

# User Manual

## Robot200 Laser Spot Welder



Wuhan Questt Asia Technology Co., Ltd

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## ※ Preface

Thanks for choosing laser welding machine manufactured by Wuhan Questt Asia Technology Co., Ltd

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、 When you don't need a certain electrical component (rotary/ slide way/ motorized XY), please don't connect the their power cable.
- 2、 Please don't try to change any part inside the machine with power on.
- 3、 Make sure this machine is well-grounded and regular checking is necessary.
- 4、 Use one hand only to turn on/off the switch just to avoid human body circuit.
- 5、 If you have to touch those parts with high voltage, please use well-insulated tools for security.

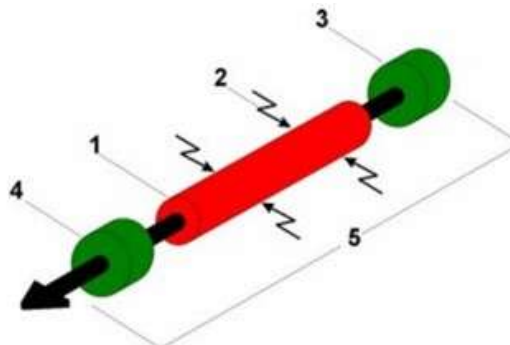
### **FRIENDLY WARNING !!!**

- 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.**
- 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.**

1.1

The word “LASER” is an acronym for Light Amplification by Stimulated Emission of Radiation. The elements of a laser are---resonator

1. Laser medium
2. Input “pump” energy
3. Rear total reflecting mirror
4. Front partial reflecting mirror
5. Resonator

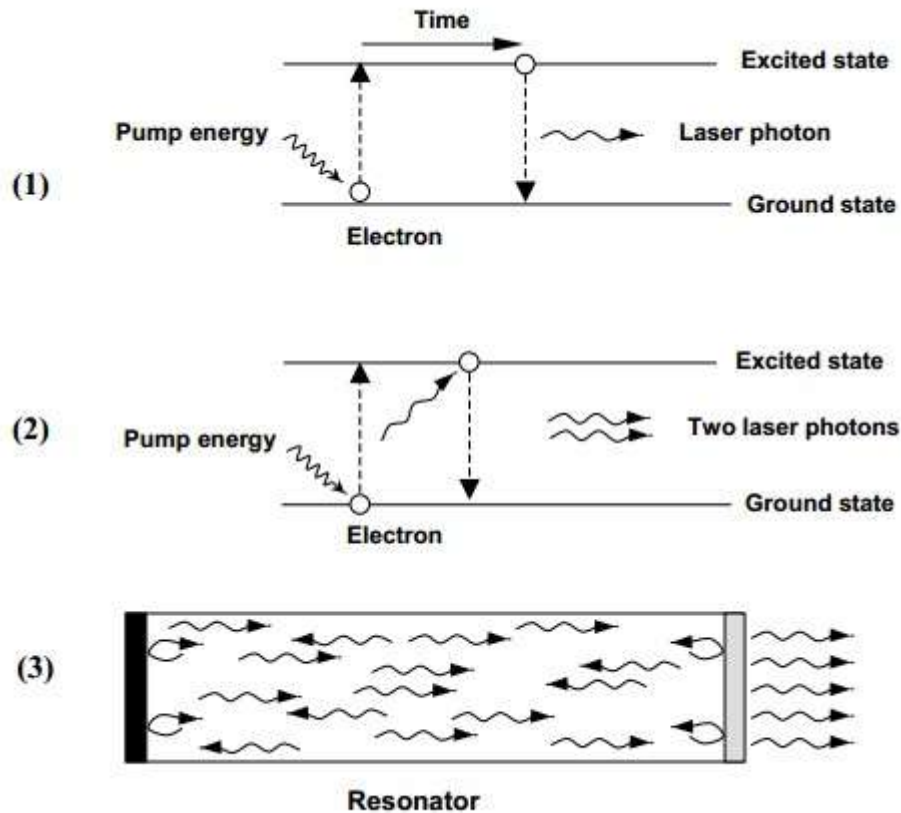


There are two of types of Nd: YAG laser welders; continuous wave and pulsed. The pulsed laser utilizes high peak power to create the weld, whereas the Questt laser uses average power. This pulsed laser to use less energy to create the weld, with a smaller heat affected zone. This provides the pulsed laser with unrivalled spot welding performance and minimal heat input seam welding.

