RAYTOOLS

BT220 SERIES

2kW Manual Focus Laser Cutting Head - User Manual

Document History

Edit date	Version	Topic, revision, action taken
2023/11/27	V1.0	First edition

Thank you for choosing our product!

This manual describes the installation and commissioning of laser cutting head 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.

If you find any errors in this document, please inform us as soon as possible. The data contained in this manual is only used to describe the product and shall not be regarded as a statement of security interest.

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

Raytools AG

Email: sales@raytools.com
Website: www.raytools.ch

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

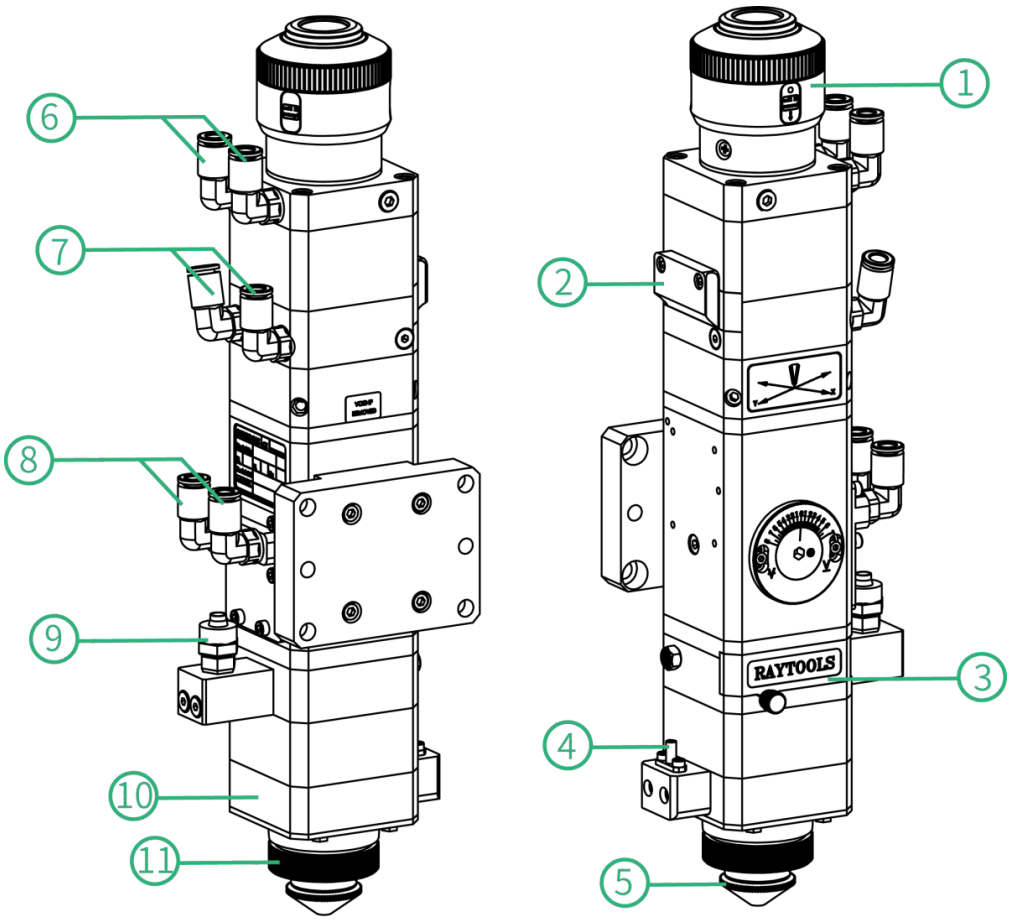
- Observe the storage temperature range allowed by the technical data.
- Take reasonable measures to prevent fire, vibration or impact.
- Do not store in or near the magnetic field.

Contents

1 Product Summary 1
1.1 Structure (with QBH Interface) 1
1.2 Feature 2
1.3 Technical Datasheet 2
1.4 Mechanical Size 3
1.5 Physical Interface 6
2 Mechanical Installation 7
2.1 Fiber Insertion 7
2.2 Mounting of Laser Cutting Head 8
2.3 Earthing of Laser Cutting Head 9
2.4 Inspection of Top Cover Glass (1st Installation/Replacement of Fiber) 10
2.5 Connection of Cooling Water and Assist Gas 11
3 Beam Alignment and Zero Focus Correction 13
3.1 Beam Alignment 13
3.2 Zero Focus Correction 14
4 Maintenance 15
4.1 Cleaning Lens 15
4.2 Removal and Installation of Lenses 16
4.3 Replace Ceramic Body and Nozzle 19
Consumables 22

1 Product Summary

1.1 Structure (with QBH Interface)



1 Fiber Interface
2 Top Cover Glass Assy
3 Bottom Cover Glass Assy
4 Preamplifier Interface
5 Ceramic Body & Nozzle
6 &7 & 8 Water Cooling Interface (□6)
9 Cutting Gas Interface (□8)
10 TRA (Nozzle Assy)
11 Retaining Ring

