

激光切管机用户使用手册

Laser Tube Cutting Machine User Manual

MK-6052T3C-6



本使用手册只适用于本公司生产的设备。

本手册最终解释权归本公司所有。

This user manual is applicable only to equipment manufactured by our company.

The final interpretation of this manual rests with our company.

前言

Preface

感谢您选择使用我公司的产品。我们将为您提供完善的售后服务和解决方案，请您妥善保管本说明书及其他附件，以便您更好地使用。本说明书对产品的安全事项、工作原理、运输储存、安装方法、操作使用、故障排除、维护保养等进行说明。本说明书适用于我司产品的标准配置。为快速有效使用该产品需操作人员具备以下条件：

1. 操作者需要一定的电脑专业知识，会使用相关编辑绘图软件，例如：SolidWorks、AutoCAD、等制图软件。
2. 操作者具有一定的光学知识和相关机电设备的维修与维护知识。
3. 设备开机前，请确认您熟悉操作流程并能按要求操作。由于产品功能持续更新，您收到的产品可能与本手册描述存在差异，对此我们深表歉意。

Thank you for choosing our company's products. We will provide you with comprehensive after-sales service and solutions. Please keep this instruction manual and other attachments safe for your better use. This manual explains the product's safety precautions, working principle, transportation and storage, installation methods, operation, troubleshooting, and maintenance. This manual applies to the standard configuration of our products. For quick and effective use of this product, operators must meet the following requirements:

1. the operator needs to have certain computer expertise and be able to use relevant editing and drawing software, such as SolidWorks, AutoCAD, and other drafting software.
2. The operator must have certain optical knowledge and knowledge of the repair and maintenance of related electromechanical equipment.
3. Before starting the equipment, please confirm that you are familiar with the operating procedures and can operate it accordingly. Due to continuous updates to product functionality, the product you receive may differ in some aspects from the descriptions in this manual. We apologize for this.

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一、安全警告

一、Safety Warning

1. 综述

1. Overview

1. 在操作机床和进行日常维修之前，操作人员必须仔细阅读本章节，以对机床安全措施和要求有所了解，并遵守相关的安全预防措施。

1. Before operating the machine tool and performing daily maintenance, the operator must carefully read this chapter to understand the safety measures and requirements of the machine tool and comply with the relevant safety precautions.

2. 安全管理的警告

2. Security warning

1. 指定安全管理人员，确定其职责范围，并对操作者进行安全操作及安全防护教育。

1. Select a safety manager, define their responsibilities, and educate operators on safe operation and protection.

2. 指定激光安全管理区域，在管理区域的出入口设立警告牌，内容包括：激光加工机的功率、激光种类、禁止外人进入、注意保护眼睛和安全管理者姓名。

2. The laser safety management area is designated, and warning signs are set up at the entrance and exit of the management area, including the power of the laser processing machine, the type of laser, the prohibition of outsiders entering, the attention to protect the eyes and the name of the safety manager.

3. 激光加工机的操作人员，必须经过专门培训，达到一定水平，并在安全管理员同意的前提下，才能上岗操作。

3. Operators of laser processing machines must undergo specialized training, reach a certain level, and obtain the consent of the safety manager before they can operate the machine.

3. 激光安全通告

3. Laser Safety Notice

1. 激光对人体的主要危害是眼睛和皮肤，激光照射到人体的任何部位都会引起灼伤。尤其光纤激光长时间观察会严重危害到眼睛视网膜！所有操作人员必须严格佩戴1064nm激光防护眼镜！禁止不佩戴眼镜进行操作以及观察！应避免将身体任何部位置于激光切割的范围中，以免误操作造成伤害。

1. The main hazards of lasers to the human body are the eyes and skin; laser radiation can cause burns to any part of the body. Prolonged observation with fiber lasers, in particular, can severely damage the retina! All operators must strictly wear 1064nm laser safety goggles! Operating or observing without goggles is strictly prohibited! Avoid placing any part of the body within the laser cutting area to prevent injury from accidental operation.

4. 眼睛和皮肤的保护

4. Eye and skin protection

1. 在激光加工中，受到直接光束或散射光束照射时，都会伤害眼睛与皮肤，甚至导致火灾。该机床所配激光器为光纤激光器，操作人员应严格佩戴防护眼镜。并且对于设备的激光调整时，必须由受过培训的专业人员对激光进行调整，操作及调整时避免皮肤及眼睛受到直接照射。

4. During laser processing, exposure to direct or scattered laser beams can damage the eyes and skin, and may even cause fires. This machine tool is equipped with a fiber laser, and operators must wear protective eyewear. Furthermore, laser adjustments must be performed by trained professionals, and direct exposure to skin and eyes should be avoided during operation and adjustments.

5. 防火保护

5. Fire Protection

1. 激光切割时，会产生火花的飞溅，容易导致火灾的危险。因此工作区不应有易燃易爆物品存在，同时具备相应的防范设施。

1. Laser cutting can generate sparks that can easily cause a fire hazard. Therefore, flammable and explosive materials should not be present in the work area, and appropriate preventative measures should be in place.

6. 电气安全

6. Electrical safety

1. 不要用湿手接触任何开关以免触电。机床贴有闪电标牌的部位，表示这些部位有高压用电器或电气元件，操作者在接近这些部位或打开维修时应格外小心，以免触电。

1. Do not touch any switch with wet hands to avoid electric shock. The parts of the machine tool with lightning signs indicate that these parts have high voltage electrical appliances or electrical components. Operators should be extra careful when approaching these parts or opening for maintenance to avoid electric shock.

2. 全面仔细阅读机床说明书，以便熟悉各项功能和对应键的操作方法。不要轻易打开电气柜门，禁止私自改变已设定的机床参数。如果需要改变，必须由设备制造厂培训且取得认可的专业人员操作，并记录下变动前的参数值，以便在必要时，能恢复原始状态。d) 加工用的激光，一般供电电压为高压，应防止激光器内部高压电及高压电下产生的X射线伤害的危险。e) 在通电状态下不要触摸电气柜内带电。

2. Read the machine manual carefully to familiarize yourself with all functions and their corresponding key operations. Do not open the electrical cabinet door without authorization. Unauthorized modification of preset machine parameters is strictly prohibited. Any required adjustments must be performed by certified personnel trained by the equipment manufacturer, with pre-change parameter values documented for potential restoration. d) Processing lasers typically operate at high voltages. Prevent hazards from internal high-voltage currents and associated X-rays. e) Never touch live components inside the electrical cabinet while powered on.

7. 机器的防护措施

7. Machine protection measures

1. 指定安全管理员，确定其职责范围，并对操作者进行安全操作及安全防护教育。

1. Appoint a safety manager, define their responsibilities, and provide safety operation and protection training to operators.

2. 指定激光切割机安全管理区域，在管理区域的出入口设立警告牌，内容包括：激光切割机的功率、激光种类、禁止外人进入、注意保护眼睛和安全管理者姓名等。

2. Designate a safety management area for the laser cutting machine, and erect warning signs at the entrances and exits of this area, including: the laser cutting machine's power, laser type, prohibition of unauthorized personnel, cautions to protect eyes, and the name of the safety manager.

3. 激光切割机不用时，应断掉总电源，以免闲杂人员误操作引起危害。

3. When the laser cutting machine is not in use, the main power supply should be disconnected to prevent accidental operation by unauthorized personnel.

4. 应把加工过程中产生的烟尘气体及激光工作气体通过废气管道排放到室外，所有气瓶均应摆放整齐、稳固。

4. Fumes and gases generated during processing, as well as laser working gases, should be discharged outdoors through exhaust pipes. All gas cylinders should be neatly and securely arranged.

8. 使用人员常识

8. Common sense for users

1. 激光切割机的操作人员，必须经过专门培训，达到一定水平，并在安全管理员同意的前提下，才能上岗操作。

1. The operator of laser cutting machine must undergo special training, reach a certain level, and can only operate with the consent of the safety administrator.

2. 激光切割机的操作者或在激光使用期间接近激光的人员，应戴上适当的激光防护镜，一定要有良好的室内光照，以保证操作者顺利操作。

2. The operator of the laser cutting machine or the person who is close to the laser during the use of the laser should wear the appropriate laser protection glasses, and there must be good indoor lighting to ensure the smooth operation of the operator.

9. 警告

9. Warn

1. 断电后，必须等待5分钟以上再触及端子。因断电后在一段时间内动力线端子间留有高电压，为避免触电请不要立即触及。

1. After power failure, you must wait for more than 5 minutes before touching the terminals. Because there is a high voltage between the power line terminals for a period of time after power failure, please do not touch them immediately to avoid electric shock.

二、产品概述

二、Product Overview

1. 产品介绍

1. Product presentation

1. 金属激光切割机，是我公司自主研发并已标准化的成熟产品，利用光纤激光器产生的激光光束聚焦后照射到板材表面时释放的能量将金属材料融化，同时利用高压气体将金属材料融化产生的熔渣吹走，从而达到切割的目的。主要用于不锈钢、碳钢、锰钢、弹簧钢、等金属板材的切割。激光切割是板材加工中采用的一种先进加工方法，具有效率高、精度高、切割面光洁度高等优点，其它加工方式无法同时具备上述优点。本公司生产的激光切割机可根据客户需求选配进口激光器或国产激光器，同时伺服电机、减速机、齿轮齿条、丝杠导轨等零部件均选配了国际知名品牌的产品，保证了切割机产品的高质量、高精度。

1. The metal laser cutting machine, a mature product independently developed and standardized by our company, utilizes the energy released when the laser beam from an optical fiber laser focuses on the surface of metal sheets to melt the material. Simultaneously, high-pressure gas blows away the molten slag, achieving precise cutting. It is primarily suitable for cutting metal sheets such as stainless steel, carbon steel, manganese steel, and spring steel. Laser cutting is an advanced processing method in sheet metal fabrication, offering unparalleled advantages like high efficiency, precision, and smooth cutting surfaces—features unmatched by other processing methods. Our laser cutting machines can be equipped with either imported or domestic lasers according to customer needs. Additionally, components such as servo motors, reducers, gear racks, and lead screw guides are all sourced from internationally renowned brands, ensuring the high quality and precision of our cutting machines.

