



# BT240S SERIES

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3000W 2D Laser Cutting Head User Manual

**RAYTOOLS**  
Brighten your machine tools

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Thank you for your choosing our product!

This manual makes a detail introduction about the use of BT240S laser cutting head, including installation, setup, operation and service, etc. Please directly contact us if you have other things to know.

Please read this Manual carefully before using the series of cutting head and related equipment. This will help you to use it better.

Because the product keeps renewing, please note the product you receive may differ slightly from the illustrations in this manual in some aspects. We apologize for your inconvenience here.

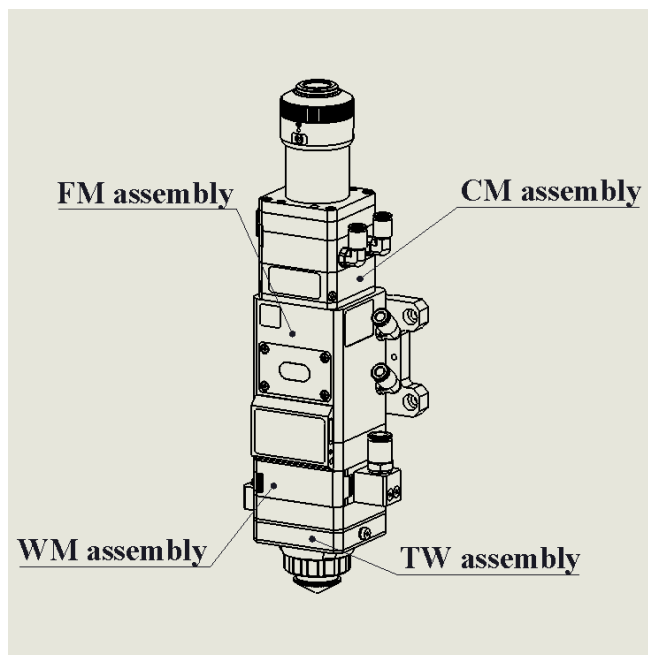
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## 1 Summary

This manual covers the general description of BT240S series products, including the basic installation, factory settings, operation, use and maintenance services and other aspects. There are a lot of specific optical mechanical or customization configurations, so only the main unit parts will be introduced in this manual.

The **BT240S** series is an optical fiber cutting head used by **RAYTOOLS AG** Company for the production and application of **3000W** industrial lasers, its overall optimized optical focusing system, annular gas path and turbulent air flow and nozzle cooling design, built-in water-cooling unit and fine adjustment of focus position and other characteristics can fully meet the industrial laser processing environment of thin plate, medium and thick plate cutting and other customized requirements for different applications. A variety of flexible optical fiber interface options and optical collimating focusing configurations can adapt it to the industry's various mainstream fiber lasers.



### 1.1 Product Characteristics

- Optimized optical configuration and smooth and efficient airflow design;
- With many kinds of optical fiber interfaces and can be adapted to all kinds of fiber lasers.
- Can calibrate dial test precision focus adjustment with the adjustable range of 20mm and the precision of 0.05mm;
- Improved to be in the structure of collimation and focus double-drawer protective lens;

- Increase the function of replacing of dust-proof of focus protective lens;
- Nozzles, focus lens and collimating mirrors all have a cooling structure;
- Increase the active anti-collision function (this function can be realized only with the corresponding sensor);
- Carry out gas path optimization to make the auxiliary cutting gas more concentrated and improve the cutting efficiency and cutting quality;
- Improve the structure of QBH connecting base, which enhances reliability;
- Increase the indication and correction function of "zero focus" scale;
- Tight sealing design greatly reduces the contamination probability of lens.

As shown in Figure. 2, the laser head includes four basic units, namely 1) collimation module component CM, 2) focusing module component FM, 3) protection window module component WM, and 4) nozzle module component TM to make up a light beam.

- 1) CM component: finish the fiber collimation function, collimate the incident laser beam into parallel beams and make center-regulation;
- 2) ATP component: adjust the angle of the incident beam for the laser head of collimated light that does not require collimation, that is, the center-regulating of beam;
- 3) FM component: focus collimating beam to a high power density convergent beam, and make the focus position to move up and down;
- 4) WM component: protective lens can protect the focusing lens from the damage of return slags and extend the life of focusing lens;
- 5) TM component: guide the convergent beam to the workpiece and generate high-speed airflow jet joint-cuttings to achieve high-quality cutting.

