GF101 SERIES

4KW Robotic Laser Cutting head - User Manual

Document History

Edit date	Version	Topic, revision, action taken
V1.4	2019/05/25	Establish GF101 User Manual
V1.5	2023/03/22	1. Mounting hole graphics modification. 2. Add requirements of 3-stage filtering.

Thank you for choosing our product!

This manual describes the installation and commissioning of control cabinet in details so that you can use this product quickly. You can consult us directly for more details.

Due to the continuous updating of product functions, the product you receive may differ from the introduction in this manual in some aspects.

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For the benefit of our customers, we will constantly try to ensure that the products we develop comply with the latest technology.

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Disclaimer

- We reserve the right to change the design in order to improve the quality or expand the application or comply to manufacturing workmanship.
- We will not bear any responsibility for losses and accidents caused by wrong operation or improper handling of our products.
- Dismantling of product will lose all warranty claims excluding the normal replacement of worn parts and components required for maintenance or commissioning operations.
- Unauthorized modification of products or use of non-original spare parts will directly lead to the invalidation of warranty and liability exemption.
- It is recommended to only use the spare parts provided by us or submit them to us or the designated professional team for installation.

Use Regulations

- Ensure that the product is used in a dry environment.
- Ensure that the product is used in the environment required by EMC standards.
- The product is only allowed to run within the parameters specified in the technical data.

Personnel Responsibilities

- Be familiar with the basic provisions of work safety & accident prevention and have received equipment operation guidance.
- Read and understand basic safety instructions and operations.
- You must have studied the relevant regulations and safety instructions and understand the possible hazards.
- Comply with relevant regulations and implement corresponding protective measures.

Safety Instructions

Prevent Electric Shock

-  Parts of the laser head such as nozzle, sensor, sensor interface and attached fasteners may not be fully protected by the ground wire due to function fault. These parts may have low voltage. When installing electrical equipment, please pay attention to taking anti electric shock measures for relevant personnel.
-  Note that the equipment shall be grounded as specified.

Guard against Danger

- Never put your hands or other body under the laser head.
- Repair and maintenance work can only be carried out after the power is turned off.
- Do not exceed the specified maximum pressure.
- It must be ensured that the laser head is in normal condition at all times.
- All fasteners such as bolts and nuts must be tightened.

 Laser Caution

- Avoid direct laser radiation or scattering to the skin.
- Do not stare at the laser beam even when wearing optical equipment.
- Use special laser protective eyeglasses that meet the requirements of safety standards IEC 60825-1.

Prevent Waterway Corrosion

- In order to avoid corrosion, use the specified coolant and comply with relevant requirements and specified maintenance intervals.

Noise Prevention

- The corresponding measures shall be specified or explained and observed in order to prevent personnel from being harmed by noise when the cutting air pressure is high.

Storage and Transportation

- Observe the storage temperature range allowed by the technical data.
- Take reasonable measures to prevent fire, vibration or impact.
- Do not store in or near the magnetic field

Content

1 Summary

This manual introduces the basic installation, ex-works setting, operation and maintenance of GF101 series product. GF101 series has a wide range of mechanical and optical configuration and this manual only gives an introduction to the main modules.

GF101 is one medium/high power 3D laser cutting head which was launched by Raytools AG in 2016. It equipped with built-in motorized drive module to drive Z axis motion automatically in 20mm range for height tracking. Optimized focus system, annular gas path and lightweight design can be fully applicable to metal sheet cutting and else 3D cutting. Optimized optical and water cooling design can enable cutting head to work in stable status continuously.

1.1 Product Feature

- Optimized optical configuration and smooth, efficient airflow design to meet different applications of thin plate cutting and other customized 3D laser cutting environment.
- Lightweight design to decline the payload of robot.
- Adjustment range of manual focus +7 to -9mm with accuracy 0.25mm.
- Additional top cover glass above collimation lens to prevent dust dropping onto collimation lens directly.
- Drawer type cover glass holder to facilitate the replacement of cover glass.
- Modular design and skinny nozzle to decline interference from workpiece.
- Adjustment of fiber insertion.
- Various fiber interfaces available to match different lasers.
- Reliable seal design.