## 1.2 Principle of Laser Generation

The generation of a laser beam is essentially a three-step process that occurs almost instantaneously

- 1) The pump source provides energy to the medium, exciting the laser medium atoms such that electrons held with in the atoms are elevated temporarily to higher energy states. The electrons held in this excited state cannot remain there indefinitely and drop down to a lower energy level. In this process, the electron looses the excess energy gained from the pump energy by emitting a photon. This is called spontaneous emission and the photons produced by this method are the seed for laser generation.
- 2) The photons emitted by spontaneous emission eventually strike other electrons in the higher energy states. “Eventually” is a very short time due to the speed of light and density of excited atoms! The incoming photon “knocks” the electron from the excited state to a lower energy level creating another photon. These two photons are coherent meaning they are in phase, of the same wavelength, and traveling in the same direction. This is called stimulated emission.
- 3) The photons are emitted in all directions, however some travel along the laser medium to strike the resonator mirrors to be reflected back through the medium. The resonator mirrors define the preferential amplification direction for stimulated emission. In order for the amplification to occur there must be a greater percentage of atoms in the excited state than the lower energy levels. This “population inversion” of more atoms in he excited state leads to the conditions required for laser generation.



## 2. Introduction of Robot200 Spot Laser Welding

Questt series laser spot welder is firstly designed for jewelry ornaments manufacturing, jewelry repairing, rings or bracelets resizing, gold and silver re-tipping, stone setting, eyewear welding or repairing, denture welding, small auto parts welding, etc. Generally, it is especially suitable for tiny target precision welding. It works on gold, platinum, titanium, silver, copper, nickel, aluminum, magnesium, stainless steel, etc.

### 2.1 Characteristics

- Energy, pulse width, frequency and focus can be adjusted within a wide range to achieve different welding effects.
- Ceramic reflector used in the laser pump chamber is imported, which is corrosion resistant, high temperature resistant, high electrical/optical conversion.
- World-leading automatic light shielding system is employed to remove harmful lighting on eyes during operation.
- 24-hour continuous operation, with stable operating performance,
- Free of maintenance within 10000 hours.
- Personalized design in compliance with ergonomics principles.

### 2.2 Specifications

Laser Source: Nd3+:YAG  
Wavelength: 1064nm  
Pulse frequency: 1~50Hz adjustable  
Pulse width: 1.5~20ms adjustable  
Single pulse Energy: 60J  
Rated Laser Power: 200W  
Cover Gas Channel: 1 line quick connection  
Focused Beam Diameter: 0.1~3mm  
Expanding Ratio: 3X  
Microscope Ratio: 10X  
Focal Length: 100mm  
Power Supply: Single phase AC 220V±10%  
Power consumption: 9kw  
Running Environment: Temperature 5°C~30°C, humidity < 85%.  
Continuous Working Time: 24 hrs  
Shield Gas Connection: 1 line quick connection (argon)

### 2.3 Main Structure & Maintenance

The whole system is composed of:

- A. Laser Generator
- B. Laser Power
- C. Optical System
- D. Control system
- E. Cooling system



## A. Laser Generator

### 1. Brief introduction of laser generator

The laser is the device of transforming the electricity energy to the laser energy. In this system, the laser is Nd<sup>3+</sup>:YAG laser. It is mainly composed of the following parts: (1) pump lamp (2) laser rod (3) cavity (4) optical resonator (6) other accessories

Pump lamp excites the laser medium to transform the electricity energy to optical energy. The laser rod transforms the optical energy to laser energy. In this system, the pump lamp is the pulsed Xenon lamp and the laser medium is Nd<sup>3+</sup>:YAG rod.

In the cavity, the light emitted from the pump lamp is focused on the laser medium. In our system, it is the close ceramic cavity.

In the optical resonator, the laser is amplified to form the high intensity laser output. There are two high damage threshold coated plane mirrors which are set parallel in the resonator.

Only 3% of the electricity energy is transformed into laser energy during the laser working, the other electricity energy is transformed into heat and distributed in the pump lamp, laser rod, and the cavity body. To protect the laser, this heat has to be taken away. In this system, the pump lamp, laser rod and the cavity body are cooled by the circulation deionized water.

