

# **Owner's Manual**

**CMA, PN Series Machine**

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

For the followings:

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

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

## Foreword

Thanks for purchasing the laser engraving machine control system of our company.


Before operating, please read this manual carefully to ensure proper operation.


Please keep the manual properly for reference.

Since the configs are different, certain models do not have the functions listed in this manual. Please refer to the specific functions for details.







Due to the constantly tech update, the specification for reference only, subject to the real standard.


Tags in this book:

 <b>Alarm</b>	Special Attention: User must follow and perform as the manual; otherwise, it could lead to errors or relatively serious problem.
--	--

 <b>Note</b>	Note: User should comply with the attention and suggestion in this manual; it could bring much easier operation.
--	--

## Safety Precautions

 Attention	<ul style="list-style-type: none"> <li>◆ Before using the machine, users are required to carefully read this manual and other operating requirements, strictly abide by the operating specifications. Professional are required for operating the machine.</li> </ul>
 Attention	<ul style="list-style-type: none"> <li>◆ The machine uses class 4 laser (strong laser radiation). The laser radiation may possibly cause the following accidents:           <ol style="list-style-type: none"> <li>① emblaze the surrounded flammable materials;</li> <li>② generate other radiations and toxic or hazardous gas by processed objects during laser processing;</li> <li>③ direct irradiation of laser radiation cause harm to human body. Therefore, fire fighting devices are required in the operating place of the machine. Stacking flammable or explosive objects near the machine is strictly prohibited. Good ventilation is a must. Only the qualified personnel are authorized to approach the machine.</li> </ol> </li> </ul>
 Attention	<ul style="list-style-type: none"> <li>◆ ◆ The processed objects and discharged materials are required to satisfy requirements as per local laws and regulations.</li> </ul>
 Attention	<ul style="list-style-type: none"> <li>◆ Laser processing is with potential risks. Users should carefully make sure if the processed objects are suitable for laser processing.</li> <li>◆ There is high voltage and potential risk in the laser machine. Unauthorized disassembly by unqualified personnel is prohibited.</li> <li>◆ Reliable earthing is required for the machine and related other machine before power-on.</li> <li>◆ During operating, removing any cover of the machine is strictly prohibited.</li> <li>◆ During operating, the operators are required to observe working status of the machine all the time. In case of any abnormality, it is immediately to disconnect power supply and take active and corresponding measures.</li> <li>◆ After power-on, special personnel are required for monitoring. Unauthorized leaving is strictly prohibited.</li> <li>◆ It is a must to disconnect the power supply before leaving.</li> </ul>
 Attention	<ul style="list-style-type: none"> <li>◆ It is strictly prohibited to placing any unrelated all-reflective or diffusion reflective objects in the machine to prevent laser reflecting to human body or flammable materials.</li> </ul>
 Attention	<ul style="list-style-type: none"> <li>◆ The environment for the machine should be dry, free of interference and influences from pollution, vibration, high voltage and strong magnet. The operating ambient temperature ranges 5-40°C, and the humidity ranges 5-95% (no dew);</li> <li>◆ The machine should be far from electric appliances sensitive to electromagnetic interference;</li> <li>◆ Operating voltage: AC220V, 50Hz. Power-on is strictly prohibited in case of</li> </ul>

	unstable voltage of the power grid or unspecified voltage.
 Attention	Chapter two of this manual is for <i>Safety Rules</i> . Please refer to the chapter more details concerning safe operation of the machine. Users are required to carefully read and abide by all the requirements of safety.

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# Chapter 1 Machine Introduction

CMA series laser machine is a universal low power laser processing device developed by our company. The machine is mainly equipped with sealed max. 200W CO2 glass laser tube or metal radio-frequency tube with the function of cutting and carving common non-metal materials and with the wide scope of application in the field of printing, advertisement, garment, leather and electronics.

## 1.1 Instructions of machine model

Indications of Han's Yueming laser machine model:

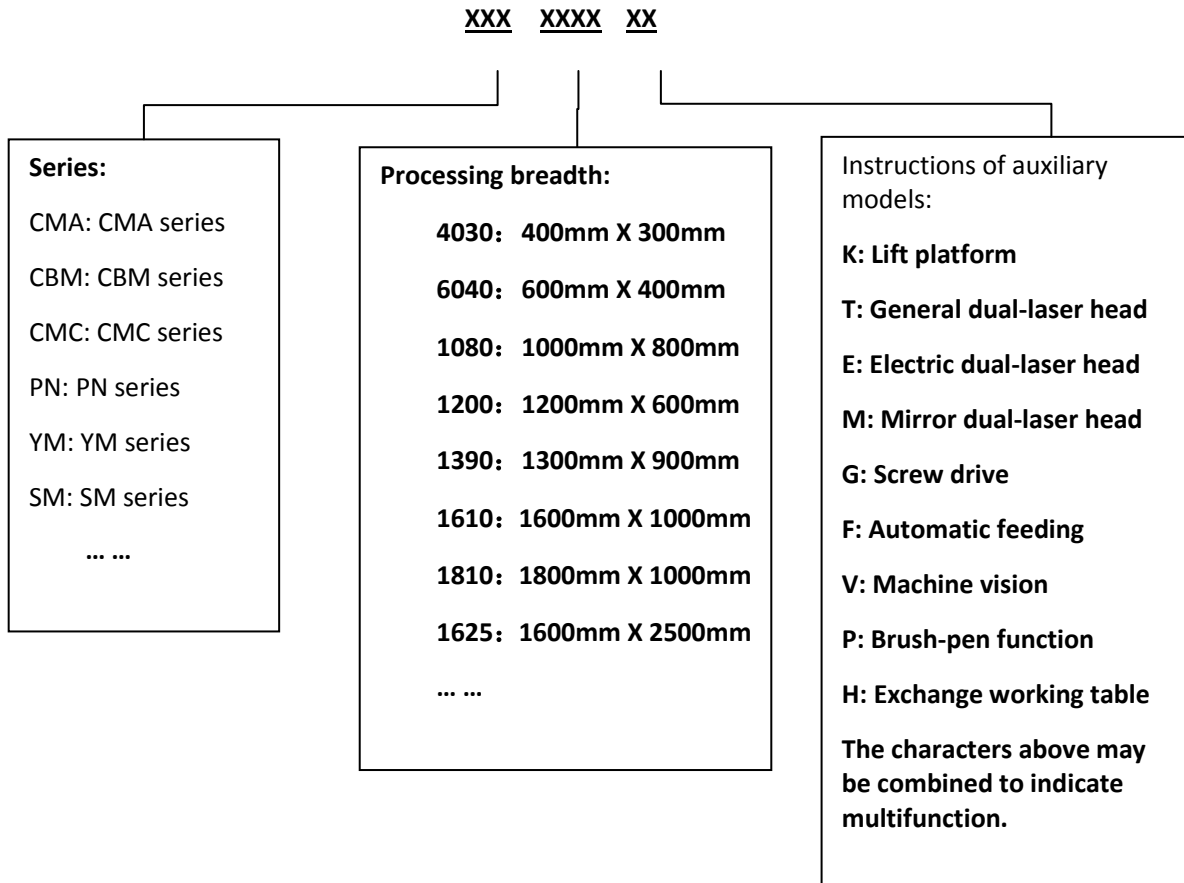



Fig.1-1 Instruction of machine model

From the figure above, we can know that CMA6040 indicates the single laser head machine with processing breadth of 600mm X 400mm, CMA1390T indicates the general dual-laser head machine with the processing breadth of 1300mm X 900mm, and CMA1610EFT indicates the electric dual-laser head automatic feeding machine with the processing breadth of 16010mm X 1000mm.

CMA series laser machine is a device with the largest seal volume and most wide range of application of our company and with various models. This manual contains general operation instructions for the series machine including installation, mechanics, electrics, light route, use and maintenance of control software. Due to the special model or special field of application of some

special machine types, we will provide additional extra instructions for them. Owner's Manual is subject to the manual attached to the machine.

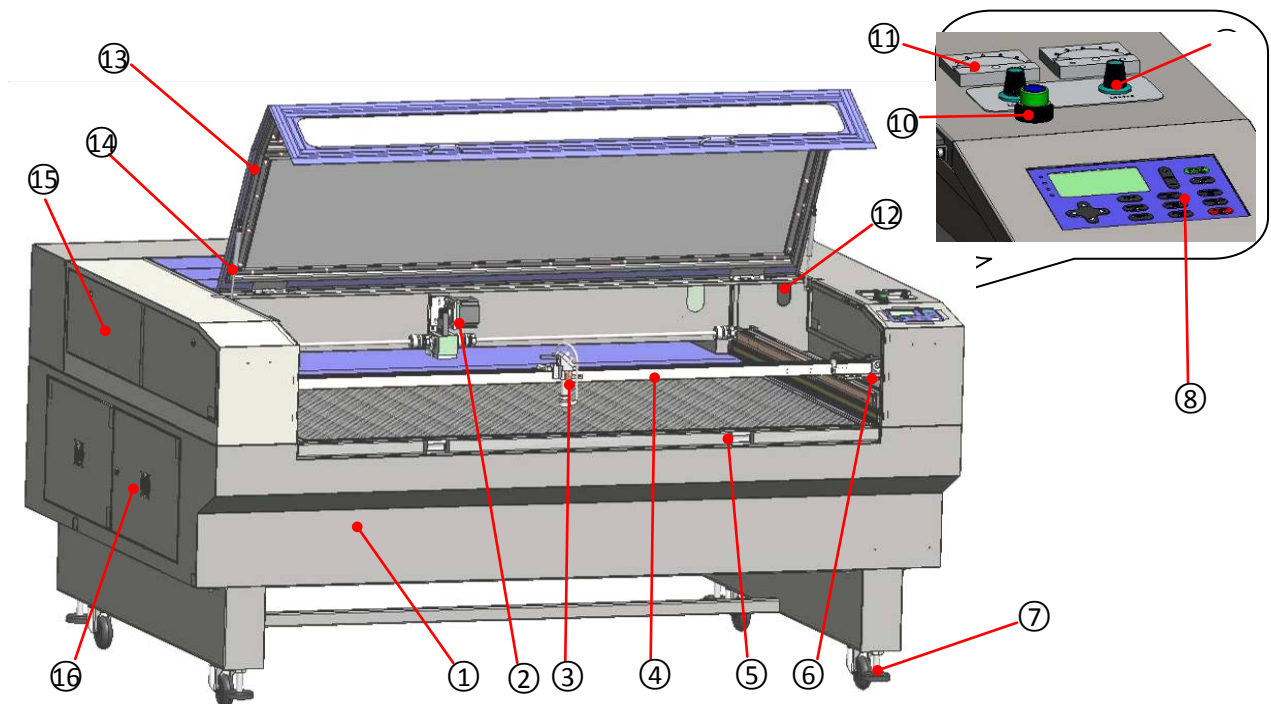
 Attention	As time goes by, naming rules of some models may possibly be different from what mentioned above. And they are subject to the actual product model and manual attached.
--	---

## 1.2 Machine compositions

Due to different models and improvement of products, the industrial design and details of some types of machine may be different. The compositions are subject to the actual product. The following takes general CMA1610 as an example for the compositions of the machine.

### 1.2.1 Compositions of the machine

◇ Front view of the machine is as shown in the figure below:



- |  |   |
|--|---|
| ① Main unit (material collector included)    | ⑨ Potentiometer (Power adjusting knob)      |
| ② Y-axis movement mechanism                  | ⑩ Laser switch                              |
| ③ Laser head                                 | ⑪ Ampere meter (Power indicator)            |
| ④ Machine crossbeam                          | ⑫ Laser outlet (Each one at left and right) |
| ⑤ Working table (Beehive or strip soleplate) | ⑬ Upper cover of the machine                |
| ⑥ X-axis movement mechanism                  | ⑭ Gas spring (Each one at left and right)   |
| ⑦ Foot wheel and footmaster caster           | ⑮ Left end cover of the machine             |
| ⑧ Control panel                              | ⑯ Cabinet door of left case                 |

Fig.1-2 Front view of the machine

✧ Back view of the machine is as shown in the figure below:

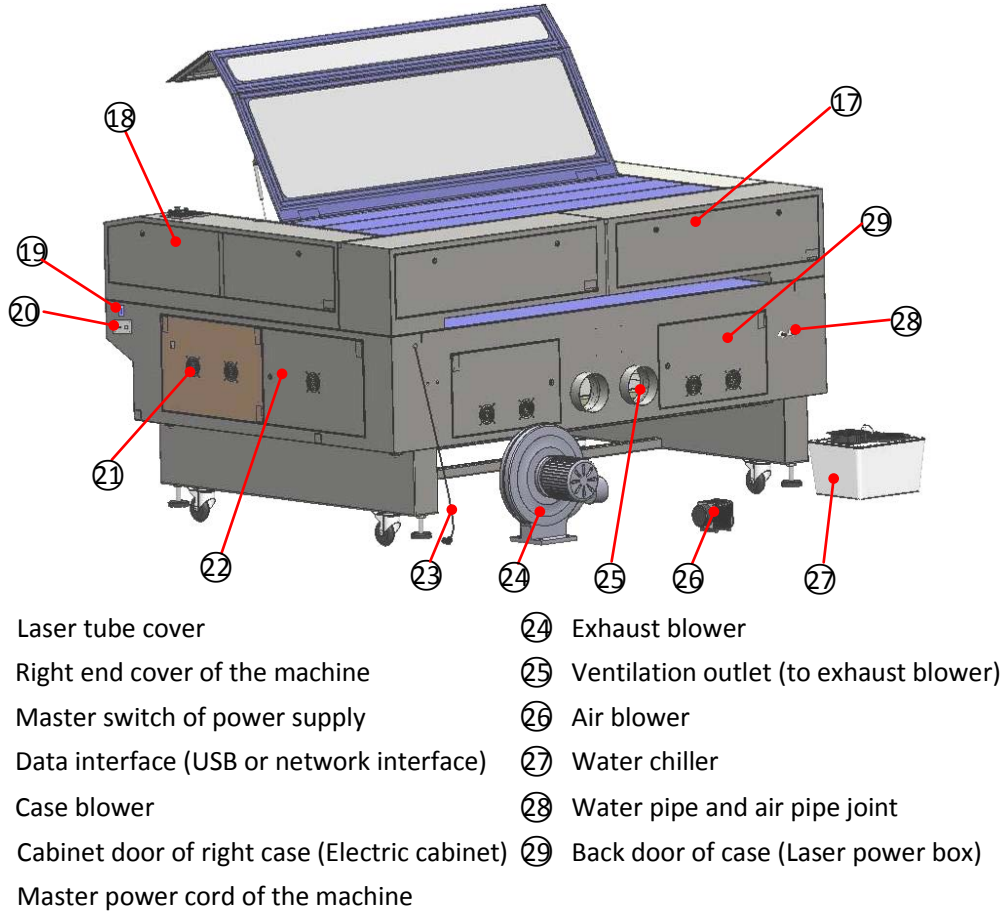


Fig.1-3 Back view of the machine

✧ Machine control is as shown in the figure below:

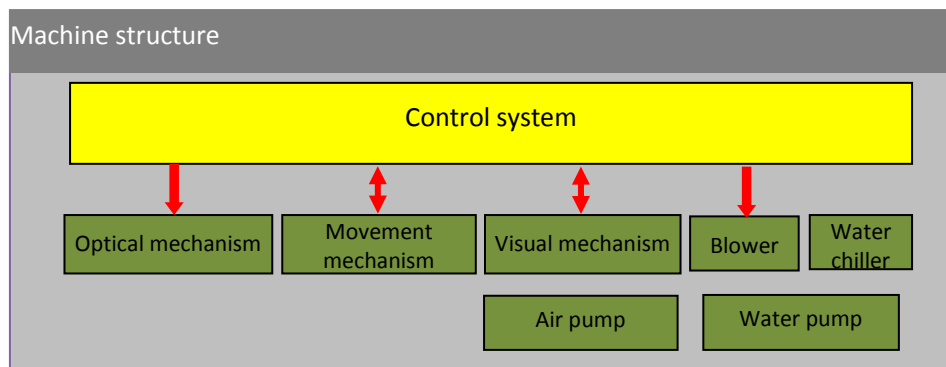
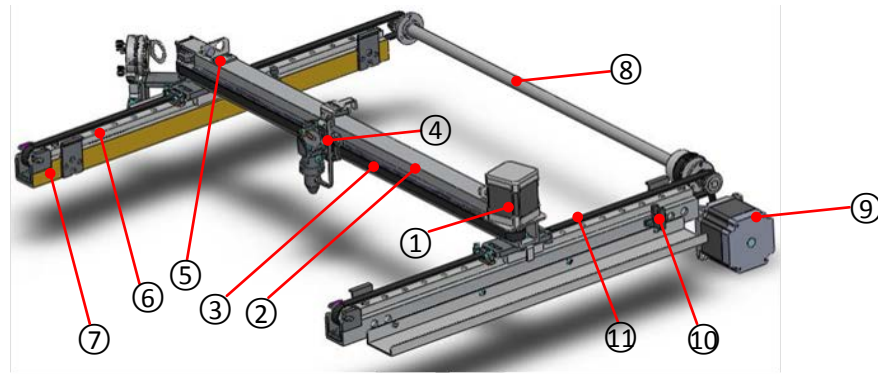


