency at 4-10Hz for spot welding or 10Hz-30Hz for continuous welding.

◆Do not energize the machine before installation finished in order to avoid electric shock or other dangerous accidents.

◆The water inside the chiller tank has to be changed once a month. Deionized water is preferable, but purified drinking water is also accepted.

2-2 Connection:

1) From laser chamer there are two hoses come out. Connect one random hose to “OUTLET” on water chiller and another hose to “INLET” on water chiller, then tighten two hose clamps to avoide water leakage.

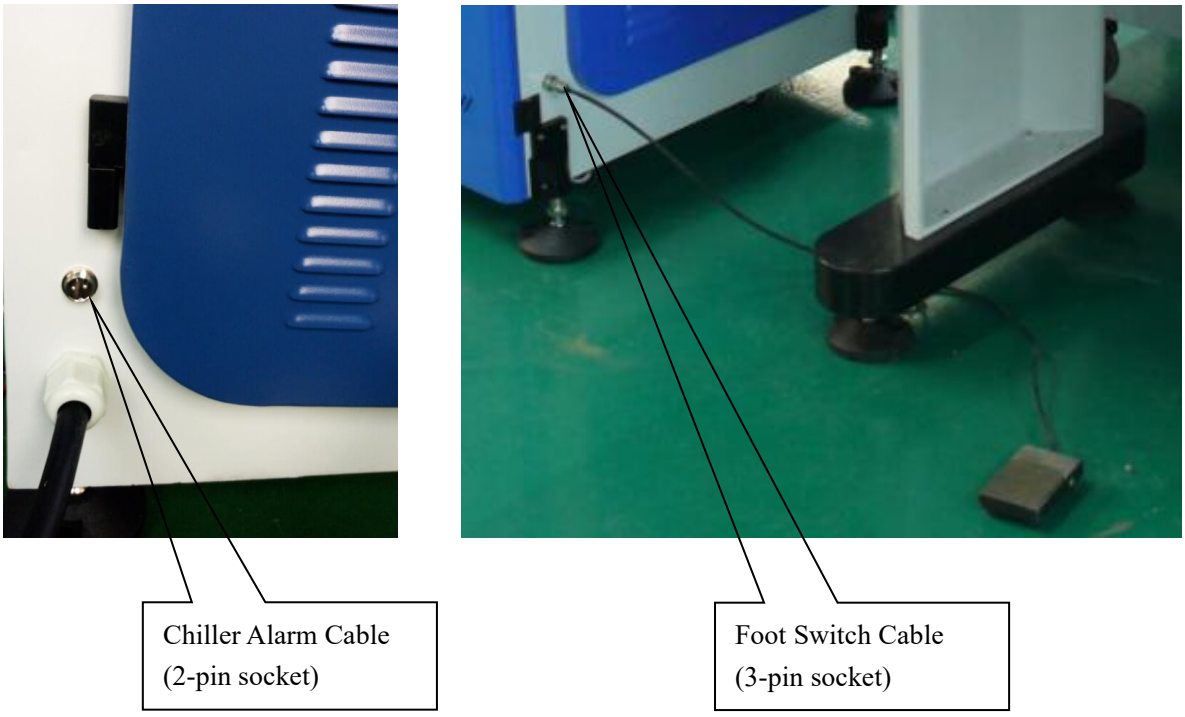


2) Connect chiller and laser power supply as below instruction

Chiller Power:
220V/50HZ 1 phase
Brown- L
Blue-N
Yellow/Green-Earth

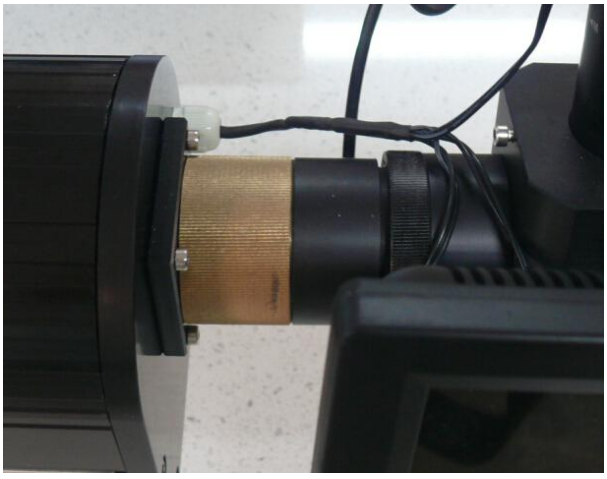
Laser Power:
220V/50Hz 1 phase
Red-L
Blue-N
Yellow-Earth

3) Connect foot switch and chiller alarm signal cable to laser welder.

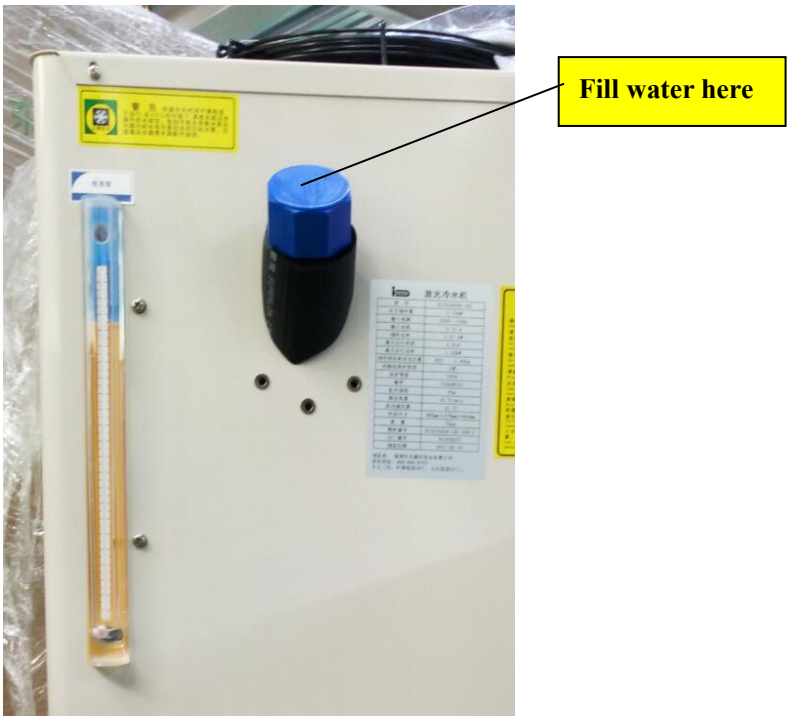


4) Insert locating pin into brass base and install the assembly in the hole on work table

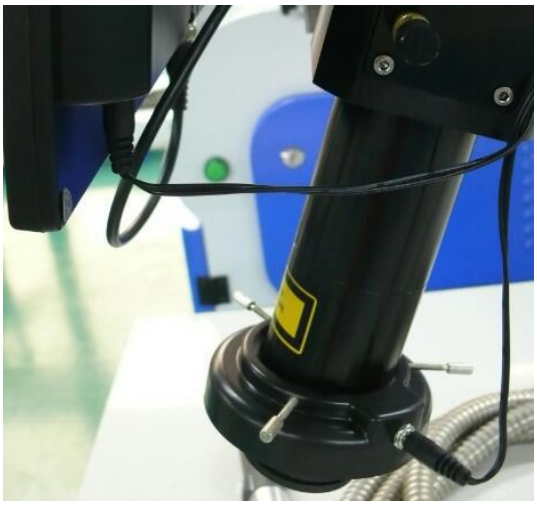
5) Turn on red laser by pressing the red button to match your locating pin with red dot.