1.2 Feature

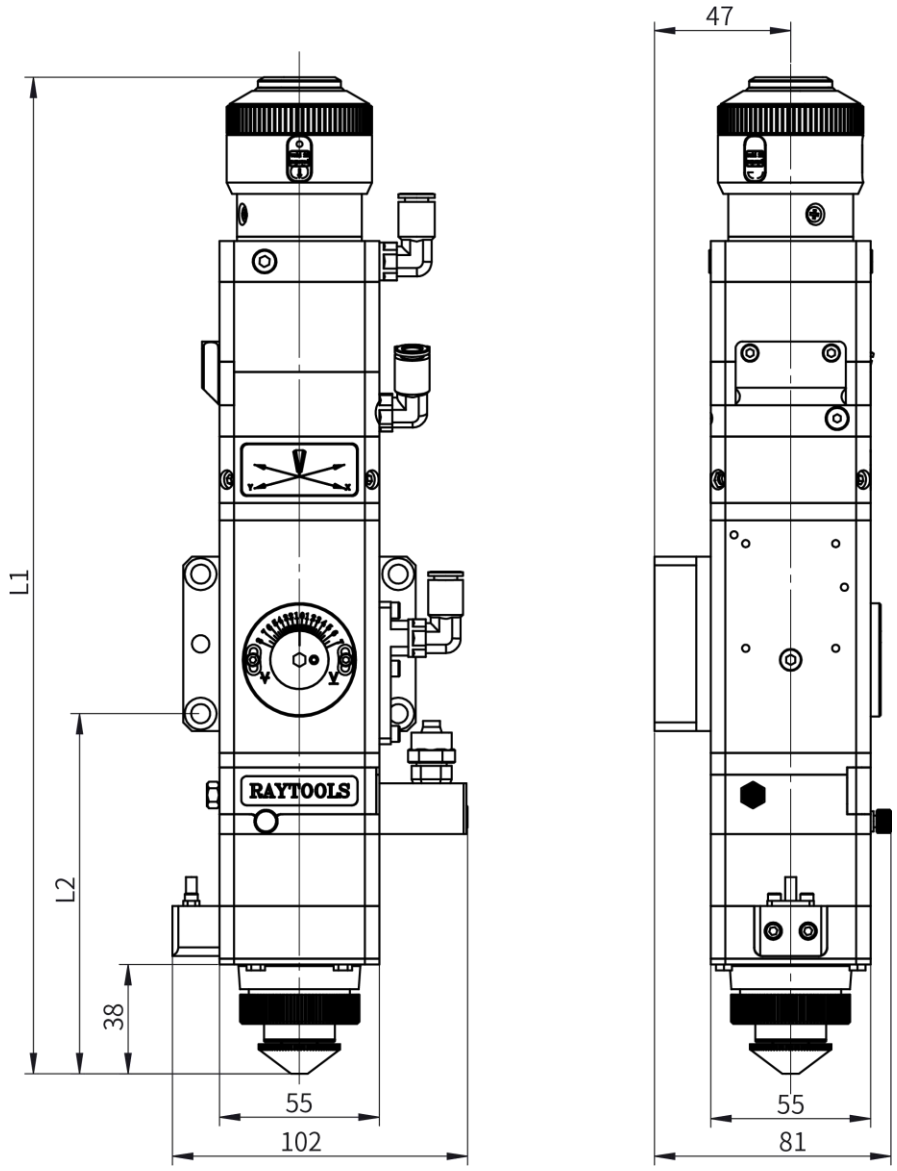
- Light and small
- Various mounting ways such as screw mounting and dovetail mounting.
- Multiple applications including flat cutting, 3D cutting, etc.
- Manual adjustment of focus position, convenient to operate

1.3 Technical Datasheet

Model		BT220
Wavelength		1064nm
Fiber Interface		QBH
Power Rating		2kW
Flat	Collimation Length (fC)	75/100mm
	Focusing Length (fF)	100/125mm
3D	Collimation Length (fC)	75/100mm
	Focusing Length (fF)	150mm
NA max		0.13
Focus Range-Vertical		-8mm…+7mm
Focus Range-Horizontal		-1mm…+1mm
Mounting Size of Cutting Head		4xM6.6
Mounting Size of Pin		2×Ø6
Mounting Size of Preamplifier		4xM3
Cutting Gas		⌀8, max. 25bar
Water Cooling		⌀6, max. 5bar, min. 1.8L/min
Operating Temperature		5℃～55℃
Humidity		30％～95％, without condensing
Weight		About 2.3kg

1.4 Mechanical Size

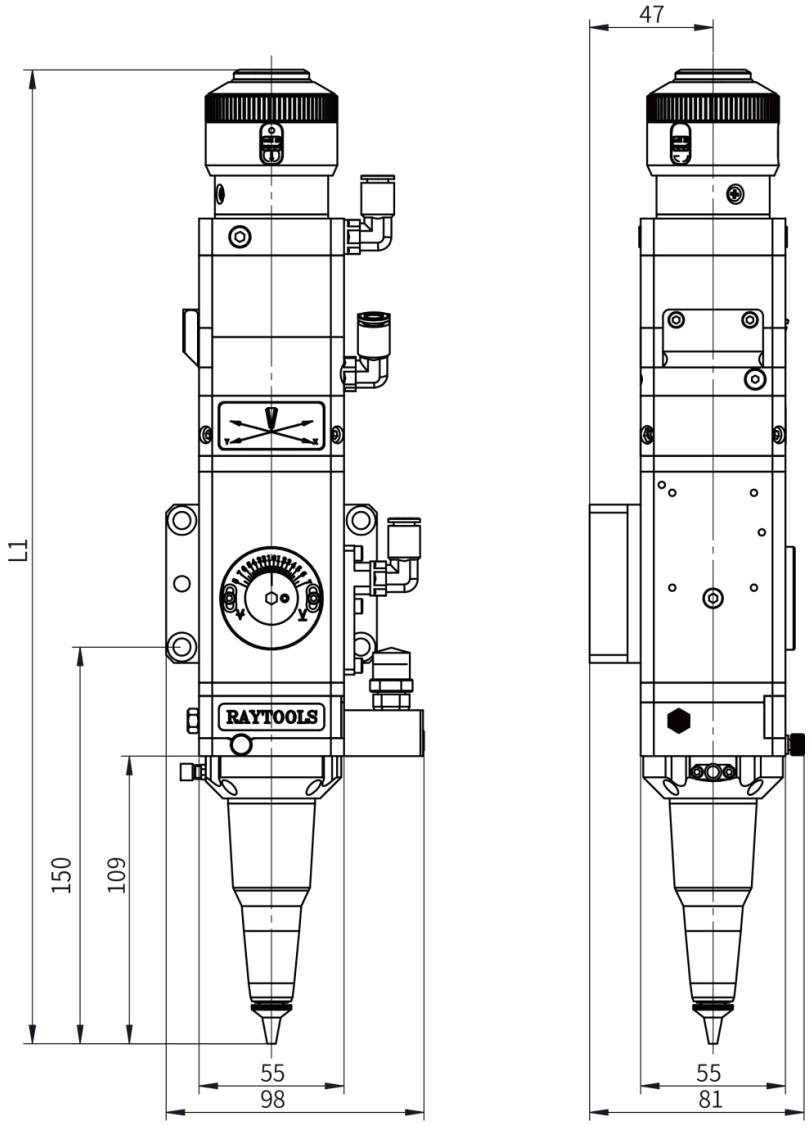
1.4.1 Flat Cutting



Optical Configuration (fC: fF)	L1	L2
75:100	293	99
75:125	318	124
100:100	318	99
100:125	343	124