Fig.1-4 Illustration of machine control

## 1.2.2 Compositions of movement mechanism

### 1.2.2.1 Plane movement mechanism

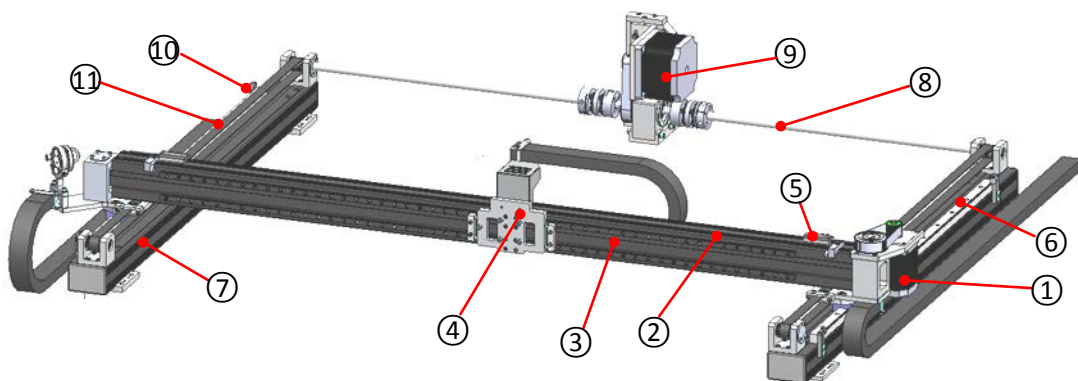
Plane movement mechanism is composed of X-axis and Y-axis movement mechanisms in vertical relation as shown in the figure below:



- |  |   |
|--|---|
| ① X-axis motor                                   | ⑦ Y-axis guide rail beam (each one at left and right) |
| ② X-axis beam and guide rail                     | ⑧ Y-axis drive shaft                                  |
| ③ X-axis timing belt                             | ⑨ Y-axis motor  |
| ④ Dolly (connecting to cutting head)             | ⑩ Y-axis sensor (Reset or limit signal)               |
| ⑤ X-axis sensor (Reset or limit signal)          | ⑪ Y-axis timing belt (each one at left and right)     |
| ⑥ Y-axis guide rail (each one at left and right) |   |

Fig.1-5 Illustration of plane movement mechanism

The figure below is an illustration of another plane movement mechanism mainly used in processing machine with larger breadth. The differences lie in installation position and configuration of movement parts.

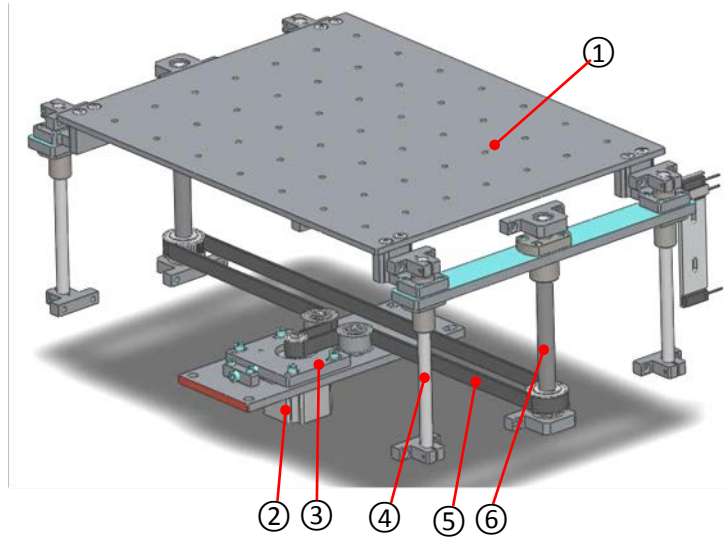


- |  |   |
|--|---|
| ① X-axis   | ⑦ Y-axis guide rail beam (each one at left and right) |
| ② X-axis beam and guide rail                     | ⑧ Y-axis drive shaft                                  |
| ③ X-axis timing belt                             | ⑨ Y-axis motor  |
| ④ Dolly (connecting to cutting head)             | ⑩ Y-axis sensor (Reset or limit signal)               |
| ⑤ X-axis sensor (Reset or limit signal)          | ⑪ Y-axis timing belt (each one at left and right)     |
| ⑥ Y-axis guide rail (each one at left and right) |   |

Fig.1-6 Illustration 2 of plane movement mechanism

### 1.2.2.2 Lift movement mechanism

✧ Some types of machine are with life platform function (e.g. CMA1080K). The life platform mechanism is as shown in the figure below:

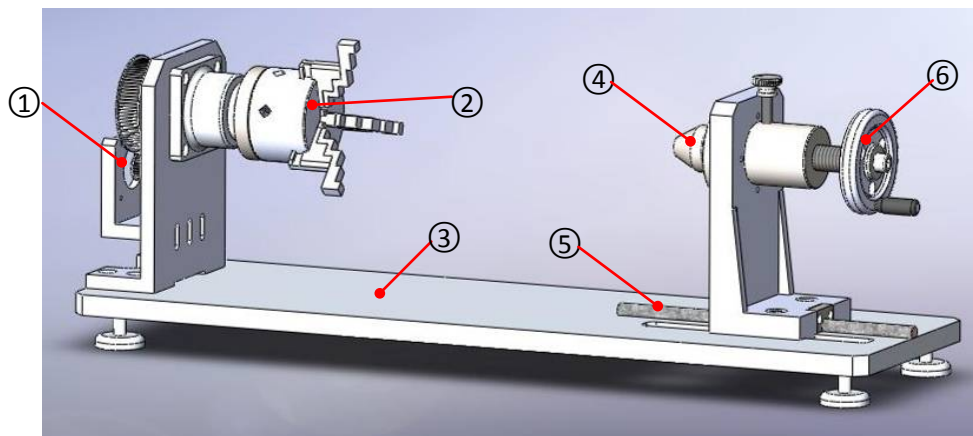


- |                    |  |
|--------------------|--|
| ① Working platform | ④ Lift guide rail (two each at left and right) |
| ② Life motor       | ⑤ Lift timing belt                             |
| ③ Motor stand      | ⑥ Lift ballscrew (one each at left and right)  |

Fig.1-7 Illustration of lift platform movement mechanism

### 1.2.2.3 Rotary device mechanism

Some types of machine are with rotary fixture device (e.g. CMA6040L). The rotary device is as shown in the figure below:

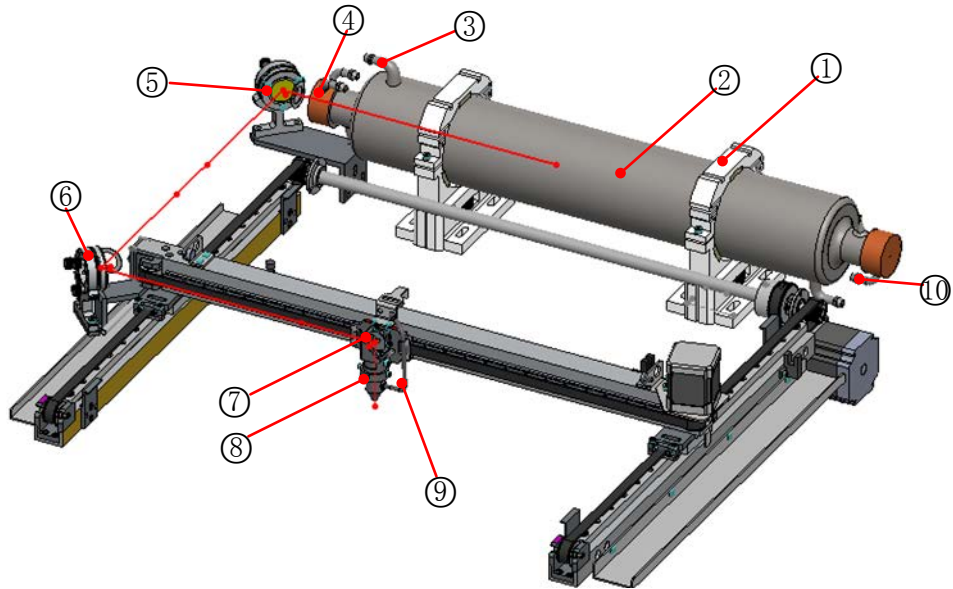


- |                          |                     |
|--------------------------|---------------------|
| ① Rotary motor and stand | ④ Pusher            |
| ② 3-claw chuck           | ⑤ Linear guide rail |
| ③ Rotary device stand    | ⑥ Crank handle      |

Fig.1-8 Rotary device

### 1.2.3 Optical mechanism

CMA and PN series laser machine are basically the same in optical principle. Single-path laser light route is as shown in the figure below:



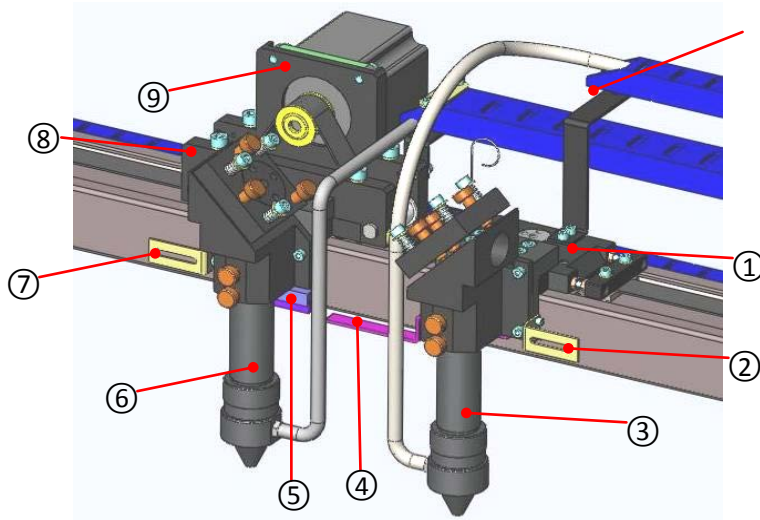
- |  |                     |
|--|---------------------|
| ① Laser tube bracket                     | ⑥ No. 2 reflector   |
| ② Laser tube                             | ⑦ No. 3 reflector   |
| ③ Water circulation joint (an outlet and | ⑧ Focus             |
| ④ Laser outlet                           | ⑨ Blowing pipe      |
| ⑤ No. 1 reflector                        | ⑩ High voltage line |

Fig.1-9 Machine optical mechanism

### 1.2.4 Electric dual-laser head mechanism

Some types of machine are with electric dual-laser head function (e.g. CMA1610EFT). The structure composition of the electric dual-laser head is as shown in the figure below:



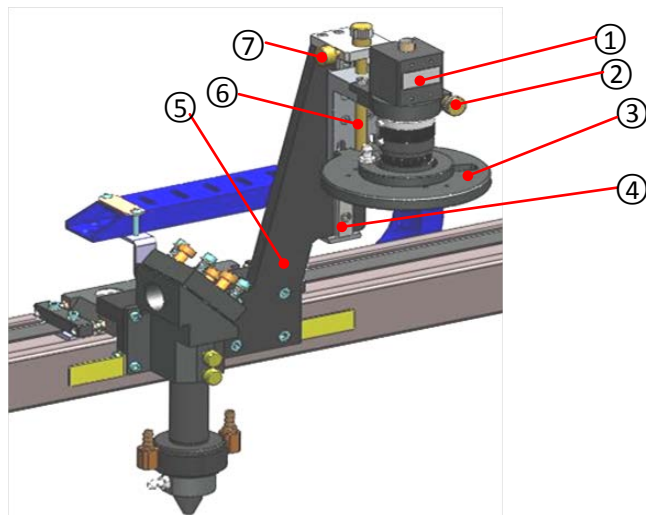


- |  |  |
|--|--|
| ① Right dolly head                     | ⑥ Right laser head (Slave laser head)  |
| ② X positive sensor block              | ⑦ X negative sensor block              |
| ③ Right laser head (Master laser head) | ⑧ Left dolly head                      |
| ④ Z positive sensor block              | ⑨ Z-axis motor (Left dolly head motor) |
| ⑤ Z-axis sensor                        |  |

Fig.1-10 Electric dual-laser head mechanism

## 1.2.5 Machine visual mechanism

Some types of machine are with machine visual function (e.g. CMA1610V). The structure of the visual mechanism is as shown in the figure below:



- |                                     |                                 |
|-------------------------------------|---------------------------------|
| ① Industrial camera (lens included) | ⑤ Installation connecting board |
| ② Camera fixation screw             | ⑥ Lift bolt                     |
| ③ LED light source                  | ⑦ Lift lockup bolt              |
| ④ Lift guide rail                   |                                 |

Fig.1-11 Machine visual mechanism

## 1.2.6 Brush-pencil mechanism

Some types of machine are with brush-pencil function (e.g. CMA1610ETP). The brush-pencil mechanism is as shown in the figure below:

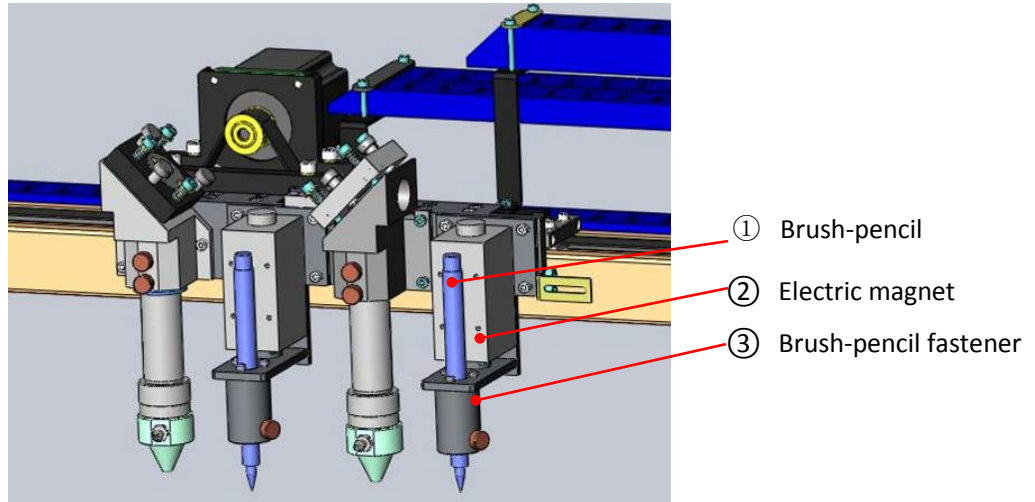


Fig.1-12 Brush-pencil mechanism

## 1.2.7 Mesh belt feeder type

Some types of machine are with mesh belt feeder function (e.g. CMA1810F). The feeder model is as shown in the figure below:



Fig.1-13 Mesh belt automatic feeder type

## 1.2.8 Exchange working table type

Some types of machine are with exchange working table structure (e.g. CMA1200H) as shown in the figure below:

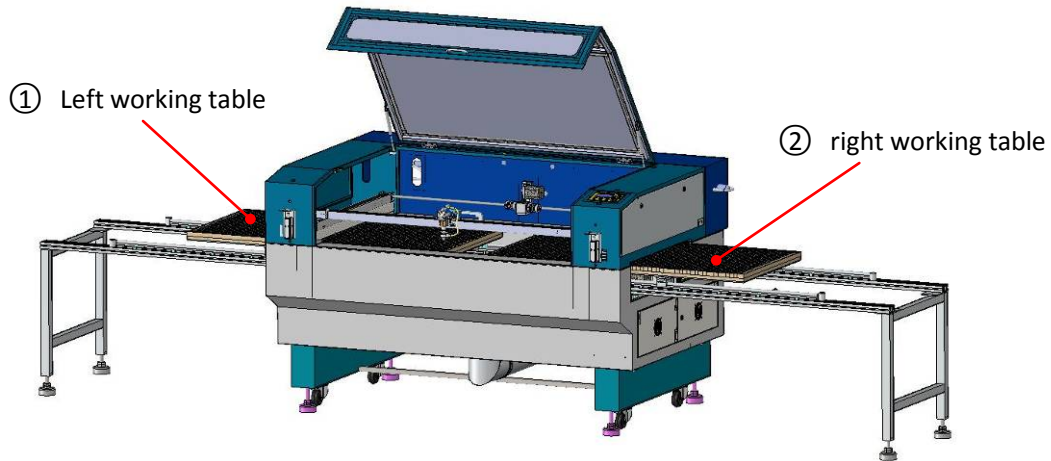


Fig.1-14 Exchange working table type

## 1.2.9 Working platform

Working platforms of CMA and PN series laser machine are mainly beehive soleplate or strip soleplate. Some types of machine with higher requirements for absorption are equipped with vacuum absorption platform. Beehive soleplate is mainly used for placing soft materials like cloth or leather, while strip soleplate is mainly for hard materials like organic glass or thick plank.