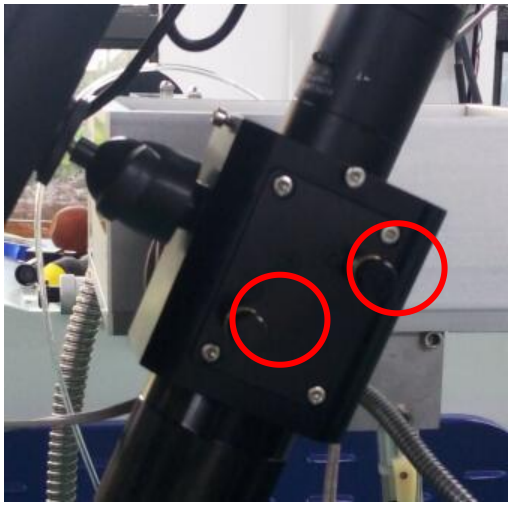
6) Fulfill the water chiller with tanned water or drinking water and pay attention to the highest water level on the meter. You may find the manual for water chiller attached for more know-how and maintenance.

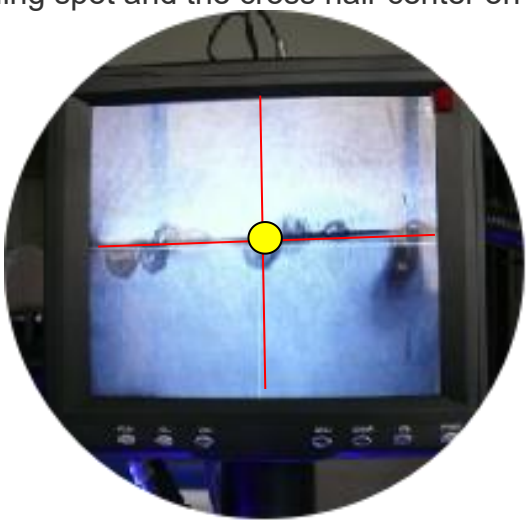


7) Connect monitor screen, LED circle lamp and CCD camera as below:



8) Turn these two knobs slowly to match welding spot and the cross hair center on monitor.





2-3 Machine operation

A. Turn on the machine

1. Turn on air switch/safety fuse on the wall
2. Turn on water chiller and wait for 1 min. Attention: Always set water temperature between 10 and 35 Celsius degree,in most cases we set 25 Celcius Degree)
3. Pull and twist emergency stop button
4. Turn key switch on
5. Press the ON/OFF button on screen for once.

6. Wait for the capacitor charging and lamp pre lighting for 60 seconds, then you can adjust the parameters by + and - or input numbers directly.

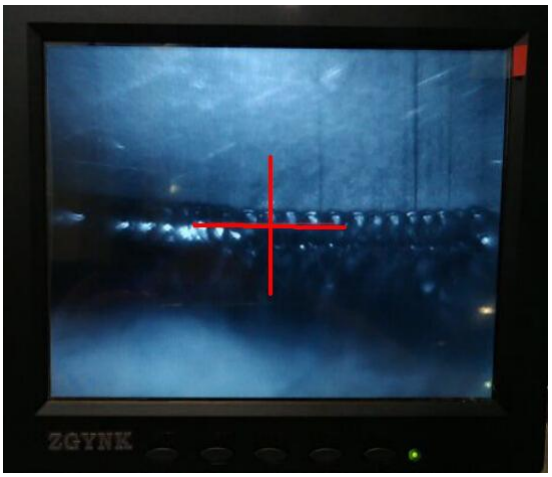
B. Turn off the machine

1. Press the same ON/OFF button on screen for once

2. Turn off the Key switch.
3. Turn off Emergency Stop
4. Let the chiller run for 1 last minute and turn off
5. Shut off General Power supply.

2.4 Welding

Firstly, the appropriate parameters, such as width, frequency and current, should be selected according to the nature of the work piece to be welded. The pulse width, frequency and working current can be adjusted through the off-focus adjusting device at the optical head. Once the parameters are properly set, the operator can observe the work piece to be welded through the object lens of the microscope, while the work piece can be moved upward or downward so that the work piece can form a clear image in the visual field, the ejected faculas are shape as fish scales, no concave or dent around the edge of facula can be seen . To adjust the facula, the operator can use the three adjusting screws to allow the intersection of across to be overlapped to the welding point on the work piece. At this time, press the foot pedal to trigger the laser.



Chapter 3 Technical Index

3-1 Laser System:

Laser Power: 300W

Laser Source: Nd^{3+}:YAG rod ϕ7*145mm

Laser Wavelength: 1064um

Pulse Width: 0.2~20ms, gradational adjustable

Pulse Frequency: 1-30HZ

Max Single Pulse Energy: 80J

3-2 Electrical & Machinery System:

Model No.	CY-WY300HZ
Power Consumption	Max 9KW
Power Supply	220V/50HZ/60HZ(laser) ; 220V/50HZ/60HZ(chiller)
Table Size	1100*750mm
Work Diameter	Max 1600mm
Package Dimensions	1540*950*1490mm + 585*490*980mm
Gross Weight	325KG

3-3 Control System

Operation Interface: English, 7' LED touch screen
Loading Period: 1 minute
Program Memorization: 100 settings can be memorized and quick selected.
Additional Features: chiller alarm (water pressure and temperature)

3-4 Optical System:

Extending ratio: 8 times
Focus length: 150mm
Protective Glass: ф40mm, thickness 2mm

3-5 Cooling System

The equipment employs water cooling system in which the magnetic pump drives the circulating water to cool the laser crystal and pumping lamp, with overheat and overflow protection. The deionized water with resistance rate more than 0.5MΩ-cm is used as the circulating water, 15 liters for each time. The circulating heat is taken away by the refrigerating machine and finally discharged into the outside atmosphere by the fan.