2. 主要特点

2. Main features

1. 高性能激光器，配合稳定操作系统，使切割效果达到最优。
1. High-performance laser, combined with a stable operating system, ensures optimal cutting results.
2. 具有完善的冷却、润滑及除尘系统，使整机运行稳定、高效、耐用。
2. It has a complete cooling, lubrication and dust removal system, which makes the whole machine run stably, efficiently and durable.
3. 带自动调高，保持焦距恒定，切割质量稳定。
3. Features automatic height adjustment to maintain a constant focal length and ensure stable cutting quality.
4. 可对多种金属材质切割，切割效果优秀稳定。
4. It can cut a variety of metal materials with excellent and stable cutting results.
5. 采用龙门结构、整体铸造横梁以及航空铝材横梁，具有较高的刚性、稳定性、抗震性。

5. It adopts a gantry structure, integral cast crossbeams, and aviation aluminum crossbeams, which have high rigidity, stability, and seismic resistance.
6. 以精密直线导轨和齿轮齿条作为传动元件，精度高、速度快。
6. It uses precision linear guides and gear racks as transmission elements, resulting in high precision and high speed.
7. 可通过网线通讯，对激光切割过程进行远程交流和监控。
7. The laser cutting process can be remotely communicated and monitored via network cable.

三、设备结构

三、Equipment Structure

1. 切割机结构介绍

1. Introduction to the Structure of a Cutting Machine



参考示图，具体以实物为准。

Refer to the illustration; the actual product shall prevail.

2. 床身部分

2. Bed part.



参考示图，具体以实物为准。

Refer to the illustration; the actual product shall prevail.

3. 卡盘

3. Chuck

1. 所有卡盘均为气动卡盘。使用压缩空气提供动力。最大加工管材尺寸由前卡盘决定。

1. All chucks are pneumatic chucks. Powered by compressed air. The maximum diameter of the pipe that can be processed is determined by the front chuck.

2. 主卡盘可以更改夹爪的形式和安装方法来适应不同的管材安装。

2. The rear chuck can change the form and installation method of the clamp to adapt to different pipe installation.

**B1****B2****B3**

4. 伺服系统

4. Servo system

1. 所有轴和卡盘运动均采用伺服系统控制。精度高，反应灵敏。保障加工提供精密尺寸。

1. All axis and chuck movements are controlled by servo system, which ensures high precision and sensitive response, and guarantees the precision dimensions of machining.



5. 润滑系统

5. Lubrication system

1. 集中润滑系统，对滑块自动供油，保证了传动系统的精度，提高了直线导轨的使用寿命，在机床后方安装一个智能油泵。此油泵接受系统信号，通常以时

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间为节点，大约设备每运行100分钟自动润滑15秒；没有到时间节点时油泵处于休眠状态。请时常关注油泵的油量，以便及时补充润滑油；本机使用的润滑油为68号导轨油。

1. An intelligent oil pump is installed at the rear of the machine tool. It operates based on system signals, automatically lubricating for 15 seconds every 100 minutes of equipment operation, with the pump remaining dormant until the scheduled time. Regularly check the oil level to ensure timely replenishment. The machine uses 68-grade guide rail lubricant.



2. 油路直接传输至滑块，实现精准润滑。

2. The oil is directly delivered to the slider, ensuring precise lubrication.



分油排
Oil separation



分油排
Oil separation



导轨滑块
Guide rail slider



导轨滑块
Guide rail slider

6. 冷却系统

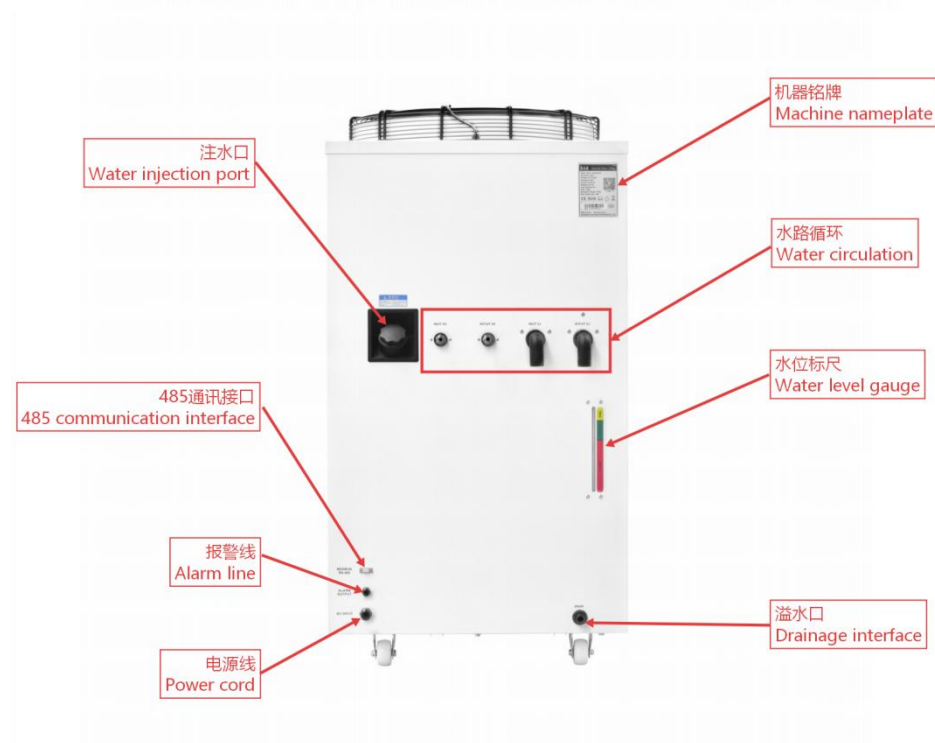
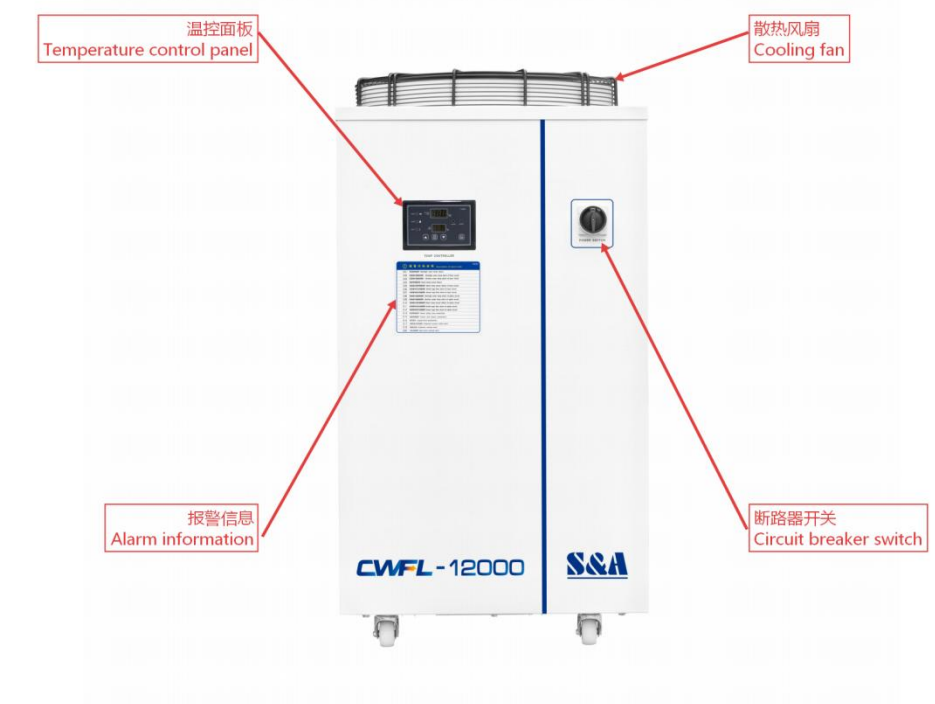
6. Cooling system

1. 激光切割机的水路系统采用的是双温冷水机，一路对激光器进行冷却，一路对切割头进行冷却。

1. The water system of the laser cutting machine uses a dual-temperature chiller, one cooling the laser and the other cooling the cutting head.

2. 以下为水冷机面板功能介绍

2. The following describes the functions of the water-cooled machine panel



7. 气路系统

7. Air system

1. 激光切割机的气路可以满足同时使用氧气和氮气，切割用氧气安装电器比例阀可通过软件实现气压调节。氧气主要用于切割普通碳钢；氮气主要用于切割不锈钢和合金钢。针对不同的材料选用不同的切割气体。大功率的激光器还可以根据客户的实际情况增加冷却气路，为切割头和喷嘴进行吹气冷却。还可以用压缩空气代替氮气切割。压缩空气必须使用激光专用空气压缩机，产生无水、无油、干燥的压缩空气。

1. The gas system of laser cutting machines supports simultaneous operation with both oxygen and nitrogen. The oxygen supply valve for cutting can be adjusted via software to regulate pressure. Oxygen is primarily used for cutting ordinary carbon steel, while nitrogen is mainly employed for stainless steel and alloy steel. Different cutting gases are selected based on material properties. High-power lasers may also incorporate cooling gas circuits according to customer requirements, providing airflow cooling for cutting heads and nozzles. Compressed air can alternatively replace nitrogen in cutting processes, provided it is generated by laser-specific air compressors that produce dry, oil-free, and dehydrated compressed air.



