Product Manual for ZR-CU-02

1. Overview

This manual provides a general description of the basic installation, factory settings, operation, maintenance, and service of the ZR-CU-02 series products. Due to the large number of specific optical-mechanical components and customized configurations, this manual only introduces the main unit parts.

The ZR-CU-02 series laser cladding head is a proven high-performance processing head suitable for laser cutting systems. It supports integrated internal and external processing, offering convenience, flexibility, and high efficiency. Its features—including an optimally designed overall optical focusing system, annular gas path, turbulent airflow, nozzle cooling design, built-in water cooling unit, and fine adjustment of the focal position—fully meet the requirements of industrial laser processing environments for cladding of pipes and medium-thick plates in various applications, as well as other customized needs. Multiple flexible optical fiber interface options and optical collimation-focusing configurations enable it to be compatible with mainstream fiber lasers in the industry.

1.1 Product Features

- Fully sealed body design for excellent dustproof performance.
- Compact size and light weight, facilitating equipment integration.
- Horizontal optical fiber insertion, enabling easy internal and external circle cutting operations.
- Digital display for focus adjustment, simplifying process parameter setting.
- Upper and lower protective lens design for comprehensive sealing.

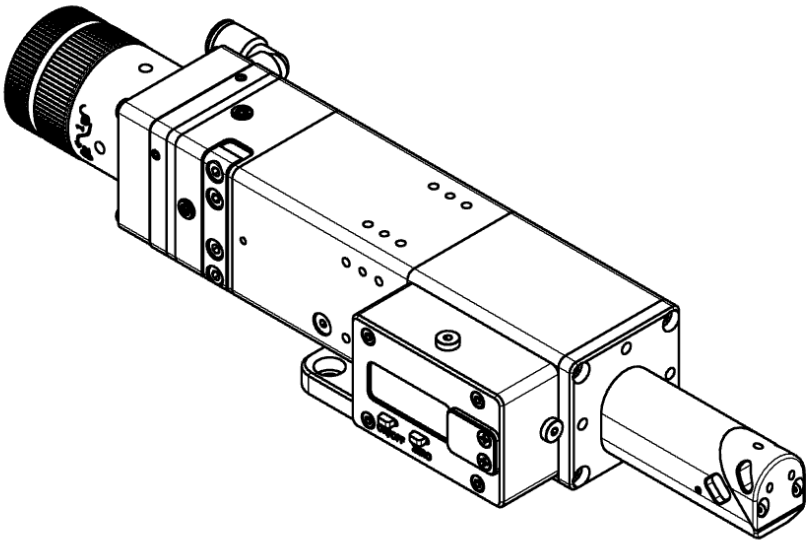


图 1

2 Function Introduction

The labels in Figures 2/3 are explained as follows:

- a 1: Cutting gas interface, outer diameter 6mm.
- a 2: QBH water cooling interface, outer diameter 6mm.
- a 3: QBH water cooling interface, outer diameter 6mm.
- a 4: QBH optical fiber interface.
- a 5: Upper protective lens drawer, containing an upper protective lens (specification: D21.5*2); the lens replacement method is detailed below.
- a 6: Digital focus display window.
- a 7: TRA component, with built-in focusing lens, reflecting lens, lower protective lens, etc.