## 2 Installation-Mechanical Part

### 2.1 Hole Site Installation

The BT240S laser head is fixed through the installation plate and the machine tool connected to the FM component, and the relationship between the size and position of the installation hole is shown in Figure 2. It is suggested that the client should install the laser head vertically on the processing board face according to the requirements of the drawing, and ensure that the laser head is locked and has no sloshing during the processing. This is one of the prerequisites for guaranteeing subsequent stability of cutting effect.



**Note: the Z-axis sliding base for fixing laser processing head should be connected with machine tools and well grounded.**

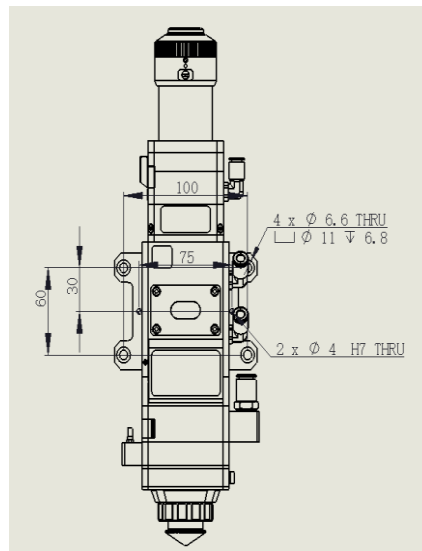


Figure 2 Diagram of mounting plate

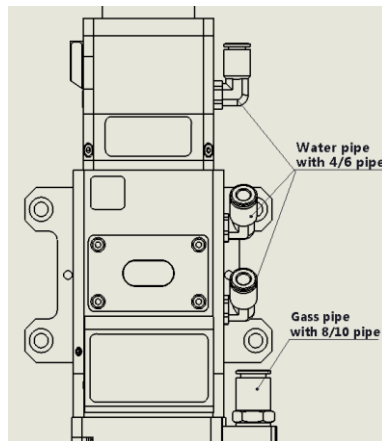
## 2.2 Water Pipe and Gas Pipe

### 2.2.1 Water-cooled Interface

|                                     |   |
|-------------------------------------|---|
| <b>Minimum flow speed</b>           | 1.8 L/min(0.48gpm)                          |
| <b>Entry pressure</b>               | 170-520kPa(30-60 psi)                       |
| <b>Entry temperature</b>            | ≥room temperature /> dew point              |
| <b>Hardness (relative to CaCO3)</b> | <250mg/liter                                |
| <b>PH range</b>                     | 6 to 8 (deionized water or distilled water) |
| <b>Particles size available</b>     | The diameter is less than 200 microns       |

BT240S processing head is equipped with a set of waterways for cooling water, the direction of its water entry and exit can be arranged at will. It is necessary to note that water cooling is recommended when the laser power is more than 500 watts. The position and quantity of the water cooling joint can be seen from Figure 3. The recommended water speed is listed below in detail, [and please adjust the temperature of the cooling water at room temperature of ±5℃](#).

This water-cooled interface is designed as a closed-loop water-cooled system and can also be used in cooperation with external free water supply to meet the requirements in the above list.



**Figure 3 Water and gas water pipe connector position of two-dimensional laser**

## 2.2.2 Assist Gas Interface

Impurities such as hydrocarbons and water vapor in the auxiliary gas can damage the lens, and causing cutting power fluctuations will also result in inconsistencies in the workpiece section. The following table shows the recommended auxiliary gas specifications.

| Gas      | Purity  | Maximum content of water vapor(ppm) | Maximum content of hydrocarbon(ppm) |
|----------|---------|-------------------------------------|-------------------------------------|
| oxygen   | 99.95%  | <5 ppm                              | <1 ppm                              |
| nitrogen | 99.995% | <5 ppm                              | <1 ppm                              |
| argon    | 99.998% | <5 ppm                              | <1 ppm                              |
| helium   | 99.998% | <5 ppm                              | <1 ppm                              |

Impurity can be filtered out in gas supply tube, but oxygen and water vapor can permeate the system through nonmetal materials, which is the source of the appearance of dust and hydrocarbon. Stainless steel fittings are recommended, operators must use filters which can remove a minimum of 0.01 micron particle to purify the light path system, and meanwhile, use a filter to reduce the diameter of the particles passing through to less than 0.01 micron.