比例阀
Proportional valve



比例阀
Proportional valve



电磁阀
Solenoid valve



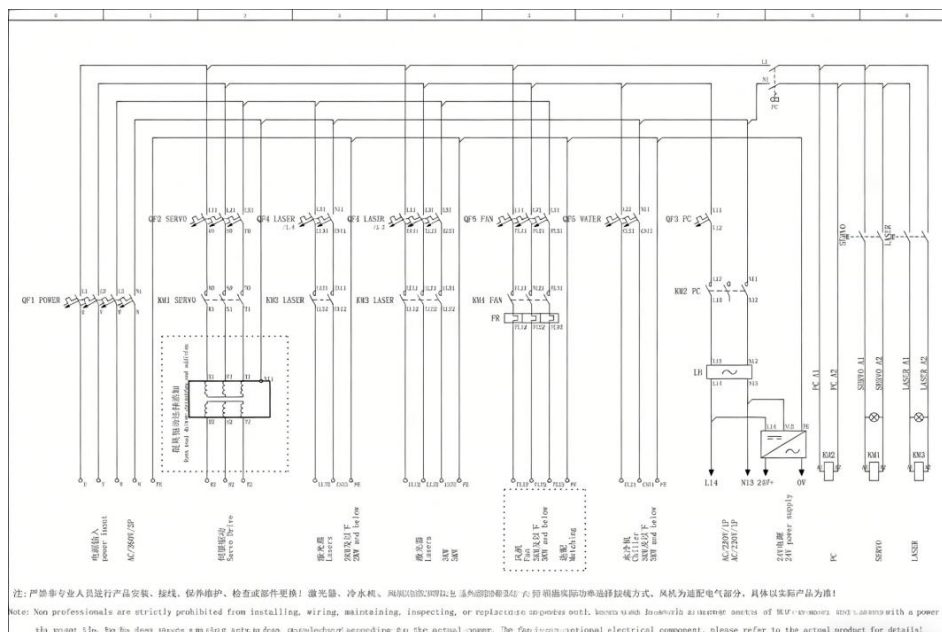
单向阀
One-way valve



压力报警开关
Pressure alarm switch

8. 电气线路

8. Electrical circuits



以上述通用电路图为例, 如有疑问请及时联系我们。

For the general circuit diagram above, please contact us if you have any questions.

9. 工控机

9. Industrial Computer

激光切割机所使用的工控机是一种专为工业环境设计的计算机, 用于控制激光切割设备的运行, 确保切割过程的精度、稳定性和高效性。

The industrial computer used in laser cutting machine is a computer specially designed for industrial environment, which is used to control the operation of laser cutting equipment and ensure the precision, stability and efficiency of the cutting process.



10. 伺服驱动器

10. Servo Drive



1. 可以控制速度，位置精度非常准确，可以将电压信号转化为转矩和转速以驱动控制对象。由于伺服电机的高转速特性需要配合减速机来完成驱动工作。

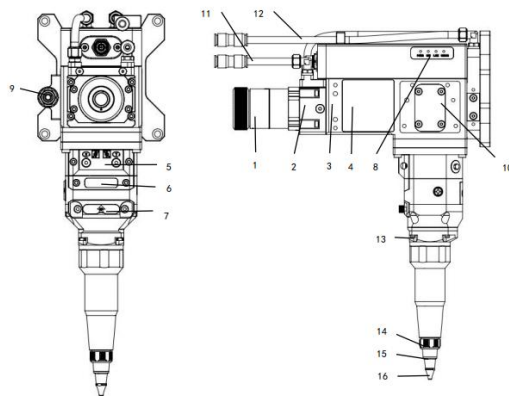
1. Servo motors provide precise speed and position control, converting voltage signals into torque and rotational speed to drive controlled objects. Their high-speed performance requires a reducer to complete the driving process.

11. 切割头

11. Cutting head

1. 切割头：通过聚焦、变焦使激光能量集中于板材的相对位置，配合辅助气体对板材进行切割加工；根据客户的不同需求我们会安装不同品牌的切割头，以下嘉强切割头为例：

1. Cutting head: The laser energy is precisely focused on the target area of the sheet metal through focusing and zooming, with auxiliary gas assisting the cutting process. We customize cutting heads for different brands based on client requirements. The RayTooLs cutting head is demonstrated below as an example:



产品视图（结构和接口说明）

- | | |
|--|---------------------------------------|
| 1. 光纤接口 1.Fiber Interface | 9. 切割气体接口 9.Cutting Gas Interface |
| 2. 上保护膜 2.Upper Protective Lens | 10. 反射镜模块 10.Reflective Mirror Module |
| 3. 上二保护膜 3.Upper Secondary Protective Lens | 11. 冷却水出口 11.Cooling Water Outlet |
| 4. 准直模块 4.Collimation Module | 12. 冷却水进口 12.Cooling Water Inlet |
| 5. 聚焦模块 5.Focusing Module | 13. 防撞螺丝 13.Anti-Collision Screw |
| 6. 下二保护膜 6.Lower Secondary Protective Lens | 14. 陶瓷体锁环 14.Ceramic Body Lock Ring |
| 7. 下保护膜 7.Lower Protective Lens | 15. 陶瓷体 15.Ceramic Body |
| 8. 工作指示灯 8.Operation Indicator Light | 16. 喷嘴 16.Nozzle |

12. 激光器

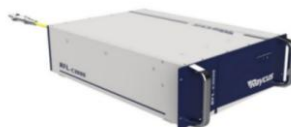
12. Laser

1. 激光器:切割机使用光纤激光器; 类型为连续激光器。作用是产生激光通过光纤传导至切割头。为切割板材提供激光能量。对于3000W以下或体积较小的激光器。我们通常会安装于机床内部, 激光器的电源由机床提供。当安装于机床内部时, 不需要客户进行二次安装, 所有连接均属于出厂设置。当使用6000W及以上的级别或体积较大的激光器时, 我们会选择激光器独立供电, 在安装时需要为激光器单独提供电源, 并且连接激光器与机床的信号线、光纤等。

1. Laser System: The cutting machine employs a continuous-wave fiber laser, which generates laser energy transmitted through optical fibers to the cutting head for sheet metal processing. For 3000W or smaller laser systems, we typically install them internally within the machine tool, with power supplied by the machine. This in-machine configuration eliminates the need for secondary installation, as all connections are factory-configured. For 6000W+ systems or larger units, we opt for independent power supply solutions requiring separate installation of the laser unit, along with dedicated signal cables and fiber optics connecting the laser to the machine tool.



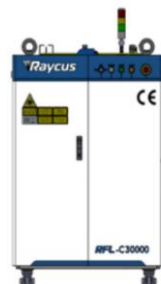
创鑫
MAX



锐科
Raycus



创鑫
MAX



锐科
Raycus



2. 使用方法：当使用max激光器时，为激光器接通电源后，复位急停开关，转动钥匙，等待水冷机温度稳定后（在寒冷冬季大约需要10分钟时间），按下并点亮start按钮后便可以使用。

2. Operating instructions: To operate the Max laser, first power it on. Then reset the emergency stop switch and turn the key. Wait until the water-cooled unit stabilizes (about 10 minutes in cold winter). Finally, press and activate the start button to begin operation.

3. Raycus激光器部分型号没有钥匙和按钮，只需要接通电源后等待水冷机稳定后可以使用。如果设有钥匙和按钮，请参考MAX激光器。

3. Some Raycus laser models require no key or button; simply power them on and wait for the water-cooled unit to stabilize before use. For models with a key or button, refer to MAX laser specifications.

4. 当激光器遭遇非正常操作或环境发生较大变化时（如电压、温度），激光器会发出警报（可能伴随灯光闪烁、蜂鸣声等）并停止工作。这是需要你打开激光器内控软件查明原因并解除警报。激光器内控软件会安装于机器的电脑上。当你不能操作时请联系我司的技术人员。

4. When the laser encounters abnormal operation or significant environmental changes (e.g., voltage or temperature fluctuations), it will trigger an alarm (possibly with flashing lights or a buzzer) and shut down. In such cases, you must activate the laser's internal control software to diagnose the issue and disable the alarm. The software is installed on the machine's computer. If you cannot operate the system, please contact our technical support team.

四、设备参数

四、Technical parameter

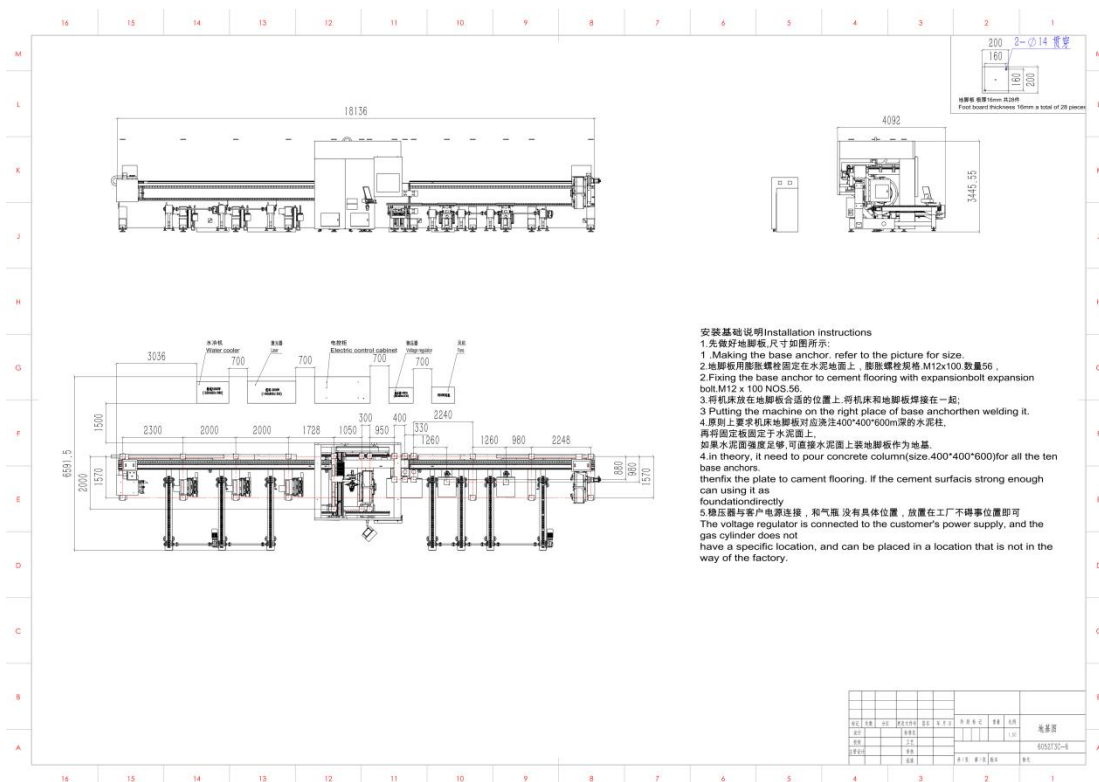
1. 主要参数

1. Main parameters

型号	MK-6052T3C-6
净重	19T
适配功率	1.5-12kw
切割尺寸	25-520mm
可移动卡盘数	2
卡盘承重	2T
卡盘转速	30r/min
加速度	0.3G
最大移动速度	50m/min
定位精度	±0.15mm/m
重复定位精度	±0.15mm/m
切割管长长度	6.5m
尾料长度	0mm
支撑	自动并且带3个伺服电机
氧气比例阀	SMC/安沃驰
电压/频率	380V/50HZ
外观尺寸	18500*3950*3450（含链条式上料）
注意	不含风机，不含独立电柜，不含接料台
Model	MK-6052T3C-6
Net weight	19T
Adapted power	1.5-12kw
Length of cut	25-520mm
Number of movable chucks	2
Collet bearing capacity	2T
Turning speed of chuck	30r/min
Acceleration	0.3G
Maximum movement speed	50m/min
Setting accuracy	±0.15mm/m
Repeated positioning accuracy	±0.15mm/m
Cut pipe length	6.5m
Tail length	0mm
Prop up	Automatic with 3 pieces servo
Oxygen proportional valve	SMC/AVENTICS
Frequency/Voltage	380V/50HZ
External dimensions	18500*3950*3450 (including chain-type feeding system)
Take care	Excludes fans, independent electrical cabinets, and material handling platforms