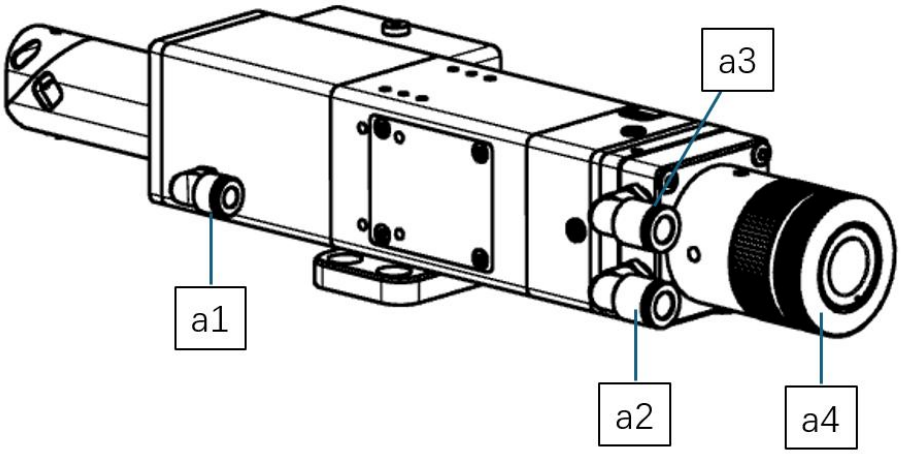


图 2

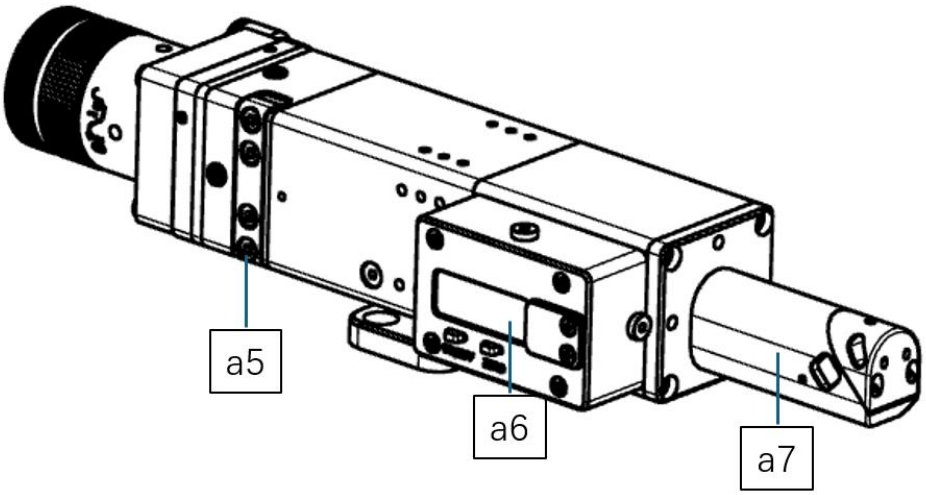


图 3

2. Installation

2.1 Mechanical Installation

The dimension diagrams of the ZR-CU-02 product are shown in Figures 4-5. The M6 threaded holes on both sides can be used for installation and connection.

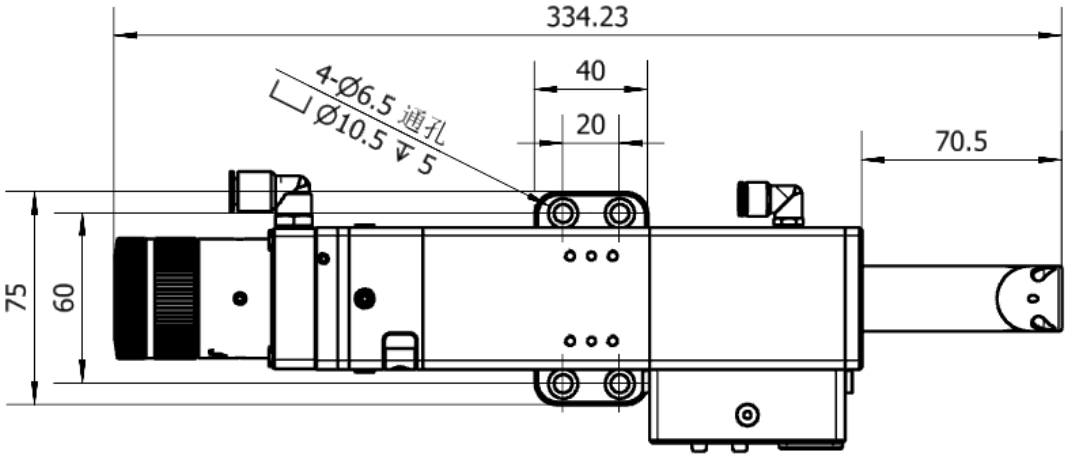


图 4

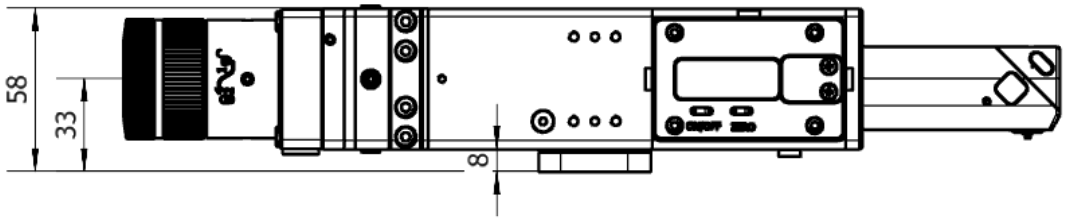


图 5

2.2 Water Cooling Interface

The ZR-CU-02 laser processing head is equipped with one set of cooling water channels, and the direction of water flow can be freely arranged. It is important to note that water cooling is recommended when the laser power exceeds 3000 watts. Figures a2-a3 in Figure 2 show the location and number of water cooling interfaces, and the table on the right details the recommended water flow rate.