Besides the above parts, there are still the other accessories as follow:

(1) High voltage electrode, (2) The insulating base, (3) Positioning support, (4) The adjustable mirror support, (5) Laser support.

### 2. Things to be aware of:

The laser system is the opto-mechano-electrically integrated. It is very precise and has to be operated by the authorized person who has the professional technology and technique.

### 3. Optical resonator

The optical resonator is composed of two coated plane mirrors which are set strictly parallel in the resonator. These two mirrors can not be touched and moved after the adjustment and keep clean, otherwise, the surface of the mirror may be destroyed. So, the laser cover can not be moved at any time. When the laser output becomes low, firstly, it has to be checked whether the surface of the mirrors are stained. If it has been stained, use the lens paper or absorbent cotton to erase softly with the cleaning liquid (the mixture of 50% no water ethanol and 50% aether). Then, check the adjustment of the resonator.

### 4. Cooling of laser

There are two water hoses connected to the pump lamp and the laser rod respectively. Either of the hoses is blocked, unredeemable damage may be caused. Every time when the system is reinstalled, before starting the laser, it has to be checked carefully that the water flow is correct.

### 5. Change flashing lamp

The pulse Xenon lamp is consumable part. Its service lifetime is 10<sup>6</sup> flash times. To guaranty the normally work of the system, the lamp has to be changed when it is out of service life or when the laser energy is weaken.

**More attention must to be paid to the two ends of the Xenon lamp during the changing:**

- (1) Turn off the system, close the water and discharge the remain charges in the energy store capacitance;
- (2) Unload the electrode of the lamp;
- (3) Remove the top of the lamp, draw out the Xenon lamp carefully beside the reflecting mirror;
- (4) Clean the cover tube with the cotton and the cleaning liquid;
- (5) Verify the size of the Xenon lamp;
- (6) Insert the lamp in the cavity, close the top and mount the electrode;
- (8) Check the water leaking;
- (9) Turn on the main power supply to check the discharge;
- (10) Check the laser output power by using the single pulse mode. If the laser output power can not meet the requirement, the resonator need to be re-adjusted repeatedly;
- (11) Close the laser cover.

**6. Nd<sup>3+</sup>:YAG rod**

Nd<sup>3+</sup>: YAG rod is the core of the laser, it must be very careful to handle the rod during the installation and the using. The two end of the rod must be keep parallel strictly. If there is dirtiness on the two end surface, it has to clean the room firstly, then ask the professional service people to handle the rod. Take out the Nd<sup>3+</sup>: YAG rod, clean it by lens paper and cleaning liquid. The reasons of the rod damage may be the followings:

- a. The flow of the cooling water is low or the water hose is blocked. It lead to an overheat in the lamp and the laser rod.
- b. The end surface is damaged by something hard.
- c. The coated end surface is burned out because of the dirtiness on the surface.
- d. The strong and uneven stress from the installation of the rod breaks the laser rod. So, usually, the operator can not open the laser cover and can not touch the YAG rod. If there is dirtiness on the end surfaces of the YAG rod, it has to be handled by the professional service people.

**7. Maintenance of condenser cavity**

The condenser cavity is ceramic cavity imported from UK, which has very high reflectivity. It is free of maintenance but never allowed to take apart.

**8. The protection of high voltage**

To start the laser, there are three voltages applied to the Xenon lamp. They are the triggering voltage: about 15~20kV; the pre-igniting voltage: about 1.7kV~2kV and the arc discharge voltage: about 500~1900 voltage. It must keep at least 15mm distance with the surrounding component. During the operating, the insulating board must be clean and dry to prevent short-circuit of the high voltage.

**B. Laser Power****1. Specification**

The laser power supply in this system is pulse mode power supply. The IGBT is supplied by the L-C resonating charging and the energy storing circuit. The control circuit has two SCM as the core. So the output power and the repeatability can be adjusted conveniently. The power



supply can be adjusted independently or together with the control system. There are multi-inter-lock protections in this system, to shut off the main power supply in emergency situation.

## 2. Description for the electric circuit

The electric circuit is composed of the followings:

Main circuit: include the charging circuit, energy storing circuit, discharging circuit loop and pre-igniting circuit.

The control circuit: include the electric control circuit, microcomputer control circuit and all kinds of the protection circuit.