2. 地基图

2. Foundation drawing



五、电气部件简介

五、Introduction to Electrical Components

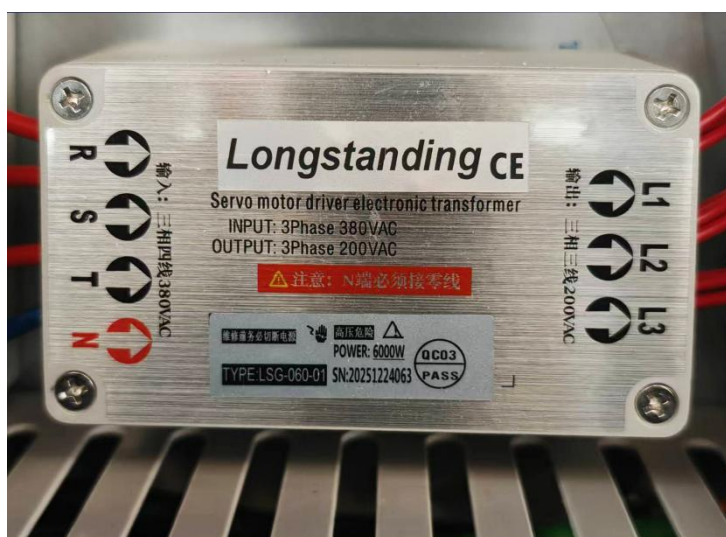
1. 伺服驱动器：是用来控制伺服电机的一种控制器，其作用类似于变频器作用于普通交流马达，属于伺服系统的一部分，主要应用于高精度的定位系统。一般是通过位置、速度和力矩三种方式对伺服马达进行控制，实现高精度的传动系统定位，目前是传动技术的高端产品。

1. Servo driver: A controller designed to regulate servo motors, functioning similarly to a frequency converter for standard AC motors. As a core component of servo systems, it is primarily employed in high-precision positioning applications. By controlling the motor through three parameters—position, speed, and torque—it achieves ultra-accurate positioning in transmission systems. Currently recognized as a cutting-edge product in transmission technology.



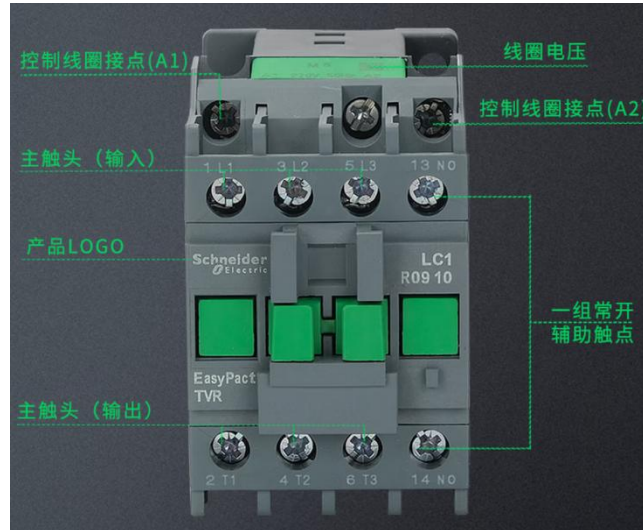
2. 伺服变压器：伺服变压器就是专门为伺服驱动系统提供的变压器，该类型的变压器可以有效地为伺服驱动器提供必要的电能。

2. Servo transformer: A servo transformer is a specialized transformer designed for servo drive systems, which efficiently supplies the necessary electrical power to servo actuators.



3. 交流接触器：利用线圈流过电流产生磁场，使触头闭合，以达到控制负载的电器。

3. AC contactor: An electrical device that uses a magnetic field generated by current flowing through a coil to close contacts, thereby controlling a load.



4. 断路器：断路器可用来分配电能，不频繁地启动异步电动机，对电源线路及电动机等实行保护，当它们发生严重的过载或者短路及欠压等故障时能自动切断电路，其功能相当于熔断器式开关与过欠热继电器等的组合。而且在分断故障电流后一般不需要变更零部件。

4. Circuit Breaker: A circuit breaker is designed to distribute electrical power, prevent frequent startups of asynchronous motors, and protect power lines and motors. It automatically cuts off the circuit when severe faults like overloads, short circuits, or under voltage occur. Its functionality combines that of a fuse switch with over/under heat relays. Importantly, it typically requires no component replacement after interrupting fault currents.



5. 系统控制板：系统板卡在设备中负责收集、发送控制信号和回应信号。类似于人体大脑。其控制设备的激光器、伺服电机、气体、润滑、以及切割软件的承载等。连接工控的电脑能实现集中处理报警信号和对设备的控制。

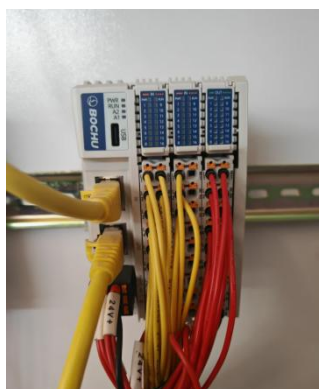
5. System Control Board: This board in the equipment collects and transmits control signals and response signals, functioning similarly to the human brain. It controls the laser, servo motor, gas, lubrication, and software for cutting operations.

The connected industrial computer centralizes the processing of alarm signals and equipment control.



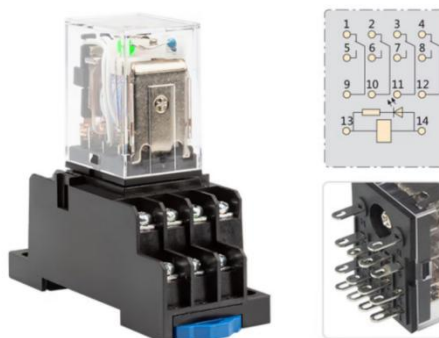
6. 扩展卡: 这是为了扩展功能使用, 连接到系统板, 与系统控制板一起进行上动作。

6. Expansion card: This is used to extend functionality by connecting to the system board to perform the aforementioned actions with the system control board.



7. 中间继电器: 用于继电保护与自动控制系统中, 以增加触点的数量及容量。它用于在控制电路中传递中间信号。

7. Intermediate relay: used in relay protection and automatic control system to increase the number and capacity of contacts. It is used to transmit intermediate signals in control circuits.



8. 电源模块: 提供24V电源。

8. Power module: Provides 24V power supply.



9. 滤波器：电源滤波器是由电容、电感和电阻组成的滤波电路。滤波器可以对电源线中特定频率的频点或该频点以外的频率进行有效滤除，得到一个特定频率的电源信号，或消除一个特定频率后的电源信号。

9. Filter: A power filter is a filtering circuit composed of capacitors, inductors, and resistors. It can effectively filter out specific frequencies or frequencies outside the target range in the power line, obtaining a power signal with a specific frequency or eliminating a power signal after removing a specific frequency.



六、设备连接

六、Device attachment

1. 电路要求

1. Circuit requirements

1. 在开始连接机器电源之前，要保证车间的配电设施满足需求。首先准备一个带有漏电保护的空气开关，并且预留足够的接线位置。断路器容量约63A~100A。

1. Before connecting the machine's power supply, ensure the workshop's electrical distribution meets the requirements. First, prepare an air switch with leakage protection and reserve sufficient wiring space. The circuit breaker capacity should be approximately 63A to 100A.



2. 安装准备

2. Installation preparation

1. 为了保证安装顺利，一些物料必不可少请在安装前准备妥当。

1. To ensure a smooth installation, make sure to prepare all necessary materials beforehand.

2. 主电源线：本机使用3相380V电源，请准备最少一根5*10平方毫米的电源线。机床到配电柜的距离决定电源线的长度。若机器配备稳压器等电源设备或激光器水冷机为独立供电，请准备2-3根不等。

2. Main power cable: This machine operates on a 3-phase 380V power supply. Please prepare at least one 5×10 mm² power cable. The cable length depends on the distance between the machine and the power distribution cabinet. If the machine is equipped with voltage stabilizers or other power devices, or if the laser water-cooled unit requires independent power supply, prepare 2-3 additional cables as needed.

3. 水平仪：为了使机器运行更加稳定，请准备水平仪对机器的安装进行测量。

3. Level: To ensure stable machine operation, prepare a level to measure the installation.

4. 压缩空气：配备了接料和支撑功能或增加切割头气冷的机器，需要准备气泵为气缸提供动力。

4. Compressed air: Machines equipped with material handling and support functions, or those with added air-cooled cutting heads, require a gas pump to power the cylinders.

5. 铁片若干：当车间地面高度差异过大时，需要使用厚度不同的铁片调节水平。

5. Multiple iron plates: When the workshop floor has significant height variations, use iron plates of different thicknesses to level the surface.