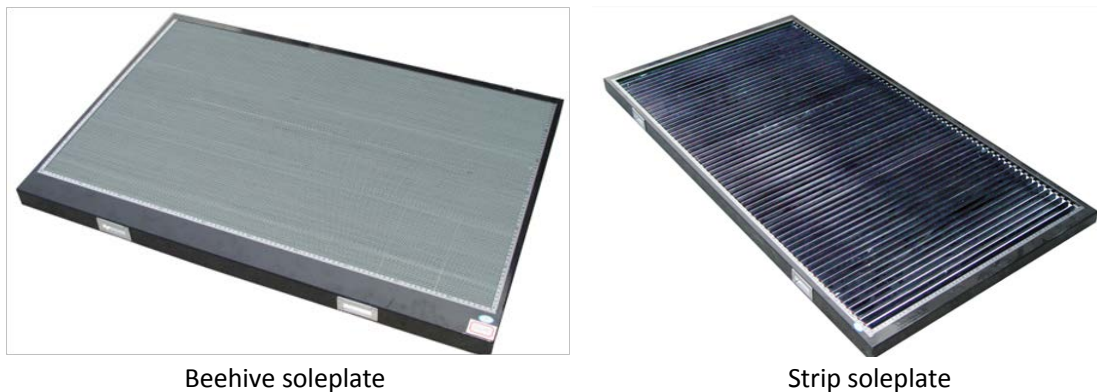


Fig.1-15

## 1.2.10 Auxiliary parts:

To ensure normal operation, the laser machine needs also some auxiliary parts like blower, air pump and water tank. Different types of machine are with different auxiliary parts, and those are subject to the actual machine.



- Laser power: Rated power of the laser machine;
- Power supply: the master imputer power supply of the machine. They are generally AC220V. However, the exported types differ from each other due to the countries exported to;
- Total power: the rated power during working;
- Series No.: the unique number of each machine;
- Manufacture Date: the date on which the machine is produced;

In addition, each device is attached with an independent ex-factory parameter list usually stuck on the inner part of right end cover of the machine. The parameter lists are different from each other due to the differences of type of machine and configured controller. The following is a parameter list for CMA1610EFT:


Type III machine ex-factory parameter list								
Item	√A axis		√Z axis		√Y axis		√X axis	
Pulse/mm	55.8		83.1		198.98		158.82	
Max. stroke (mm)	/		1465		1000		1600	
Control method	P+D		P+D		P+D		P+D	
Max. speed (mm/s)	200		300		300		400	
Max. acceleration (mm/s <sup>2</sup> )	3000		5000		5000		16000	
Reset direction	/		+		-		+	
Zero (limit) level (Note 1)	Alorism numerical value (196)							
	-	+	-	+	-	+	-	+
	1	1	0	0	0	1	0	0
	<input type="checkbox"/> Laser head 1 <input type="checkbox"/> PWM <input type="checkbox"/> Frequency    √Analog				<input type="checkbox"/> Laser head 2 <input type="checkbox"/> PWM <input type="checkbox"/> Frequency √Analog			
Energy regulation method	√Dynamic energy <input type="checkbox"/> Constant Energy				√Dynamic energy <input type="checkbox"/> Constant Energy			
PWM frequency (Hz) (Note 2)	/				/			
Pre-voltage (V) (Note 2)	1.0				1.0			
Focus (mm)	63.5				63.5			
Space between two laser heads (mm)	135							
Note 1: level trigger signal; high level trigger is 0, low level trigger is 1, and suspension is 1; Note 2: when power control signal is PWM, PWM power setting is required; when control signal is analog, pre-voltage setting is required.								

Table 1-1 Ex-factory parameters of No.3 controller

The above is a parameter list of No.3 controller, and the followings are an introduction to the parameters:

- Pulse equivalent: Pulse required for each 1mm forward of the movement shaft. Correctness of movement length is depended on this parameter;
- Max. stroke: The maximum stroke of each movement shaft of the machine;

- Control method: Control methods differ from each other due to different motors configured, and general method is pulse + direction mode (P+D);
- Max. speed: The maximum movement speed of each movement shaft. Speed beyond this value may possibly cause failure of motion to the machine;
- Max. acceleration: The maximum acceleration of each movement shaft. Acceleration beyond this value may possibly cause failure of motion to the machine;
- Reset direct: Reset direction of the machine. Aero position may differ due to different machine;
- Zero (limit) level: Trigger level of sensor differs due to different types of machine and configurations. Setting based on actual need is required;
- Power control signal: Power control method of laser device including PWM, frequency and analog;
- Energy regulating method: Energy regulating method during cutting and processing including dynamic energy and constant energy;
- PWM frequency: When the configured laser device is a metal radio frequency tube, this parameter is required to be set;
- Pre-voltage: When the configured laser device is a glass tube, and laser power control signal is an analog, this parameter is required to be set;
- Focus: Set it according to model of focus lens configured on the machine, and it indicates focus of the focus lens;
- Space between two laser heads: Electric dual-laser head machine is required to set this parameter, and it indicates the minimum space between the two laser heads;

 Tips	Please refer to User Manual for 3rd Control System for more details.
---	--

## 1.4 System configuration

Component	Parts	Type	Manufacturer	Note
Movement system	Motor	Step, servo	China-made or imported	Optional
	Transmission mechanism	Timing belt, ball screw	China-made or imported	Optional
	Guide rail	Inner rail, linear guide rail	China-made or imported	
Optical system	Reflector	Molybdenum reflector	China-made or imported	Optional
	Focus lens	75、63.5、50.8	China-made or imported	Optional
Pneumatic system	Exhaust blower	350W、550W	China	Optional
	Air blower pump	Large, medium,	China	Optional

		small		
Cooling system	Water tank +water pump	Water tank, industrial water chiller	China	Optional
Control system	Controller	No. I, II, III, IV controller	Our company	Optional
	Control software	SmartCarve series	Our company	
Dust disposal	Dust and smoke collector		China	Optional

Table 1-2: System configuration list

## 1.5 Operating environment

- Humidity: 5%~95% (no dew)
- Temperature: 5°C-40°C
- Power supply: AC220V;50/60Hz
- Earthing: Grounding resistance should be less than 5Ω
- Environment of the machine should be dry, and free of interference like dust, pollution, vibration, high power and strong magnetic field;
- Air pressure: 86-106kpa
- Working table load capacity: 50Kg/m<sup>2</sup>

## 1.6 Suitable materials

CMA and PN series machine are suitable for the materials with good absorption of CO2 laser, e.g. non-metal material like cloth, leather, organic glass, wooden product, plastic, rubber ceramic tile, crystal, boulder, and bamboo product.

## 1.7 Applicable fields

CMA and PN series machine are applicable for professional users with high requirements for carving and cutting effect in the industry of garment, leather, cloth toy, computerized embroidery, electronics and electrics, model, craft, advertisement decoration, building decoration, package printing, and paper product.

## Chapter 2 Safety Rules

This chapter mainly introduces safety warnings for protecting personnel and the machine. The machine is already equipped with sufficient safety guarantee, yet it is still with certain risk. All the operators are required to carefully read through and well understand the safety rules.

### 2.1 Product safety

The following conditions are required to be satisfied to ensure safe work:

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

### 2.2 Safe equipment

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

### 2.3 Safety awareness

The machine can be operated only by skilled personnel or under supervision of them. Improper use or operation may possibly be very dangerous and cause damage to the machine. Therefore, the followings are strictly prohibited:

- Placing heavy objects or stepping on the working table of the machine;
- Used for processing the materials unapproved by manufacturer;
- Staying of unauthorized personnel in the dangerous area (It is the responsibility of operators to ensure keeping unauthorized personnel away from the working area.);
- Block of using emergency stop button (Regular check is required to ensure a good condition for the emergency stop button.);



## 2.4 Requirements for personnel

After trial operation, maintenance personnel from the manufacturer may perform training on the operators;

It is the responsibility of machine owner to have operators trained at corresponding level;

We have prepared ready a series of training course for your option. Please make phone call to our **Customer Training Center** for details.

### 2.4.1 Definition of terms

All the personnel using or operating the machine are called **User** in the manual;

Different requirements are for different users. Users are classified into the followings:

- Owner

Owner means the authorized person or representative to sign contract with the manufacturer. With authorization, the owner has rights to sign the agreement with binding force of law;

- Operator

Operator means the personnel trained for operating the machine. Training of the operator includes participation of training held by the manufacturer.

- Maintenance personnel

Maintenance personnel mean the technicians having received formal training for machine and electric engineering. The maintenance personnel are responsible for daily maintenance of the machine, and repair at low level if needed. Training on the maintenance personnel contains participation training held by manufacturer.

### 2.4.2 Qualifications

The operator is required to accept guidance and training of the owner, and the operator is responsible for the safety of a third party in the working area; the personnel required for further training and guidance are required work or operate the machine under supervision of the operators.

### 2.4.3 Responsibility

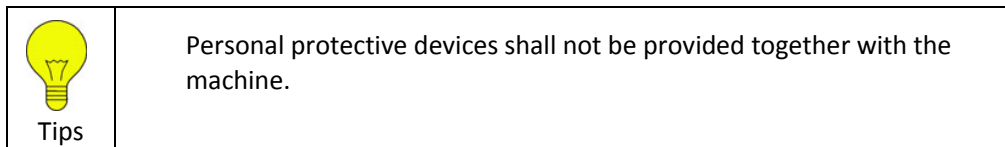
It is a must to clarify the related responsibilities of each performance (operation, maintenance, parameter setting), and carry it out. Unclassified responsibilities will cause safety hidden risks.

Owner is required to provide operation manual for the operators and maintenance personnel, and ensure that they have read and understood the operation manual.

## 2.4.4 Personal protective devices

When technology or measures fail to absolutely avoid risk of health, the owner is required to provide personal protective devices for operator and maintenance personnel. For example,

- Boot with steel cover
- Protective gloves
- Laser-proof goggle
- Light respirator



## 2.5 Special product risks

### 2.5.1 Laser radiation risk

Based on level of potential risk of laser radiation, the national standard GB 7247.1-2001 makes classification for them. Laser class applicable for this laser cutting machine depends on operation mode. The followings are abstract of laser device classification prescribed by the state:

Class 1: safe laser device under reasonable and foreseeable working conditions

Class 2: laser device emitting visible light at wave length of 400nm-700nm. Generally, avoidance response including blink reflection provides protection;


Class 3A: safe laser light visible to naked eyes. Generally, avoidance response including blink reflection provides protection. Harm to naked eyes of other wave lengths will be less Class 1 laser device. Class 3A light beam internal observation with optical device (e.g. glasses, telescope, microscope) may be dangerous.

Class 3B: dangerous laser device is to directly and internally see light beam. Generally, observation of diffuse reflection is safe.

Class 4: laser device with diffuse reflection causes danger. They may possibly cause skin burn, or fire accident. Great care is required to use this kind of laser device.


#### 2.5.1.1 Common mode

In the normal operating mode, the laser cutting machine equals to Class 1 laser radiation. In this operating mode, there will no harm of laser radiation to eyes and skin; however, you are recommended to wear goggles with antiglare filter in case of long-term exposure to cutting light beam.

 Tips	<ul style="list-style-type: none"> <li>● It is a must to ensure normal operating mode;</li> <li>● Correct installation of all protective covers;</li> <li>● Keep upper cover of crossbeam closed;</li> <li>● Correct operation of the laser cutting machine;</li> <li>● Materials to be processed have been verified suitable for CO<sub>2</sub> laser processing</li> </ul>
---	--

### 2.5.1.2 Maintenance mode

In case of having opened the safety cover (e.g. door) or having removed (e.g. crossbeam cover) or short connected of the crossbeam protective cover and crossbeam organic glass cover opened, the laser cutting machine is in a maintenance mode, no matter the purpose of the operation is for checking work, cleaning or maintenance.

 Attention	<p>In maintenance mode, laser radiation is not entirely shielded. At this time, the laser cutting machine equals to Class laser device radiation. Direct laser beam and reflection radiation will cause unrecoverable harm or skin burn.</p> <ul style="list-style-type: none"> <li>● The operation at this time can only be performed by trained and qualified maintenance personnel;</li> <li>● All the unauthorized and unqualified personnel are prohibited to come into the dangerous area;</li> <li>● Cover or remove the reflective objects;</li> <li>● Remove the flammable materials;</li> <li>● Avoid generation of explosive solvent gas;</li> <li>● Wear laser-proof glasses</li> </ul>
---	---

### 2.5.1.3 Direct laser

You are required to pay attention to the followings while operating the laser machine:


- It is strictly prohibited to directly expose any parts of human body, explosive object and flammable objects to direct laser;
- Modification of fasteners on the optical parts is strictly prohibited;
- Unauthorized change of light route is strictly prohibited;
- Abide by all instructions prescribed in the operation manual.


### 2.5.1.4 Reflection and diffuse radiation

Avoid exposing eyes and skin to mirror reflection and diffuse radiation. In the maintenance mode, the maintenance personnel are required to wear laser-proof glasses, and the laser-proof glasses should satisfy the requirements as per **EU standard EN207A1:2002**.




Fig.2-1 Picture of laser-proof glasses

 Tips	Wavelength of CO2 laser device of this class is 10.6 micron and light density is 4+; You are recommended to use SD-5 type of protective glasses made by Shield Company.
---	---


 Attention	<ul style="list-style-type: none"> <li>● You are prohibited to directly watch strong light and laser even with laser-proof glasses on;</li> <li>● Laser-proof glasses are made from high polymer material, and dipping into organic solvent or cleaning with it are prohibited;</li> <li>● It is a must to replace the laser-proof glasses at the expiration.</li> </ul>
--	--

## 2.5.2 High voltage risk

Laser module (laser power supply and its high voltage line) will generate high voltage at 15,000V. There is the risk of electric shock.

 Attention	High voltage 15,000V! The voltage over 50V and the current over 20mA are with the risk of danger and may cause death. Only the maintenance personnel from the manufacturer are permitted to perform operation on the inner parts.
--	--

## 2.5.3 Risk of electric shock

 Attention	While operating electric machine or device, mis-operation or neglect during operation may possibly cause serious hurt or human body or even death; Technicians with related qualifications are required for operating the electric machine or device or perform operation under their supervision.
--	--

The followings are required for operating of installing the electric machine:

- It is a must to use the specified fuse provided by the manufacture;
- Immediate disconnection of power supply is required in case of power failure;

- Unless otherwise prescribed, power disconnection of the electric part is required for maintenance;
- First check if there is live power on the insulated part, and then perform the treatment of earthing and open circuit, and perform insulation for the nearby live (charge) parts;
- Make regular check on the electric equipment. Timely correct failure like poor contact or burnt power cord;
- While operating live (charge) parts, minimum two persons are required at the site for pressing the emergency stop button or disconnecting power supply if necessary; Mark the working area with red-and-white band and warning sign;
- It is a must to use insulation tools.

## 2.5.4 Hazard of processing outgrowth

During laser processing, outgrowth may possibly generated, and their hazard must satisfy the requirements specified in Appendix A for example of processing outgrowth as national standard GB 18490-2001 laser processing machine. The abstract is as below:

◇ ceramic processing

Al<sub>2</sub>O<sub>3</sub>, Mg, oxide of Ca and Si; BeO (virulent poison);

◇ silicon slice processing

Crumb of silicon and silicon monoxide suspended in the air (possibly breathed into lungs causing silicosis);

◇ metal processing

In a view of iatrolgy, minimum the following metals and their compounds are influential: Mn, Ni, Co, Al, Zn, Cu, Be, Pb, Sb

Medical influences are as below:

Toxic	Cr <sup>6+</sup> , Mn, Co
Allergic reaction, burn caused by metal smoke	Zn, Cu
Lung fibrosis	Be
Carcinogenesis	Cr <sup>6+</sup> , NiO

Metal beryllium is very dangerous, especially cutting alloy or metal containing Zn in open air will generate heavy metal smoke.

◇ Plastic cutting

When cutting plastics, various kinds of substances with potential risks may be generated. At lower temperature, aliphatic hydrocarbon is produced; at higher temperature, aromatic hydrocarbon (e.g. benzene PAH) and polyhalo-polynuclear hydrocarbon (e.g. dioxin, furan) are increased. Some of these substances may possibly generate cyanide, isocyanate (PU), acrylate (PMMA) and hydrogen chloride (PVC).


Medical influences include:


- Toxic: Cyanide, CO, derivative of benzene
- Allergy source/irritation: isocyanate, acrylate
- Respiratorytract irritation: formaldehyde, acradehyde, amine;
- Carcinogenesis: benzene, some PAH substances
- ◇ Surface modification

Generally, there is no noticeable outgrowth, but sometimes heavy metal steam is generated.