1.4.2 3D Cutting

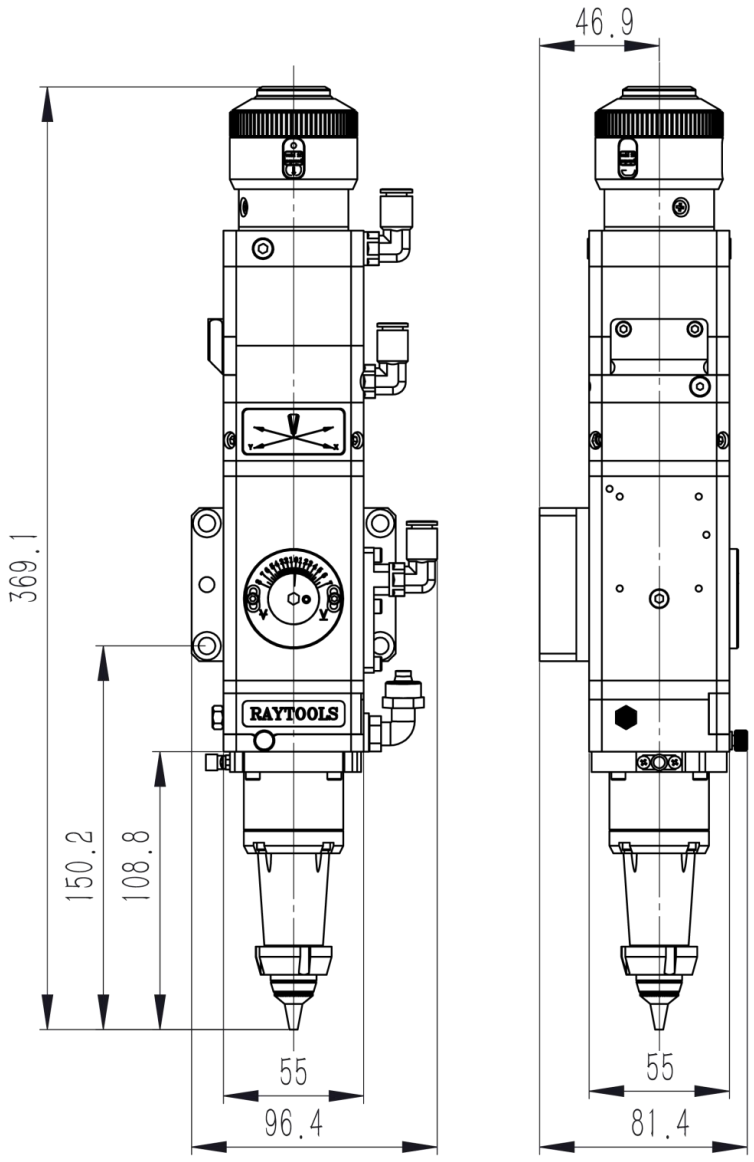
without ceramic body



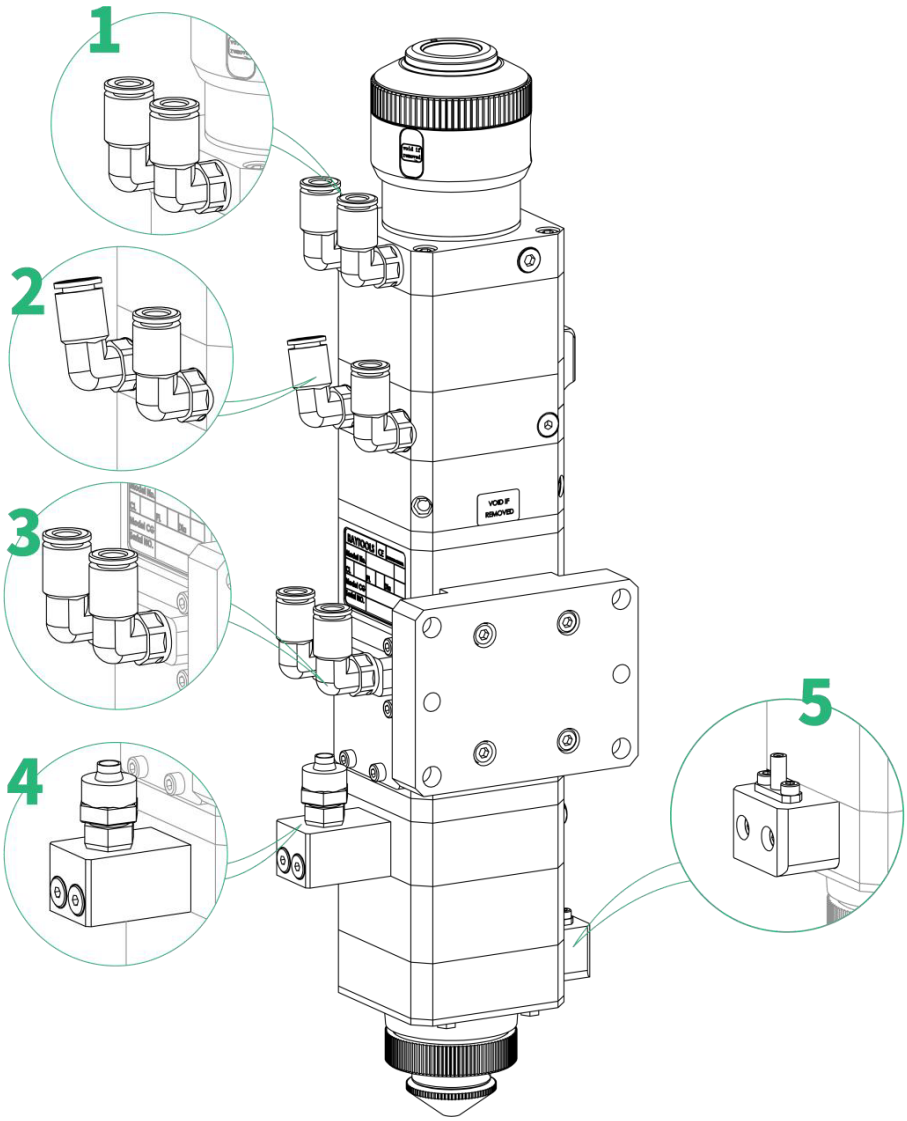
Optical Configuration (fC: fF)	L1
75:150	344
100:150	369

with ceramic body

Optical Configuration (fC: fF): 100:150



1.5 Physical Interface



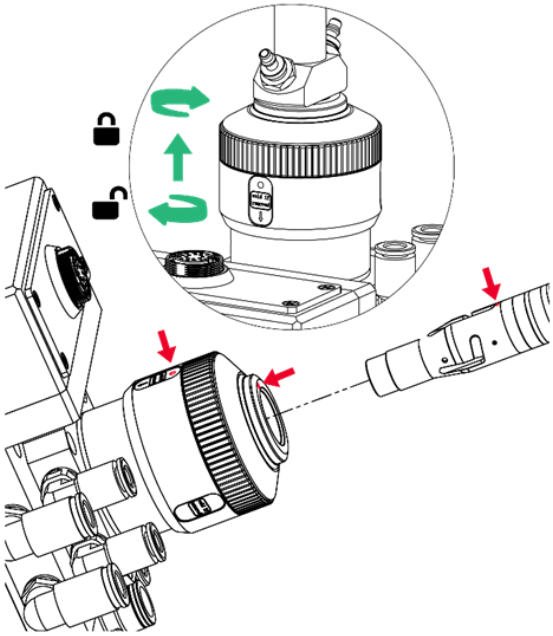
No. 1	Cooling water (⌀6)	No. 4	Cutting gas (⌀8)
No. 2	Cooling water (⌀6)	No. 5	Preamplifier Interface (SMB)
No. 3	Cooling water (⌀6)		