As shown in figure 1, the laser cutting head consists of 7 modules as below.

- FIA assembly: to accommodate fiber, compatible to QBH, QD and others.
- CWM assembly: to prevent dust from dropping onto collimation lens directly to cause damage.
- FRA assembly: to collimate laser beam from laser source.
- F-M assembly: built-in motorized module to drive Z axis motion for height tracking.
- F-FM assembly: to focus the collimated laser beam and achieve the movement of focus point and automatic Z axis motion.
- WM assembly: cover glass to protect the focus lens from back metal slags and prolong the lifespan of focus lens.
- TM assembly: to deliver focused laser beam to workpiece and conduct high speed gas flow to achieve high quality cutting.

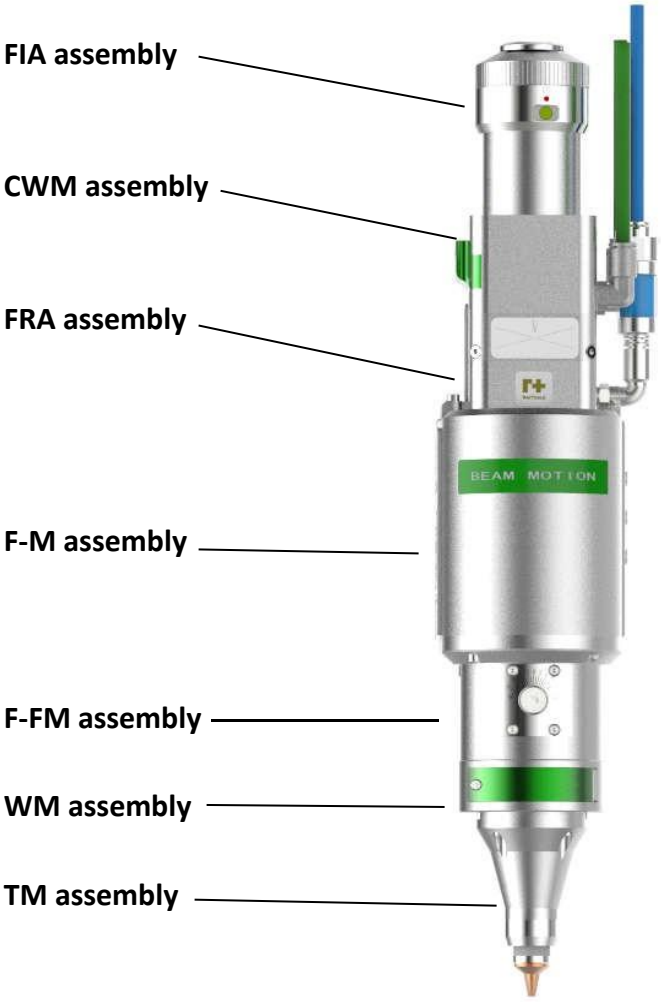


Figure 1 Diagram of Laser Cutting Head

2 Mechanical Installation

2.1 Mounting Hole

GF101 laser cutting head is to be mounted on flange of robot by the mounting plate which is located on the F-M assembly. The location of mounting hole and size is shown as Figure 2 & 3.

Attention: the laser cutting head shall be conductive to robot with good earthing.