3-6 Power Supply: 220V/50HZ for laser; 220V/50HZ for chiller (60HZ machine optional)

3-7 Working environment and continuous operation time

Working environment should be clean, oily fog and dust free, far from vibration, temperature 5℃-32℃,humidity≦90%. Continuous working time up to 18 hours per day.

Chapter 4 Maintenance

The integral machine is composed of five parts, namely, the control cabinet, cooling system, power cabinet, laser and optics processing system.
The equipment can also be divided into five parts in terms of functions, which are:
1) Laser;
2) Laser power supply;
3) Optics system;

4) Controlling system;
5) Cooling system.

4-1 Laser

(1) Structure

The laser is a device that converts the electrical energy into the laser energy. This machine employs Nd^{3+}：YAG Laser, consisting of the following parts:

a) **Pumping lamp**: it converts the electrical energy into the optical energy that can activate the substances for laser processing. The machine adopts pulse xenon lamp with repetition rate of XMC7-125. Both the electrode and quartz glass tube surface need to be cooled during working.

b) **Laser crystal**: it converts the optical energy into the laser energy. This machine employs the crystal ф7*125mm Nd^{3+}: YAG as its working substance.

c) **Condensing cavity**: it focuses the light from the pumping lamp onto the working materials.

d) **The optical resonant cavity** can provide optical feedback, allowing the laser to be magnified to form high strength laser for output. This machine employs the plane and parallel cavity made up of flat mirrors with ceramics as its medium. The full reflector's transmissivity is less than 0.4%, output reflecting mirror's transmissivity is 85%.

e) **Other parts**: high voltage electrode, insulation base plate, positioning bracket, adjustable diaphragm frame and laser holder.

(2) Precautions and maintenance

As the machine is highly precise equipment whose discharging features the high pulse voltage and charging features the large capacity, and the laser focusing energy is highly centralized, the operators must obtain professional knowledge and skills before they work on the machine.

A. Optical resonant cavity

The two medium diaphragms of optical resonant cavity are absolutely parallel to the laser bar's end face, touching or random adjustment is not allowed. Do not open the outer hood of the laser randomly and keep the optics surface highly clean. Otherwise, the high-energy laser will damage the diaphragm layer. When the laser output energy is lowered down, the operator should first check whether the medium diaphragm is clean. If any dirt, he can use lens paper or cotton wool moistened by the cleaning agent (liquid mixture with ethanol absolute and ethanol respectively occupying 50%, the same when mentioned in the following part) to clean it gently. Then check the resonant cavity to see if it is misadjusted.

B. Cooling system

The laser has one water inlet pipe and one outlet pipe, respectively connected to the cooling channels of the lamp and bar. Unsmooth water flow at any part will cause large loss. Each time when the equipment is assembled, the operator should check the water flow at each path and make sure no fault exists before starting up the laser.

C. Xenon lamp replacement

The average service time of the pulse xenon lamp is 10^8 times of blinking if it works under its rated power. To ensure the normal performance of the machine, the lamp must be replaced

when it has reached its rated blinking times (about 10^8 times) and the energy becomes low. In cases that the xenon lamp is damaged or its service time is shorted due to other causes (for example, it can't pre-illuminate or no energy output is available when the voltage is increased to 500V), the xenon lamp should also be replaced.

As the strength of the sealing at the lamp's two ends is relatively low and apt to being damaged, special caution should be offered when substituting the lamp. The following procedures should be followed:

a. Turn off the machine, cut off the water supply and discharge the remaining electricity on the energy-storage capacitor;
b. Remove the electrodes of lamp;
c. Remove the gland of lamp, carefully pull out the lamp from the side of the full reflector;
d. Use cotton moistened by cleaning agent to clean the sleeving;
e. Check to see if the appearance, size and other aspects of the new lamp is conforming;
f. Install the new lamp into the chamber, press the gland tight and mount the electrodes;
g. Connect to the water supply and check the sealing of each part to see if they are reliable;
h. Turn on the main power to check whether the lamp can discharge normally;
i. Try single spot operation, check whether the output energy of laser meet the requirements. If the output is not ideal, repeatedly adjust the resonant cavity;
j. Cover the laser with outer hood.

D.Nd3+：YAG crystal is the core part of the laser, and is fairly expensive. Therefore it should be installed with great care. The two end faces of Nd^{3+}：YAG crystal bar is absolutely parallel to each other and has high cleanliness. If there is any pollutant on the end faces, the luminous efficiency will be lower, the facula mode will deteriorate, or even can't illuminate normally. In that case, the space housing this machine must be cleaned and professionals should be called for related treatment. Take out the Nd^{3+}：YAG crystal bar, use lens paper or absorbent cotton moistened by cleaning agent (liquid mixture with ethanol solution and another respectively occupying 50 %,) to remove the dirt gently. The causes leading to the damage of crystal bar can be described as follows:

*a.*The flow of cooling water is over or interrupted, the energy input into the lamp makes the lamp and bar overheated, which results in the cracking of the lamp and bar;

*b.*The end face is bumped, scratched or even damaged by hard object;

*c.*As the diaphragm layer is polluted , the bar is damaged when the high strength laser passes by;

*d.*The bar is pressed too tightly or the applied force is uneven when it is installed, the over high interior stress breaks the bar. In this case, the operator should not open the hood of the laser, nor operate the YAG bar. If the end face is found polluted, professionals should be called for the related treatment.

E.The condensing cavity doesn't need maintenance work. Normally, it is not allowed to dismantle the condensing cavity.

F. Over voltage protection

There are three kinds of voltage applied to the pulse xenon lamp in succession, namely, trigger voltage about 13-18 kv, pre-burning open-circuit voltage 1500-1800 v and arc-discharge

voltage about 500-2500 v. Therefore, the lamp electrode should not get too close to other metal objects, and a distance of more than 15mm should be kept. The insulation panel's surface should be kept dry and clean so as to avoid pollutions which may lower down the insulation performance to bring short circuit.

4-2 Laser Power supply

This machine can be operated either through the keys on the control panel or the joystick.

(1) Principle

The laser power supply system with repetition rate is employed, the L—C resonance charging is adopted for the charging circuit. The capacitance-inductance energy storage network is used for supplying the power for the lamp. The control circuit is centered by the single-chip microprocessor, which can be used to adjust the output energy of power and the repeated frequency. The system also features its multiple linked protections, ensuring the emergency stop of the power under abnormal conditions.

(2) Electric circuit

The electric circuits are made up of the following parts:

Main return circuits: including the charging circuit, energy storage network, discharging circuit and pre-burning and trigger circuit.

Controlling circuits: including the electric controlling circuit, microprocessor controlling circuit and different kinds of protection circuits.