### a. Voltage rising/rectifying circuit

By raising the single-phase voltage, the voltage rising / rectifying circuit convert the 220 ACV to 620 DCV to supply the power of the charging circuit.

### b. The charging circuit

The charging circuit is composed of the IGBT power transistors. This kind of circuit can increase the repeatability of the charging.

### c. The discharging circuit loop

The discharging circuit loop is controlled by the SCR. During the discharge, the discharging IGBT power transistors have to be shut off. After the charging of the energy storing circuit, the charging IGBT power transistors are shut off, waiting for sometime delay, the discharging IGBT power transistors are turned on to discharge. When the energy storing capacitor discharging finished, the discharging IGBT power transistors will be shut off automatically.

### d. The pre-igniting and the triggering circuit

It includes the voltage rising transformer, high voltage rectifier, filter, barrater, current relay, high voltage pulse transformer and high voltage triggering circuit.

The pulsed Xenon lamp is working in the aura discharging during the pre-igniting, which has the characteristic of the negative resistance. To maintain the aura discharging of the Xenon lamp after the arc discharging, the pre-igniting circuit must have the characteristic of constant current. So the pre-igniting circuit must have very high limit resistance.

The triggering mode in this laser is inner triggered by 50Hz pulse automatically. When the pre-igniting circuit works, the high voltage pulse transformer produces the high voltage of 15,000V ~ 20,000V. When the pre-igniting begins, the triggering circuit shut off automatically and immediately.

### e. Control circuit

The control circuit includes two parts of operating circuit and microcomputer control circuit. The operating circuit controls the water pump, pre-igniting circuit, main power supply, the power supply of the control circuit and the inter-lock protection by means of the components such as the button, contactor and relay. The microcomputer control circuit is integrated in a PCB.

### f. Protection circuit

When the pre-igniting circuit shut off, the pre-igniting shut-off protection circuit takes into function and sends out the fault signal.

When the water flow is low in the cooling system, the water flow relay breaks and shuts off the pre-igniting circuit and the main power supply, thus to stop the system.

## C. Optical System

### 1. Binocular microscope

To observe the working piece clearly, the binocular large caliber and long focus length microscope has been used in this system. Before the object lens, there is a coated protection glass to protect the lens from the spatter during the laser processing. The ocular can be taken down by loosen the fixing bolt for the shipping and maintenance purpose.

### 2. Laser beam expander and the focusing system

To ensure the laser welding spot in the center of the view all the time during the focusing, the laser beam has to be co-axial with the beam path of the microscope. In this system, the laser beam and the optical path of the microscope share the same object lens. The offset of the focus point is adjusted by the up and down keys. The offset of the focus point is determined by the experiment according to the welding processing technology.

### 3. The indication of the welding spot

**Because the YAG laser is invisible infrared ray of  $1.06\mu\text{m}$ , there is a cross in the ocular, whose intersection accords to the laser spot, to indicate the laser position. Thus the laser beam can be aimed at the welding position on the piece to be welded easily.**

### 4. Cautions

- (1) It is forbidden to touch the surface of the optics by hand or scratch by something hard. It is also forbidden to blow the dusts on optics by mouth. It can be blown by the special blowing ball or cleaned by the long fiber absorbent cotton ball or the lens paper, if the optics is stained.
- (2) Normally, don't disassemble the optical system to prevent from the damage and the dust.
- (3) Move the tube of the object lens carefully and don't touch the protect glass. Before changing the protect glass, remove the front tube of the object lens first and the press ring carefully.

## D. Control System

The system can be controlled by the operation panel before using, or by joystick inside the welding chamber during using.

## E. Cooling System

### 1. Construction

The cooling system is the main part of the laser system. It is composed of the heat exchanger, magnetic pump, filter, water tank, switch of water flow, the temperature contactor, ABS hose and valves to form a closed circulation water system.