2 Mechanical Installation

2.1 Fiber Insertion

WARNING: The optical components must be dust free and all dusts must be cleaned before use. The fiber shall be horizontally inserted into fiber interface to prevent dust from entering the interface and falling on the surface of the lens. Upper limit in the fiber before fixing the laser head.

2.1.1 QBH Fiber Insertion

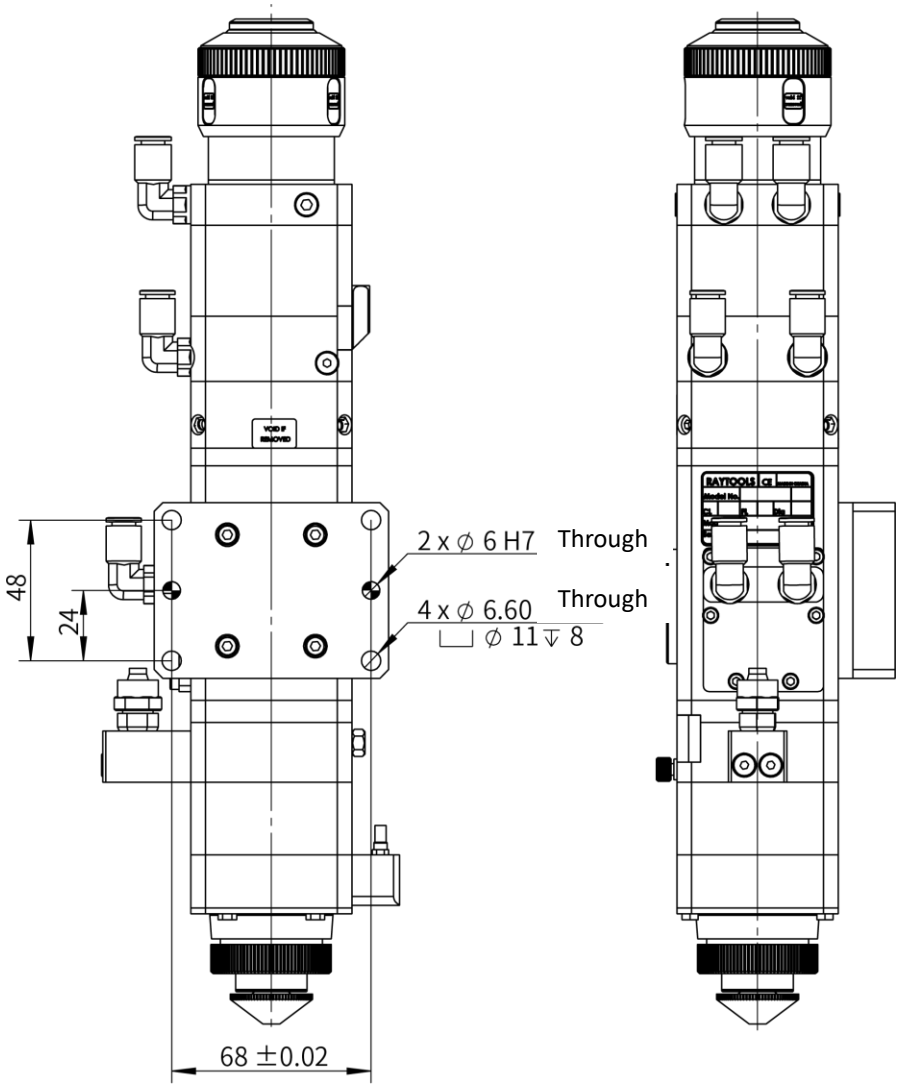


- Align the red point at the end of the QBH interface to the red point of the handwheel.
- Remove QBH dustproof cover.
- Align the red mark of male fiber end to red mark on female QBH of cutting head when you insert the fiber end straightly to bottom of QBH interface of cutting head.
- Turn the QBH handwheel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

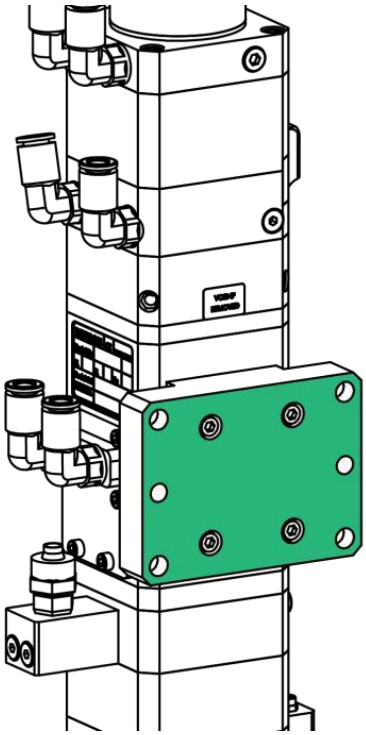
It is recommended to use textured tape to seal the connection of female and male fiber interface after the installation is finished in order to prevent from dust as much as possible in critical dusty environment.

2.2 Mounting of Laser Cutting Head

The mounting of laser cutting head to machine tool is shown as below. Customers are advised to Install the laser head perpendicular to the bed surface as requested and make sure the laser head is locked, which is one of the premises to ensure the stable cutting.