A.Step-up/rectification circuit: it employs the single-phase stepping up, which converts AC 220V into DV 500V that supplies power to the charging circuit.

B. Charging circuit

The charging circuit is composed of the IGBT switch tubes. Such a charging mode will increase the repetition rate of the circuit.

C. Discharging circuit

The discharging circuit can be controlled by the silicon controlled switch that must be kept shut off. After the energy storage network is charged, the silicon controlled switch is shut off, then after the delayed time, the discharging can be realized by turning on the silicon controlled switch. Once the energy storage capacitance is fully discharged, the silicon controlled switch will be automatically shut off.

D. Pre-burning and trigger circuit

It is made up of the step-up and transforming circuit, high voltage bridge rectifier, filter, current-limiting resistor; current relay, high voltage pulse transformer and high voltage trigger circuit.

As the pulse xenon lamp is in the state of normal glow discharge when it is pre-burned, it has the nature of negative resistance. To ensure the normal glow discharge of the xenon lamp after the arc-discharge is finished, the pre-burning circuit must have the nature of high current source and its current-limiting resistor must be relatively high. The internal triggering mode is employed for this machine, with 50Hz automatic triggering. Once the pre-burning switch is closed, the high voltage pulse transformer will generate high voltage of 15-20 kv to

be applied onto the resonance cavity. As long as the pre-burning is established, the trigger circuit will be disconnected immediately.

E. Protection circuit

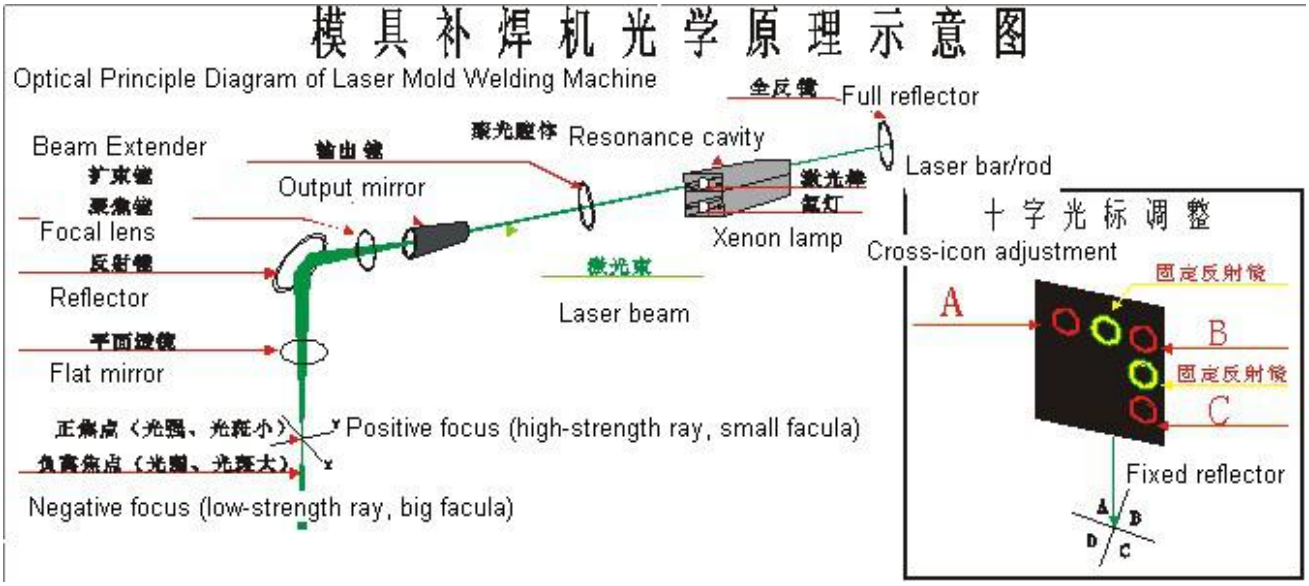
a) Pre-burning disconnection protection

When the pre-burning current is shut off, the discharging circuit will have failure, the protection circuit will be activated to send out failure signal.

b) Flow interlocking protection

When the flow of the circulating water inside the cooling system is insufficient, the flow breaker will be opened and the pre-burning circuit and main circuit will be disconnected, resulting in the shutoff of the whole machine.

4-3 Optical System Demonstration



Impact of Focus Setover on Welding Quality

The laser welding normally needs a certain degree of off-focus operation, for the welding point can be vaporized into a hole if the power density at facula center of laser focus is excessively high. The planes that are not with the laser focus will have relatively even distribution of power density.

Two off-focus modes are available: positive off-focus and negative off-focus. If the focal plane is above the work piece, it is called positive off-focus, contrarily; it is called negative off-focus. According to the theory of geometrical optics, when the positive off-focus distance is the same as the negative off-focus distance, the power density on corresponding planes will approximate to each other. However, the shape the obtained molten pool is different. Under the circumstance of negative off-focus, the large penetration depth could be reached, which is related to the forming of the molten pool. Experiments show that when the material is heated by laser for 50～200us, it begins to be molten, forms the liquid-phase metal and the evaporation appears to form the pressure-applying vapor that spurs at extremely high speed with dazzling white light. At the same time, the high density gas moves the

liquid-phase metal to the edge of the molten pool to form the dent at the center of the molten pool. Under the circumstance of negative off-focus, the power density inside the material is even higher than the surface, which is apt to cause stronger melting and vaporizing that pass the optical energy into the in-depth part of the material. Therefore, in actual applications, if the large penetration depth is required, the negative off-focus operation should be carried out. When thin materials are welded, the positive off-focus operation is needed.

(1) Microscope/ CCD

This machine employs the binocular zoom stereo microscope, featuring its clear and stereo vision. The coated protection glass is added in front of the object lens to avoid the pollution which can be caused by the splashing metal articles during processing. For transportation and storage, the ocular can be removed by loosening the fixing screws.

(2) Laser extending and focusing system

The machine employs the design that both the laser and microscope's beam path share the same object lens. The focus setover is determined by the welding process and adjusted by the off-focus handle, with procession graduation marks.

(3) Welding point indication

There is a reticle in the object lens, the intersection point of which is overlapped with the laser point. Through the intersection point of the reticle, the laser beam can be aligned to the welding part during work.

(4) Precautions

A. The surface of optical parts can't be contacted or wiped with hand, cotton yarn or hard object, nor blown with mouth. The blowing ball can be used to remove the dust on them. If there is any pollutant, the operator can use cotton wool or lens paper moistened by cleaning agent to clean them

B. To avoid damage, do not dismantle the parts. Otherwise, dust or smoke may enter into the inside of the optical system.

C. When the protection glass needs to be replaced, the object lens and the press ring should be removed. Replacement work should be done with great care.