- ◇ Cutting paper and wood

General fibrin outgrowth, ester, acid ethanol, benzene

 Attention	<ul style="list-style-type: none"> <li>● During laser cutting, the smoke generated may be very toxic. The smoke is removed by upper exhaust blower system;</li> <li>● Cutting with abnormal blower system is prohibited.</li> </ul>
--	---

 Tips	<ul style="list-style-type: none"> <li>● Make frequent check on the ventilation system;</li> <li>● Make regular cleaning and maintenance for the ventilation system;</li> <li>● Foreign matter coming into duct of the ventilation system is strictly prohibited;</li> <li>● Ensure a good ventilation and a through removal of exhaust air in the working room;</li> <li>● Ensure a necessary disposal of the exhaust air to satisfy emission requirements prescribed by the state and local government</li> </ul>
---	---


## 2.5.5 Risk of optical system

### 2.5.5.1 Routine operation

The reflector of the optical system is the gold plating silicon reflector, and the focus of the cutting head is made from zinc selenide. In normal condition, these optical parts are free of danger.


However, polluted focus or focus with damaged coating will cause thermal decomposition by laser beam over 400°C together with toxic smoke generated. At this time, the laser device must be powered off, mechanical movement and blowing air to the lens must be stopped. At this moment, cleaning and parts replacement should be performed.

When gold plating silicon reflector is decomposed by high temperature laser beam due to pollution or damaged coating, the decomposition will generate dust and smoke containing silicone monoxide, steam of heavy metal. At this time, it is a must to power the laser device off, stop running the machine and keep good ventilation. When all the smoke and dust are removed, it is to perform cleaning and replacement of lens.

 Tips	<p>During cleaning, please wear on goggle and gloves. The damaged parts must be sealed in a container and properly packaged, and then returned to the manufacturer.</p> <p>Good ventilation is required in case of any damage of the parts.</p>
---	---

### 2.5.5.2 Warning for fire accident

Damaged machine or improper operation of the machine will cause risk of fire accident. Fire extinguisher must be equipped according to fire control regulations prescribed by the state.

 Attention	Atomizer or flammable or explosive substances are strictly prohibited to approach the machine, make regular check on the fire extinguishers to ensure a good condition.
--	---

### 2.5.6 Other risks

To ensure safety, modification or changing use of the machine with no consent from the manufacturer is strictly prohibited; any change of operating software or function to the machine is strictly prohibited, or it is strictly prohibited to perform integration of the machine with other system.

### 2.5.7 Measures for emergency

#### 2.5.7.1 Measures for personal injury

In case of personal injury, the followings should be performed:

- Stop hurting (e.g. stop the machine, disconnect the power supply)
- It is a must to take first aid measures;
- Notify professional medical personnel;
- Notify the competent management department;
- Abide by the related regulations prescribed by the state and the company

#### 2.5.7.2 Measures for fire accident

In case of fire accident, the following measures should taken:

- Emergency stop of the machine, disconnection of power supply;
- Control of fire with the fire extinguisher, evacuation of personnel;
- Notify the competent management department;
- Abide by the related regulations prescribed by the state and the company

# Chapter 3 Machine Installation and Debugging

## 3.1 Machine Installation

### 3.1.1 Steps of unpacking

Before installation, unpacking the wooden box for the machine from our company is needed in the following steps:

- 1. Remove the upper cover of the wooden box with a crowbar (prepared by user);



Fig.3-1

- 2. Remove the left, right, front and back wood plank respectively with the crowbar;

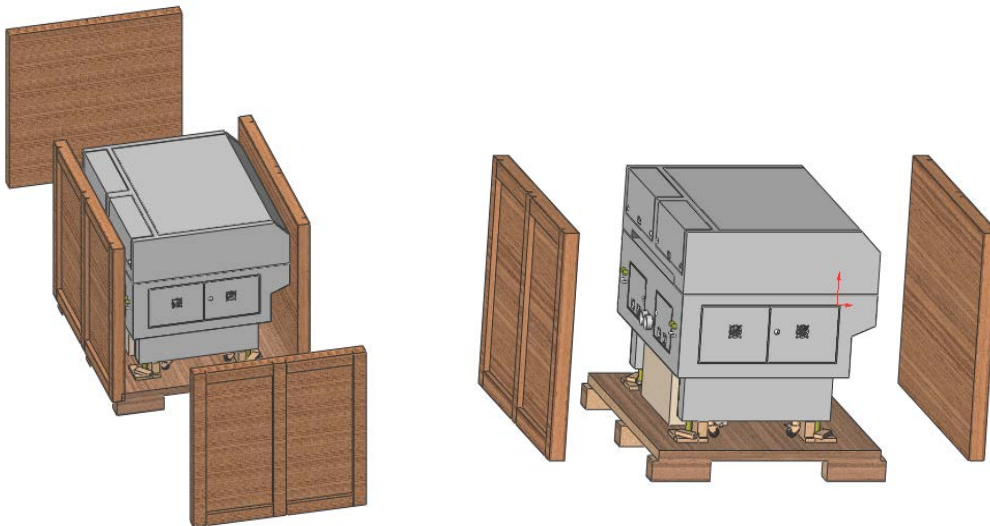


Fig.3-2



- 3. Take out accessory box under the machine;

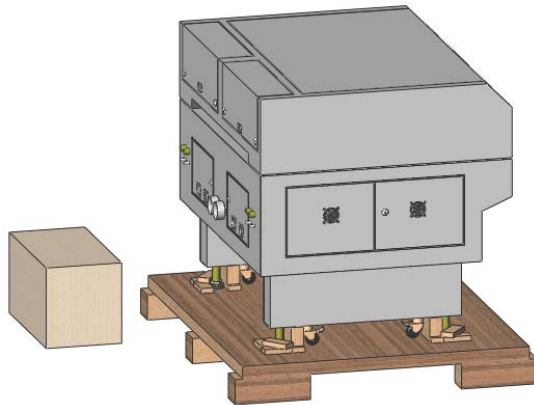


Fig.3-3

- 4. Remove the plank for fixing foot caster with the crowbar;

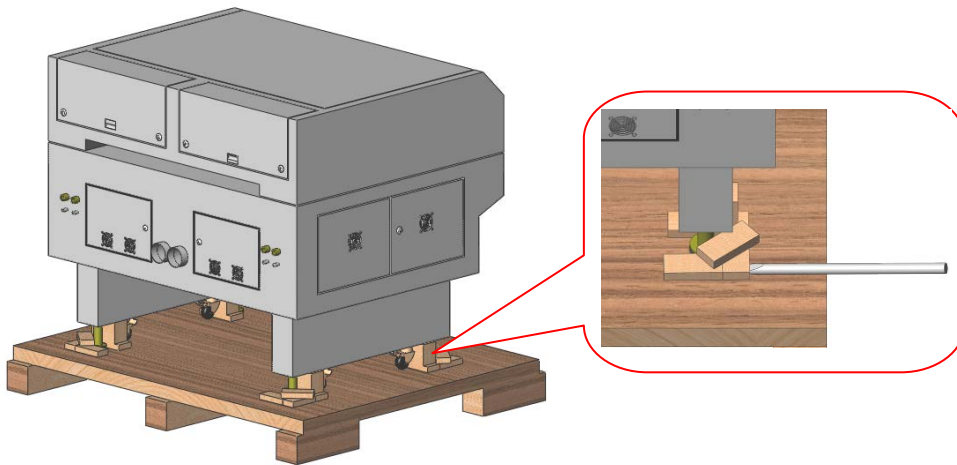


Fig.3-4

- 5. Unfasten the screw on upper part of the foot caster with a wrench and lift the foot caster to keep a distance to the pallet larger than to the multi-direction foot wheel;

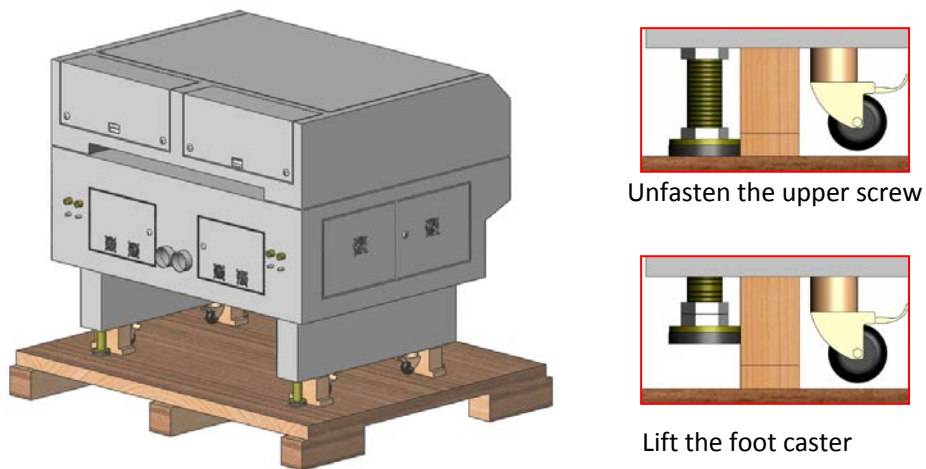


Fig.3-5

- 6. Lift the machine from the pallet with forklift and move the destination;

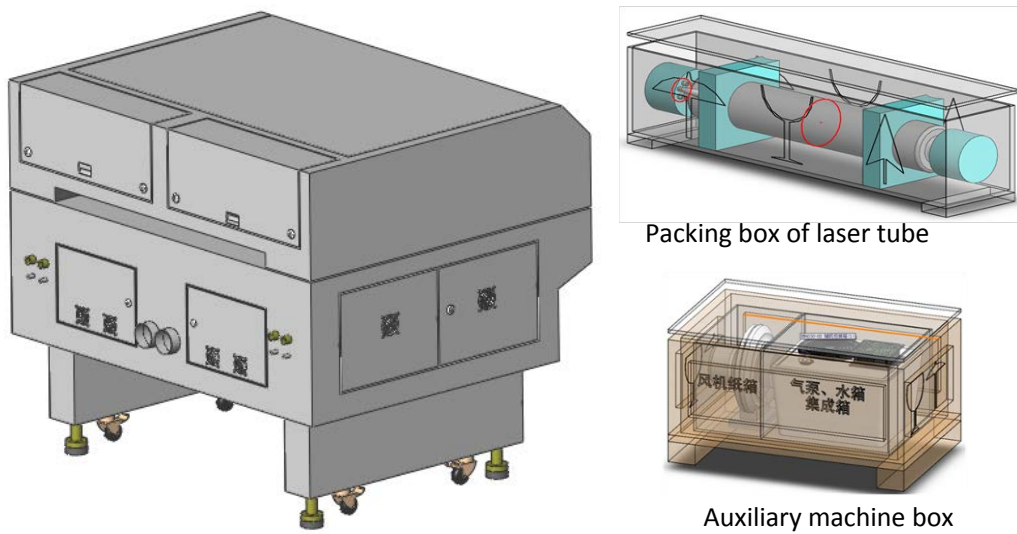


Fig.3-6

### 3.1.2 Unpacking check

Check on the machine and auxiliary parts after unpacking is required to ensure them free of failure caused during transportation. Items to check are as below:


- ◆ Check on machine model  
Please make sure that machine model is just what purchase.
- ◆ Check in machine appearance  
Please make sure that the machine is free of scratch, damage, distortion and corrosion by appearance.


- ◆ Check on machine case

Remove the upper, left and right cover to make sure that the machine is free of parts or cable caused by poor contact or internal damage.

- ◆ Check on machine parts and auxiliary parts

Open the auxiliary case and laser tube packing box to verify parts following the packing list and check if there is damaged accessory or accessory with distortion.

 Attention	Unauthorized unpacking is prohibited. If unpacking by user is needed, prior consent from our after-sales personnel or salesman is required. Otherwise, our company shall not be liable for any accidents caused.
--	---

 Attention	In case of the problems above found after unpacking, please timely notify our after-sales personnel or salesman, or directly contact our company. Unauthorized disposal is prohibited.
--	---

### 3.1.3 Preparations for machine installation

Preparations for installation are as below:

- ◆ Installation site

There are requirements for site and working environment to the laser machine. Please make sure if the site satisfies the related requirements from our company as specified in Section 1.5;

- ◆ Personnel


Our company requests that the personnel for installation are professional customer service personnel from our company. If installation by customer is needed, the installation personnel are required to have received all trainings held by our company and grasped the related key points relating to the installation of our laser machine.

- ◆ Tools

The related tools for installation are attached to the machine. In addition, users should prepare some installation and testing tools if necessary, e.g. screwdriver, multimeter, etc.

- ◆ Others

Water, electricity, exhaust air channels, sample material, computer and power socket relating to the machine should be prepared ready in advance by users.

 Attention	During installation by our customer service personnel, the customer is required to participate from the beginning to the end. Machine installation and debugging are parts of training, and the customers are required to learn them well.
--	--

### 3.1.4 Steps of installation

#### 3.1.4.1 Laser tube installation

- The laser tube is mounted on the back of the machine. After removing the protective cover of the laser tube, you will find two laser tube brackets and two open cover protective inducers (each four for the dual-laser head type). As shown in the figure below:

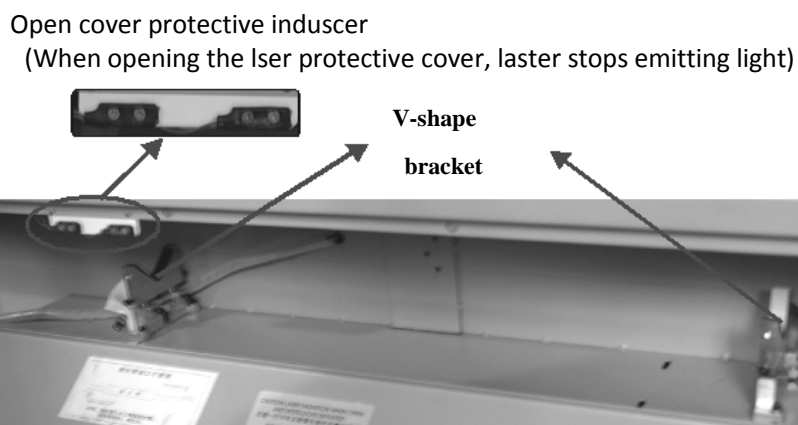


Fig.3-7

- Firstly open the two brackets and carefully insert light outlet (negative end) of the laser tube toward reflector No. 1 into the V-shape bracket as shown in the figure below:

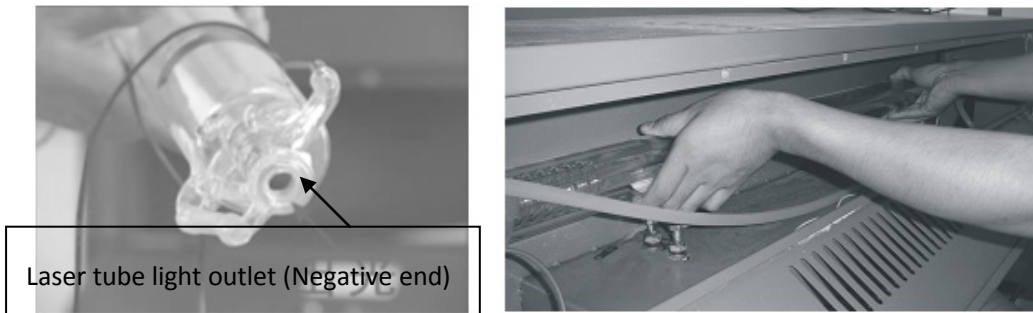


Fig.3-8

- Then, buckle the belt on the laser tube bracket and screw down to fix securely the laser tube as shown in the figure below:

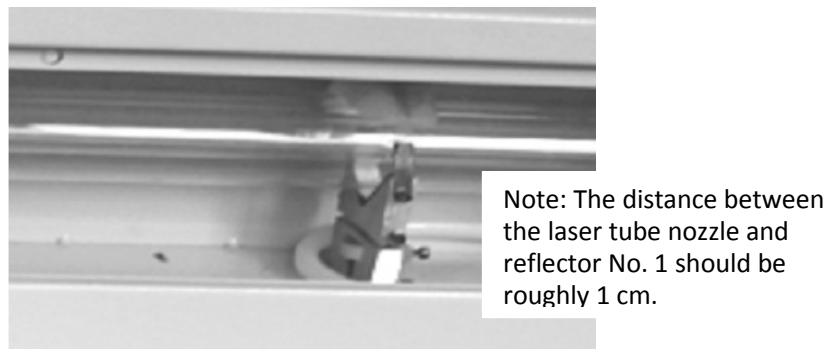



Fig.3-9

 <p>Attention</p>	<ul style="list-style-type: none"><li>● Fix the laser tube with proper force to avoid damage against it.</li><li>● It is a must to keep the water inlet (light outlet end) at lower part of the tube.</li></ul>
--	---

- After fixation of the laser tube, connect the water inlet end with water protection to water inlet at negative end of the laser tube, and connect another water inlet hose reliably to water outlet with high pressure as shown in the figure below:

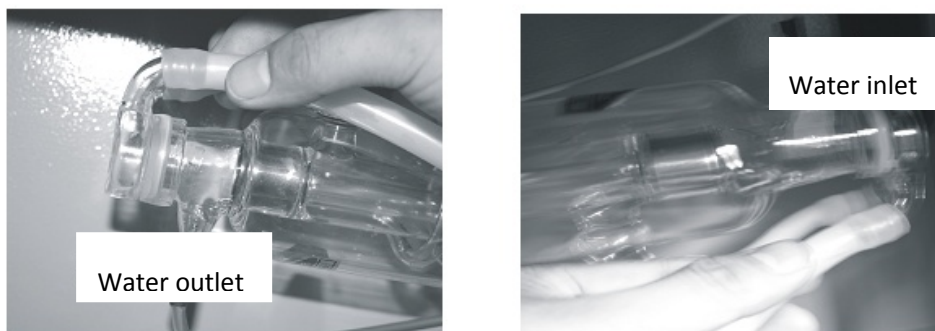



Fig.3-10

 Attention	<ul style="list-style-type: none"> <li>● Reliable connection of each water hose is required to avoid leakage;</li> <li>● Keep water hose in good order free of twist for smooth water flow.</li> </ul>
--	--

- Finally, pass the laser tube power cord through the hole in the case and pull it towards the laser power supply as shown in the figure below:

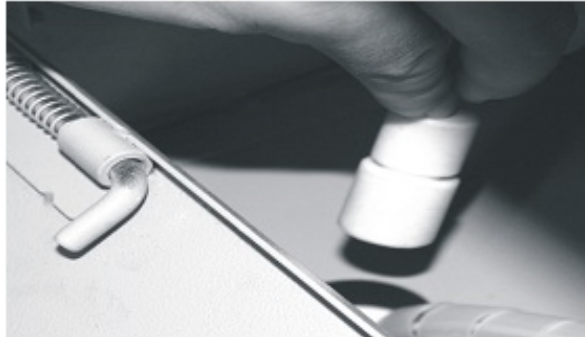


Fig.3-11

### 3.1.4.2 Laser power supply installation

The appearance of laser power supply is as shown in the figure below:

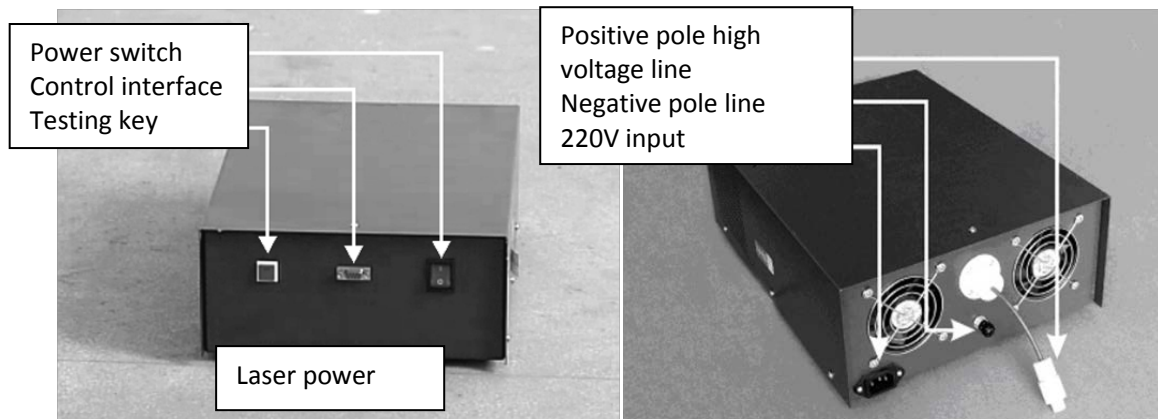


Fig.3-12 Laser power supply

- Put the laser power supply into the box (laser power supply box) at the back of the case. Firstly connect the positive pole line, unfasten white plastic screw cover of the laser tube positive pole line as shown in the figure below:

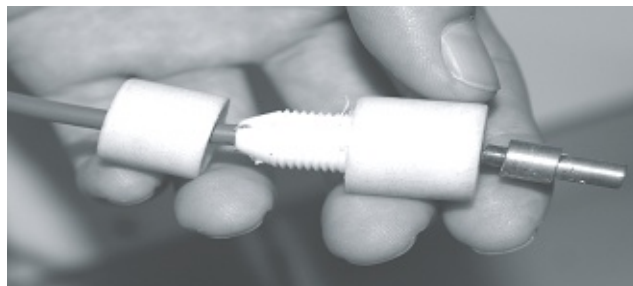


Fig.3-13

- Align the copper hole with positive copper post of the laser power supply, and then slowly screw down the white plastic screw cover as shown in the figure below:

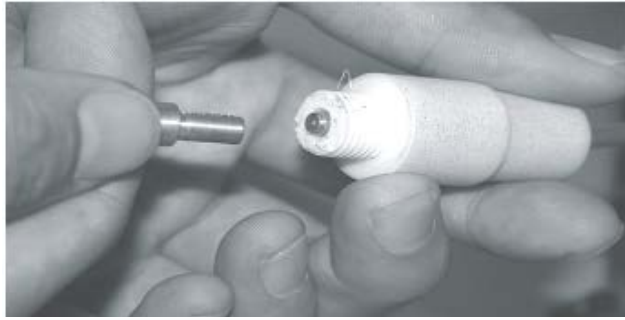


Fig.3-14

- And then securely connect the negative pole line to the negative pole end of the laser power supply and fix positive pole high voltage connector on to the insulation bracket as shown in the figure below:

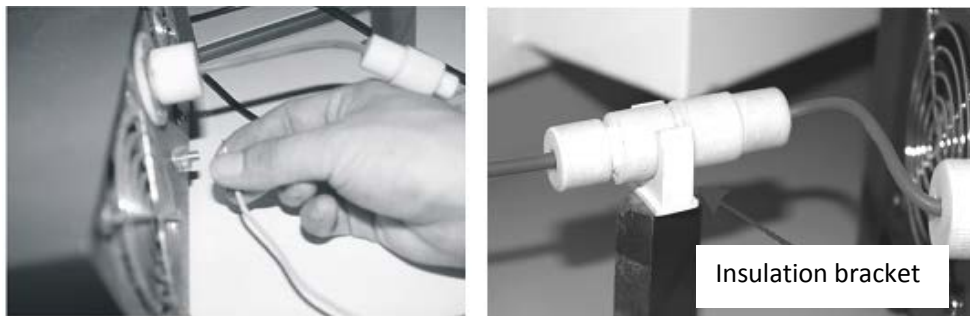




Fig.3-15

- Finally open the side door of the carving machine to pass the control line through the small hole in the working table, connect it to control interface of the laser power supply and securely fix it. Installation of laser power supply is then completed as shown in the figure below:



Fig.3-16

 <p>Attention</p>	<p>Red positive pole line and yellow-and-green negative pole line are a pair of high voltage line of the laser tube, and they with extremely high voltage (20,000V) and super strong static radiation. Reliable line insulation and isolation, as well as secure earthing of the machine, are required. Otherwise, sparkle and serious interference may possibly caused and influencing on the operation of the machine. Serious current leakage is dangerous to human body.</p>
--	--

 Attention	During operation of the machine and after power-off, please do not touch the high voltage line with hand. Otherwise, electric shock or even death may be caused.
--	--



### 3.1.4.3 Water cooling system installation

- Fill up water tank (or industrial water chiller) with purified water;
- Securely connect water pump and water outlet connector, insert water hose, and place it into the water tank;
- Pass the water hose connecting to the water pump through the small hole in the water tank cover and connect it to water inlet of the machine, and then connect another water hose to water outlet of the machine and place it into the water tank to complete water circulation piping connection as shown in the figure below:



Fig.3-17

- Connect through power supply. At this time, you will find that water is gradually filled up the laser tube, smooth water flow in the water outlet indicates normal operation of the water pump.

 Attention	To ensure normal circulation of cooling water in the laser tube, the water circulation system is equipped with a water protective inducer. In case of unsmooth water flow or abnormal operation of the water pump, the machine will automatically enter protective mode, and the laser tube will emit laser. Therefore, during daily maintenance, please keep the water pump and water hose clean.
 Attention	Water cooling laser tube is required to ensure a normal operation of water circulation. Otherwise, laser tube explosion may be caused.

### 3.1.4.4 Air pump installation

- Connect air outlet of the air pump (or air compressor) to air inlet of the machine with an air pipe, and connect through the power supply as shown in the figure below:

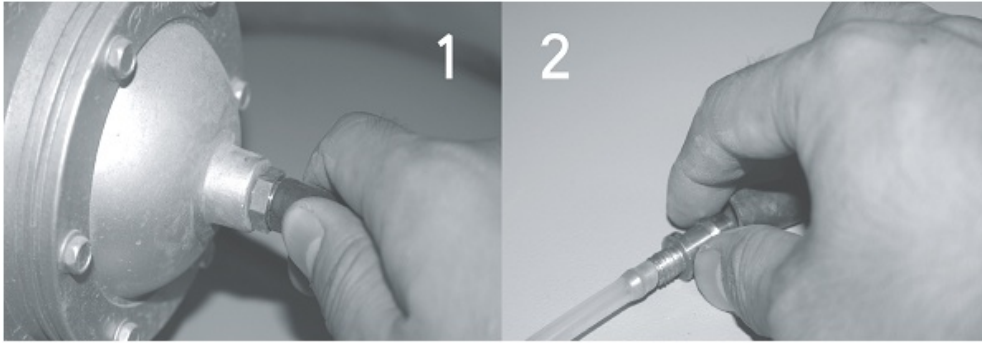


Fig.3-18

The air pump (or air compressor) is very important in the system. High pressure air is jetted out from light outlet in the laser head through air pipe. On one hand, this ensures focus lens clean. On the other hand, it plays the function to prevent from being burning of the material caused by laser. Therefore, during daily maintenance, users are recommended to keep the air pipe straight free of twist. Otherwise, abnormal blowing may cause burning of the materials.

### 3.1.4.5 Blower installation

- Firstly connect air inlet of the blower to dust inlet of the carving machine with an air pipe, and securely buckle it. Then, connect another air pipe with air outlet of the blower and stretch it outside the room, and finally reliably connect the power cord of the blower as shown in the figure below:



Fig.3-19

### 3.1.4.6 Machine earthing

Safe earthing is strictly required for power supply system of CMA and PN series laser machine. Power supply of users must satisfy safety regulations of the local government:

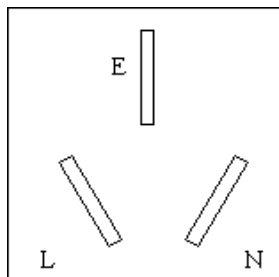



Fig.3-20



- L: Live line of 220V AC system. Safety electric switch is required for this line (The switch is required to be mounted on the live line.)
- N: It is popularly named as null line with the function of completing power supply together with the live line.
- E: Earthing line. All casings (earthing end) of electric parts are connected to this line to ensure safety. Earthing resistance should be less than  $5\Omega$ .

Users are required to consult professional electric equipment installer (electrician), and have the professional electric equipment installer check and determine if the earthing is reliable.

 Attention	Poor earthing may cause high rate of failure to the machine. In addition, safety accident may also be caused. Our company shall not be liable for the accidents and failure caused it.
--	--

If your power supply system is not with an earthing, it is a must for you to have professional electric equipment installer mount a safety earthing net in the following method:

- It is a must to use 2-4 pieces of  $4\times 35\times 1500\text{mm}$  angle iron hammered into any wet place surrounding the house as earthing. Distance between each two angle iron is 1m. And then use a  $3\times 30\text{mm}$  flat plate leads each angle iron out from earth surface to form a good earthing net.
- After completing the earthing net, measure earthing resistance with an apparatus, the standard value is 3-5 ohm.
- After measuring the resistance, connect one end of the  $\text{RVV}2.5\text{mm}^2$  copper core cable to the eduction of the earthing net, one end is connected to the earthing of the carving machine and earthing hole of the socket as shown in the figure below:

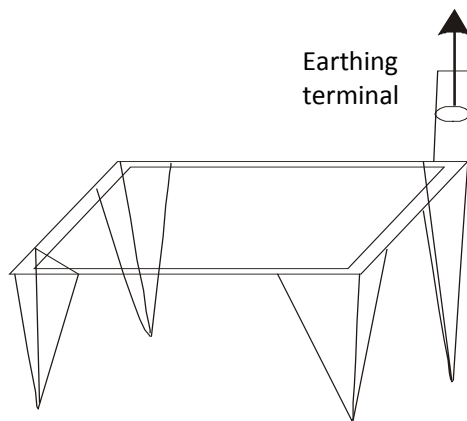


Fig.3-21

### 3.1.4.7 Removal of fixation block

At-ex-factory, to avoid unexpected impact during transportation, the machine is equipped with fixation block on XY movement mechanism. During installation, they should be removed. Removal of the fixation block is as shown in the figure below:

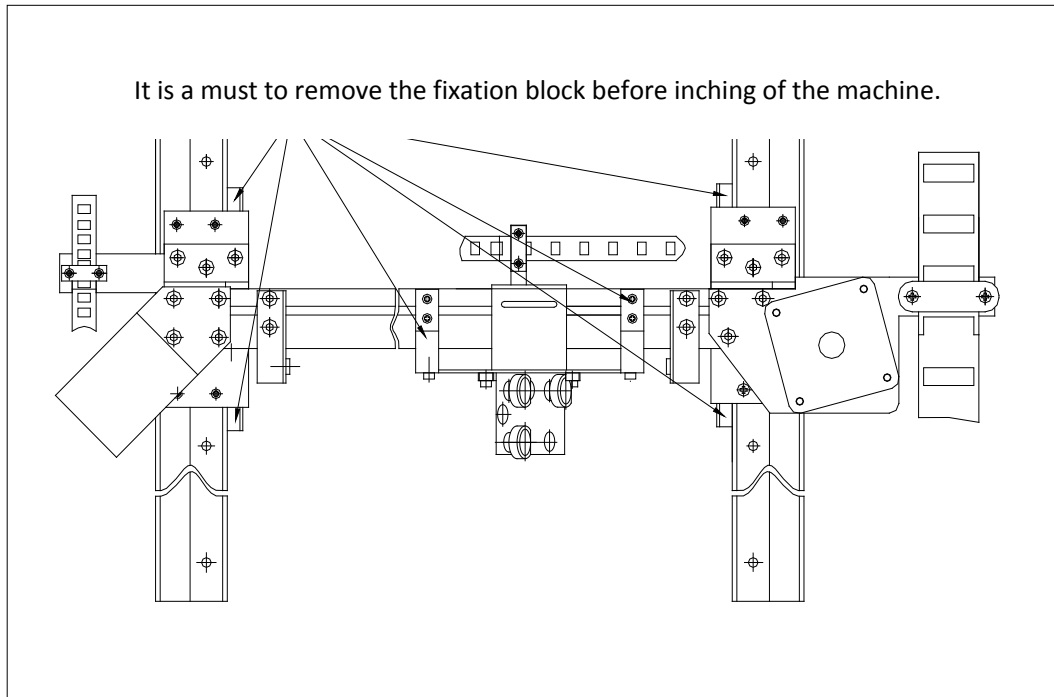
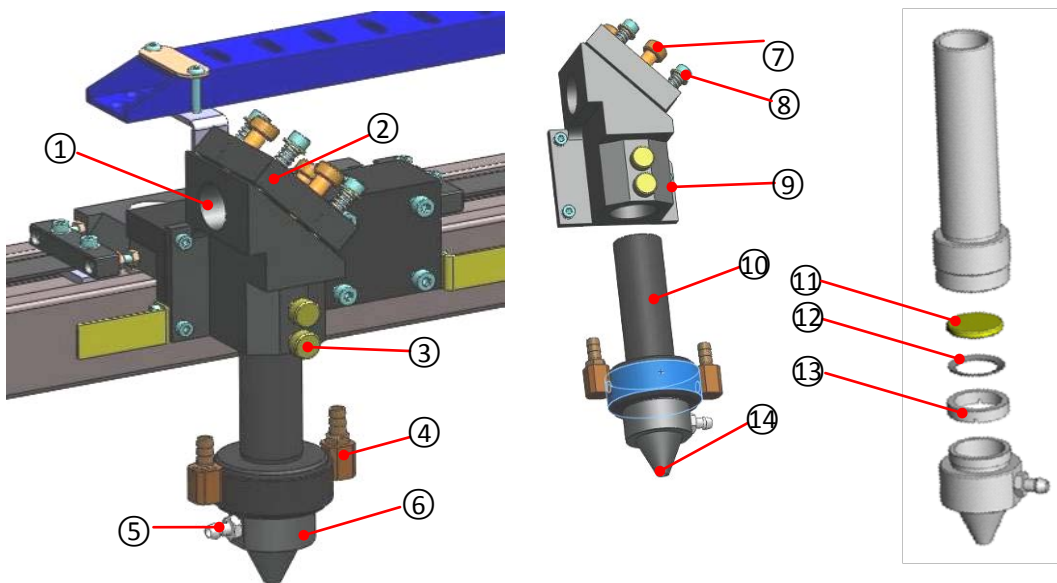


Fig.3-22

### 3.1.4.8 Cutting head installation


At ex-factory, to ensure safety and prevent the laser head from being polluted during transportation, the cutting head (focus canister) of some types of machine are individually packaged and kept. During installation of the machine, they should be replaced back.