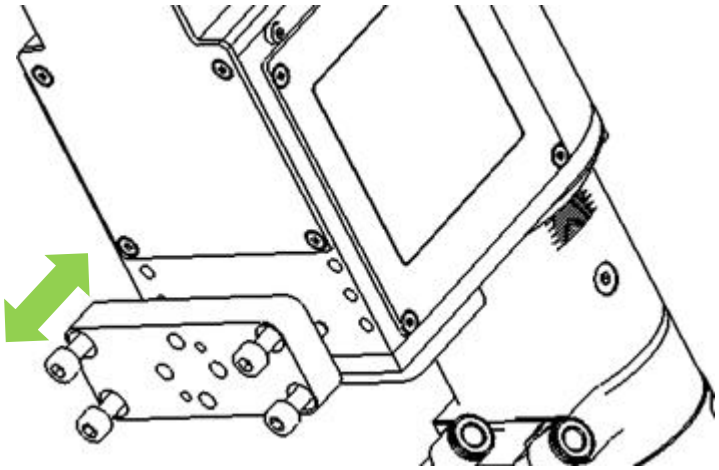


Figure 2 Mounting Hole

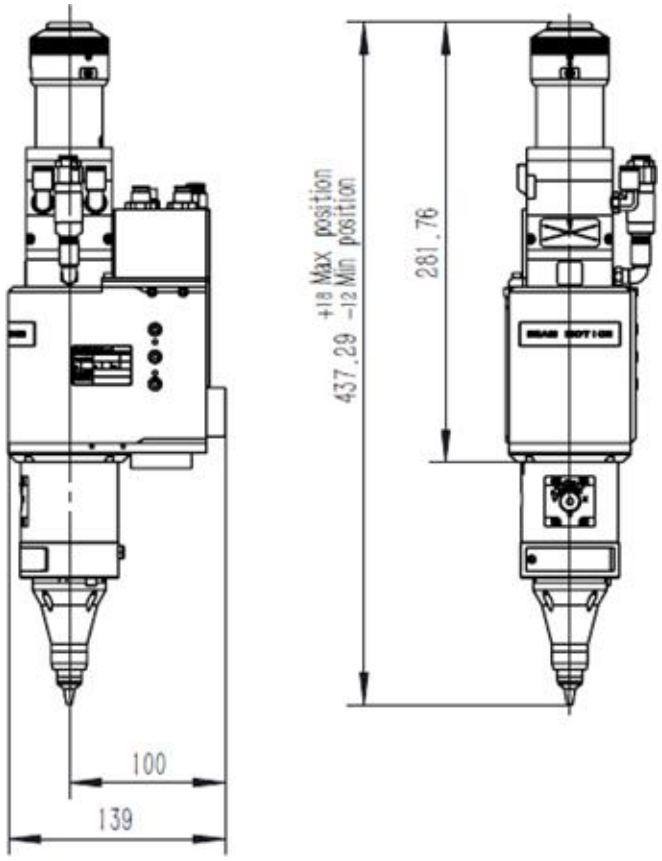


Figure 3 Size of cutting head

2.2 Connection of Cooling Water and Assist Gas

2.2.1 Connection of Cooling Water

GF101 gets water IN/OUT interfaces as show in Figure 4.

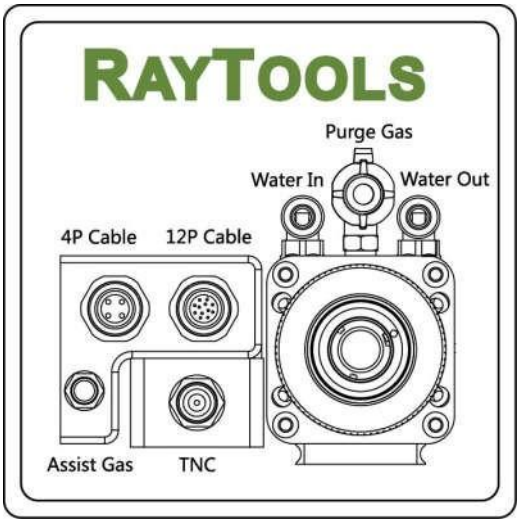


Figure 4 Interface of Water and Gas

The recommended water flow is as below:

Minimum flow speed	1.8 l/min(0.48 gpm)
Entry pressure	170-520kPa (30-60 psi)
Entry temperature	≥room temperature / > dew point
Hardness (relative to CaCO3)	< 250mg/liter
PH range	6 to 8
Particle size allowed	Diameter less than 200 microns

2.2.2 Assist Gas Interface

The impurity in assist gas such as hydrocarbon and steam will damage the lens and cause cutting power fluctuation as well as inconsistencies between the sections of the work piece. The table below is the recommended auxiliary gas specification. The higher the purity of the gas, the better the quality of the cutting section.

Impurity can be filtered out in gas supply tube, but Oxygen and water vapor can permeate light path through nonmetal materials, which is the source of the appearance of dust and hydrocarbon. Stainless steel fittings are recommended, at the same time must use filters which can remove a minimum of 0.01 micron particle to purify.

A pressure gauge with a stainless steel diaphragm is recommended. Industrial pressure gauges suck in air. Rubber diaphragm produce hydrocarbon by aging or other factors.

N2 or fine filtered air with pressure less than 10 bar is recommended for nozzle cooling. The O2 is prohibited for nozzle cooling.

Gas	Purity	Maximum content of water vapor	Maximum content of hydrocarbon
oxygen	99.95%	<5 ppm	<1 ppm
nitrogen	99.99%	<5 ppm	<1 ppm
argon	99.998%	<5 ppm	<1 ppm
helium	99.998%	<5 ppm	<1 ppm
Diameter of auxiliary gas pipe (Outer diameter)	10mm		
Diameter of cooled gas pipe (Outer diameter)	8mm		

CAUTION: Gas interface cannot be replaced arbitrarily, especially do not use PTFE TAPE, Otherwise, the gas path will be blocked and cannot do normal cutting which will damage cutting head at the same time.

2.2.3 Protective Gas of Internal Pressure boosting

Clean compressed air is available, which shall be pure and dry with the pressure less than 2 bar.

Requirements of 3-stage filtering:

Filter Regulator	5μm
Mist Separator	0.3μm
Super Mist Separator	0.01μm
Front refrigeration dryer	

2.3 Fiber Interface

The fiber insertion way is described as below by example of QBH.

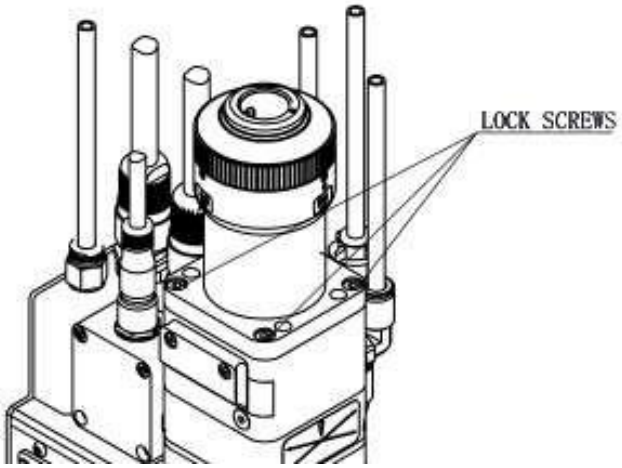


Figure 5 Adjustment of fiber

- Align the red point at the end of the QBH interface to the red point of the handwheel.
- Remove QBH dustproof cover.
- Align the read mark of male fiber end to red mark on female QBH of cutting head when you insert the fiber end straightly to bottom of QBH interface of cutting head.
- Turn the QBH handwheel clockwise. It is in place when you hear the "Da" voice, then pull the handwheel up and turn clockwise to end. (see Figure 5)

If the red mark on fiber is too far away from the red dot on laser head interface when the fiber connector is inserted into the interface causing an out of alignment insertion, you can refer to steps below to adjust the position of fiber interface on laser head for solving the problem. As shown in Fig. 4, unscrew the 4 locking screws of the position of the part icon with a wrench, rotate the QBH interface and screw the locking screws after the red mark is in place.