6. 气体减压阀：切割气体使用氧气或氮气，需要准备气体减压阀来连接机床气体接口。

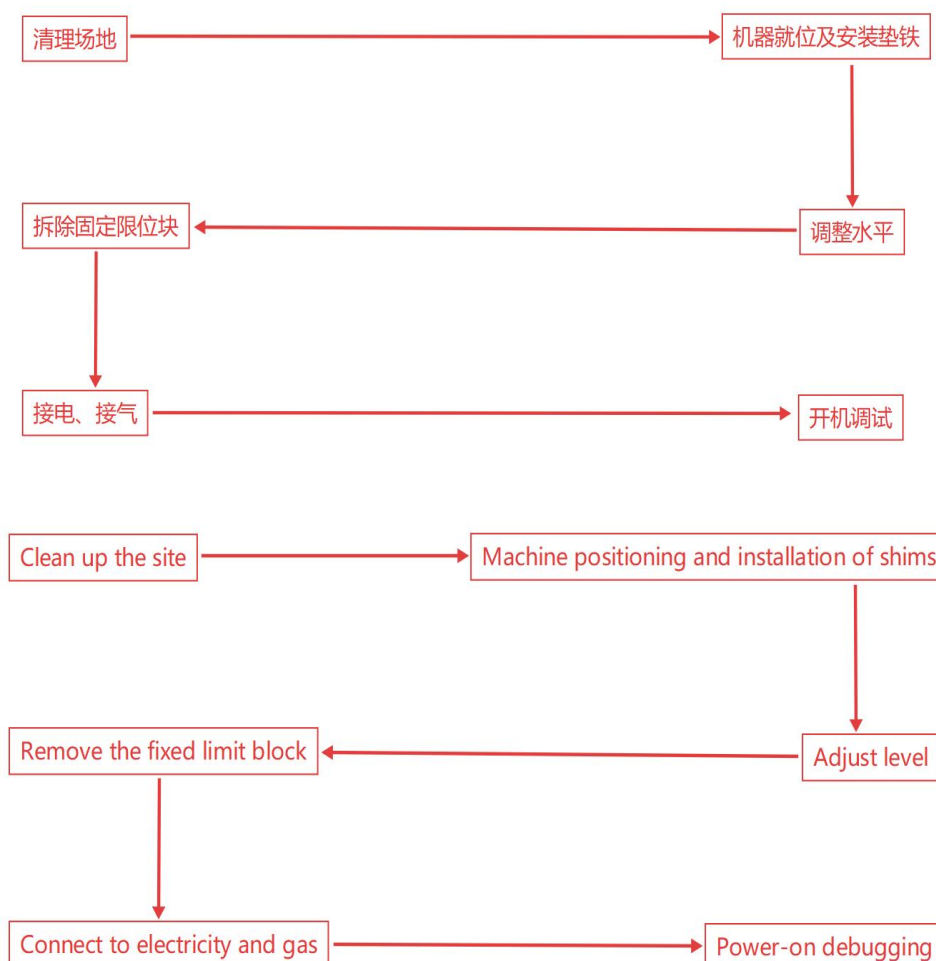
6. Gas pressure reducing valve: When cutting with oxygen or nitrogen, a pressure reducing valve must be installed to connect the machine tool's gas port.

7. 工具箱：准备各种工具来应对可能遇到的安装需要。

7. Toolbox: Prepare various tools to handle installation needs.

3. 安装流程

3. Installation



4. 电路连接

4. Circuit connection

1. 机器有多部分组成，每个部分都要接电，请确保每部分电路连接正确。错误的连接可能会造成设备的损坏；推荐专业电工进行安装接线；设备电源应使用380V三相电源，三相不平衡度<2.5%，线电压波动<5%。若用电环境不理想请加装

稳压器。三根相线请按照L1L2L3NPE顺序与外部电源对应（定制机除外）；水冷机、激光器需要单独为其连接电源，除尘风机可以连接到电气柜内部。

1. The machine consists of multiple components, each requiring electrical connections. Ensure all circuit wiring is properly installed. Incorrect connections may cause equipment damage; professional electricians are recommended for installation and wiring. The device must be powered by a 380V three-phase supply with an unbalance factor $<2.5\%$ and line voltage fluctuation $<5\%$. A voltage stabilizer should be added if the electrical environment is suboptimal. The three-phase lines should be connected to the external power supply in the L1L2L3NPE sequence (except for custom models). Water-cooled systems and lasers require separate power connections, while dust removal fans can be integrated into the electrical cabinet.

2. 用电安全注意事项:

2. Precautions for electrical safety:

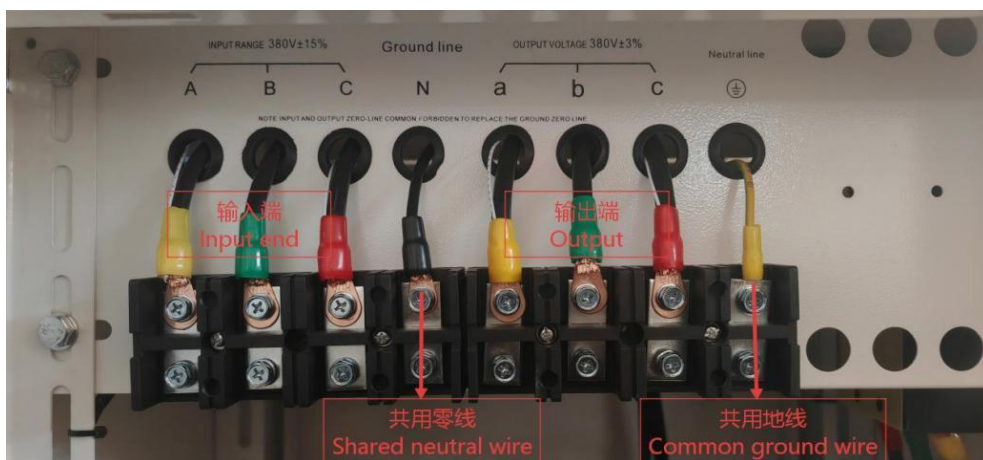
确保所有设备电压符合机器要求，确保电源线与断路开关连接牢固，以免电源缺相造成的设备损坏；各设备外壳必须接地，防止静电对设备电器元件造成损害，同时防止电路损坏漏电时对操作人员造成人身伤害；维修更换电器元件时应切断电源并等待一段时间后操作，严禁带作业；定期清除断路器、变压器、及接线板上面的灰尘，以免电流击穿灰尘，造成设备损坏；工作完成后应关闭电源。

Ensure all equipment voltage meets machine specifications and secure power cords to circuit breakers to prevent equipment damage caused by phase loss. All equipment casings must be properly grounded to protect electrical components from static electricity and to prevent operator injuries during circuit failures or leakage currents. When replacing electrical components, disconnect power supply and allow sufficient downtime before operation—never perform maintenance while powered on. Regularly clean dust from circuit breakers, transformers, and terminal blocks to avoid current-induced dust discharge that may damage equipment. Always turn off power after completing operations.

3. 若用电环境不理想则必须使用稳压器，稳压器接线方式如下。

3. If the electrical environment is suboptimal, a voltage stabilizer must be used.

The wiring method for the voltage stabilizer is as follows.



5. 水冷水路的连接

5. Connection of water and cooling water

1. 水冷机使用前必须加水，否则会造成水冷机损坏。水位保持在标尺的绿色区域。首次使用水冷机时，通电循环后水位会下降，请立即关机补水至绿色区域。水冷机为设备提供循环水冷，水冷水路分为两个路线。一部分为切割头循环水冷，另一部分为激光器循环水冷；水冷机管路与机床管路按照标签一一对应，因水冷机循环有一定压力，请连接可靠以免水压崩开管路。

1. The water-cooled machine must be filled with water before use to prevent damage. The water level should remain in the green zone on the scale. When using the machine for the first time, the water level will drop after the power cycle. Immediately shut down and refill the water until the level reaches the green zone. The water cooler supplies circulating water to the equipment, with two separate water circuits: one for the cutting head and the other for the laser. The water cooler pipes are labeled and matched with the machine tool pipes. Since the water cooler's circulation carries pressure, ensure a secure connection to prevent pipe rupture due to water pressure.



注意事项

Precautions

1. 水冷机内添加不含矿物质的纯净水、蒸馏水或去离子水，禁止添加任何有腐蚀性的液体或异味的水均不可注入水冷机。

1. The water-cooled machine must be filled with mineral-free purified water, distilled water, or deionized water. The injection of corrosive liquids or water with unusual odors is strictly prohibited.

2. 加水时应避免任何与水的无必要接触（例如手），所有注水的辅助设备，如泵、软管等，均应只用于此水冷机。

2. Avoid any unnecessary contact with water (e.g., hands) during refilling. All water-filling accessories, including pumps and hoses, must be used exclusively for this water-cooled machine.

3. 打开水冷机电源前，应检查水冷机水位，严禁无水或水位过低时开启水冷机，以免造成水冷设备损坏。水冷机进出水管严禁挤压、踩踏，保持水路畅通。

3. Before powering on the water-cooled machine, check the water level. Never start the machine without water or when the water level is too low, as this may damage the equipment. Do not squeeze or step on the inlet and outlet pipes to ensure the water flow remains unobstructed.

4. 气温在0℃以下时，应冷却水中加注防冻液，比例为70%水+30%防冻液；建议每两到三个月更换一次水冷机内的水。

4. When the temperature is below 0°C, antifreeze should be added to the cooling water in the ratio of 70% water+30% antifreeze. It is recommended to replace the water in the water-cooled machine every two to three months.

6. 气路的连接

6. Connection of airway

1. 机床会配备两根白色的气管，一根用来连接氮气（切割用压缩空气与氮气共用），另一根用来连接氧气。请通过氮气表把氮气管和提供氮气的装置连接起来，通过氧气表把氧气管和提供氧气的装置连接起来。机床床身有氧气和氮气连接口的标签，请对应标签连接气管。

1. The machine tool is equipped with two white air hoses: one for nitrogen (shared by cutting compressed air and nitrogen systems) and another for oxygen. Connect the nitrogen hose to the nitrogen supply device using a nitrogen pressure gauge, and link the oxygen hose to the oxygen supply device via an oxygen pressure gauge. The machine tool bed features labels indicating oxygen and nitrogen connection ports; connect the hoses accordingly to these labeled ports.