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.



**CAUTION: gas interface can not be replaced arbitrarily, especially do not use PTFE TAPE, Otherwise, the gas path will be blocked, the normal cutting will not be possible and the laser head parts will be damaged at the same time.**



**Note: the gas pipeline on the customer site is likely to hide condensate water, pite tape for joint sealing and other impurities, after valving the gas for 3-5min under the pressure of more than 15bar, access the air pipe to the laser head.**

## 2.3 Fiber Input Interface

BT240S is suitable for most industrial laser generators. It is equipped with a collimator assembly.

The connection between the end of the fiber and the cutting head is called fiber optic splice. The common types of fiber optic splices include QBH, QCS and QD. In respect of QCS joint, BT240S BT240S has 14mm, 24mm, 25mm, 30mm clip ring interfaces, other optical fibre splices can also fit. Each optical fibre splice has its own unique fixing methods. Please refer to the corresponding introduction of fiber optic splices. Figure 1 shows the installation interface of the QBH joint.



**Warning: the optical device must be kept clean. All dust must be removed before use. If the laser head is inserted vertically by the fiber, then the laser head must be rotated 90 degrees to the horizontal position, and then insert the fiber to prevent dust from falling on the surface of**



the lens. After fixing the fiber, fix the laser head.

## 2.4 Insertion Direction Adjustment of Fiber Interface

This article explain the fiber insertion method of the QBH splice.

1. Before use, blow off the dust on the QBH fiber interface and the protective cap with clean gas to ensure that there is no dust residue at the time of installation.



**Note:** As shown in Figure 1, when the QBH optical interface is not used, the QBH fiber interface should not be exposed on the top and bottom, and must be covered with dust cover to keep it clean inside.

As shown in Figure 2, when the protective cap is not used, the protective cap needs to be sealed with a clean self-sealing bag so as to avoid dust falling into it.



Figure 1 QBH fiber interface

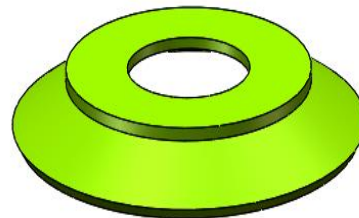


Figure 2 Protective cap

2. As shown in Figure 3, please align the center hole of the protective cap to the optical fibre splice and put it on the optical fibre splice. Notice that all the sealing rings on the fiber head are exposed below the protective cap.

3. As shown in Figure 4, check the red dot to the red dot on QBH first, then align the T-shaped pin slot on the optical fiber and the red dot to form a line, and insert the optical fiber head with the protective cap into the QBH optical fiber interface.



**Note:** It is best to insert the optical fibre splice horizontally to prevent dust from entering the laser head when inserting the optical fibre splice, insert the fiber head firmly into the bottom to ensure that the sealing ring on the optical fibre splice is completely sunk into the QBH optical fibre splice.

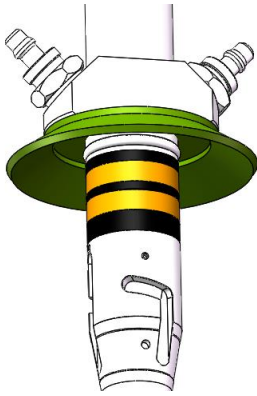


Figure 3 Protective cap and head of optical fiber

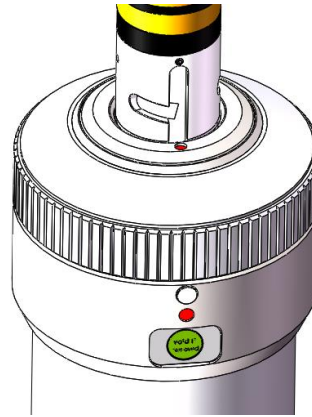


Figure 4 QBH optical fibre splice and optical fiber head

3. Turn the rotating ring to the left clockwise, rotate it to the end, complete the "first-level locking". Lift the rotating ring vertically, then turn the rotating ring to the left clockwise, and lock the "second-level locking".
4. Swing the fiber connector to the right and left and up and down to check if the QBH fiber is completely fixed. Complete the locking procedure.