2.4 Beam Adjustment

Cutting quality in a great extent depends on whether the lens is in the middle. If the lens is not in the middle, the laser beam may contact with nozzle or inner wall to produce high temperature deformation. Lens centering operation should be considered when nozzle is replaced or the cutting quality declines.

Lens centering of laser cutting head can be finished by adjusting focus lens, X-Y direction. The adjusting screw is located as shown in Figure 6. By using inner hexagon spanner can loosen or screw the adjusting screw until the beam is located in the middle of nozzle. Make sure the laser beam output from the center of nozzle. A method commonly used tape dotting method:

- Pick a scotch tape, flatten it, and attach it to the center of nozzle which directly below the hole end face;
- Open the inner guiding red light of the laser. Find and observe the position of nozzle center that the red light in the scotch tape relative to;
- Next open and adjust laser generator at the range of 80W-100W and dot manually.
- Tear off the tape and check the hole in the center of the nozzle;
- Repeat the above steps to find the optimum relative nozzle center position of the beam;
- This adjustment requires a series of adjustments, which is the basic operation of general laser beam adjustment.

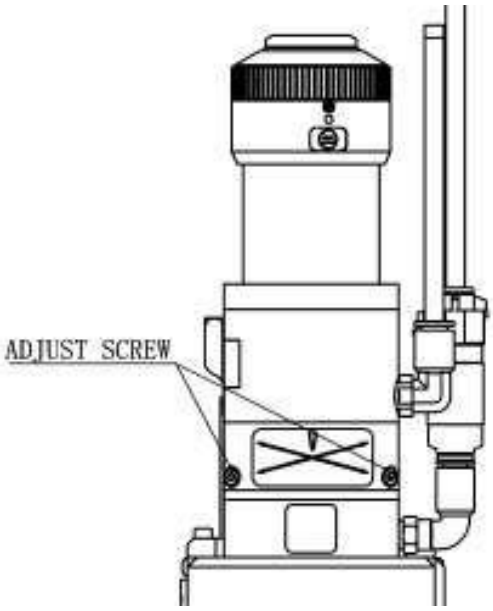


Figure 6 Beam adjustment

2.5 Adjustment of Focus Point

GF101 is fixed with one knob as shown in figure 7 to adjust the focus point in order to optimize the cutting process. The adjustment range of focus point is 16mm (+7 to -9). You have to find out the focus point in various ways before cutting of which one method is introduced as below.

- To attach one textured tape on nozzle tip and adjust the scale to biggest value by one inner hexagon spanner.
- Set laser power 50-80W by duration of 100ms.
- While moving each 0.5mm (as small as possible), shot a hole on the textured tape;
- By dotting several times, to find out the scale corresponding to the smallest hole which is zero focus. The focus point is just at the tip of nozzle.
- Scale range from +7 to -9mm; Scale 0: focus point at nozzle tip; Scale +7: focus point at 7mm above nozzle tip; Scale -9: focus point at 9mm below nozzle tip.

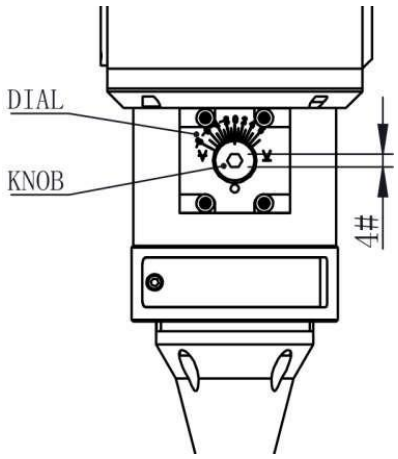


Figure 7 Adjustment of focus point

3 Maintenance

3.1 Cleaning Lens

It's necessary to maintain lenses regularly because of the characteristic of laser cutting process. Cleaning to the cover glass once a week is recommended. The collimating lenses and focusing lenses are recommended to be cleaned once every 2~3 months. In order to facilitate the maintenance of the cover glass, the cover glass holder adopts a drawer type structure.