注意事项

Precautions

1. 氧气、氮气的连接和氮气表、氧气表的压力范围应满足上图要求，气体应满足下表要求：

1. The pressure ranges for oxygen and nitrogen connections, as well as for nitrogen and oxygen gauges, must comply with the requirements specified in the diagram above. The gases must meet the specifications listed in the table below:

切割气体	纯度（最低）	主要应用板材
氧气	99.99%	碳钢
氮气	99.99%	不锈钢
空气	洁净、无油、无水等杂质	条件允许的碳钢、不锈钢

Cutting gas	Purity (minimum)	Main application boards
Oxygen	99.99%	Carbon steel
Nitrogen	99.99%	Stainless steel
Air	Clean, free of oil, water and other impurities	Carbon steel and stainless steel, if conditions permit

2. 气体的纯度会对切割速度以及效果造成影响高纯度的气体会得到更佳的速度与效果。

2. The purity of gas will affect the cutting speed and effect, and the high purity gas will get better speed and effect.

3. 因各国家或地区标准不一样, 我司展示的氮气表和氧气表可能不能连接到您的供气装置上, 所以请在当地另外采购氮气表和氧气表。

3. Due to varying national or regional standards, the nitrogen and oxygen gauges displayed by our company may not be compatible with your gas supply system. Please purchase these gauges separately in your local area.

4. 使用气体温度不允许超过50 °C。

4. The gas temperature should not exceed 50°C.

5. 原则上建议气体方面的问题与气体供应商保持联系。

5. In principle, it is recommended to contact the gas supplier for gas-related issues.

6. 气体初次安装应排气, 保证管路清洁后才可接入机床。

6. The gas should be vented during the initial installation and the pipeline should be cleaned before connecting to the machine tool.

7. 本台机器还需要使用压缩空气。切管单元卡盘, 支架等部件使用的压缩空气; 接气入口在切管单元的左侧。

7. This machine also requires compressed air. The air is used for components such as the pipe-cutting unit's chuck and bracket. The air inlet is located on the left side of the pipe-cutting unit.

7. 激光器的安装

7. Laser installation

1. 激光器为独立安装, 那么需要重新连接激光器与机床的连接, 第一步需要把光纤连接切割头。

1. If the laser is installed independently, the connection between the laser and the machine tool needs to be reconnected. The first step is to cut the fiber optic connector.



2. 光纤必须穿过线槽，进入横梁。然后穿过X轴拖链，进入机头。然后穿过Z轴拖链连接至切割头。

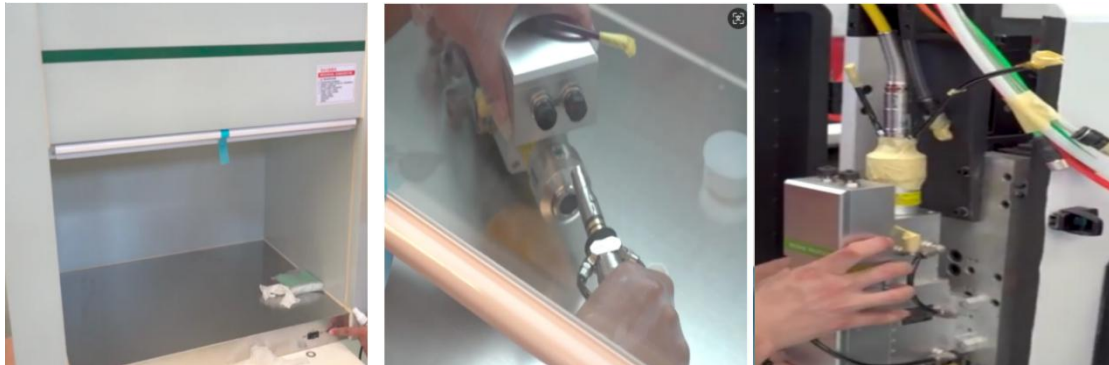
2. The optical fiber must pass through the cable tray and enter the crossbeam. It then passes through the X-axis drag chain to the machine head, and finally through the Z-axis drag chain to connect with the cutting head.

3. 光纤与切割头的连接必须要在无尘箱中进行，不能使切割头受到任何污染，否则可能会引起切割头的烧坏。

3. The connection between the fiber optic and the cutting head must be performed in a clean room to prevent any contamination of the cutting head, which could otherwise cause it to burn out.

4. 连接光纤与切割头之后，请把切割头按照原来的安装方式安装好复位。所有连线都按照最初的方式重新连接。整个安装过程一定要保证不能使切割头任何部位受到污染。

4. After connecting the optical fiber and cutting head, reinstall the cutting head to its original position. Reconnect all cables as initially. Ensure the cutting head remains uncontaminated throughout the installation process.



5. 连接光纤与切割头之后，请把切割头按照原来的安装方式安装好复位。所有连线都按照最初的方式重新连接。整个安装过程一定要保证不能使切割头任何部位受到污染。

5. After connecting the optical fiber and cutting head, reinstall the cutting head to its original position. Reconnect all cables as initially. Ensure no contamination occurs on any part of the cutting head during the entire installation process.

6. 激光器信号线的连接：通常会设置一个接线排在线槽内或机床内部，线排的一端有接好的信号线，只需要将激光器的信号线按照线排另一侧的标识对应链接。

6. Laser signal line connection: Typically, a terminal block is installed in the cable tray or machine tool. One end of the block has pre-wired signal lines. Simply connect the laser signal lines to the other side of the block according to the mark

七、设备开机试运行

七、Device startup trial run

1. 开机前准备

1. Preparations before turning on the device

1. 注：机器上电前请再次确认各设备动力电源线的连接符合设备要求，接线牢靠，设备安装完整且各运动轴方向无异物无阻碍，检查后方可开机供电。

1. Note: Before powering on the machine, verify that all power cables meet the equipment requirements, ensure secure wiring, complete installation, and no foreign objects or obstructions on the movement axes. Power on only after inspection.



2. 初次上电请在确保接线正确后，打开电箱门依次将断路器上电，每个断路器上有标签显示。闭合断路器没有异常后关闭电箱门进行下一步操作。

2. When powering on for the first time, ensure the wiring is correct, then open the power box door and power on the circuit breakers in sequence. Each circuit breaker has a label indicating its status. After closing the circuit breakers without any abnormalities, close the power box door and proceed to the next step.

3. 上电后安装遥控手柄和键盘鼠标，遥控器和键盘鼠标均为无线安装。需将接收器插进屏幕侧面的USB接口。

3. After powering on, install the wireless remote control and keyboard/mouse. Connect the receiver to the USB port on the side of the screen.

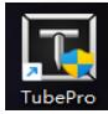


键盘鼠标接收器
Keyboard and mouse receiver

无线遥控器及接收器
Wireless remote control and receiver

2. 开机并检查伺服运动系统

2. Check the servo motion system after turning on the device.

第一步：打开旋钮开关 Step 1: Turn on the knob switch	
第二步：打开 PC 钥匙开关 Step 2: Turn on the PC key switch	
第三步：按下伺服按钮 Step 3: Press the servo button	
第四步：图标启动软件 第四步：Icon to launch the software	

1. 按顺序打开开关后等待电脑开启后点击

1. Turn on the switch in sequence, wait for the computer to start, then click.

2. 打开软件（打开软件有回原点的提示，请取消）。找到软件运动控制按钮（下图所示）低速运动各运动机构（X轴、Y轴、Z轴等）是否正常下运动，并移动至限位开关处测试所有限位开关是否有效。

2. Open the software (a prompt will appear asking to return to the origin; please cancel). Locate the motion control button (as shown in the figure below). Check if all motion mechanisms (X-axis, Y-axis, Z-axis, etc.) move normally at low speed, then move to the limit switches to test if all limit switches are effective.

3. 检查冷水机水路

3. Check the water circuit of the chiller.

1. 电箱内的断路器开启后，打开水冷机上的空气开关，这时水冷机会工作，查看整个水路各接口，若发现漏水，立刻关闭水冷机，再去整修漏水的地方。整修后再进行测试，确保无漏水为止。

1. After activating the circuit breaker in the electrical cabinet, open the air switch on the water-cooled machine to start its operation. Inspect all water line connections. If any leakage is detected, immediately shut down the machine and locate the leak. Conduct repairs and retest until no leakage is found.

4. 检查气路和气体控制

4. Check the airway and gas control

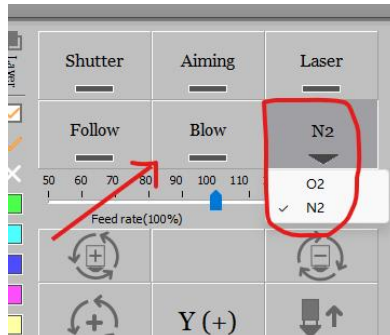
1. 首先确保您的供气装置内有相应气体，再检查一下各气路及接口是否都已连接。打开各供气装置的开关，分别旋开氧气表和氮气表上的开关，建议氧气表旋至0.3-1.0Mpa之间，氮气表旋1.0-2.5Mpa之间，若听到有漏气的声音，找到其位置，解决漏气现象。

1. First, ensure that the gas supply device has the corresponding gas, then check if all gas lines and connections are properly connected. Turn on the switches of each

gas supply device, and turn the oxygen meter and nitrogen meter switches separately. It is recommended to turn the oxygen meter to between 0.3-1.0Mpa and the nitrogen meter to between 1.0-2.5Mpa. If you hear any gas leakage sounds, locate the source and address the leak.