4-4 Cooling system

(1)Structure

The cooling system is enclosed water circulation system composed of heat exchanger, magnetic pump, filter, water tank, flow switch and temperature contactor, valve and other parts.

(2) Working principle

The magnetic pump pumps the deionized water in the water tank that will cool the working material (YAG bar), xenon lamp, lamp electrode of the laser. The deionized water with absorbed heat will pass by the heat exchanger discharging the heat and flow back to the water tank.

The resistance rate of the deionized water is required to be higher than 0.5MΩ—cm. After some time of use, the deionized water's resistance rate will be lowered down and it may have impurities, dirt or turbidity that will make the xenon lamp not lightened or pollute the laser cavity and glass tube, and lower the luminous efficiency. If so, the used deionized water should be substituted immediately (if the machine is continuously operated, the deionized water in the system should be replaced once a week).
The heat exchanger works through the Freon to exchange the heat for the cooling water and carry away the heat in the purified water. A flow controller and over-temperature contactor are installed in the cooling system to monitor the water that comes into the laser. Once the flow of the circulating water is insufficient or the water pump in the system works abnormally, the power for the laser should be turned off immediately so as to avoid the accident that can be caused by the explosion of the lamp or YAG bar.

Attachment 1: Parameters Setting Guide

Material Type	Current（A）	Pulse（MS）	Frequency（HZ）
0.3MM SS	60	2	5-20
0.5MM SS	65	2	5-20
0.8MM SS	70	2	5-25
1.2MM SS	75	2	5-30
1.5MM SS	80	2	5-40
0.3MM Titanium	50	2	5-10
0.8MM Titanium	60	2	5-20
1.2MM Titanium	70	2	5-30
0.5MM Galvanized Iron	80	3	5-15
1.0MM Galvanized Iron	100	3	5-20
1.5MM Galvanized Iron	120	3	5-30
0.5MM Aluminum	100	2	5-8
1.0MM Aluminum	120	3	5-10
0.6MM Brass	100	2	5-15
1.0MM Brass	110	2	5-15

NOTE:

1) No matter what materials you're welding, the best finishing result requires the best quality of laser spot. As we stated in video manual, when you find the laser spot roundest and the shooting sound loudest, that means the spot quality is the best.
2) To get best welding performance, laser spot size is also an important factor. Generally speaking, smaller laser spot gives higher energy and melts deeper than bigger laser spot. But too small laser spots might penetrate your material. So please try to do some testing with different spot sizes in order to get a balance.
3) Parameters above only for your reference. You may adjust them a little bit higher or lower according to difference materials you're welding.

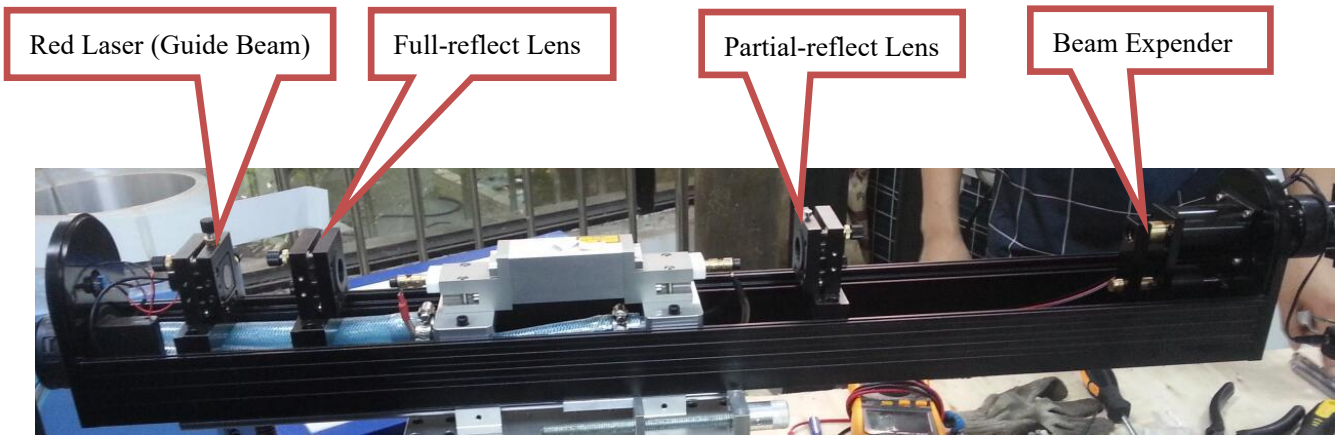
Attachment 2: Troubleshooting

Fault	Possible Reasons	Proper Solutions
Machine won't work with the power on	1. Flow alert is not connected 2. AC fault	1.Check the water chiller connection 2.Check the total power supply
Xenon lamp won't light up with the power on	1.Lamp is broken 2.Lamp tube gets black 3.Pre-ignition circuit failure 4.Lamp's service life runs out 5.Lamp poles fall off	1.Replace a new lamp 2.Change the water in the chiller 3.Check the volts according to the circuit map 4.Replace a new lamp 5. Check and plug the poles
Cooling fan won't work	Fan power failure	Replace a new fan
Output energy reduce	1.Water polluted 2.lamp worn out 3.Condenser cavity worn out	1. Change the water in the chiller 2.Replace the lamp 3. Clean or replace the condenser cavity

*If the above steps do not correct the malfunction, do not disassemble. Contract us immediately!

Attachment 3: Alignment

◆MUST KNOW about laser chamber:

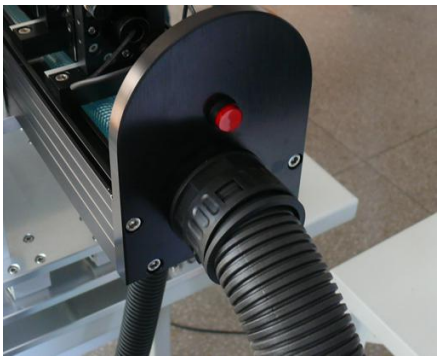


◆Part A. Red Light Alignment

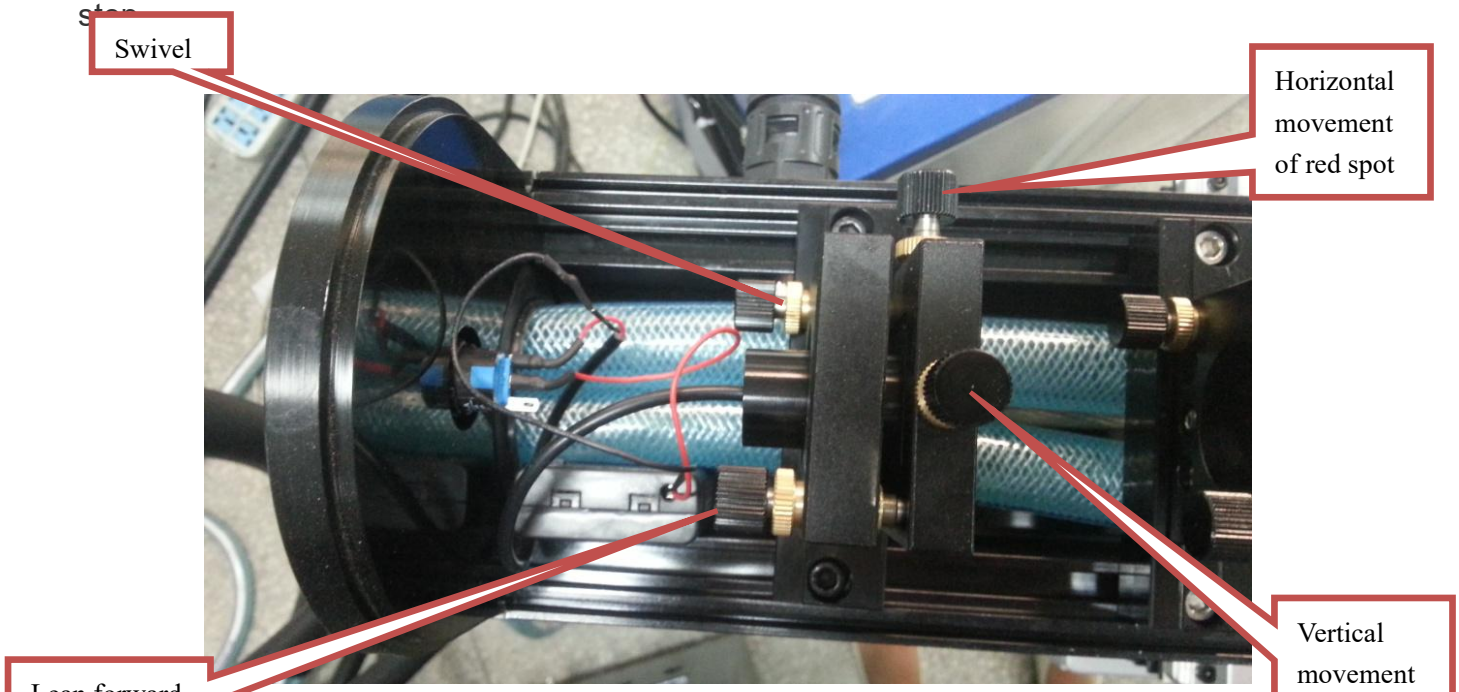
WARNING: Only do red light alignment when technician asked you to do!

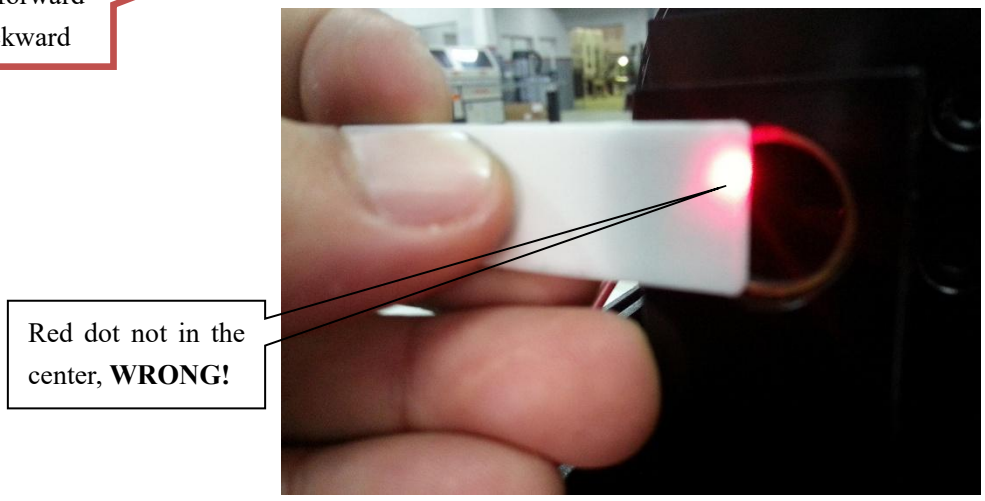
Red light is the guide light for observation.Don't energetic the welding machine when you do

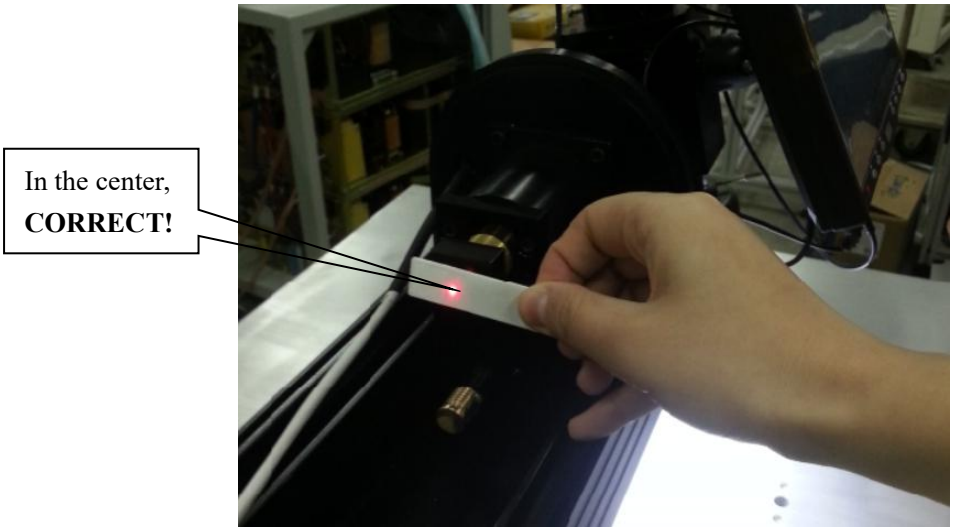
red light alignment. Just turn on red light by pressing the red button at the end of optical chamber and open the chamber lid.