**Note: the picture effect is for reference only. The shapes of various optical fiber connectors are different, and the bonding effect of the protective cap after assembly may be different to some extent.**



Figure 5 Locking completed

## 2.5 Adjust

### 2.5.1 QCS Beam Center-regulating

If the angles of the red dot on the optical fiber and the red dot on the laser head interface are too far away from each other when the optical fiber connector is inserted into the interface, resulting in failure of aligned insertion, at this time, refer to the following steps to adjust the position of the fiber interface on the laser head to solve this problem, as shown in Figure 4-1.

Unscrew 4 locking nuts in the position of the part with a wrench. Be careful not to turn the screw down, rotate the QBH interface, and tighten the screw when in place.

The optical fiber insertion method of BT240S QCS interface is shown in Figure 4-2.

- (1) Loosely locking rings 1 and 2.
- (2) Horizontally insert the fiber interface
- (3) Lock the locking rings 1 and 2 and use the wrench if necessary.

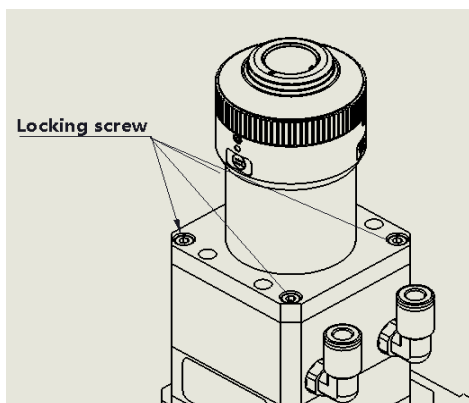


Figure 4-1 Optical fiber guidance regulation

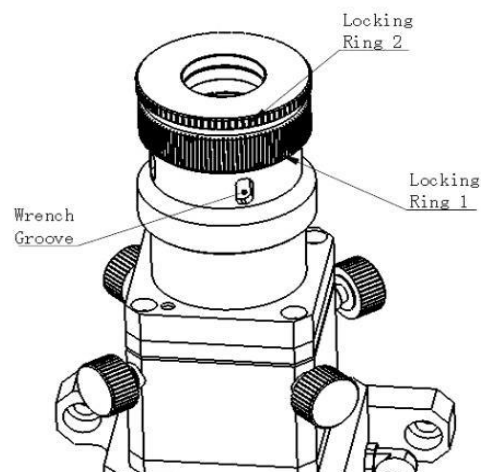


Figure 4-2 Optical fiber guidance regulation

### 2.5.2 QBH Beam Center-regulating

The best cutting quality depends largely on the central lens. If the lens is not in the middle, the laser beam may contact with the nozzle or the inner wall, which will cause high temperature deformation.

When the nozzle is replaced or the cutting quality is reduced, it is necessary to conduct the center-regulation of the lens.

The center-regulation of BT240S products can be done by adjusting the position of the collimator mirror in the X-Y direction. The adjusting screw is located on the cutting head, as shown in Figure 5-

2. The 2.5 mm internal hexagonal wrench can be used to loosen or tighten the adjusting screw until the light beam is in the middle of the nozzle.

Make sure that the laser beam exits the center of the nozzle. One common method is tape dotting:

1. Take a piece of transparent tape and flatten it directly under the end face of the center hole of the nozzle;

2. Turn on the red light inside the laser to find and observe the position of red light relative to the center of the nozzle. Adjust the screw to make the red light spot to the relative central position of the nozzle;

3. The next step is to turn on and adjust the power range of the laser generator from 80W to 100W, and perform manual dotting;

4. Tear off the adhesive tape to check whether the hole is located in the center of the nozzle;

5. Repeat the above steps to find the best relative nozzle center position of the light beam;

Such center-regulation requires a series of adjustments, which is the basic operation of any laser center-regulation.