2. 确保无漏气后, 如下图, 在操作软件中点击“Blow”, 是否出气, 再点击“Blow”, 是否关气。更换另一种气体 (“Blow” 右面的按钮), 再点击“Blow”, 是否出气, 再点击“Blow”, 是否关气。若有异常, 需解决。见下图:

2. After confirming no gas leakage, follow these steps: In the software interface, click 'Blow' to test airflow, then click 'Blow' again to verify gas shutdown. Switch to another gas (the button to the right of 'Blow'), then click 'Blow' to test airflow, followed by 'Blow' to confirm gas shutdown. If any issues occur, troubleshoot accordingly. See the diagram below:

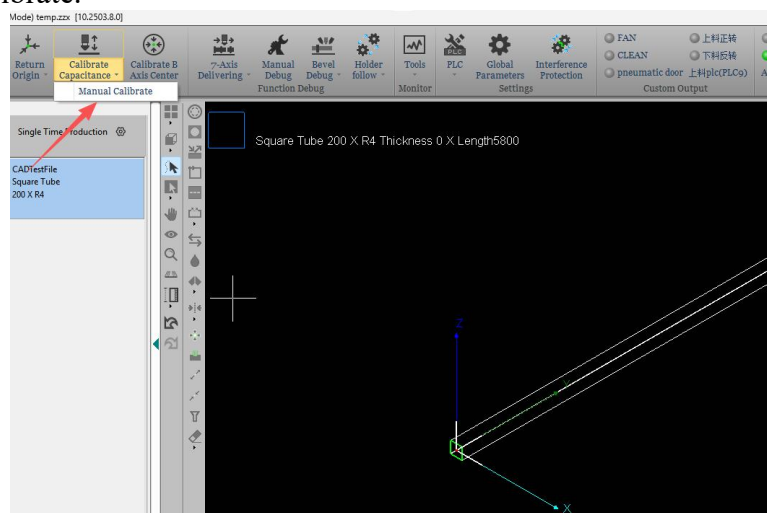


5. 电容标定

5. Capacitance calibration

1. 标定时, 切割头下方必须有金属管材。移动切割头向下运动。距离管材大约20mm左右处停下。点击标定按钮进行标定。

1. When calibrating, there must be a metal tube below the cutting head. Move the cutting head downward and stop about 20mm from the tube. Click the calibration button to calibrate.



2. 注意: 以上两项参数标定出来的指标至少需要为“中”, 否则会影响切割质量。而这两项指标比较理想的情况是“优”或“良”。如该结果不理想, 需要重新标定。建议每次开机后或更换板材后, 进行一次标定操作。

2. Note: The calibration results for these two parameters must be at least "Medium" to ensure cutting quality. The ideal calibration results should be "Excellent" or "Good". If the results are unsatisfactory, recalibration is required. We recommend performing a calibration after each startup or board replacement.

6. 调光（激光同轴）

6. Dimming (laser coaxial)

调整激光从喷嘴中心穿过的步骤是：

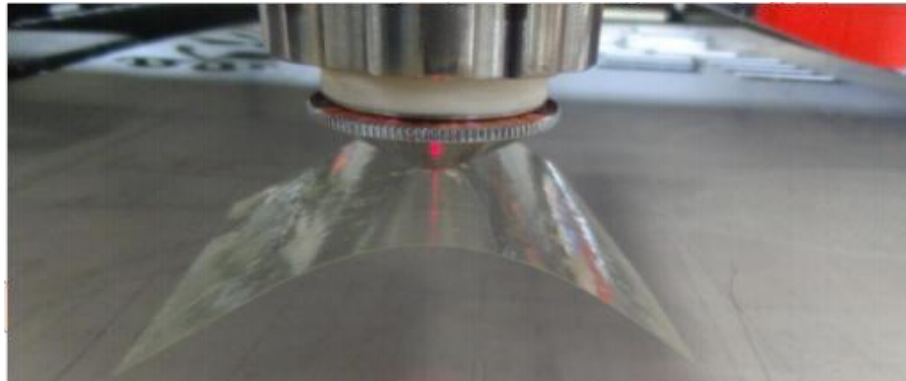
The step for adjusting the laser passing through the nozzle center is:

1. 打开软件，移动横梁和激光切割头至合适的位置。

1. Open the software and move the crossbeam and laser cutting head to the appropriate position.

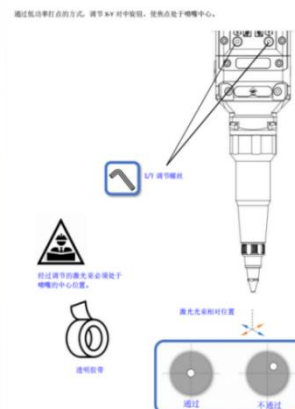
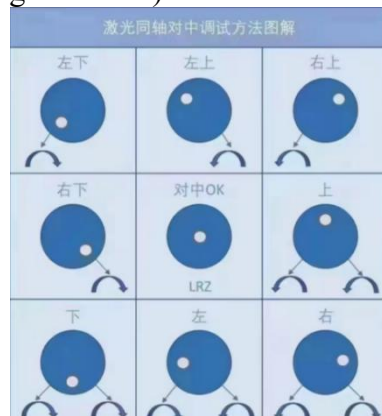
2. 将透明胶带用拇指均匀贴到喷嘴的端面上（见下图）。

2. Apply the transparent tape evenly with your thumb to the end face of the nozzle (see the picture below).



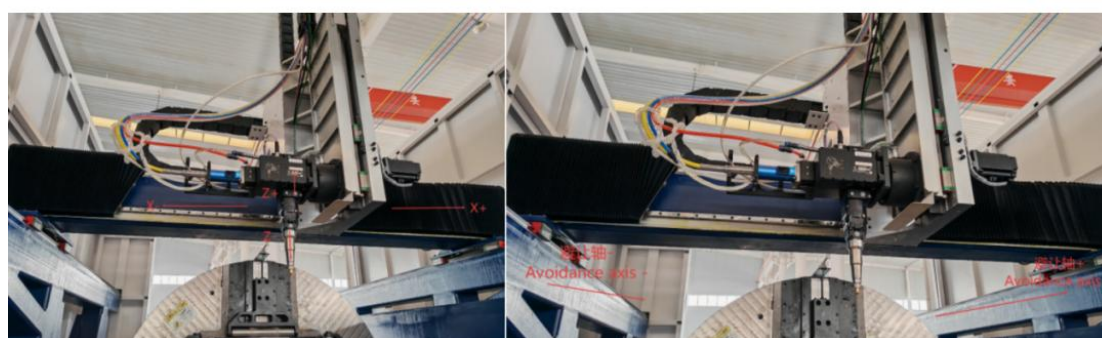
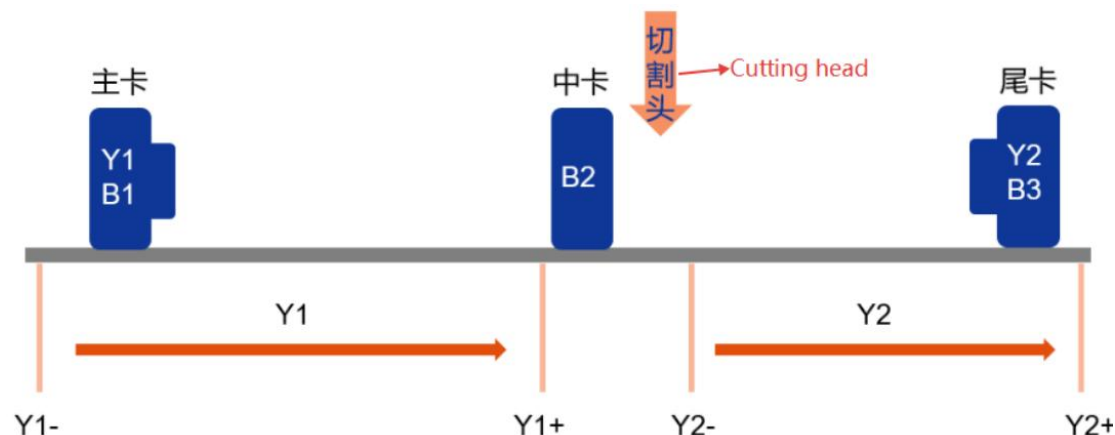
3. 在软件中点击“Laser”（或手柄上的“Laser”按钮），会在胶带上出现“⊙”图标，将透明胶带拿下来，注意不要转动其相对位置。若打出的光点不在喷嘴中心，需通过调整切割头的上面的旋钮，使光点在喷嘴中心。反复上述动作，直到激光在透明胶带上打出的孔与喷嘴的中心重合。（调整方法见下图）

3. In the software, click the "Laser" button (or the "Laser" button on the controller) to display the "⊙" icon on the tape. Remove the transparent tape, ensuring it doesn't shift position. If the laser spot isn't centered on the nozzle, adjust the knob above the cutting head to align the spot with the nozzle's center. Repeat this process until the laser hole on the tape matches the nozzle's center. (See the adjustment method in the figure below)



7. 轴定义

7. Axis definition



1. 七轴拉料只有主卡和尾卡会进行插补运动，主卡和尾卡的移动轴分别为Y1轴和Y2轴

1. In a seven-axis material handling system, only the main clamp and tail clamp perform interpolation movements. The moving axes of the main clamp and tail clamp are Y1 and Y2, respectively.

2. Y1和Y2的正方向一致；因此Y1原点开关远离切割头，Y2原点在正向，分别两侧回原点

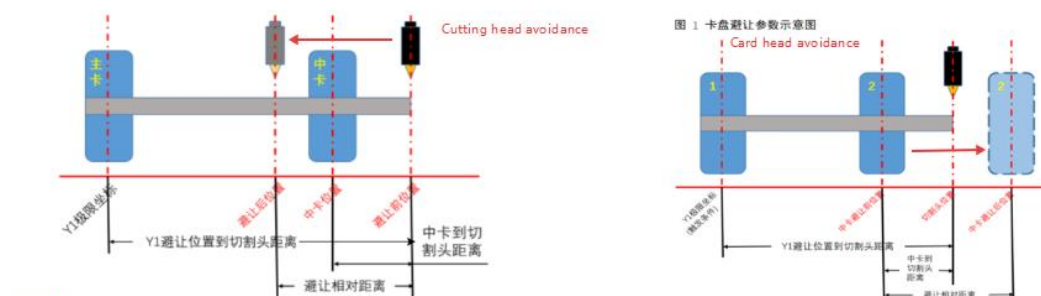
2. The positive directions of Y1 and Y2 are the same; therefore, the origin switch of Y1 is away from the cutting head, and the origin of Y2 is in the positive direction, returning to the origin on both sides respectively.