2.3 Earthing of Laser Cutting Head

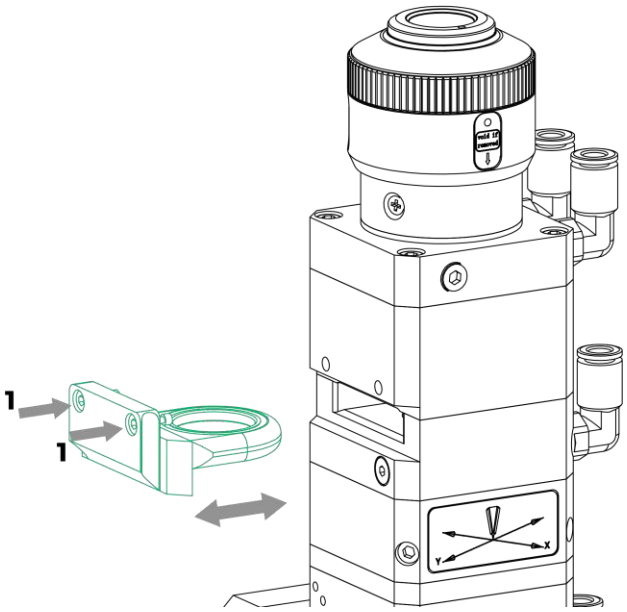


Earthing

The shaking or vibration of cutting head due to incorrect earthing could cause damage to sensor mechanism and machine.

2.4 Inspection of Top Cover Glass (1st Installation/Replacement of Fiber)

Maintenance or Repair shall be implemented at dust free workstation.

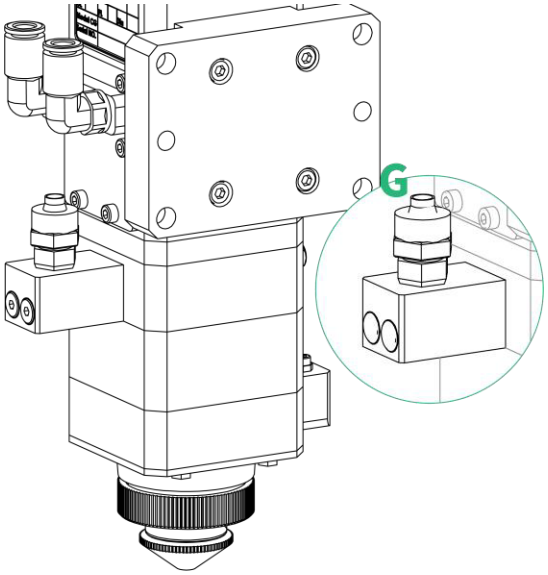


- Loose bolts (item 1) and pull out the glass holder until you see the complete cover glass.
- Seal the openings of cutting head by textured tape immediately.
- Check if the top cover glass is clean. If not, blow the cover glass by clean compressed air until it is clean.

The cover glass shall be replaced if it cannot be cleaned or a damage happens.

2.5 Connection of Cooling Water and Assist Gas

2.5.1 Connection of Cutting Gas

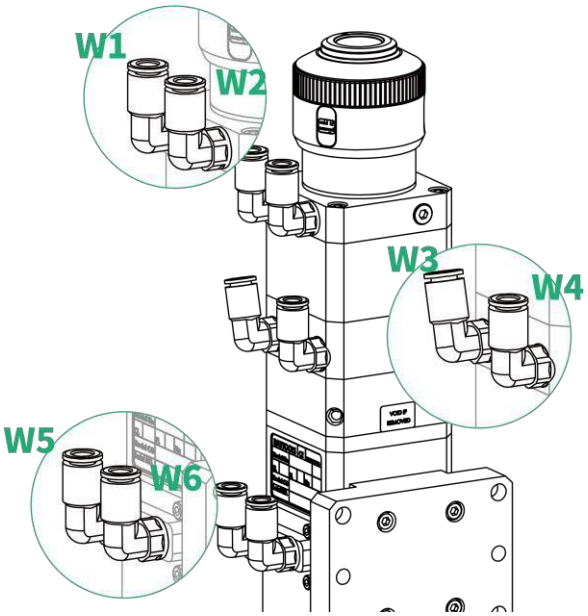


The impurity in cutting gas such as hydrocarbon and steam will damage the lens and cause cutting power fluctuation as well as inconsistencies between the sections of the work piece. The table below is the recommended cutting gas specification. The higher the purity of the gas, the better the quality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

Gas	Purity	Maximum content of water vapor	Maximum content of hydrocarbon
Oxygen	＞99.95%	<5 ppm	<1 ppm
Nitrogen	＞99.995%	<5 ppm	<1 ppm
Argon/ Helium	＞99.998%	<5 ppm	<1 ppm
Diameter of cutting gas pipe (Outer diameter)		ø8mm (G)	
Gas Pressure		Max. 25bar (2.5MPa)	

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.

2.5.2 Connection of Cooling Water



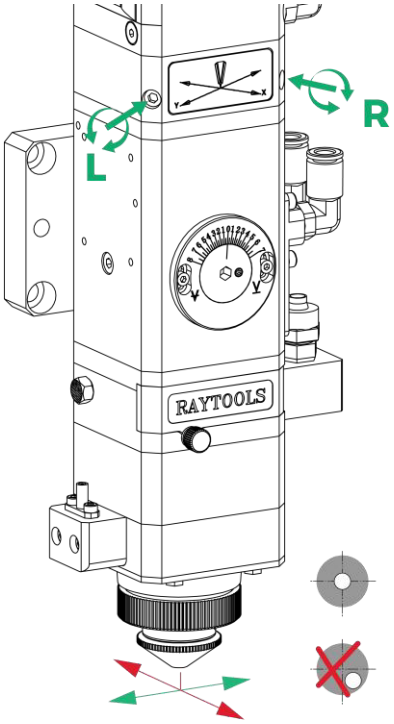
It is important to note that when the laser power is greater than 500W, it is recommended to use water cooling. The recommended water flow is suggested below.