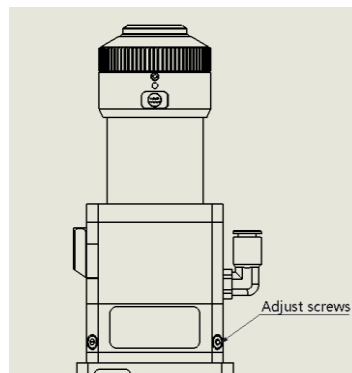


Figure 5-2 QBH Beam Center-regulating

## 2.6 Adjust the Focus Position

BT240S is configured with a focusing rotating scale ring, which is used to move the focus position to optimize laser cutting technology. The lens have 20mm reciprocating stroke. Before cutting, it is necessary to confirm the focal point. When leaving factory, the "zero focus" also corresponds to the window "0" and the rotating ring scale "0". There are many ways to find the focal point, one of which is to apply masking paper directly under the nozzle of the laser cutting head:

1. Directly adjust the laser head to the 0 scale ("ex-factory zero focus"), that is, the window scale is adjusted to "0". At this time, the scale of the rotating ring should be 0.

2. Adjust the scale of the focal length compass, adjust from +2 to -2, laser power is recommended to be 80-100w;

3. Then open the laser and drill a hole on the masking paper within 0.5mm each move (the smaller,

the better) to determine whether the "ex-factory zero focus" is suitable for the "actual zero focus" at the scene. If the "ex-factory zero focus" and the "actual zero focus" are identical, lock "Screw 2" and confirm that zero focus is over.

If the actual zero focus and scale zero focus are not the same, do the following operations:

1. Adjust the rotation ring and adjust the focus position to the front of the nozzle;
2. Loosen "Screw 1", rotate the scale ring, align the scale ring "0 scale" to the laser head shell arrow and lock "Screw 1" again.
3. Loosen the window cover, slightly loosen "Screw 3" to adjust the scale block to the "0" scale line, and tighten "Screw 2 and Screw 3" again, then the on-site "actual zero focus" is coincident with the laser head focusing "0" scale indication.

Scale display and focus relationship:

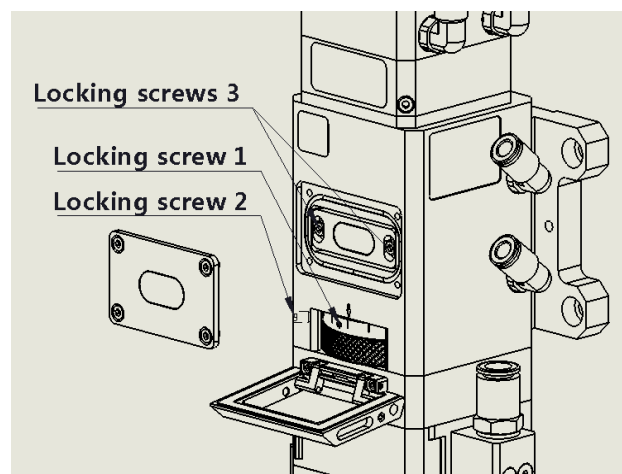
The adjustment range of the focal point is "+8~-12".

For example, the scale is 0, that is, the focus is located at the end of the nozzle.

The scale is +8, that is, the focus is located at the 8mm in the nozzle.

It is necessary to adjust the focus position according to the following steps, as shown in Figure 6:

- Unscrew "Screw 2" against clockwise
- Toggle the dial and adjust the focal length combined with the scale of the window.
- Once the focal point position is adjusted properly, tighten "Screw 2" clockwise so as to prevent the change of focus position caused by mechanical vibration.



**Figure 6 Adjust the Focus Position**

## 3 Maintenance

### 3.1 Clean the Lens

It's necessary to maintain lenses regularly because of the characteristic of laser cutting process, it is recommended to clean the protective lenses once a week, and the cleaning of collimating lens and focusing lens depends on the using circumstances. If it is necessary to check or replace the lens for cleaning, only professional personnel authorized by our company can carry out disassembly and maintenance.