## 2. The principle of the cooling

The inner deionized water in the water tank is pumped by the magnetic pump to cool the YAG rod, pulse lamp, two electrodes. The heated deionized water goes through the heat exchanger and returns to the water tank. The resistivity of the deionized water must be higher than  $0.5 \text{ M}\Omega\cdot\text{cm}$ . When the deionized water becomes dirty or the resistivity of it becomes higher, the Xenon lamp may can not be ignited and the laser cavity and the glass tube may be stained. In this situation, the deionized water has to be changed immediately. ( the deionized water should be changed one time every week when the laser system is operated continuously)

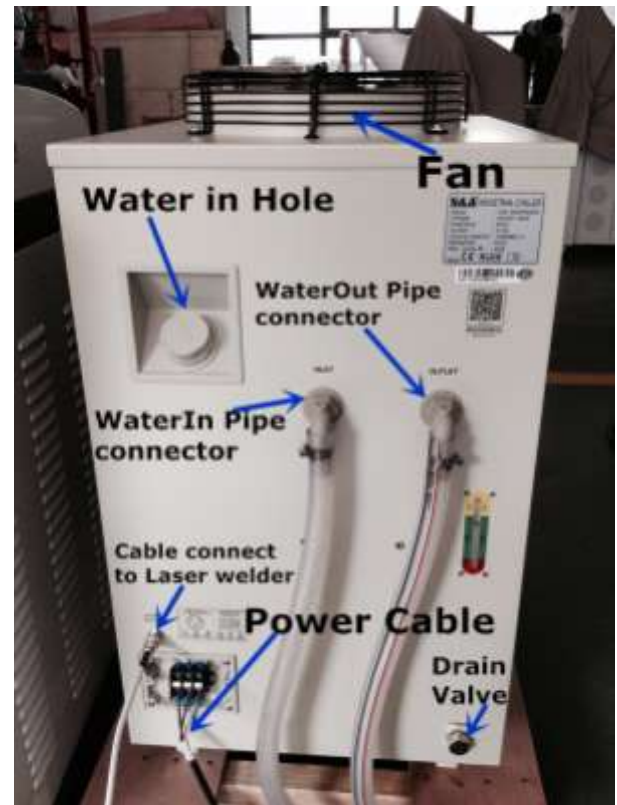
In the heat exchanger, the Freon is used to take the heat away from the inner deionized water. In order to ensure the proper working of the system, there is an over temperature contactor and over flow controller in the cooling system to supervise the water in the laser. Once there is no enough water flow or the water pump does not work properly, or there is no enough water in the water tank, the laser power supply will be turned off immediately to prevent from the lamp exploding or the rod exploding.



## 3. Pre-using

### 3.1 Hardware Connection

A. Connect water inlet and outlet with chiller inlet and outlet, then tighten the hose clamps



B. Connect the water protective cable





- C. Connect the chiller power:  
 coffee wire=Live wire, blue wire=Null wire,yellow wire=Earth wire,  
 Connect the welder power:  
 red wire=Live wire, blue wire=Null wire, black wire=Earth wire



- D. Connect the Foot Switch



- E. Fulfill the chiller tank with drinking water until the water surface covers all the pipes

### 3.2 Laser Activation

Wuhan Questt Asia Technology Co., Ltd  
 Lake High-tech Dev. Zone, Wuhan, Hubei, China  
 Tel: 00862787611146 Fax: 00862759908808

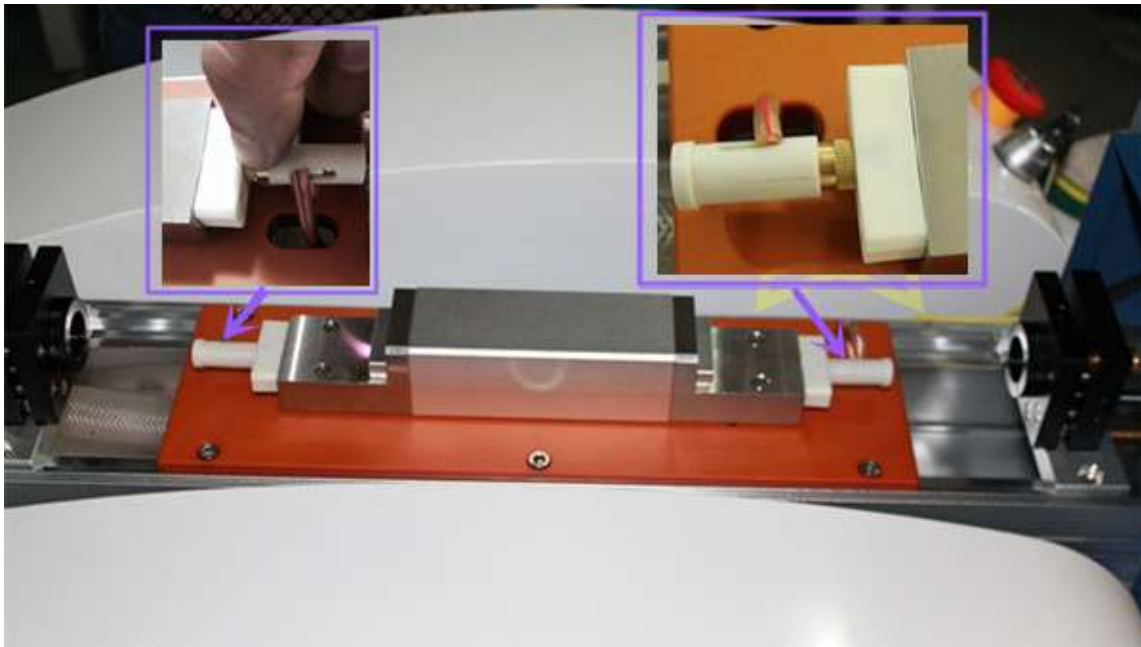
Address: A7-101, Hangyu building, Wuhan University Sci & Tech Park, East  
 Http://www.questt.com.cn; Email:info@questt.com.cn