a. Tools: Dust-proof gloves or fingertip, polyester swab, absolute ethanol, rubber gas blow (purely compressed air).

b. Cleaning instruction:

- To put fingertip onto left thumb and index finger.
- Spray absolute ethanol onto the polyester swab.
- Hold the edge of the lens with left thumb and index finger gently. (note: avoid touching the surface of the lens by fingertip in case of trace)
- Hold the lens to face eyes by left hand and hold the polyester swab by right hand. Wipe the lens gently in single direction, from bottom to top or from left to right (Should not wipe back and forth in case of secondary pollution to lens) and use rubber blow (purely compressed air) to blow the surface of the lens. Both surfaces should be cleaned. After cleaning, make sure that there is no residual like detergent, floating ash, foreign matters and impurities.

3.2 Removal and Installation of Lens

The whole process needs to be completed in a dust free room. Wear dust-proof gloves or fingertips when removing or installing the lenses.

3.2.1 Removal and Installation of Top Cover Glass

The cover glass is wearing part which needs to be replaced once it is damaged.

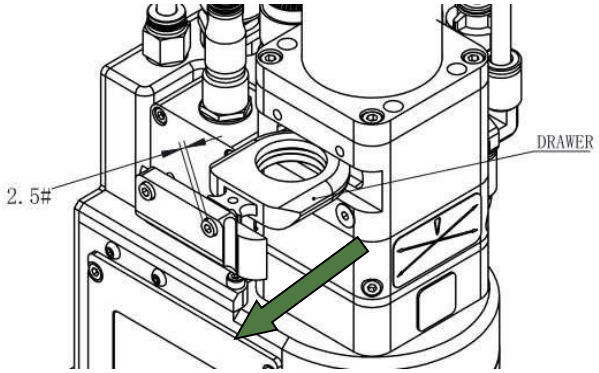


Figure 8 Replacement of top cover glass

- Use an inner hexagon spanner to unscrew the screw of top cover glass (as shown in figure 8);
- Pull out the cover glass holder by pinching the two edges;
- Seal the opening by textured tape so as to prevent the entry of dust;
- Wear the fingerstall and take out the cover glass;
- Clean the cover glass, cover glass holder and seal rings. replace a new one if the seal ring is damaged;
- Install the cleaned cover glass (regardless of the front or back surface) into the holder;
- Re-install the seal ring;
- Re-insert the cover glass holder to the laser processing head and tighten the locking screw.

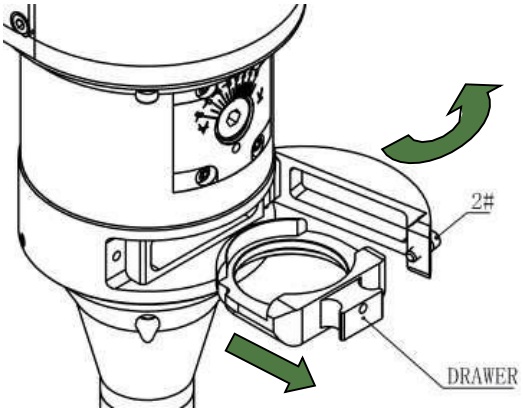
Note: It is not allowed to pull out the edge of seal ring directly as it is very easy to damage the elastic seal ring.

3.2.2 Removal and Installation of Cover glass

The cover glass is wearing part which needs to be replaced once it is damaged.