#### Lens cleaning

I. Tools: dust-proof gloves or finger stall, long fiber cotton stick, ethanol, rubber gas blowing.

II. Cleaning instruction:

1. The left thumb and index finger wear fingertips;

2. Spray ethanol onto the absorbent cotton stick

3. Hold the slide edge of the lens with left thumb and index finger gently.(note: avoid the fingertip touching the surface of the lens so as to leave traces)

4. Put the lens facing to eyes, and hold the absorbent cotton stick with the right hand. Wipe the lens gently in single direction, from bottom to top or from left to right, (not wipe back and forth so as to avoid secondary pollution of the lens) and use rubber blowing to sway the surface of the lens and both sides should be cleaned. After cleaning, make sure that there is no residual: detergent, absorbent cotton, foreign matter and impurities.

### 3.2 Removal and Installation of Lenses

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

#### 3.2.1 Removal and Installation of Focusing Protective Lenses of Laser Head

Protective lens are wearing parts and need to be replaced after damage. Refer to Figure 7 and 8.

- Slightly touch the edge of the dust-proof cover to raise and the dust cover will pop open;
- Pinch the two sides of the drawer-type lens holder and pull out the base of protective lens;

- Lock the pressure ring of stainless steel with hands and lift it upwards;
- Remove the protective lens and clean or replace the lens;
- Install the lens (regardless of the positive or negative sides) into the drawer type lens holder.
- Put the pressing ring of the protective lens back into the slot.
- Keep the stainless steel ring pressed upwards and slowly insert it the lens holder.
- Buckle the dust cover.

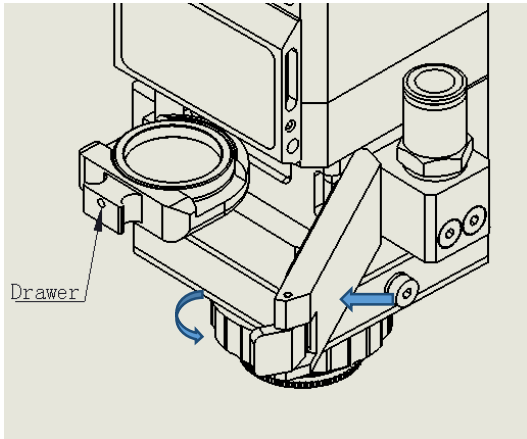


Figure 7 Replace the protective lens

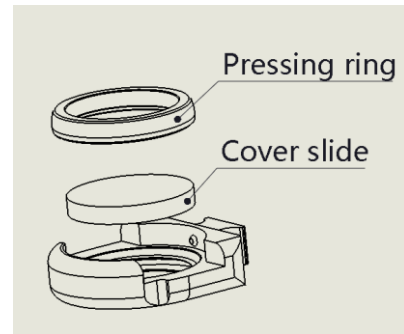


Figure 8 Structure of protective lens holder

### 3.2.2 Removal and Installation of Collimating Protective Lenses of Laser Head

Protective lens are wearing parts and need to be replaced after damage. Refer to Figure 9 and 10.

- Loosen the lock nut
- Pull out the protective lens holder by holding both sides of the drawer lens holder
- Press the edge of the lens with fingers, push one side of the lens of the spring seal ring from the lens holder so that both the seal ring and the protective lens can be pulled out (please place the spring seal ring)
- Clean or replace the lenses
- Install the lens (regardless of the positive or negative sides) into the drawer type lens holder.
- Gently put the spring seal ring back into the slot, if it has been damaged, please change it into a new spring seal ring
- Pinch the two sides of the protective lens holder and reinsert the lens holder into the laser processing head.
- Tighten the nut