A. Take off the cover of the laser welder chamber.



(A)

B. Take off the white caps and connect the two electrodes of xenon lamp.  
(When you change the lamp, you need this step. New machine,no need.)



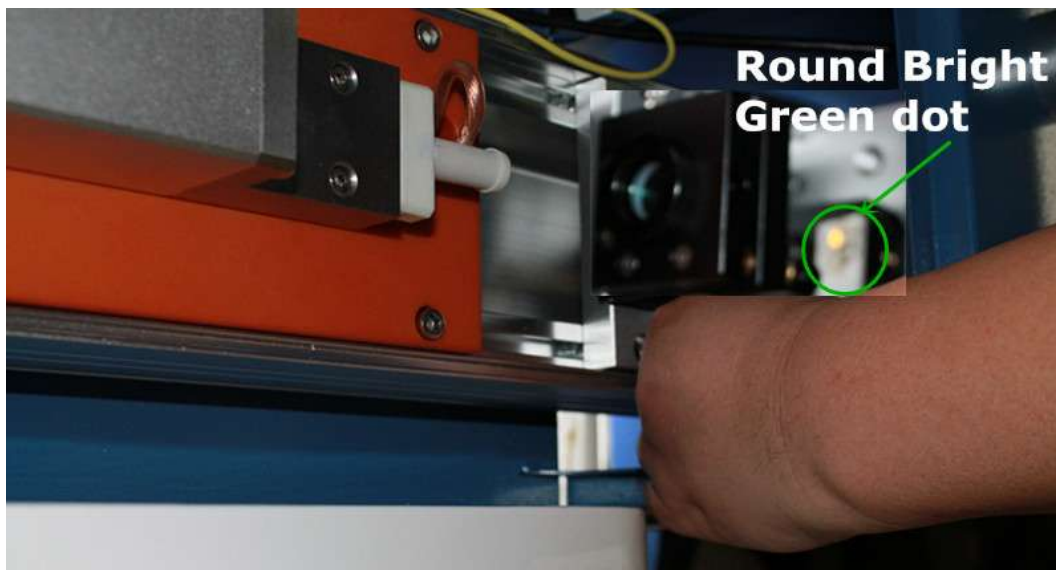
(B)