- |                                 |                                   |
|---------------------------------|-----------------------------------|
| ① Light inlet                   | ⑧ Lens fastening bolt             |
| ② Base of reflector No. 3       | ⑨ Fixation base of focus canister |
| ③ Lockup for some types machine | ⑩ Focus canister                  |
| ④ Water circulation joint       | ⑪ Lens fastening cushion          |
| ⑤ Blower pipe joint             | ⑫ Lens fastening cushion          |
| ⑥ Air jet ring                  | ⑬ Lens fastening screw            |
| ⑦ Light route adjusting bolt    | ⑭ Light outlet                    |

Fig.3-23

- Firstly install the focus canister. Unfasten the lockup bolt of the focus canister as shown in the figure above, insert the focus canister into the base, adjust to a proper height (depend on the focus), and then it will be OK to screw down the bolt.
- And then connect the air pipe. Focus equipped on some types of machine with larger power is with water circulation cooling joint, and it should also be connected.
- If height of the cutting head is needed to adjust in the future, it is only to unfasten the lockup bolt of the focus canister for manually adjusting the height.

 Attention	Do not adjust height of the cutting head during processing (during light emitting) to avoid burn to human body. The height from the cutting head to surface of work piece is a fixed value. The value differs due to different focuses configured.
--	---


 Tips	One triangular rule is attached to the machine for providing convenience to users to measure and adjust height of the cutting head.
---	---

### 3.1.4.9 Software and machine drive installation

User need to prepare the computer required ready in advance. The operation system should be the version of Windows XP or above.

- For No.1 controller or No.1.1 controller, USB interface communication is applied and machine drive installation is needed. Drivers are attached to the CD. Refer to *User Manual of No. 1.1 Control System* for detailed installation steps.
- For No.3 controller, Ethernet interface is used for communication, and it does not need to install the machine drive. However, setting the computer and IP of the machine to the same gateway is needed. Refer to *User Manual of No.3 Control System* for detailed use method.
- For No.4 controller, a computer will generally attached to the machine by our company. At ex-factory, the related drive and software, and system backup as well, are installed ready. In reinstallation is needed, the drivers are stored in backup partition or attached CD. Refer to *User Manual of No. 4 Control System* for detailed installation steps.
- For camera type of cutting machine (e.g. CMA1610A), besides installation of controller (No.4 controller) drive, installation of industrial camera drive is also needed. Refer to *User Manual of Machine Vision System* for more details of installation.
- No.1.1 controller, No.3 controller, No.4 controller and vision cutting machine use the software of version SmartCarve 4.2 from our company. Refer to *Software Manual for SmartCarve 4.2* for more details of installation of the software.

Refer to the owner's manual instructions to the related controller for installation and use of software or drive of other types of machine or controller.

 Attention	<p>Please properly keep the CD and software encoder encryption dog attached. In case of missing, please cont our company for purchasing.</p> <p>Reinstallation of the software may cause parameter loss of the system. Please perform backup of the related parameters before reinstalling the software or system.</p>
--	--

### 3.1.4.10 Other auxiliary part installation

Some types of machine are attached with other auxiliary parts (e.g. foot switch) as per request from customers, and these parts should be installed by our customer service personnel. Moreover, users shall install scanner, printer and other machine prepared by themselves.

## 3.2 Machine debugging

After completing installation, machine debugging and processing test are needed. The machine debugging is mainly to complete status test of each nodule if the machine including movement module, laser module and electric IO module.

### 3.2.1 Sequence of power-on and power-off


There is an instruction of sequence of power-on and power-off stuck on the master power switch.

- Sequence of power-in:

Master power supply of the machine→Water chilling system→Laser power supply→Computer→Other auxiliary parts

- Power-off is in the reverse sequence as:

Other auxiliary parts→Computer→Laser power supply→Water chilling system→Master power supply of the machine

 Attention	Users should operate following the requirements as per power-in and power-off sequence. Otherwise, failure may be caused to the machine.
--	--

### 3.2.2 Movement debugging

Movement debugging is mainly to check if movement status of each movement shaft is normal. At ex-factory, movement debugging has been performed. In case of no accident occurred during transportation and installation, there will be no any problems with the machine. The followings are instructions for motor shaft movement, resolution setting, strike and limit configuration, test on straightness and perpendicularity.

#### 3.2.2.1 Motor shaft movement

After normal power-on of the machine, the No.1 controller and No.1.1 controller will automatically reset (if automatic reset is set on the No.3/4 controller, they will also reset after power-on.). After completing of reset, the system will enter s standby state.


In standby mode, it is to press the four directional keys (X+, X-, Y+, Y-) on the control panel for manually controlling movement of the laser head. If the four directional keys are normal in movement, it means X-axis and Y-axis motor are normal in movement. Please refer to the operation instructions of the related control system for movement testing. In case of failure found with the motor shaft movement, please contact customer service personnel from our company for a solution.

The following is an illustration of control panel of No.3 and No.1.1 controller:



Fig.3-24 Illustration of control panel

(The left one is for No.3 controller and right one for No.1.1 controller)


 Tips	Please refer to operation instructions for control system of each mainboard for more details concerning the operation of the control panel.
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### 3.2.2.2 Resolution setup

Movement accuracy is decided by movement resolution, and the precision of movement as well.

For the No.1 controller and No.1.1 controller, unit of the resolution is micron ( $\mu\text{m}$ ) or dpi (legible points per inch in length). The control system takes pulse to indicate length. Physical length represented by each pulse is called as resolution, e.g. the resolution for a certain shaft is  $0.00625\mu\text{m}$  (4064dpi), meaning that as long as the control system sends one pulse, the shaft will go forward  $0.00625\mu\text{m}$ .

For No.3 and No.4 controller, in the setting of movement shaft parameters, “pulse equivalent” indicates resolution. Unit of pulse equivalent is pulse/mm, meaning that each millimeter forward of the shaft, the pulse required for the control system to send is just in reciprocal relation with “resolution”. For example, if resolution is  $0.00625\mu\text{m}$  (4064dpi), the result converted into pulse equivalent is:  $1/0.00625 = 160(\text{pulse}/\text{mm})$ . On the contrary, suppose pulse equivalent of a certain shaft is 100 pulse/mm, the resolution converted is:  $1/100 = 0.01(\mu\text{m})$

 Attention	At ex-factory, calculation of resolution or pulse equivalent has already been made. Unauthorized change of parameters by user before making clear its meaning is prohibited. Otherwise, improper location of shaft movement or wrong size of processing figure may possibly be caused.
--	--

The following an interface for setting related parameters of No.3 controller and No.1.1 controller:

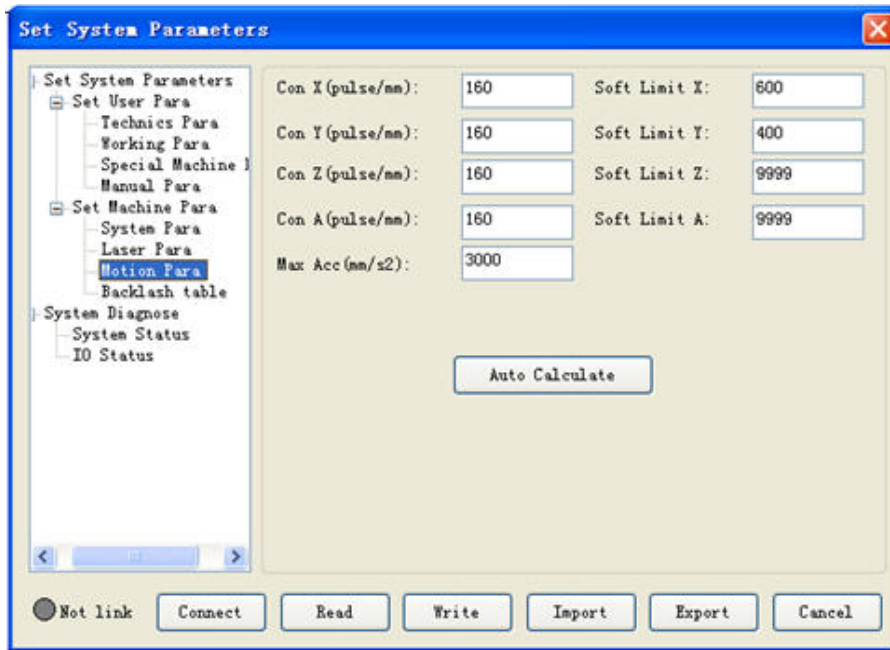


Fig.3-25 Interface for setting machine parameters of No.3 controller

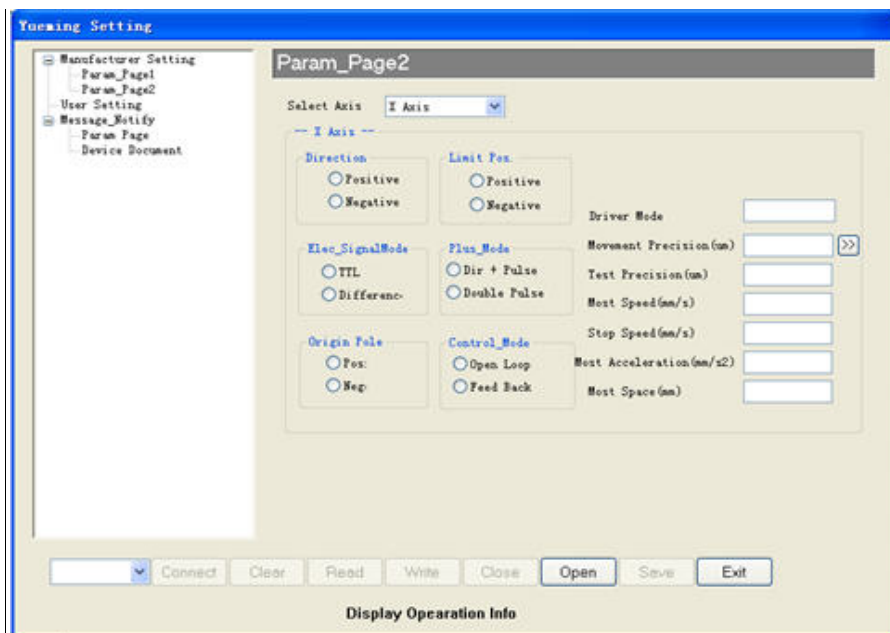



Fig.3-26 Interface for setting machine parameters of No. 1.1 controller

In case of improper location of movement or wrong size of processed figure, values of resolution or pulse equivalent are needed for modification. The software provides the automatic calculation tool. Please refer to the operation instructions for use method. Method of testing resolution or movement equivalent: control machine goes along a rectangle frame (e.g. rectangle 100mm X 100mm), measure if distance between each side is 100mm. In case of difference found, it means setting resolution or pulse equivalent is incorrect.


For No.1.1 controller, default parameter setting can only be performed by upper computer software (SmartCarve4.2). Firstly “read” parameters, and then modify them, and finally “write”. By now, it is valid.

For No.1.1 controller, default parameter setting can only be performed by upper computer software (SmartCarve4.2). The steps are the same as the above. However, it will not be valid until re-start after writing the parameters. In addition, **No.3 controller can directly modify parameters of “pulse equivalent” through the control panel.**

 Tips	Software SmartCarve4.2 is compatible for control on various controller and types of machine from our company. For the first time of installation and use, users should correctly set the corresponding controller type. Otherwise, wrong parameter setting and wrong generation of data will be caused.
---	---


### 3.2.2.3 Stroke, limit and reset

Different models of machine are with different working breadth, and setting stroke of each shaft of the machine will play the function of breadth protection (equals to software limit). Stroke parameter setting is shown in figure 3-25 and figure 3-26 respectively for No.3 controller and No.1.1 controller. Wrong stroke setting will possibly cause fail to have a full breadth work or “overreaching” of the laser head. Taking CMA6040 type of machine as an example: theoretically the effective processing breadth of the machine is 600mm X 400mm. Then, strike of X-axis should be set to 600, and Y-axis to 400.

 Attention	Due to the less difference caused during production and assembly of the machine, the actual strike of each shaft on the same type of machine may be with a small difference. Stroke setting is subject to the actual stroke.
--	--

Limit switch is the hardware sensor equipped on limit position of the two ends of each shaft. After detecting limit triggering signal, the movement shaft will perform emergency stop to avoid “overreaching”. Minimum one limit switch is needed for each shaft to indicate limit position of the current shaft. In figure 1-5, you can find the installation position of the limit sensor. The installation position of limit switch may differ due to different types of machine, so the triggering signal. Therefore, configuration is needed. Generally, \the limit switch of No.1.1 controller is located at right corner of the machine, meaning the positive limit position of X-axis and Y-axis. In addition, There is Z-axis limit switch equipped on the lift platform, electric dual-laser head.

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


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

Before starting formal processing, testing of movement straightness of each movement shaft and perpendicularity of X-axis and Y-axis are needed. The straightness ensures movement accuracy and stability of movement for this shaft. The testing shaft can be controlled to move along a straight line. If the straight line is measure unstraight, it means twittering exists during movement of the shaft, and a solution is required. Reasons for straightness of single shaft frequently lie in transmission of the motor or mechanical movement and machine vibration.

Movement coordinate system of CMA and PN series machine is a rectangular Cartesian coordinate system. Theoretically, X-axis and Y-axis should ensure be in absolute uprightness to ensure processing accuracy. If case of large tolerance for the straightness, distortion of the processed figure will be caused. Method of measuring the straightness is to have the control machine go a rectangle frame on the surface of processing, and measure if the length of four sides and diagonal are the same. Method of adjusting perpendicularity is to make adjustment of assembly of X-axis and Y-axis movement mechanism.

 Attention	Debugging of straightness of perpendicularity of each shaft has been already performed at ex-factory of the machine. In case of problems found by users, please timely contact our customer service personnel for a solution. Unauthorized disassembly of the machine is prohibited.
--	--

### 3.2.3 Laser debugging

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

#### 3.2.3.1 Light emitting test

After normal start up in case of power-on, with “spot spray” button (“laser switch” button on software control panel of No.4 controller) on the control panel of the machine, you can test if laser emitting is normal. Light emitting energy and spot spray time can be directly set on the panel to check if laser spot spray power is normal. If there is no laser emitting from the spot spray laser tube, it means that there is problems with the laser emitting, and check is required. In case of laser emitting found from the laser tube, but no laser emitting from the cutting head, it means improper position of the light route, and adjustment of light route is needed.