**Note: do not pull out the edge of the spring seal ring directly, which is very easy to damage the spring seal ring.**

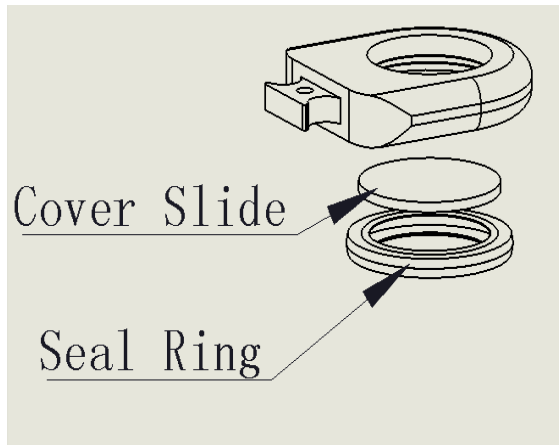


Figure 9 Structure of the protective lens holder

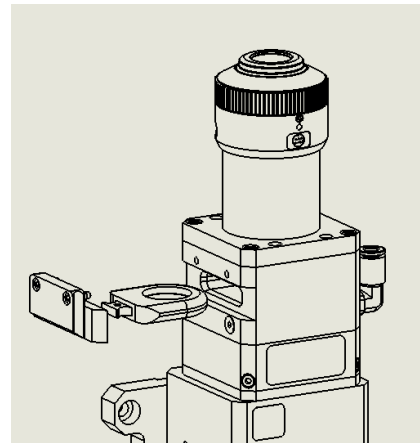


Figure 10 Structure of the protective lens

### 3.2.3 Removal and Installation of Collimating Lenses

The collimating lens can be replaced when the laser head is removed from the machine. This manual is only explained for the collimation of RayTools. For the third party's collimation, please refer to the installation manual provided by the manufacturer.



**Warning: be careful when moving the fiber. Damage to the fiber port may cause the fiber to deflect. Use a light-shielding cover on the fiber to prevent it from being damaged.**

- Wipe off the dust on the surface of BT240S;
- Use a 3mm internal hexagonal wrench to unscrew the screws above the optical fiber collimation mirror as shown in Figure 11. Place it in a clean place;
- Screw out the collimating lens holder and remove the spring pressing ring and collimating mirror;
- Replace or clean the collimating lenses
- As shown in Figure 12, reassemble the collimating mirror assembly in sequence. Note that the spring pressing ring is tightened properly and re-threaded into the FRA assembly;
- Follow the above steps to reverse the operation for locking;
- Check whether the focus position is in the center of the nozzle hole, if it is not in the center, it is



necessary to carry out center-regulating operation again;

The collimator lens can be replaced when the laser processing head moves away from the machine. This manual is only explained for the collimation of RayTools. For the third party's collimation, please refer to the installation manual provided by the manufacturer.



**Warning:** be careful when moving the fiber. Damage to the fiber port may cause the fiber to deflect. Use a light-shielding cover on the fiber to prevent it from being damaged.

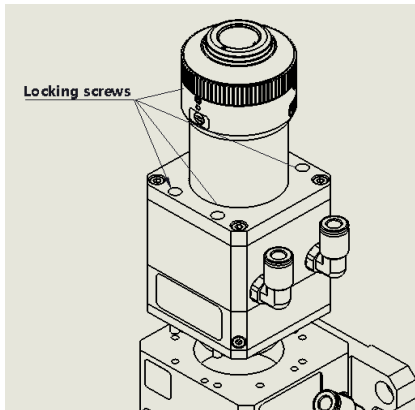


Figure 11 Collimation component CM

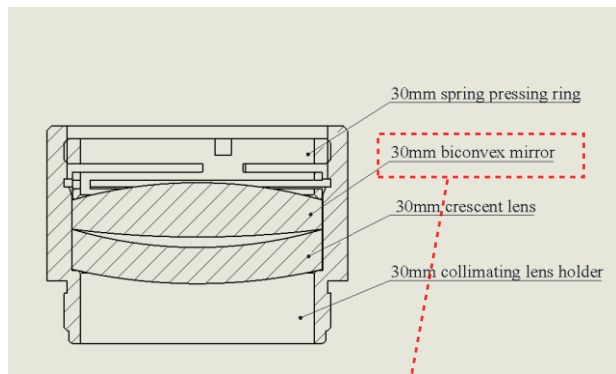


Figure 12 Installation diagram of 100 collimation 30 crescent lens

Please note that biconvex lens gets 1 big curve face and 1 small curve face. The small curve face shall be next to concave face of crescent lens

### 3.2.4 Removal and Installation of Focus Lenses

The collimating lens can be replaced when the laser head is removed from the machine. This manual is only explained for the collimation of RayTools. For the third party's collimation, please refer to the installation manual provided by the manufacturer.