This water cooling interface is designed for a closed-loop water cooling system, but it can also be used with an external free-flow water supply,

provided that the requirements listed in the table are met.

水管口径外径	8 mm
最小流速	1.8 升/分钟（0.48gpm）
入口压力	170-520kPa(30-60 psi)
入口温度	≥室温 /＞结露点
硬度（相对于 CaCO3）	＜250mg/liter
PH 范围	6 to 8
可通过微粒大小	直径小于 200 微米

Caution: Do not replace the air hose connectors arbitrarily, especially do not use Teflon tape to seal the connections, otherwise it will cause air line blockage and prevent normal operation.

2.3 Auxiliary Gas Interface

Impurities in the auxiliary gas, such as hydrocarbons and water vapor, can damage the lenses, cause fluctuations in cladding power, and lead to inconsistencies in the workpiece before and after cladding. The table below shows the recommended specifications for the auxiliary gas. Higher gas purity results in better cladding cross-section quality.

Impurities can be filtered out in the gas supply line, but oxygen and water vapor can permeate into the optical system through non-metallic materials, which is the source of dust and hydrocarbons. Stainless steel fittings are recommended, and a filter capable of removing particles as small as 0.01 micrometers must be used for purification.

Pressure gauges with stainless steel diaphragms are recommended. Industrial pressure gauges can draw in air, and if rubber diaphragms are used, hydrocarbons can be generated due to aging and other factors.

气体	纯度	水蒸气最大含量（ppm）	碳氢化合物的最大含量（ppm）
氮气	99.99%	<5 ppm	<1 ppm
氩气	99.998%	<5 ppm	<1 ppm
氦气	99.998%	<5 ppm	<1 ppm
辅助气管管径（外径）		6 mm	

2.5 Fiber Optic Connection

The ZR-CU-02 is suitable for most industrial laser generators. It is equipped with a collimating lens assembly.

The connection between the fiber end and the cutting head is called the fiber optic connector. Commonly used fiber optic connectors include QBH, QD, etc., and each type of connector has its unique fixing method. Please refer to the corresponding fiber optic connector user manual. Figure 6 shows the installation interface of the QBH connectorWarning: Optical components must be kept clean, and all dust must be removed before use. If the laser head has a vertical fiber optic connector, the laser head must be rotated 90 degrees to a horizontal position before inserting the fiber to prevent dust from entering the interface and falling onto the lens surface. After inserting the fiber optic cable...