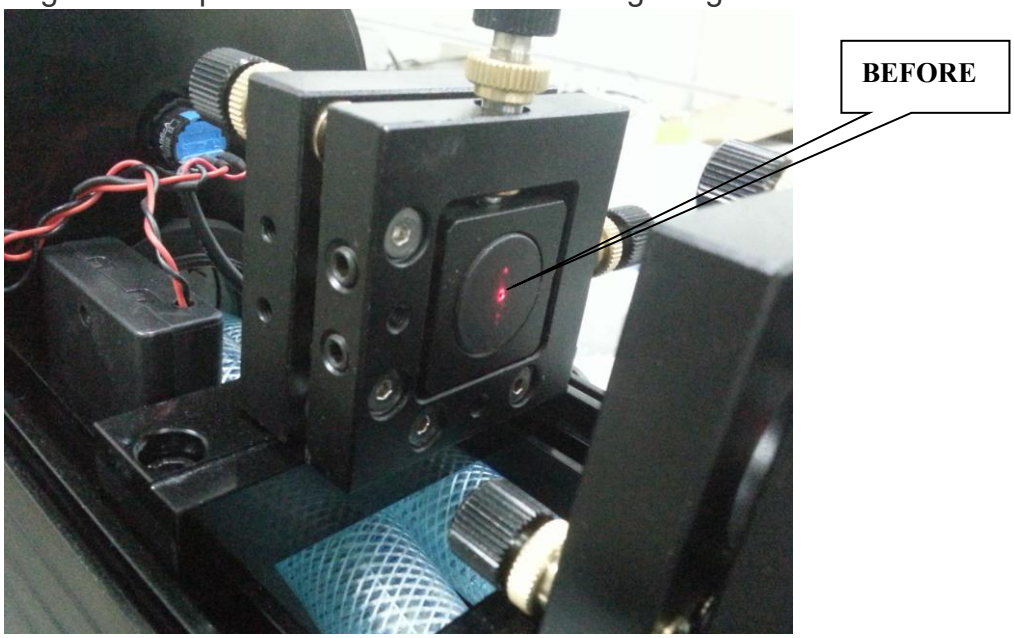
Step 1： Adjust the four knobs to make red spot in the center of every place you test with laser detector. If you find the red spot is already in the center, then please jump to the next step.

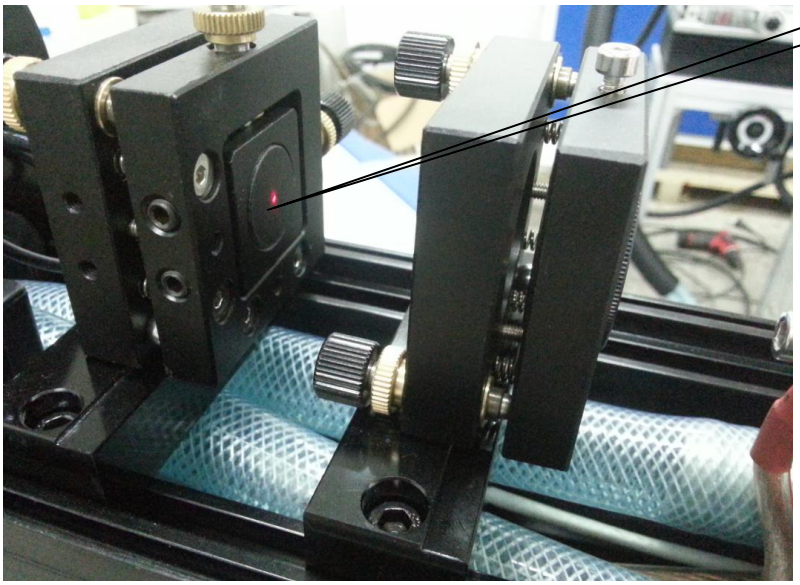


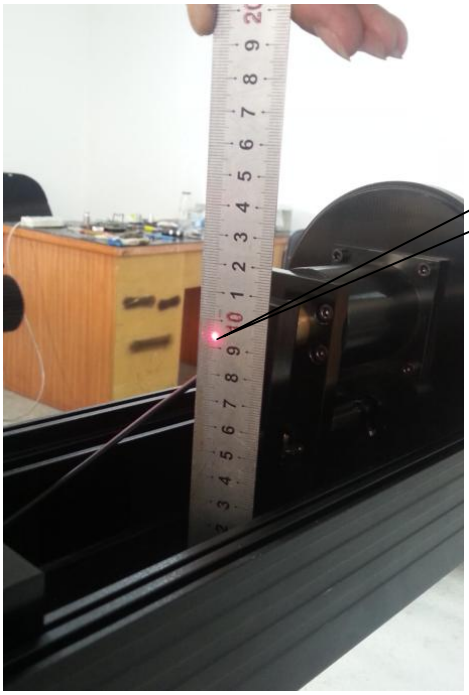


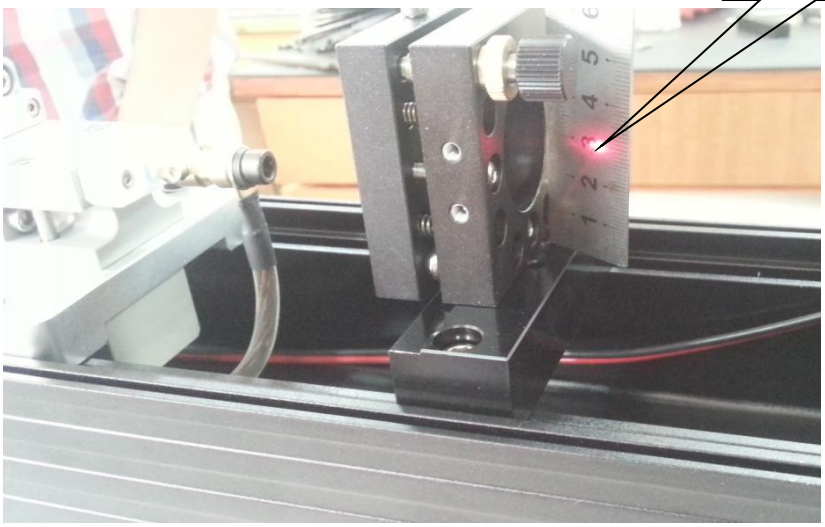


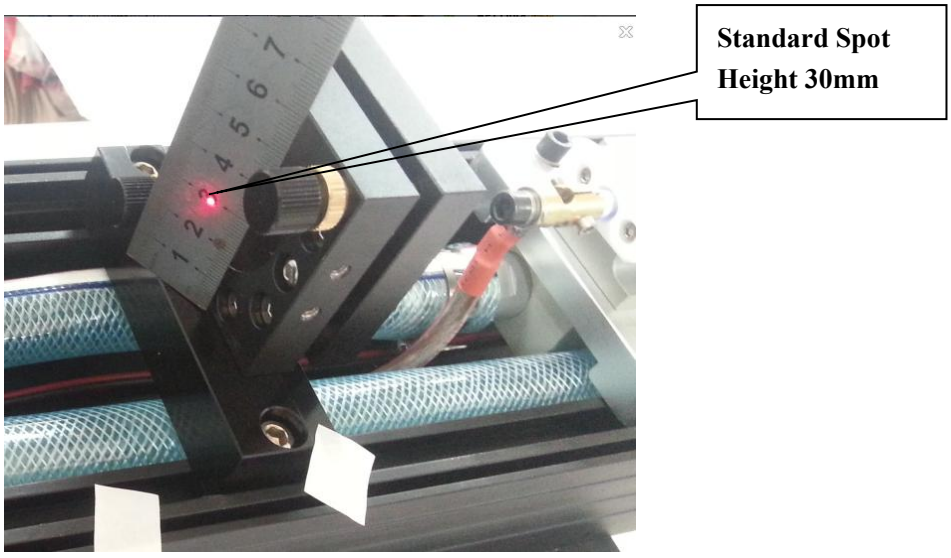
Step 2: Adjust the two knobs on half-reflect lens to make all the small red spots becomes one.Measure the height of the spot and make sure it's at the right hight.