**Note:** Keep the lens holder upright while moving the lens holder to prevent the lens from falling.

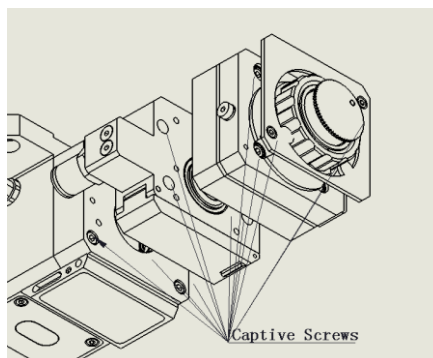
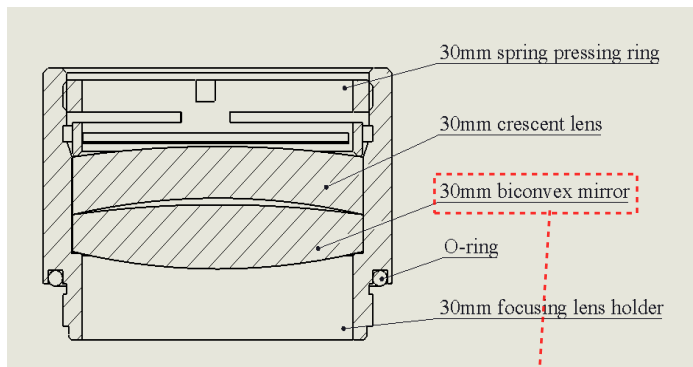
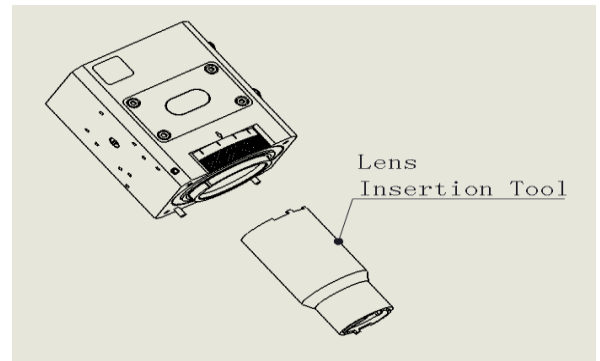


Figure 13 Remove WM and TM assembly

- As shown in Figure 13, remove the locking screws from the laser head bottom up in sequence;
- As shown in Figure 14, take out the lens holder by a lens-taking tool;
- Move the lens holder to a clean place, invert the lens holder and take out the lens;
- Replace or clean the focusing lens;
- As shown in Figure 15, carefully place the focusing lens and the spring pressing ring in the lens holder;
- Place the lens holder on the lens-taking tool, rotate it into the focus lens cone with the lens-taking tool, and tighten the lens holder;
- Reinstall the parts in order;
- Check whether the focus position is in the center of the nozzle hole, if it is not in the center, it is necessary to carry out center-regulating operation again.



**Figure 15 Installation diagram of 30 crescent lens**



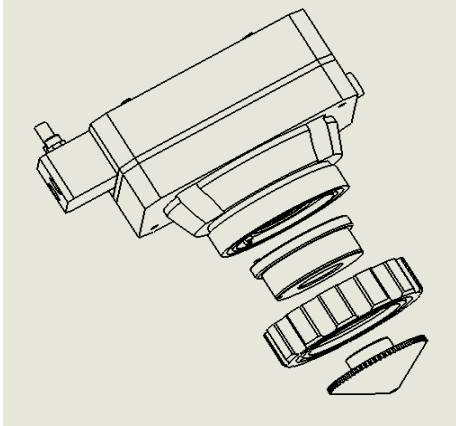
**Figure 14 Take out the focusing lens set**

Please note that biconvex lens gets 1 big curve face and 1 small curve face. The small curve face shall be next to concave face of crescent lens

### 3.3 Replace Nozzle Connector

In the process of laser cutting, the laser head will inevitably be hit, so it is necessary to replace the nozzle connector. For example: replace the ceramic body for the two-dimensional laser head of BT240S.

- Unscrew the nozzle;
- Press the ceramic body by hand to make it fixed without deviation so as to unscrew the press sleeve
- Align the two 2mm dowel holes of the new ceramic body with the two dowel pins on the nozzle connection seat, press the ceramic body by hand and screw the press sleeve.
- Screw the nozzle.



### 3.4 Replace Nozzle

- Unscrew the nozzle.
- Screw a new nozzle onto the nozzle connector.
- Make capacitor calibration once again after replacement.