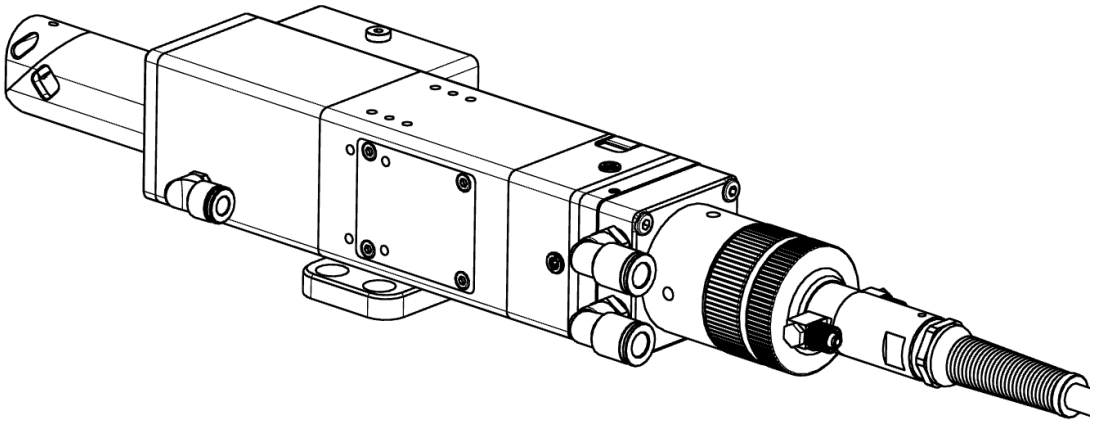


图 6

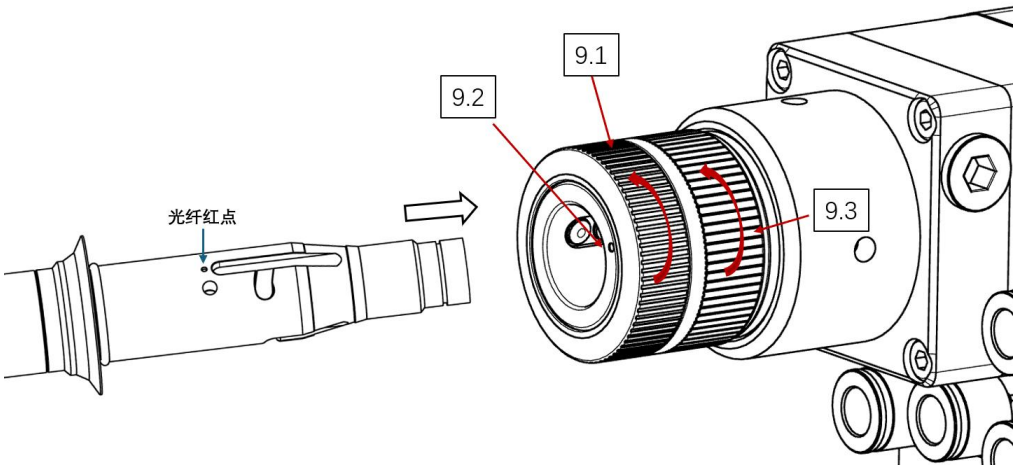


图 9.1

Specific fiber optic insertion method:

1. First, loosen the 9.2 locking nut by rotating it counterclockwise (as indicated by the red arrow in the diagram);
2. Next, rotate the 9.3 retaining ring counterclockwise (as indicated by the red arrow in the diagram);
3. Observe the red dot on the fiber optic connector and align it with the red dot on the QBH connector 9.2, then slowly insert the fiber;
4. As shown in Figure 9.2, after inserting the fiber, first rotate 9.3 clockwise until it is fully

tightened.

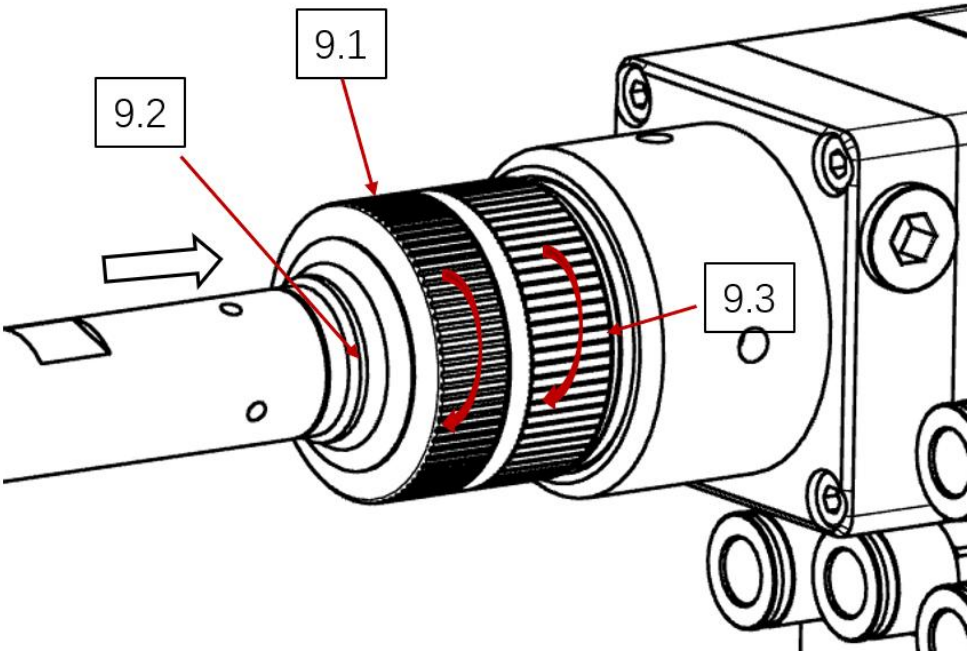


图 9.2

1. Next, rotate part 9.1 and tighten the nut in a clockwise direction!

Note: The fiber optic cable insertion process must be performed in a dust-free environment. Insert the cable as horizontally as possible to prevent dust from entering and contaminating the internal lenses!