AFTER


Standard Spot
Height 94-95mm

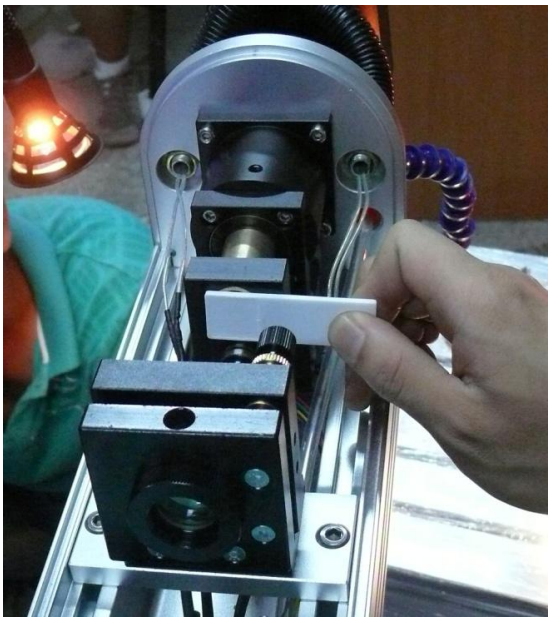

Standard Spot
Height 30mm

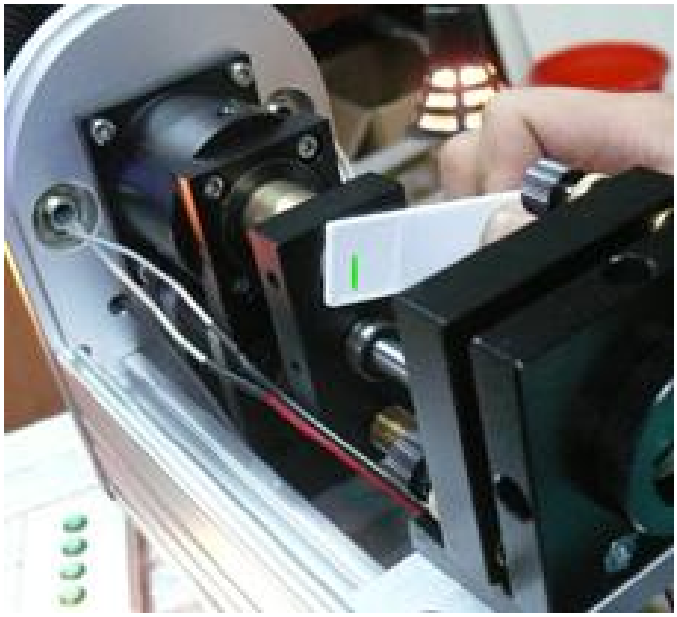


◆Part B. Laser Alignment

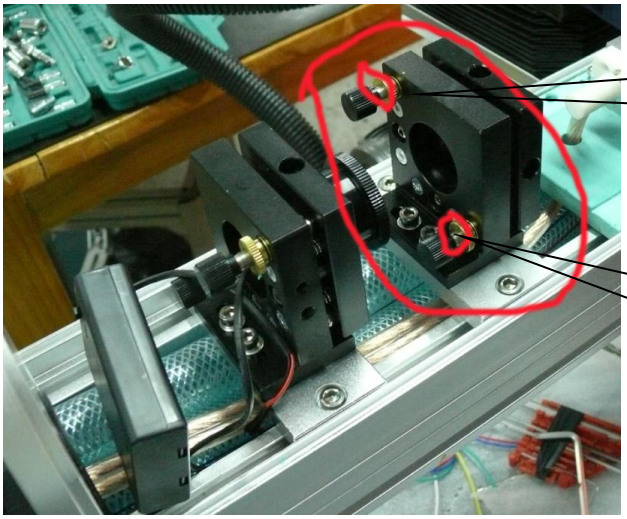
Before you start, please turn on the water chiller and laser machine ,and then set parameters as Current<80A,Width=1.0ms,Frequency=5.0HZ

Step 1: Put the ceramic laser detector in front of the brass tube and trigger the laser by foot switch, you will find a green spot on the detector. (It will be a white spot if you're using a black photo paper as the detector)



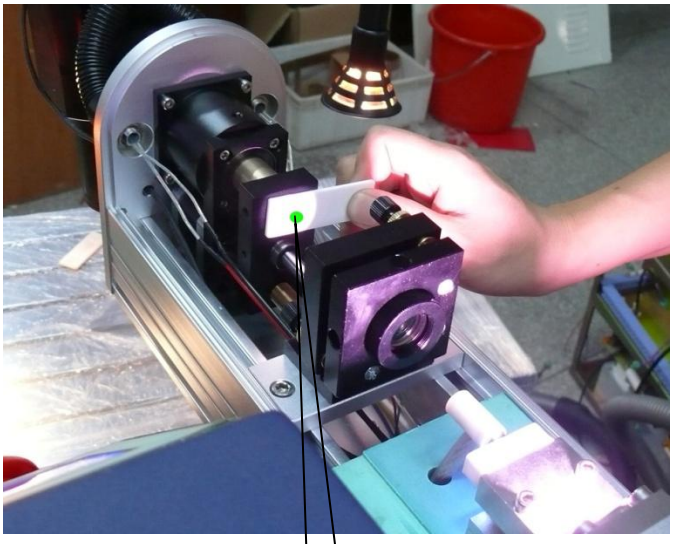


Step 2: Turn the two knobs on full-reflect lens that marked in red to adjust the green spot as round as possible.



Turn this knob and keep triggering laser to adjust the left semicircle and the right semicircle of green spot

Turn this knob and keep triggering laser to adjust the upper semicircle and the lower semicircle of green spot



Before

After

Remarks:

1) If you use black film paper for laser testing, the spots will look the following picture and you must try your best to adjust more until you have the good spot.