When no laser emitting from the spot spray, firstly make check on setting of the related parameters of the laser device. The followings are interfaces for setting parameters of No.1.1 controller and No.3 controller:

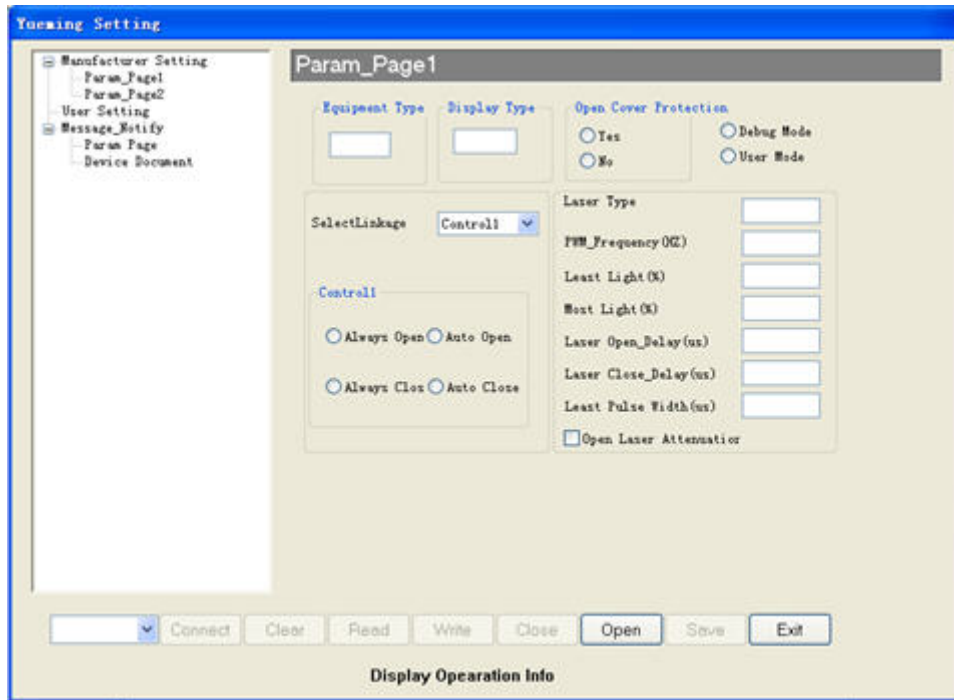


Fig.3-27 Interface of setting laser parameters for No. 1.1 controller

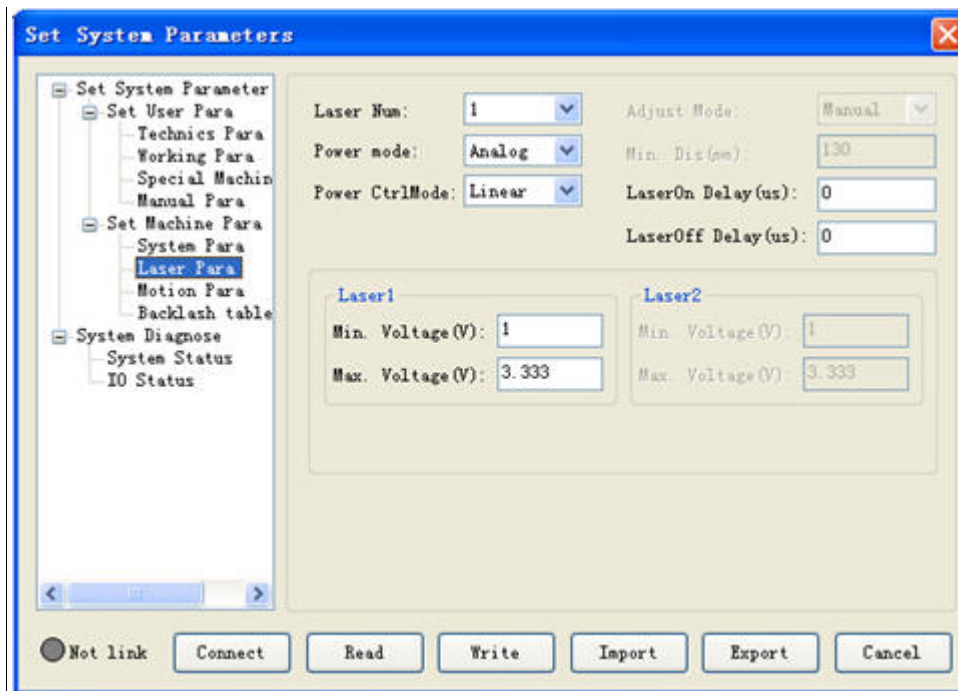



Fig.3-28 Interface of setting laser parameters for No.3 controller

Refer to the operation instructions for the related controller for more details about laser parameters. Wrong laser parameter setting may possibly cause abnormal light emitting or fail of adjusting laser power. In case of no light emitting under the condition of making sure that laser parameters are set to correct values, check on hardware is needed. You may use red “test” button on the back of laser power supply from our company to check if laser power supply and laser tube are normal as shown in figure 3-12.

In case of no laser emitting, plug out the controller control cable from the laser power supply, open the laser power supply, and press the light emitting button. If there is laser output from the glass tube at this time, it means that laser power supply and laser tube are normal in working. At this time, check on the controller and laser control line is needed. In case of no light emitting, further check on the laser power supply of the laser tube is needed.

 Tips	The control panel of some types of machine is equipped with ammeter. With the ammeter, you can check if the power is normal. Theoretically, the maximum power of 80W laser tube is corresponding to the current roughly 25mA, and the 130W laser tube to 30mA of the current.
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### 3.2.3.2 Light route adjustment

Due to vibration during transportation, aberrancy of light route may possibly be caused. At this time, light route correction is needed.

Light route of CMA and PN series laser machine is as shown in the figure below:

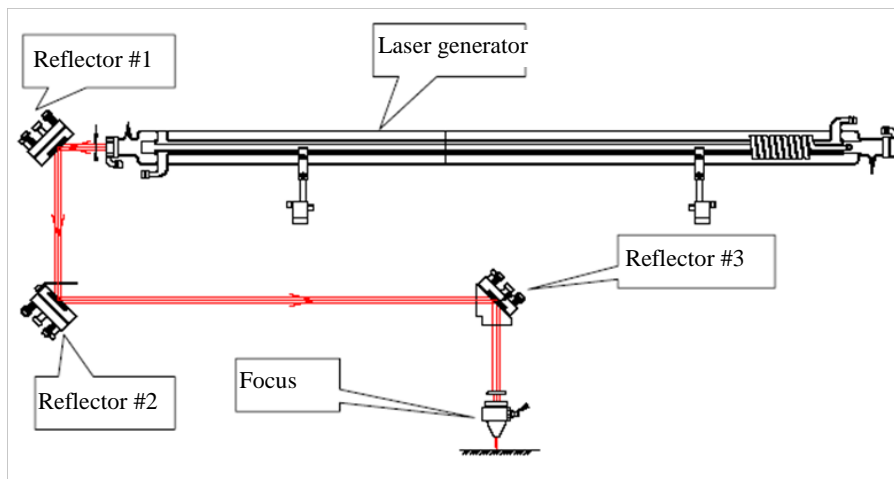


Fig.3-29 Illustration of laser route

After being emitted from the laser generator, laser successively passes through reflector #1, #2 and #3, and finally emitted to working table after be focused by the focus. Transmission of the laser is actually a course of multiple reflection and focusing. During this course, in case of loosen reflector, laser route deviation will be caused make the laser fail in finally output through the jet cup.

The adjustment steps follow:

- Firstly adjust reflector #1. Move crossbeam to the closest point to lens #1, and then move to the furthest point. By adjust the three screws at the back of the lens to adjust angle of the lens to have this light spot overlap on the first light spot.

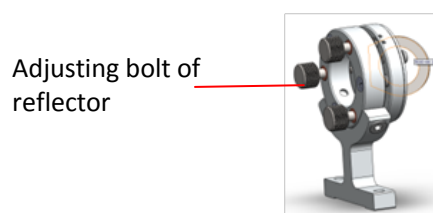




Fig.3-30 Reflector base

- Then, adjust reflector #2, in the same way to move the laser head to the closest point to lens #2 and make a light spot, and then move the furthest point and to the furthest spot overlap on the first light spot.

 Attention	The positions of the light spots above are recommended to emit at the center of lens, but not the edge. In case of being at the edge, further adjustment is needed till being at the center.
--	--

- Finally check if the light spots are overlapped if the laser heads are located at different peaks. In case of fail of overlap, please make further adjustment in the way above till achieved.
- After adjusting four spots overlapped, let's check if this point is emitted at center of light inlet of the laser head. If no, please power off the laser, adjust position of the laser tube. In case of deviation leftward or rightward, adjust to this direction if deviation towards it. For example, in case of leftwards deviation, adjust the laser tube to the left side; in case of rightward deviation, and then move the laser head to the right side. In case of up or down deviation, adjust to the opposite direction, meaning that in case of up deviation; adjust the laser tube downward; in case of down deviation, then to adjust upward. ) The adjustment above is only for negative pole end of the laser tube (light outlet end). In case that positive pole end of the laser tube needed to achieve the same effect, the direction is the opposite.)

 Attention	Laser is invisible light and with direct harm to human body. While adjusting the light route, the operator is required to pay great care. The operator is not permitted to make adjustment until having received professional training. During adjustment, pay attention to the lens to have them free of pollution by smoke and dust.
--	--

### 3.2.4 Trial operation of processing

After completing debugging of the movement and laser module with the steps above, you can start figure trail processing now.

- Firstly start up the machine according to the sequence of power-in, start up the auxiliary machine like air pump and blower;
- And then prepare ready the materials to be processed, and place the materials horizontally on to the surface of working table;
- Adjust distance of the laser head to make laser focus located on surface the materials to be processed;
- Move the laser head to the start point of processing (set positioning point);
- Open upper computer software (SmartCarve4), make figure (or figure data lead-in) and set ready the processing parameters and processing path;
- Carving output (Or generate processing data to transmit to the controller)

The above are the basic processing steps. Refer to control system operation manual of each controller and operation instructions of the related computer software for detailed processing operation.

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## Chapter 4 System Maintenance

Stable and normal operation of the machine is closely related to daily correct operation and maintenance. This chapter mainly introduces the way of daily maintenance.

### 4.1 Mechanical maintenance

Mechanical maintenance mainly includes the maintenance of: guide rail, linear shaft, slide block assembly (metal guide pulley), nylon guide pulley, synchronous belt, synchronous belt wheel, screw and coupling. It is a must to the followings well done for maintenance:

- After completing use every day, cleaning all parts of the machine and oiling sliding mechanism like guide rail with lubricant are required.
- Make irregular check on the machine to mainly check if there is poor contact of the joints. In case of abnormality, timely treatment is needed to avoid causing serious problems.

The followings are detailed information concerning maintenance of each mechanical part.

#### 4.1.1 Guide rail, linear shaft, slide block assembly (metal guide pulley), nylon guide pulley

Guide pulley and linear shaft are core parts of the machine. Their function is for direction leading and supporting. To ensure a higher processing accuracy of the machine, higher direction leading accuracy and stable movement of the guide pulley and linear shaft are required. During operation, plenty of corrosive powder and smoke are generated from the processed workplace. In case of long-term stay of the smoke and dust in the surface of the guide pulley and linear shaft, the accuracy of the machine will be greatly lowered, and corrosive points will be formed on the surface of the linear shaft causing lifespan of the machine shortened. To keep normal operation of the machine and ensure processing quality, daily maintenance shall be well done.

X and Y direction of the series laser machine applies a movement method of slide block (metal guide pulley) combined with the linear shaft.

- Cleaning and maintenance of the linear shaft:

Linear shaft on crossbeam: Disconnect the power supply of the machine, move the laser head to the rightmost (leftmost), repeatedly clean the linear shaft along with it with a piece of cotton cloth till the linear shaft free of dust; and then move the laser head to the leftmost (or rightmost), repeatedly clean the linear shaft along with it with a piece of cotton cloth till the linear shaft free of dust. Finally, apply proper amount lubricant (or sewing machine oil, but machine oil is prohibited) on to the linear shaft, slowly push the laser head along leftward and rightward repeatedly for couples of time to make the lubricant equal on the linear shaft.

In the same way, it is to clean the linear shafts on left and right rail beams.

- Cleaning, maintenance and replacement of slide block assembly (metal guide pulley):

In the same way of cleaning and maintaining the linear shaft to clean, maintain the slide block assembly (metal guide pulley).

The slide block assembly (metal guide pulley) is a part easily worn. Pay attention to the followings during replacement: adjust a proper gap between the linear shaft and the slide block assembly (metal guide pulley) to have the movement of the slide block (metal guide pulley) smooth. The detailed method of adjustment: firstly adjust eccentric wheel of the slide block assembly (metal guide pulley) to make the pulley surface of the slide block assembly (metal guide pulley) just contact the linear shaft, screw down the slide block assembly (metal guide pulley), and then screw down the fixation screws for the eccentric wheel.

## 4.1.2 Synchronous belt, synchronous belt wheel

Synchronous belt and synchronous belt wheel are the main mechanical parts of the machine, and they control movement track of the laser head. After movement for a certain period, the synchronous belt will frequently be longer and loose in a small size. That will lower the accuracy and sensibility of the laser head, Therefore, timely adjusting the transmission belt is needed.

Adjustment method: Adjustment of X direction and Y direction synchronous belt should achieve a proper tension of it; adjustment of drive motor synchronous belt is to achieve that when pressing middle part of the synchronous belt, the sinking level is 3% to 5% of the central distance between the belt wheel at the two ends.

Attention:

① If to adjust the transmission belt too tight, the belt is not only easily made distortion but also cause more severe abrasion of the bearing; if too loose, transmission accuracy and sensibility will be lowered. Therefore, you should adjust the synchronous belt at a proper tension. While adjust Y direction synchronous belt, it is to achieve a proper ten for the synchronous belt and make the left and right synchronous belts at the same tension. Only by this way, a stable transmission synchronous belt can be achieved to ensure a good carving and cutting effect of the product.

② Keep the synchronous belt away from oil, pr chemicals. Contact with acid, alkali, oil and organic solvent is prohibited. Keep the synchronous belt dry and clean.

③ There is problem of aging with rubber of the synchronous belt. In case of serous aging (or abrasion), timely replacing with a new one is required. Please note that synchronous belt wheel should also be replaced if to replace the synchronous belt.

After using the synchronous belt for a certain period, loose belt and abrasion will also be caused, and then timely replacement and lockup are needed. Please note that the new synchronous belt should match with the synchronous belt wheel.

## 4.1.3 Fasten screws and coupling

After working for a certain period, the screws at movement joints and the coupling of the movement system may be loosen causing low stability of mechanical movement. Therefore, during movement of the machine, you should observe if there is abnormal sound or other abnormality with the movement parts. In case of problems found, timely fastening and maintenance are needed. Meanwhile, the screws of the machine should be tightened one by one with tool after a certain period of use. The first fixation should be performed roughly one month later after using.

## 4.2 Electric maintenance

Electric maintenance mainly includes the maintenance for electric parts, sensor, operation buttons and working indicator of the machine.

### 4.2.1 Limit switch

Minimum once a month to make check on the effectiveness of limit switch of the X-axis and Y-axis. The limit switch plays the role of restraining the limit position of the movement to avoid machine impact (overreaching) causing damage to the machine. It is a must to make regular check on working state following the steps below:

1. Start up the machine to have the laser head reset;
2. Operate the machine to make the movement shaft move to the limit positions. If the movement shaft stops at the limit position, it means a normal operation of the limit switch. If it keeps moving while reaching the limit position, it means that the limit switch is out of order.



In case of hard impact occurs, please immediately press the emergency stop button to stop the machine, and find a solution for it.

### 4.2.2 Maintenance of each button and indicators

After disconnecting the related electric parts, test button contact points with a millimeter to check they are normal in operation.

Purposely trigger all working modes and alarm state to check if warning indicators and signal indicators are normal.

## 4.3 Light route maintenance

Light route system of the laser engraving machine is completed by reflector together with focus of the focusing lens. The focusing lens is free of the problem of deviation in light route. However, three reflectors are fixed by mechanical parts with large possibility of deviation. Although deviation is not frequently caused, users are recommended to have a check on the light route before working each time.

Although the optical lenses in CO<sub>2</sub> laser system are easily worn products, we still wish you try to use it less as possible to prolong lifespan of the laser device and lower cost of using lens.

During replacement, pay attention to placing, testing, installing the optical lens to keep it free of damage and pollution. After installing a new lens, regular cleaning is needed. This is very simple. Proper operation will prolong lifespan of the lens and lower cost. Otherwise, the lifespan will be shortened.

During laser working, it is inevitable to prevent the optical parts from contacting the suspended particles. When cutting the materials, engraving and marking with laser, processing surface will release plenty of gas and flying objects. The gas and flying objects may cause harm to the lens. When dirt falls on surface of the lens, it will absorb energy from the laser beam causing thermal-lens effect. In case of no thermal stress formed on the lens, the operator may take it down and clean it. Of course, a certain method capable of avoiding damage and further pollution should be applied.

- General rules of operation

During cleaning and installing the lens, any matter stuck on or even nail print or oil droplet may higher absorption of the lens and shorten lifespan of it. Therefore, the following prevention measures must be taken:

- 1) Suction or blowing device are prohibited to avoid scratch on surface of the lens caused;
- 2) Do not touch film layer of the lens when taking it out, but to hold its edge;
- 3) Keep the lens at dry and clean place for testing and cleaning. A good working table should be equipped with several layers of cleaning paper or lens cotton paper on the surface;
- 4) The operator shall not speak over the lens, and keep food, beverage and other pollution matter with potential risk away from the working environment.

- Correct leaning method

During cleaning the lens, the only objective is to remove pollution on the lens, but not cause further pollution and damage to the lens. To achieve this goal, people usually take the method with less risk. The followings are just for this purpose:

Firstly, use air balloon to blow off particles on surface of the lens, especially the micro particles and floccules on the lens. This is a necessary step. Yet, compressed air of the production line is strictly prohibited. This is because the air from it contains oil and moisture, and that will cause further pollution to the lens.

Secondly, gently clean the lens with acetone or absolute alcohol (Absolute alcohol is necessary. It may lower the possibility of pollution to the lens.)

After soaking acetone, use the lens paper to clean the lens under sunshine and move in a circle. When the paper gets dirty, it is must to replace it. Cleaning must be done in a one-off way to avoid scratch caused.

Certainly, some pollution and lens damage cannot be removed by cleaning, e.g. film burn by dirt, film peeling off by dew or condensate water. To recover its good performance, the only way is to replace the lens.

## **4.4 Auxiliary parts maintenance**

### **4.4.1 Water replacement and water tank cleaning**

Water quality of the circulation water will directly influence lifespan of the laser tube. You are recommended to use purified water, and keep the water at a temperature below 35°C. In case of over 35°C, water replacement is needed, or place ice into the water to lower its temperature. (You are recommended to select water chiller or use two water tanks.)