1. Optical Path Adjustment and Maintenance

3.1. Replacing the Protective Lens

As shown in Figure 10,

Loosen the two hex screws at a10.1.

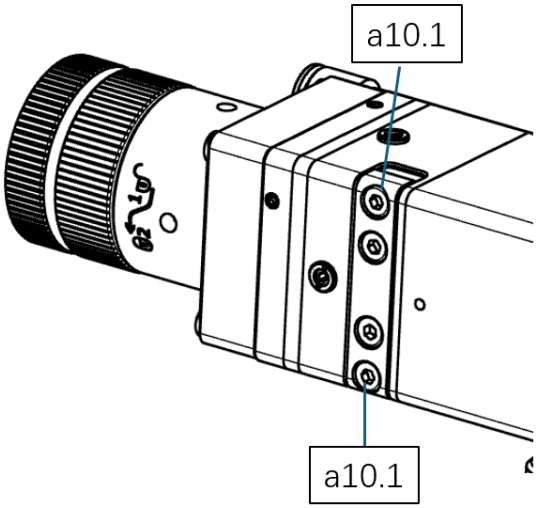


图 10

Pull out the lower protective lens drawer. Press the protective lens in the direction of the arrow in Figure 11. The specifications are D21.5-2.0.

Remove the protective film a11.1 and the O-ring a11.2 (stock number: 22*16*2.9).

When replacing the protective film, seal the laser head opening with tape to prevent dust from entering. Ensure your hands are clean during the operation! After replacing the lens, quickly insert it back into the laser.

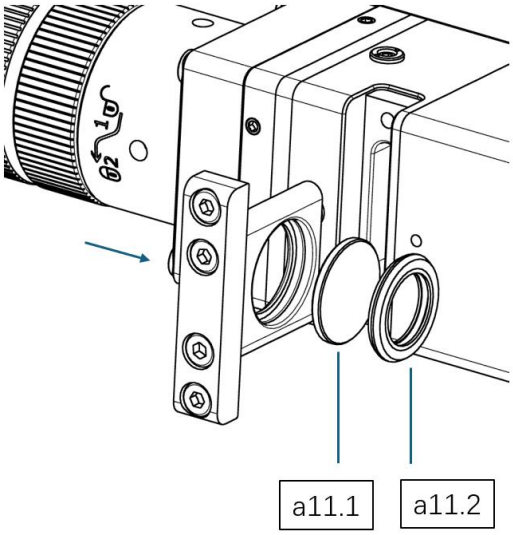
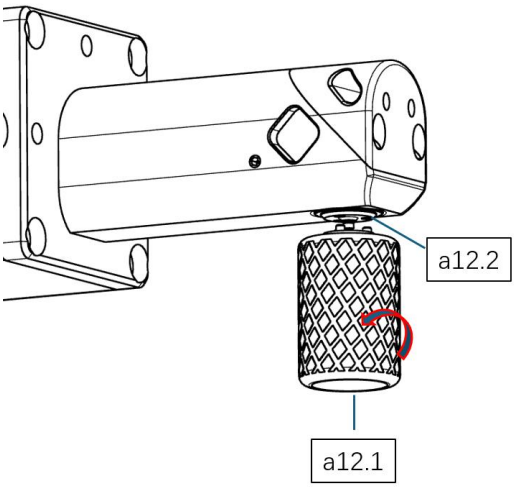


图 11

注意：不可直接抠弹性密封圈的边缘将其拉出，这样非常容易损.

Note: The upper protective lens generally does not burn out easily, so frequent

replacement is not necessary. Reducing the frequency of replacement can effectively lower the risk of dust entering the laser head. Here's a tip: Before replacing the protective lens, you can shine a red light onto a piece of white paper and observe if there are any black spots on the paper. If there are, there is some dirt on the lens. If the black spots still exist after replacing both the upper and lower protective lenses, the black spots may be on the internal collimating lens or copper mirror. In this case, the unit needs to be sent back to the factory for repair and inspection. Do not open the laser head yourself; doing so will void the warranty.