- Cooling pipeline of **fiber interface**: W1,W2
- Cooling pipeline of **collimation module**: W3,W4
- Cooling pipeline of **the machine**: W5,W6

Outer diameter of water hose	⌀6mm
Minimum flow speed	1.8 l/min
Entry pressure	170-520kPa
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

3 Beam Alignment and Zero Focus Correction

3.1 Beam Alignment



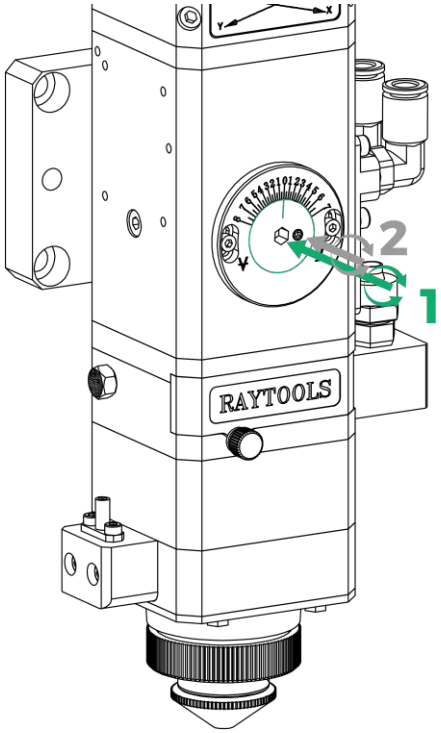
Cutting quality in a great extent depends on whether the lens is in the middle. If the lens is not in the middle, the laser beam may contact with nozzle or inner wall to produce high temperature deformation. Lens alignment operation should be considered when nozzle is replaced or the cutting quality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

Lens alignment of laser cutting head can be finished by adjusting focus lens, X-Y direction. The X/Y adjusting knob is located above bottom cover glass as shown below. Adjusting the 2 knobs 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 is tape dotting method as below:

- Fix the cutting head with a big size nozzle (tip size shall be larger than beam size) or adjust to nearly zero focus.
- Pick a scotch tape, flatten it and stick it to the nozzle tip.
- Open the red light of the laser. Find and observe the position of red light in the scotch tape.
- Shoot laser at low power to check beam penetration size. Beam penetration shall be circle and located in the nozzle tip center.
- Adjust the 2 X/Y adjusting knobs to get beam aligned. The max X/Y adjusting range is roughly from -1.5mm to +1.5mm.
- Tear off the tape and check the shooting hole position in tape.
- Repeat the above steps to find out relatively centered position.

3.2 Zero Focus Correction

Loosen the screw (item 2), rotate the dial by turning the hole (item 1) with a hexagonal wrench, the scale points to the corresponding position (i.e. the vertical offset of the focus), then tighten the screw (item 2).



Note:

1. **Counterclockwise → negative focus direction； clockwise → positive focus direction; focus range: -8mm…+7mm;**
2. Mechanical and optical manufacturing tolerance, matching tolerance between imaging proportion of optical component and optical fiber will have other effects on the actual focus position.
3. Adjust the focus offset according to the actual situation.

4 Maintenance

4.1 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.

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

Cleaning instruction:

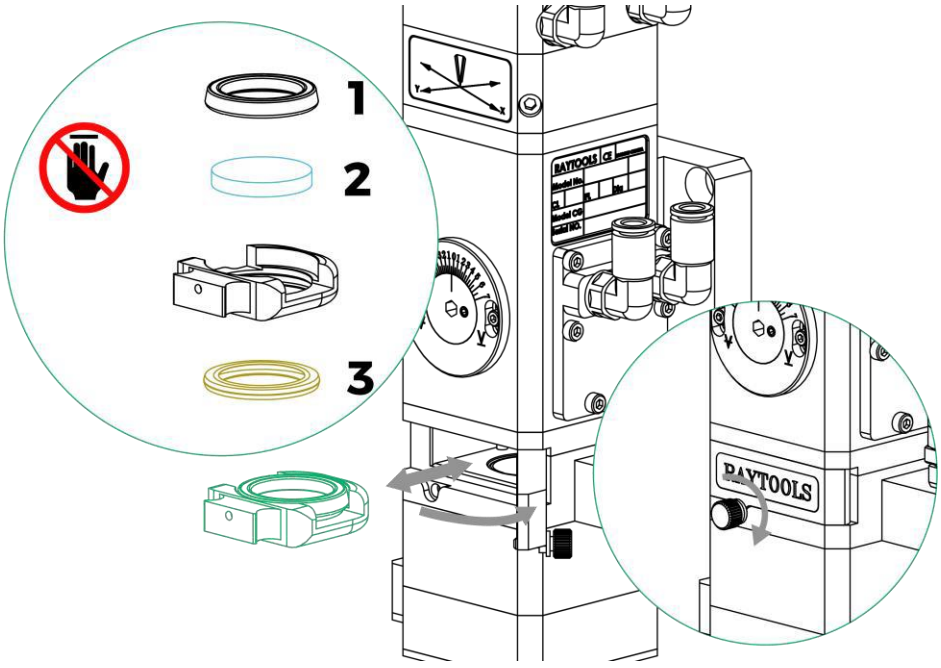
- To put fingertip onto left thumb and index finger.
- Spray absolute ethanol onto the polyester swab.
- Hold the edge of the lens with left thumb and index finger gently. (note: avoid touching the surface of the lens by fingertip in case of trace)
- Hold the lens to face eyes by left hand and hold the 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.

4.2 Removal and Installation of Lenses

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

4.2.1 Removal and Installation of Bottom Cover Glass/Protection Glass

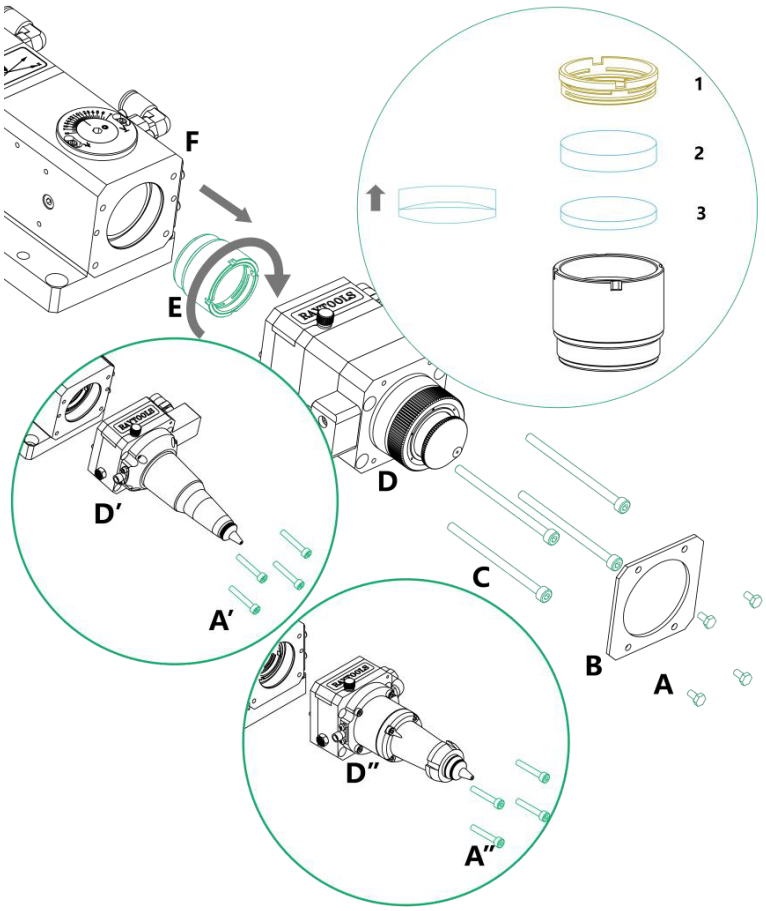
The cover glass is wearing part which needs to be replaced once it is damaged.