### 3.3 Laser Alignment



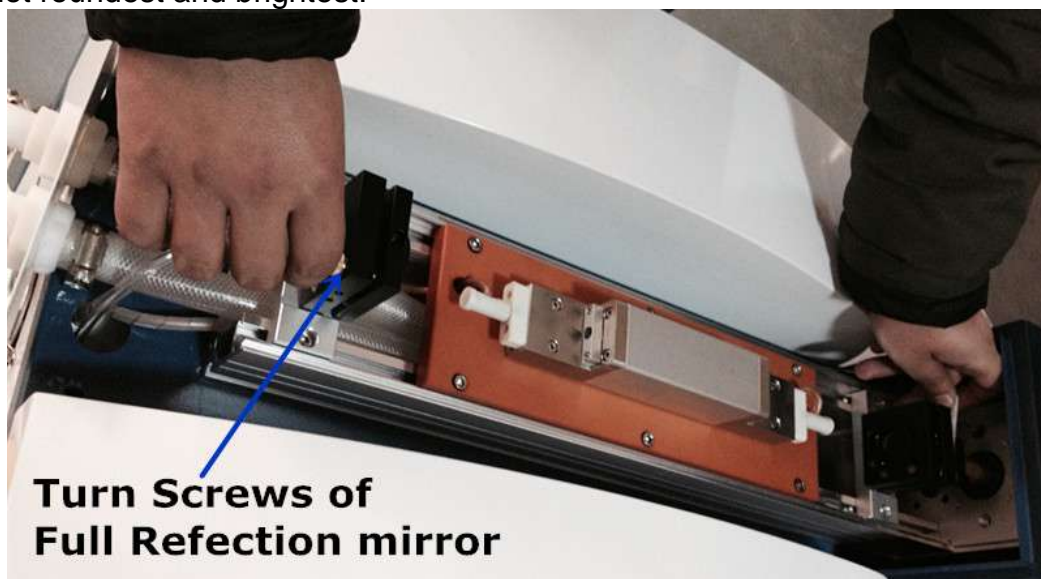
This is not a must-do when you firstly receive this machine. Only when you find the laser spot is not round any more or the laser energy becomes very weak, you may consider to do laser alignment.

- A. Start the laser welder by twisting the key switch and set parameters as:  
Curt=100A / Wid =1ms / Fre =1 Hz
- B. Hold the ceramic dimmer chip and put it in front of the brass tube with your left hand. Now the laser beam can be intercepted and becomes a green dot on the chip.



(B)

- C. Adjust the two black screws as the following picture with your right hand until you find the green dot roundest and brightest.



(C)

## 4. Operation

Step 1) Start the chiller and wait for 1-2 minutes until the water temperature reaches the target value you set. Normally 25 CelsiusDegrees.



Step 2) Turn on the safety switch and connect to the main power in factory or home.

Step 3) Twist the key switch to start laser welder



Step 4) When start the machine,the control panel will open, press the green button "ON",Wait for a few minutes till capacitance charging is finished, when the left-up corner read: "normal", it means the welder is ready to use.Select parameters and set values correctly based on the type of material and make small adjustment according to the result of test shooting. Sometimes it relies more on operator's experience.