It is recommended to clean the water tank and replace the circulation water once a week. Water tank cleaning: firstly disconnect the power supply, plug water inlet pipe out, have the water



inside the laser tube automatically flow into the water tank, open the water tank, take the water pump out, and clean dirt on the water pump. Thoroughly clean the water tank, replace ready the circulation water, place the water pump back into the water tank, insert water pipe connecting the water pump into water inlet, well arrange all the connectors. Separately connect power through to the water pump for running 2-3 minutes (make the laser tube fill up with water.)

## **4.4.2 Blower cleaning**

For every 15 days, it is to clean the air pipe, and blower to prevent foreign matters accumulated from lowering effect of air out. Check if there is leakage, foreign matter, perform repair or maintenance. Long-term use of blower will cause plenty of solid dust accumulated inside the it causing large noise and lower effect of air exhaustion ventilation and smell elimination. In case of insufficient suck force causing unsmooth smoke expelled, firstly power it off, remove the air-in pipe and air-out pipe from the blower, remove dust inside them, and then turn the blower upside down, and push the blade of it till it getting clean, and then assembly the blower ready for use.

## **4.4.3 Water chiller maintenance**

Water quality and temperature of the cooling water will directly relate to lifespan of the laser tube or radio frequency tube. Cooling water must the purified water at temperature below 35°C; the cooling water must be kept clean and regularly replaced (minimum once a month). Check if the cooling water gets muddy, with deposit, at over high temperature, or water replacement required; during processing, frequently check water level to ensure sufficient water or if the water temperature is over high (higher than 35°C).


Steps of replacing cooling water:

- ◆ Power off the machine and stop the laser device;
- ◆ Unscrew valve of water outfall of the water chiller for a thorough drainage of water from the water chiller;
- ◆ Open protective cover of the water chiller and pour purified water into the water chiller;
- ◆ Start up the machine, observe if the laser tube is filled up with water. After circulation for five minutes, if there are still plenty of air bubbles in the laser tube, it is to open the discharge valve inside the machine to expel air from the laser tube making cooling water fill up with the laser tube.

## Chapter 5 Troubleshooting

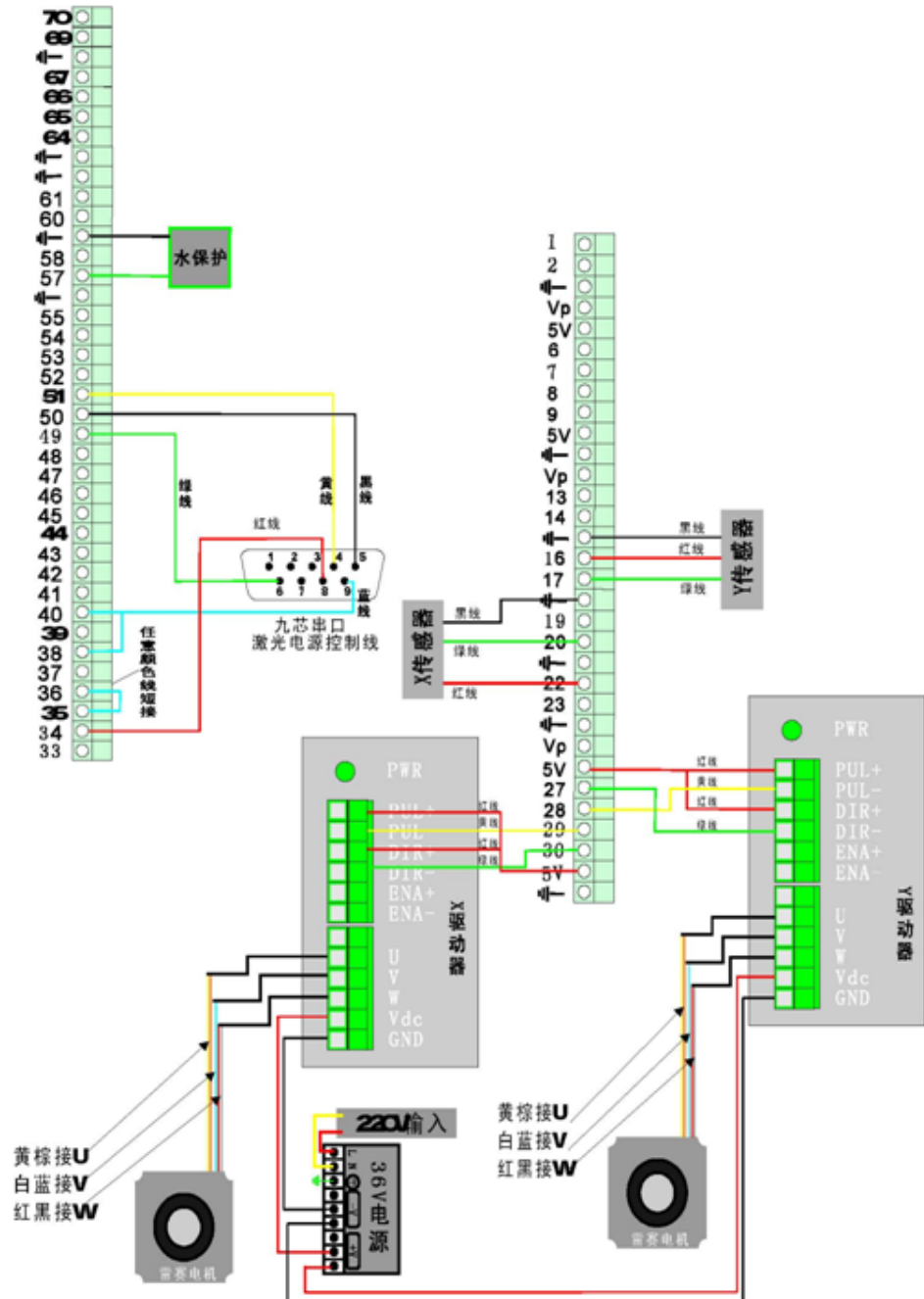
No.	Failure	Analysis Method	Solution
1	No action after power-on	<ul style="list-style-type: none"> <li>● Check if power is connected through</li> </ul>	<ul style="list-style-type: none"> <li>● Plug out the power cord and plug it in again</li> </ul>
		<ul style="list-style-type: none"> <li>● If parameters of the controller are correct</li> </ul>	<ul style="list-style-type: none"> <li>● Correct the parameters according to software operation manual.</li> </ul>
2	Continually light emitting after power-on	<ul style="list-style-type: none"> <li>● If parameter of the controller laser device are correct</li> </ul>	<ul style="list-style-type: none"> <li>● Correct parameters of the controller laser device</li> </ul>
3	Alarm given after power-on	<ul style="list-style-type: none"> <li>● If parameters of the controller are correct</li> <li>● Machine alarm signal is triggered</li> </ul>	<ul style="list-style-type: none"> <li>● Correct parameters of the controller</li> <li>● Check alarm signal source of the machine</li> </ul>
4	Laser pause during working,	<ul style="list-style-type: none"> <li>● Check if water circulation is smooth</li> </ul>	<ul style="list-style-type: none"> <li>● Clean water tank, dredge water hose</li> </ul>
		<ul style="list-style-type: none"> <li>● If power voltage is table</li> </ul>	<ul style="list-style-type: none"> <li>● Install a stabilizer to input power supply</li> </ul>
5	Wrong figure size	<ul style="list-style-type: none"> <li>● User adopts PLT output in CorelDraw software. In HGPL dialogue box, if unit of plotter in page option is set correct</li> </ul>	<ul style="list-style-type: none"> <li>● PLT plotter unit out from CorelDraw software should match with resolution of SmartCarve software lead-in PLT option</li> </ul>
		<ul style="list-style-type: none"> <li>● User adopts PLT output in CorelDraw software. In HGPL dialogue box, if zooming in page option is 100%</li> </ul>	<ul style="list-style-type: none"> <li>● Change to 100%</li> </ul>
		<ul style="list-style-type: none"> <li>● If resolution of the controller parameters are correct</li> </ul>	<ul style="list-style-type: none"> <li>● Set to the correct resolution or equivalent</li> </ul>
6	Crash to the machine and unexpected engraving	<ul style="list-style-type: none"> <li>● Discharge and sparkle of the laser tube (high voltage line ) to case</li> </ul>	<ul style="list-style-type: none"> <li>● Reconnect the laser tube high voltage line</li> </ul>
		<ul style="list-style-type: none"> <li>● Fail to connect earthing for the controller or other interferences</li> </ul>	<ul style="list-style-type: none"> <li>● Connect earthing, eliminate the interference</li> </ul>
		<ul style="list-style-type: none"> <li>● Over high temperature causes crash to the controller</li> </ul>	<ul style="list-style-type: none"> <li>● Add more measures for lowering temperature</li> </ul>
7	No light from the cutting head	<ul style="list-style-type: none"> <li>● Check if light route is with deviation;</li> </ul>	<ul style="list-style-type: none"> <li>● Re-adjust light route</li> </ul>
		<ul style="list-style-type: none"> <li>● Check if water protection is triggered</li> </ul>	<ul style="list-style-type: none"> <li>● Ensure a smooth water circulation</li> <li>● Check if water protection sensor is normal</li> </ul>
8	Reverse direction of motor shaft movement	<ul style="list-style-type: none"> <li>● If setting of controller motor movement parameters are wrong</li> <li>● If lines from the drive to the motor are connected improperly</li> </ul>	<ul style="list-style-type: none"> <li>● Set to proper motor parameters</li> <li>● Check electric earthing</li> </ul>

9	Fail in movement of motor shaft or twittering of it during movement	<ul style="list-style-type: none"> <li>● Improper setting of motor parameters cause missing step to the motor</li> <li>● Damaged drive or motor</li> <li>● Motor line broken or poor contact</li> </ul>	<ul style="list-style-type: none"> <li>● Set to the correct movement parameters</li> <li>● Change the drive or motor</li> <li>● Reconnect the motor and drive line</li> </ul>
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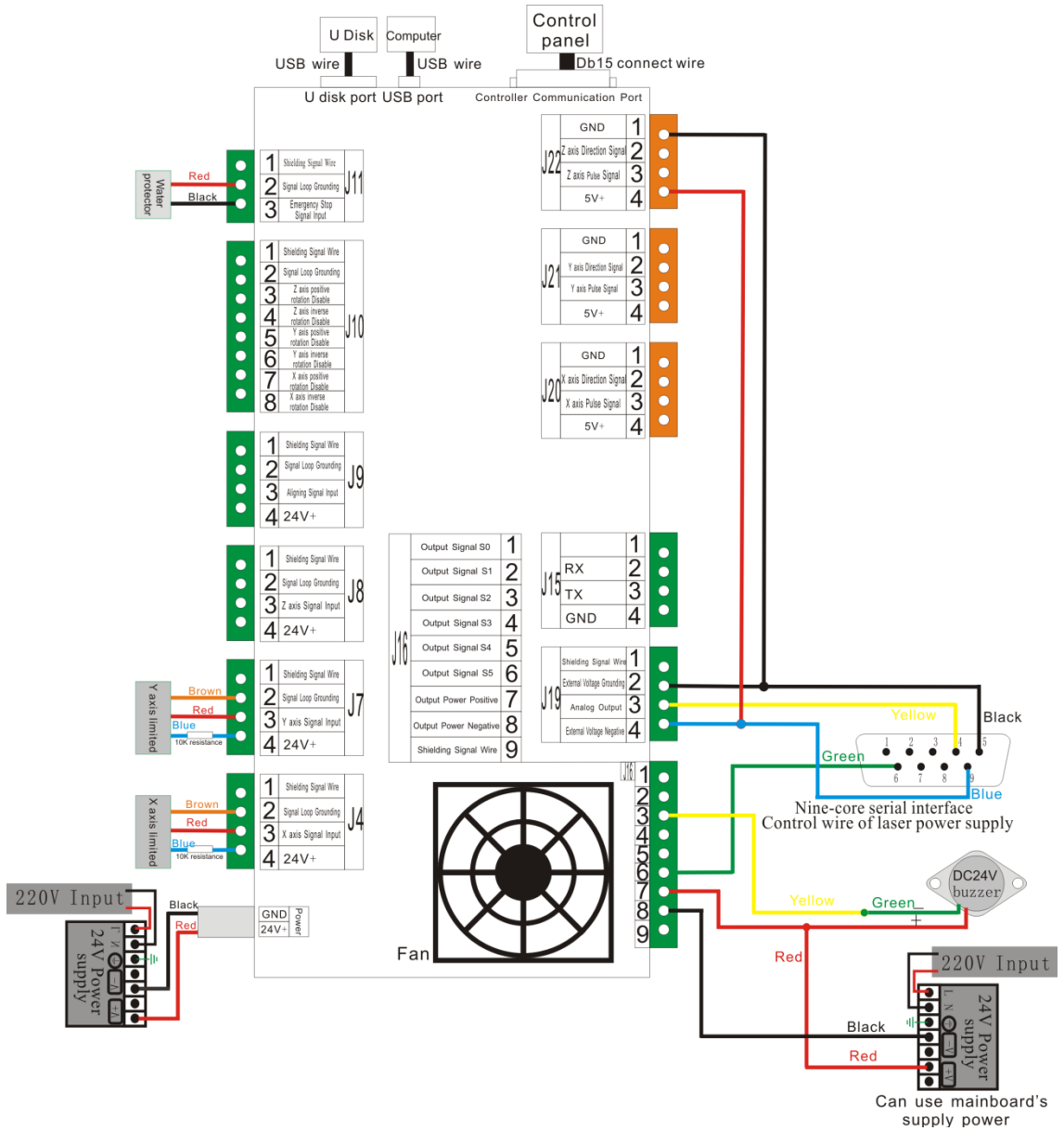
 Tips	Please refer to operation instructions of the control system for the related controller for more details concerning failure diagnosis.
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# Appendix

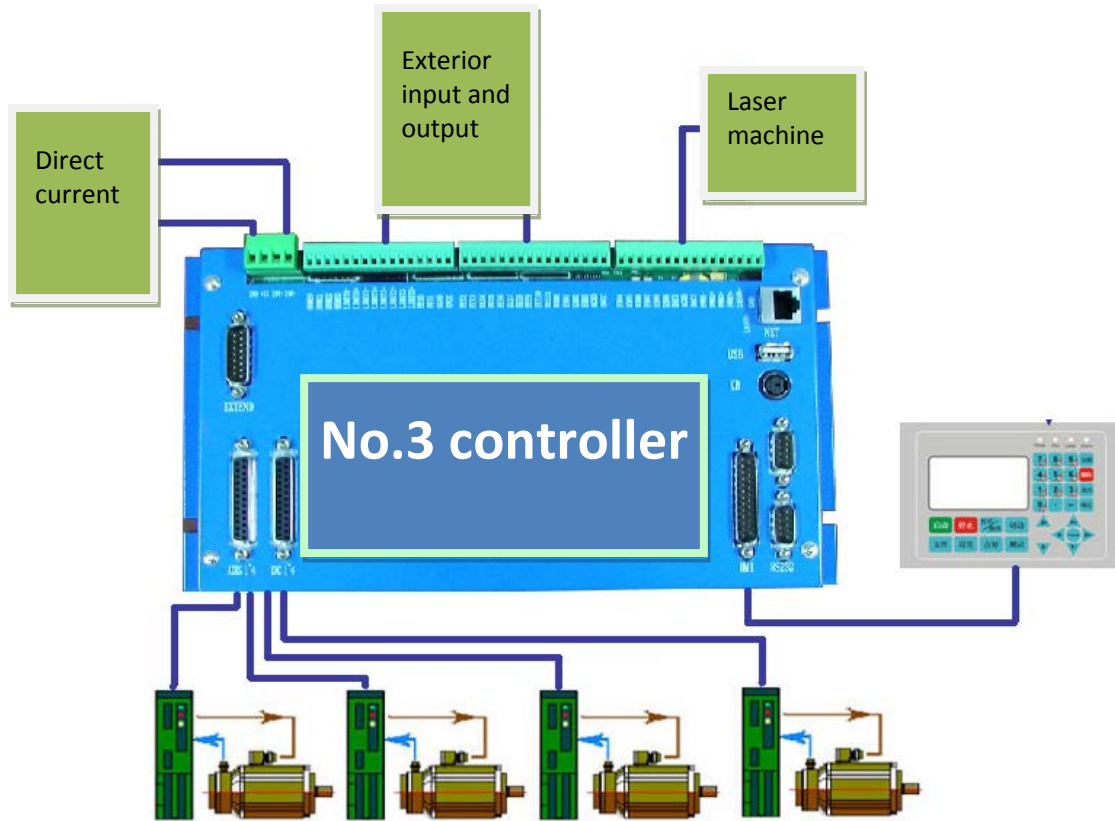
## Appendix1 Electric wiring diagram for No.1 (1.1) controller



## Appendix2 Electric wiring diagram for No.2 controller



## Appendix3 Electric wiring diagram for No.3 controller



## Postscript

All final right of interpretation of this manual belongs to our company; we will do our utmost efforts to ensure the accuracy of the contents of this manual. We do not assume any responsibility caused by misspellings and typing errors. Your comments will be highly appreciated.

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