- As shown above, loose the bolts to pull out cover glass holder by pinching 2 edges of drawer type holder.
- Seal the mounting openings by textured tape immediately.
- Remove the pressing ring (1) and cover glass (2) after wearing fingertips
- Clean the cover glass holder and seal ring (3). The elastic seal ring (3) should be replaced if it is damaged.
- Install the cleaned or new 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 head and tighten the bolts.

It is not allowed to pull out the edge of seal ring directly as it is very easy to damage the seal ring. Please wear the clean gloves or fingertips.

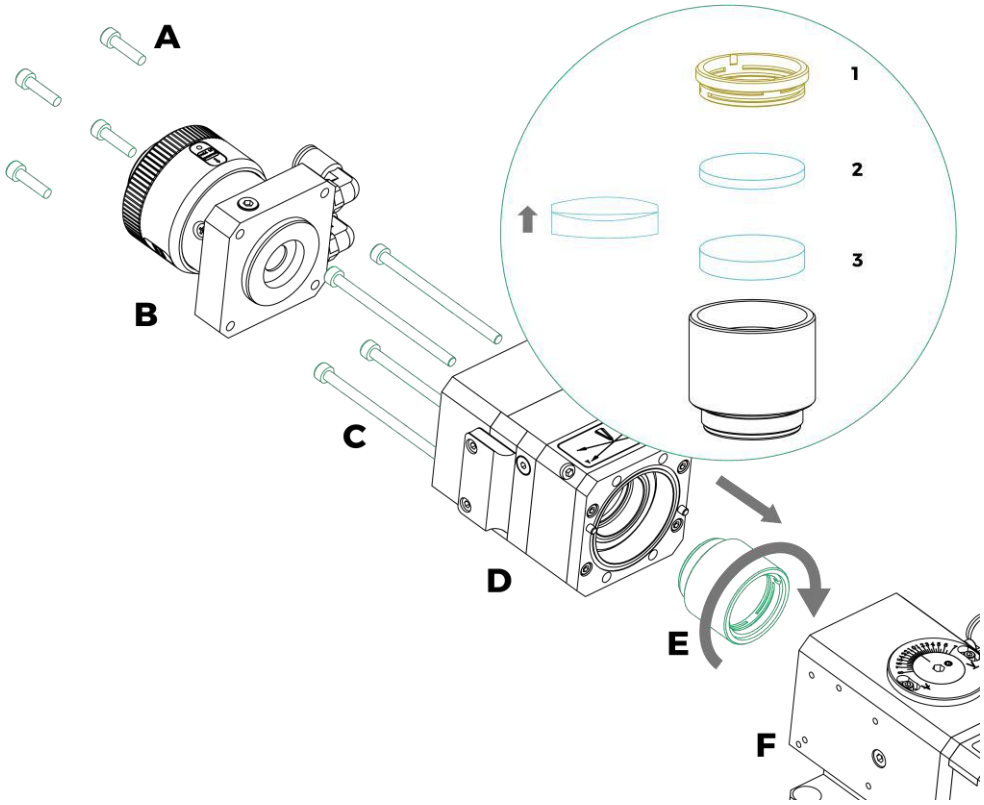
4.2.2 Removal and Installation of Focus Lens



- Clean all dusts on the laser head surface.
- Loose the bolts (A) as above to remove the cover (B) and loose the bolts (C) to remove the assembly (D)/ Loose the bolts (A'/A'') to remove the assembly (D'/D'') for 3D cutting head.
- Seal mounting openings (D&F) by textured tape immediately.
- Move the focus module by the lens tool (Product ID: 120570009C). Remove the pressing ring (1) and focus lenses (3--biconvex one and 2—meniscus one) in sequence.
- Replace or clean the focus lenses (as per direction above, the small curved face of biconvex lens shall be close to concave face of meniscus lens).
- Put focus lenses (2—meniscus one and 3--biconvex one) and pressing ring (1) into the lens holder. Tighten it by bolts.
- Insert the focus lens holder into the cutting head and tighten the bolts.

Check if the beam is aligned. If not, please do the alignment as per chapter 3.1.

4.2.3 Removal and Installation of Collimation Lens

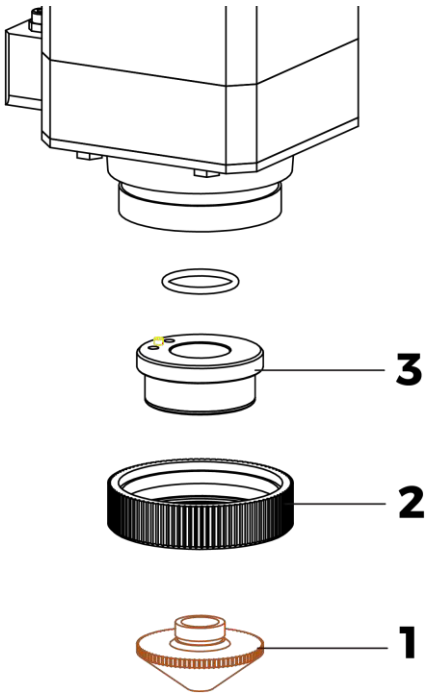


- Remove the laser head and move to a dust free room. Clean all dusts on the laser head surface.
- Loose the 4 bolts (A) as above to pull out fiber interface assembly (B).
- Loose the 4 bolts (C) as above to pull out D assembly.
- Seal the mounting openings (B &D &F) by textured tape immediately.
- Move the collimation module (E) by the lens tool (Product ID: 120AH0001A). Remove the pressing ring (1), and collimation lenses (3--meniscus one and 2—biconvex one) in sequence.
- Replace or clean the collimation lenses (as per direction above, the small curved face of biconvex lens shall be close to concave face of meniscus lens).
- Put collimation lenses (2--biconvex one and 3—meniscus one) and pressing ring (1) into the lens holder. Tighten the holder by bolts.
- Mount the assembly back to the cutting head and tighten the bolts.

Check if the beam is aligned. If not, please do the alignment as per chapter 3.1.