- As shown in Figure 9, open the buckle to pull out cover glass holder by pinching 2 edges of drawer type holder.
- Remove the pressing ring of the cover glass and cover glass after wearing fingertips
- Clean the cover glass, cover glass holder and seal ring. The elastic seal ring should be replaced if it is damaged.
- Install the cleaned cover glass (Regardless of the front or back surface) into the holder of cover glass.
- Install the pressing ring.
- Insert the cover glass holder back to the laser processing head and fasten the buckle.

Note: It is not allowed to pull out the edge of seal ring directly as it is very easy to damage the elastic seal ring.



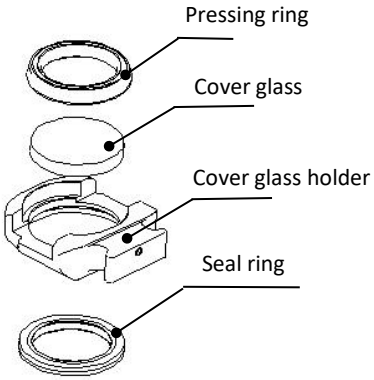


Figure 9 — Replacement of cover glass

3.2.3 Removal and Installation of Collimation lens

- Removal and installation of collimating lenses refers to the following steps:
- Remove the laser head and move to a dust free room. Clean all dusts on the laser head surface;
- Use a 3mm internal hexagonal wrench to unscrew the locking screws of the collimator (as shown in Figure 9), seal the opening with textured tape so as to prevent the entry of dust;
- Screw out the collimating lens holder, and remove the pressing ring and collimation lens by lens tool;
- Replace or clean the collimating lenses.
- As shown in Figure 11, reassemble the collimation lens assembly, pay attention to screw the pressing ring properly, and re-screw it into the collimator;
- Lock the bolts of the collimator;
- Check whether the focus point is in the center of the nozzle hole before use. If not, it is necessary to do beam centering.

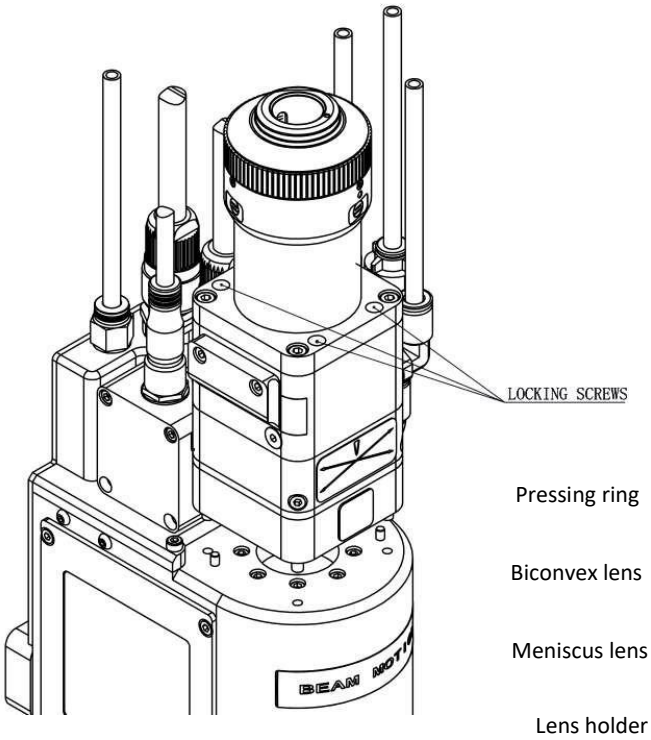


Figure 10 Removal of collimation lens assembly

Attention: the biconvex lens gets 1 big curve face and 1 small curve face. The small curve face shall be next to concave face of meniscus lens