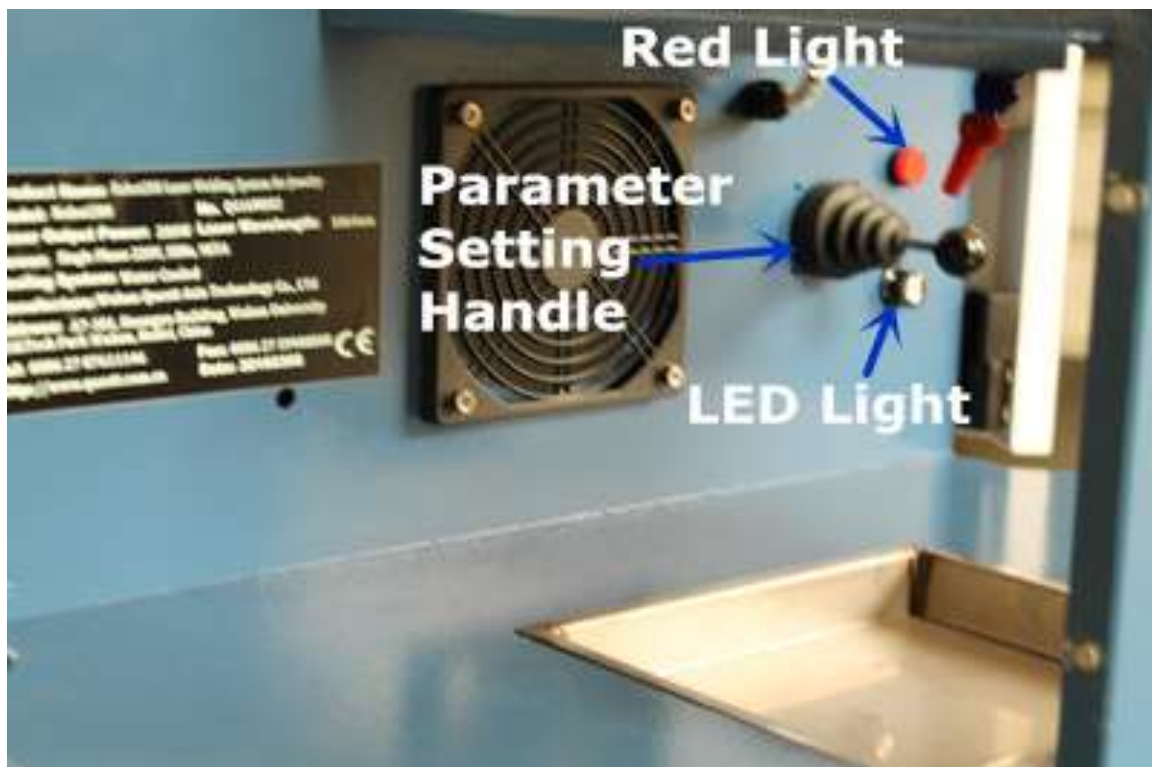
Cur: current  
spot size

Wid: pulse width  
Prog: program number

Fre: frequency

Light: laser

Step 5) Turn on the LED light and adjust the position of shield gas nozzle before welding so that your work piece can be prevented from quick oxidation. You can also re-set parameters by the joystick inside the welding chamber ,left and right is change the selections,up and down is increase and decrease the number.





Step 6) Now you are free to weld.

Step 7) When you finish welding, move the dash on CLOSE, press OK button, turn off the key switch, turn off the chiller and cut the total power.

Finally, please open the protective cover and clean the dusts in the welding chamber. We strongly suggest you to do this at least once a week.

## 5. Application

Questt series laser welding machine is specially designed for spot welding, perforating, repairing, retipping and resizing of gold/silver/titanium/platinum jewelries, stone caging and gap bridging of small accessories. It is also widely used in aviation, aerospace, sports products, eyewear frames, medical instruments, titanium alloy denture, instruments, electronics, machinery, automobile, etc. Applicable materials are various: gold, silver, steel, copper, aluminum, titanium, brass, etc,

### Laser Welding Samples



?

67 Ct citrine caged  
in 19 Kt white gold



154 Ct amethyst caged  
in platinum



Citrine and amethyst  
pendant caged  
in stainless steel



Star stainless steel body  
jewelry



?

Micro cylinder for surgical  
manipulator



Pacemaker components  
made of platinum and  
titanium



Dental bridge after welding



Titanium medical stent



?

Ultrasonic water level  
sensor for Airbus380 jet



Laser welded titanium tube



Probe for a CRJ jet made  
of beryllium copper and  
nickel



Probe for a CRJ jet made  
of beryllium copper and  
nickel

## 6. Warranty & After-sale Service

We guarantee that the technical parameters of the machine Robot200 laser welder accord to the technical requirements.

The guarantee covers a period of twelve (12) months from the date of production.

The guarantee shall not apply in the event that the sub-assembly identification markings have been removed, defaced or altered or if any sub-assembly or part has been replaced or modified without the consent of Wuhan Questt Asia Technology Co., Ltd

The guarantee does not apply to equipment or components for which inspection by Wuhan Questt shall disclose it has become defective or unusable due to misuse, mishandling, accidental damage, negligence or any other cause which does not comply with the requirements given in the instruction manual. For example:

The guarantee dose not includes shipping freight or postal fee for returned broken parts or new parts to be replaced.

## 7. Common 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 with the power on	Fan power failure	Replace a new fan
Output energy reduce	1.Water polluted 2.Xenon 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



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**If the above steps do not correct the malfunction, do not disassemble without our instruction. Do not hesitate to contact us by the following info:**

Wuhan QUESTT ASIA Technology Co., Ltd

Address: A7-101, Hangyu building, Wuhan University Sci & Tech Park, East Lake High-tech Dev. Zone, Wuhan, Hubei, China Zip: 430223

Tel: 0086 13908624127 / 0086 27 87611146 Fax: 0086 27 59908808

Email: [info@questt.com.cn](mailto:info@questt.com.cn)

Mobile: 0086 13908624127

Skype: sherryxiao\_6

QQ: 107863487

<http://www.questt.com.cn> [Http://www.questtlaser.com](http://www.questtlaser.com)