4.3 Replace Ceramic Body and Nozzle

4.3.1 Flat TRA Assy



The nozzle is required to be replaced if it gets crash or damaged by laser beam. The dirt on ceramic body is required to be cleaned or to replace the ceramic body if it gets crash.

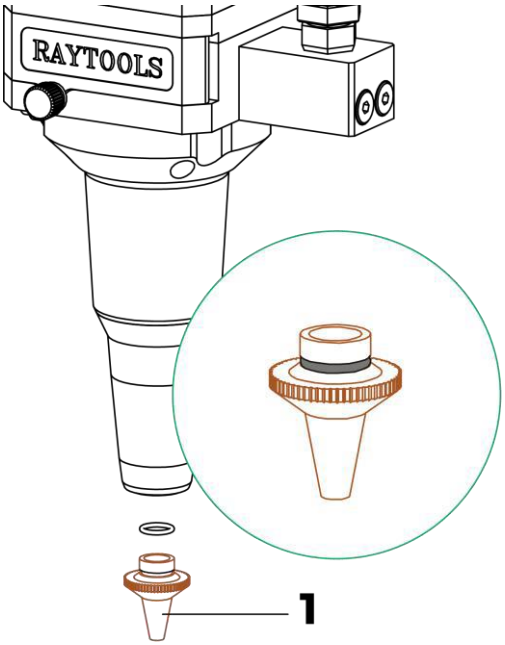
- Unscrew the nozzle (1).
- Press the ceramic body (3) upward by hand to make it fixed without deflection and then unscrew the retaining ring (2).
- Align the pin hole of the new ceramic body with the locating pin. Press the ceramic body (3) upward by hand and tighten the retaining ring (2).
- Screw the new nozzle (1) and get it properly tightened.
- Do the capacitance calibration once again after replacing the nozzle or ceramic body.

Only tighten the nozzle and retaining ring by hand (without tools) otherwise it could damage the ceramic body.

Keep the contact surface of all parts clean.

4.3.2 3D TRA Assy

Without ceramic body



The nozzle is required to be replaced if it gets crash or damaged by laser beam. The dirt on ceramic body is required to be cleaned or to replace the ceramic body if it gets crash.

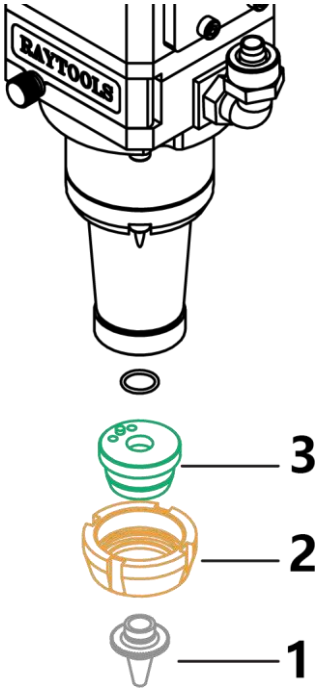
- Unscrew the nozzle (1).
- Replace the seal ring if damage happens.
- Screw the new nozzle (1) and get it properly tightened.
- Do the capacitance calibration once again after replacing the nozzle or ceramic body.

Only tighten the nozzle and retaining ring by hand (without tools) otherwise it could damage the ceramic body.

Keep the contact surface of all parts clean.

4.3.3 3D TRA Assy

With ceramic body



The nozzle is required to be replaced if it gets crash or damaged by laser beam. The dirt on ceramic body is required to be cleaned or to replace the ceramic body if it gets crash.

- Unscrew the nozzle (1).
- Press the ceramic body (3) upward by hand to make it fixed without deflection and then unscrew the retaining ring (2).
- Align the pin hole of the new ceramic body with the locating pin. Press the ceramic body (3) upward by hand and tighten the retaining ring (2).
- Screw the new nozzle (1) and get it properly tightened.
- Do the capacitance calibration once again after replacing the nozzle or ceramic body.

Only tighten the nozzle and retaining ring by hand (without tools) otherwise it could damage the ceramic body.

Keep the contact surface of all parts clean.

Consumables

Name	Technical Data	Material Code
Fiber Interface	QBH	211FIA3003
Lens	Biconvex Spherical Lens D28-F100A	3250010293
	Meniscus Spherical Lens D28-F100B	3250010294
	Biconvex Spherical Lens D28-F125A	3250010295
	Meniscus Spherical Lens D28-F125B	3250010296
Cover Glass	D24.9x1.5-4K,1064nm	211LCG0020
	D27.9x4.1-4K,1064nm	211LCG0037
Seal	32.2(0.05/0)x24x3.55	11021M2110007
Nozzle	2D Single Layer Φ1.5	120AU3515A
	2D Single Layer Φ2.0	120AU3520A
	2D Single Layer Φ3.0	120AU3530A
	2D ouble Layer Φ1.5	120AU3615A
	2D Double Layer Φ2.0	120AU3620A
	2D Double Layer Φ3.0	120AU3630A
	3D Single Layer M11-Φ1.2	120GJT1112
	3D Single Layer M11-Φ1.3	120GJT1113
	3D Single Layer M11-Φ1.4	120GJT1114
	3D Single Layer M11-Φ1.6	120GJT1116
	3D Single Layer M11-Φ1.8	120GJT1118
	3D Single Layer M11-Φ2.0	120GJT1120
	3D Single Layer M11-Φ3.0	120GJT1130
	3D Single Layer M11-Φ4.0	120GJT1140
	3D Single Layer M11-Φ5.0	120GJT1150
	3D Double Layer M11-Φ1.2	120GJT1412
	3D Double Layer M11-Φ1.3	120GJT1413
	3D Double Layer M11-Φ1.4	120GJT1414
	3D Double Layer M11-Φ1.6	120GJT1416
	3D Double Layer M11-Φ1.8	120GJT1418
	3D Single Layer M8-Φ1.2	120GJT0112
	3D Single Layer M8-Φ1.3	120GJT0113
	3D Single Layer M8-Φ1.4	120GJT0114
	3D Single Layer M8-Φ1.6	120GJT0116
	3D Single Layer M8-Φ1.8	120GJT0118
	3D Single Layer M8-Φ2.0	120GJT0120
	3D Single Layer M8-Φ3.0	120GJT0130

Name	Technical Data	Material Code
Nozzle	3D Single Layer M8-Φ4.0	120GJT0140
	3D Single Layer M8-Φ5.0	120GJT0150
Ceramic Body	M8	120515093A
	M11	120515092A