3.2 Replacing the Lower Protective Lens

1. Use the nozzle installation tool a12.1 (stock number: 025080301A-1) shown in Figure 12, align it with the three holes below the nozzle a12.2, and rotate it in the direction of the arrow to unscrew the nozzle;

2. After unscrewing the nozzle, a13.1 in Figure 13 is the lower protective lens, specifications: D10*2.0

3. Remove the dirty lens by hand, replace it with a new one, place it in the groove of the nozzle, then snap the nozzle onto the three protrusions of the tool, and screw it vertically into the TRA main body to complete the lens replacement.图 12

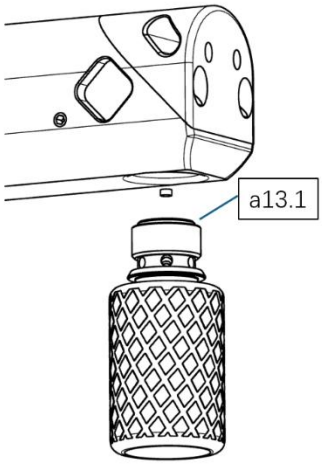


图 13

3.3 Focus Adjustment

1. When adjusting the focus, first loosen the plug a14.1 in Figure 14. There is a set screw inside; loosen the set screw before adjusting.
2. If the screen has been off for a long time, press the a14.3 ON/OFF button to turn on the digital display.
3. a14.4 in the diagram is the zero button, mainly used for zero-focus calibration. It is calibrated at the factory and generally does not need to be reset. If you have readjusted the focus, you can press the zero button to maintain the zero-focus position.
4. a14.5 in the diagram is the battery cover. If the display screen is not lit or the battery is dead, you can unscrew the two Phillips screws, remove the cover, and replace the battery. (Figure 14)

1. Focusing can be done in two directions, using the plug a14.2 in Figure 14 and the plug a15.1 in Figure 15. Loosen either one of these two plugs. Insert an Allen wrench and rotate it while observing the scale change on the digital display screen. Adjust it to the desired position. One full rotation theoretically moves the focus by 0.5 mm.

Figure 15

2. After adjustment, reinstall the plug and the anti-loosening plug.

1.4 Optical Coaxial Adjustment

1. When adjusting the optical coaxial alignment, first loosen the set screws a16.1 in Figure 16. Note that there are set screws in all four directions.
2. After loosening the set screws, observe the adjustment set screws a16.2. These are also located on all sides. If adjustment downwards is needed, first loosen the opposite set screw before adjusting this one.
3. The same procedure applies to the other direction; simply loosen the opposite set screw in the direction you need to adjust.
4. One full rotation of the set screw corresponds to a movement of 0.25mm.

Figure 16

5. After adjustment, remember to tighten the set screws around a16.1.

Note: A helpful tip: In Figure 17, a17.1 and a17.2 control the X-direction, while a17.3 and the opposing set screw control the Y-direction.

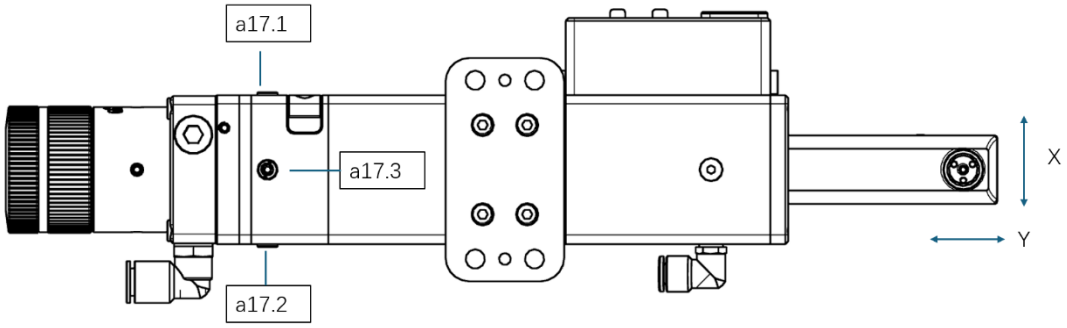


Figure 17