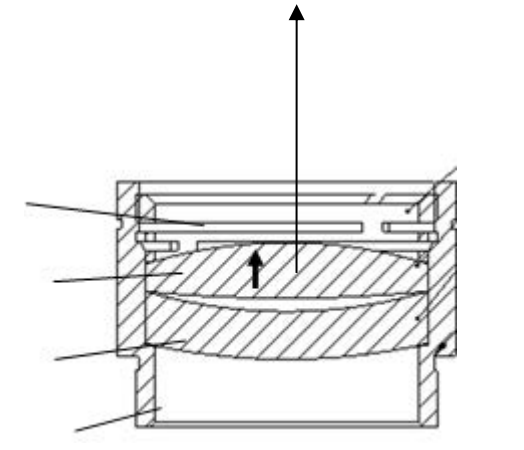


Figure 11 Installation of collimation lens

3.2.4 Removal and Installation of Focus Lens

- Removal and installation of focus lenses refer to the following steps:
- Remove the laser head and move to a dust free room. Clean all dusts on the laser head surface;
- Unscrew the locking screw as figure 12;
- Take out focus lens assembly and seal opening by textured tape;
- Remove the pressing ring and focus lens by lens tool;
- Replace or clean the focus lens.
- As shown in figure 13, put the focusing lens and pressing ring into the lens holder carefully and tighten the pressing ring properly;
- Install the focus lens assembly into cutting head and tighten screw.
- Check if the focus point is at the center of nozzle. If not, you need to repeat beam adjustment procedure.

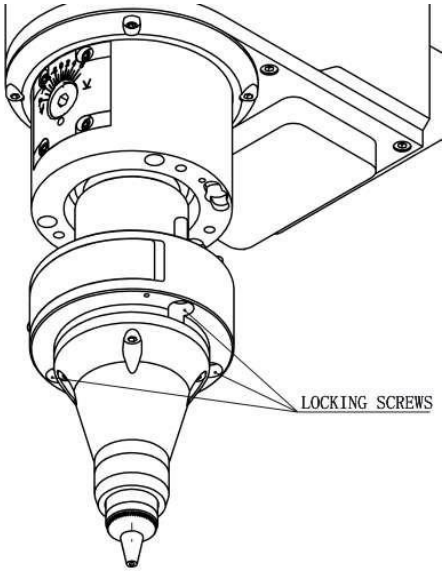


Figure 12 Removal of focus lens assembly

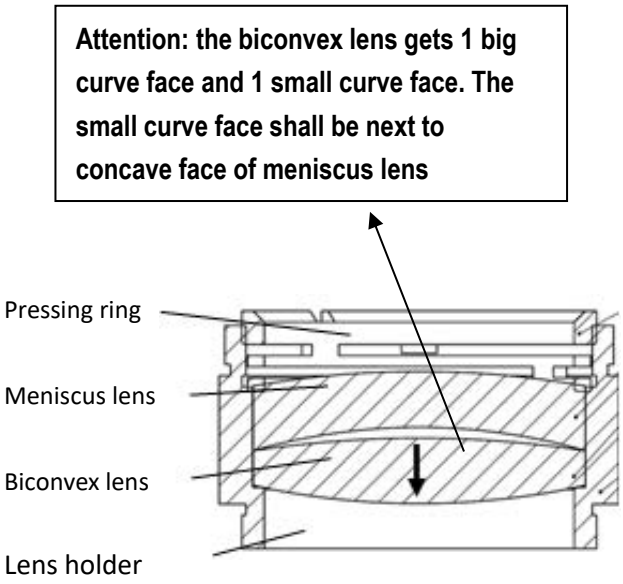


Figure 13 Installation of focus lens

3.3 Replace Nozzle Connector

3.3.1 Replace Ceramic Body

- Unscrew the nozzle;
- Press the ceramic body to make it fixed and not oblique and then screw off the fastener;
- Align the pin hole of the new ceramic body to 2 locating pins and press the ceramic body to screw on the fastener;
- Screw on the nozzle and tighten it with appropriate strength.

3.3.2 Replace Nozzle

- Unscrew the nozzle
- Replace with a new nozzle and re-tighten it with appropriate force.
- Do the capacitance calibration once again after replacing the nozzle or ceramic body.