3. 七轴机型一般都有避让或复杂上/下料支架结构，因此需注意各轴回原点的顺序，可通过PLC控制，避免机械干涉

3. Seven-axis machines generally have obstacle avoidance or complex loading/unloading support structures, so attention must be paid to the sequence of each axis returning to its origin. This can be controlled by a PLC to avoid mechanical interference.

8. 避让轴

8. Avoidance axis



1. 避让轴分“切割头避让”与“卡盘避让”，本机型采用切割头避让类型；切割头避让默认往Y负方向移动；卡盘避让默认向Y正方向移动；避让动作说明：

切割过程中，Y1 逐渐朝避让位置移动，当切割下一条轨迹会超过避让位置时，触发避让动作；

避让时，按照 避让前 PLC → 避让轴运动 → 避让后 PLC 的顺序进行；其中，避让轴运动的方向则根据避让类型决定；

避让后，切割头或卡盘的位置发生变化；如果配置了「启用 Y1 轴避让正行程」，那么 Y1 轴的正行程也会相应进行修改；

1. The avoidance axis is divided into "cutting head avoidance" and "chuck avoidance". This model uses the cutting head avoidance type.

Cutting head avoidance moves in the negative Y direction by default; chuck avoidance moves in the positive Y direction by default.

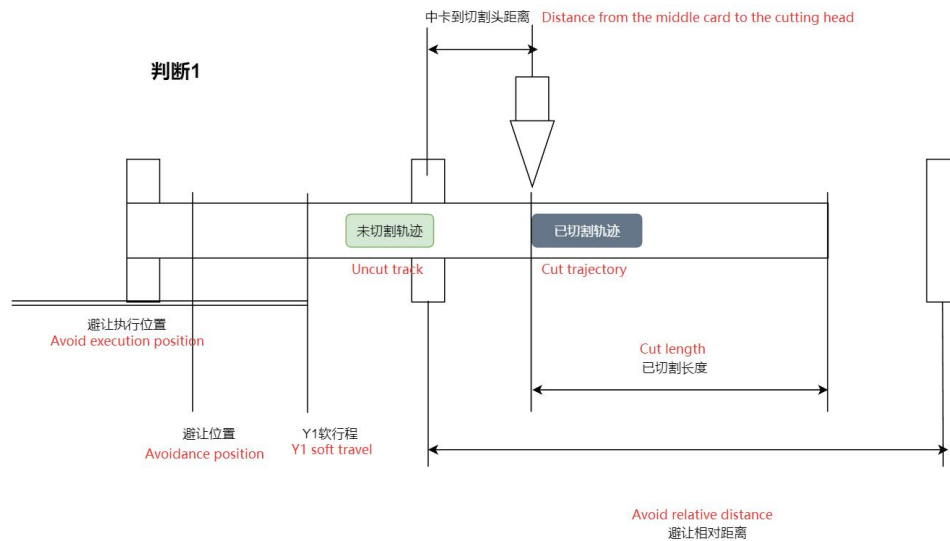
Avoidance action description: During cutting, Y1 gradually moves towards the avoidance position. When the next cutting trajectory will exceed the avoidance position, the avoidance action is triggered.

During avoidance, the sequence is: PLC before avoidance → avoidance axis movement → PLC after avoidance. The direction of the avoidance axis movement is determined by the avoidance type.

After avoidance, the position of the cutting head or chuck changes. If "Enable Y1 axis avoidance positive travel" is configured, the positive travel of the Y1 axis will also be modified accordingly.

9. 避让触发条件

9. Avoidance Trigger Conditions



1. 必要条件：下条轨迹最大值等于或超过Y极限坐标，但需要满足以下条件：
触发避让的轨迹是在最后一个零件的轨迹上，除非开启单零件检测，才允许避让在最后一个零件之前触发。

条件1： 零件伸出长度 > 避让相对距离 - 中卡到切割头的距离

不然无法避让，会提示管材会被拉出中卡

条件2： 启用短零件允许避让

如果零件伸出长度 < 避让相对距离 - 中卡到切割头的距离 避让会触发，但会自动松开中卡

1. Necessary Conditions: The maximum value of the next trajectory must be equal to or exceed the Y-limit coordinate, but the following conditions must be met: The trajectory that triggers the avoidance must be on the trajectory of the last part. Avoidance is only allowed to be triggered before the last part if single-part detection is enabled.

Condition 1: Part extension length > Avoidance relative distance - Distance from the center clamp to the cutting head

Otherwise, avoidance will not be possible, and a message will be displayed indicating that the pipe will be pulled out of the center clamp.

Condition 2: Short part avoidance is enabled.

If the part extension length < Avoidance relative distance - Distance from the center clamp to the cutting head, avoidance will be triggered, but the center clamp will be automatically released.

10. 避让配置

10. Avoidance configuration



Even after configuring the avoidance mechanism, you still need to activate the control in the software for it to work.

1. 请不要随意修改里面的参数，会发生撞机风险，如需修改请联系工程师，确认以后在执行

1. Please do not modify the parameters arbitrarily, as this may cause a collision risk. If modifications are necessary, please contact an engineer for confirmation before execution.

1. 主要参数

1. Main parameter

根据避让类型配置主要参数：

1. 触发条件，Y1极限坐标：触发避让动作的Y1坐标，如果切割下一条轨迹，会导致Y1运动到该位置之外，则会触发避让动作。
2. 避让轴选择：根据实际选择通用轴，并在相应通用轴设置好相关参数。
3. 避让相对距离：避让时相对当前位置移动的距离；（注意：此值区分正负）
4. 避让轴避让到绝对位置：勾选后避让时绝对移动至设定坐标；（建议勾选）
5. Y1避让位置到切割头的距离：Y1在触发避让坐标卡爪内部距离切割头的距离

6. 中卡到切割头的距离：中卡卡爪外侧到切割头的距离

1. Trigger condition, Y1 limit coordinate: The Y1 coordinate that triggers the avoidance action. If the next trajectory is cut, causing Y1 to move beyond this position, the avoidance action will be triggered.

2. Select the bypass axis: Choose a general-purpose axis based on actual requirements and configure the relevant parameters on the selected axis.

3. Relative avoidance distance: The distance moved from the current position during avoidance. (Note: This value distinguishes between positive and negative values.)

4. Move the avoidance axis to absolute position: After checking, move absolutely to the set coordinates during avoidance; (Recommended)

5. Distance from Y1's avoidance position to the cutting head: The internal distance between Y1 and the cutting head within the trigger avoidance coordinate gripper.

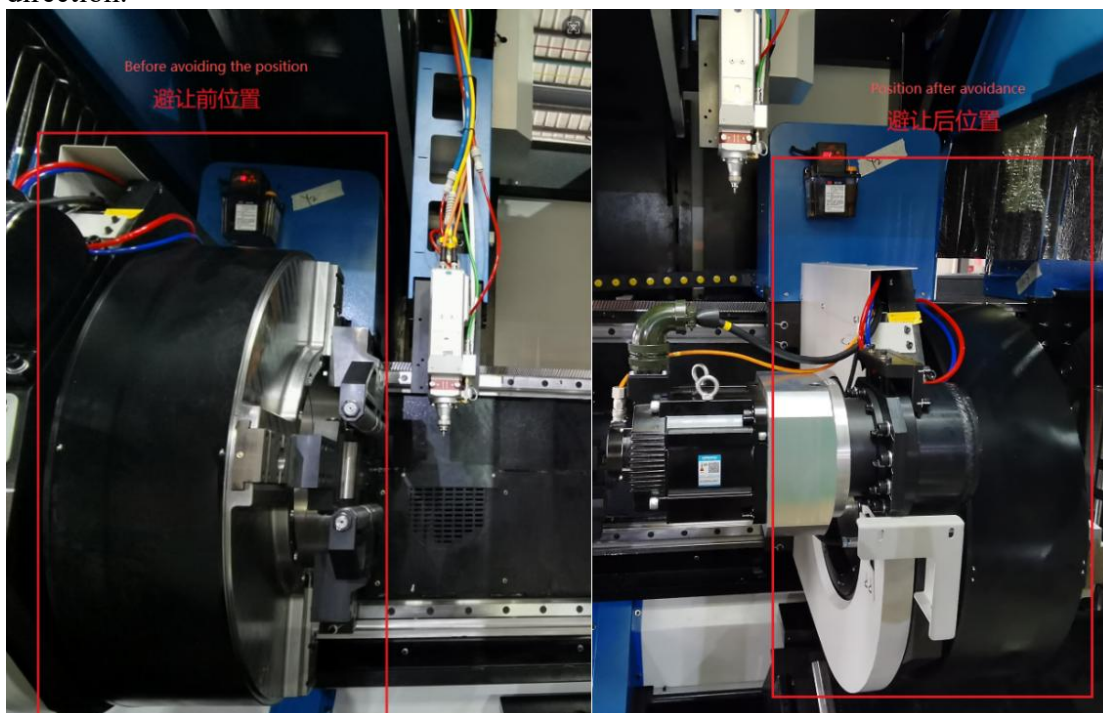
6. Distance from the center chuck to the cutting head: The distance from the outer side of the center chuck jaws to the cutting head.

11. 避让相对距离

11. Avoid relative distance

1. 手动移动避让轴时，需要先让A-Z-X轴返回原点，在安全距离才可以移动避让轴，以免因为机型干涉原因导致切割头发生碰撞，在切割软件打开避让轴手动调试可以移动避让轴回原点和点动避让轴，避让轴通常是像Y负向移动。

1. When manually moving the avoidance axis, the A-Z-X axes must first be returned to their origin, and the avoidance axis can only be moved within a safe distance to prevent the cutting head from colliding due to machine interference. In the cutting software, you can enable manual adjustment of the avoidance axis to move it back to its origin and jog it. The avoidance axis typically moves in the negative Y direction.



12. 七轴拉料辅助参数

12. Auxiliary Parameters for Seven-axis Drawing

1. Y2送料临界位置:用于反复拉料的场景，需勾选“B3中空”才会生效；不勾选则B3默认最大拉料范围为Y2的正软限位；

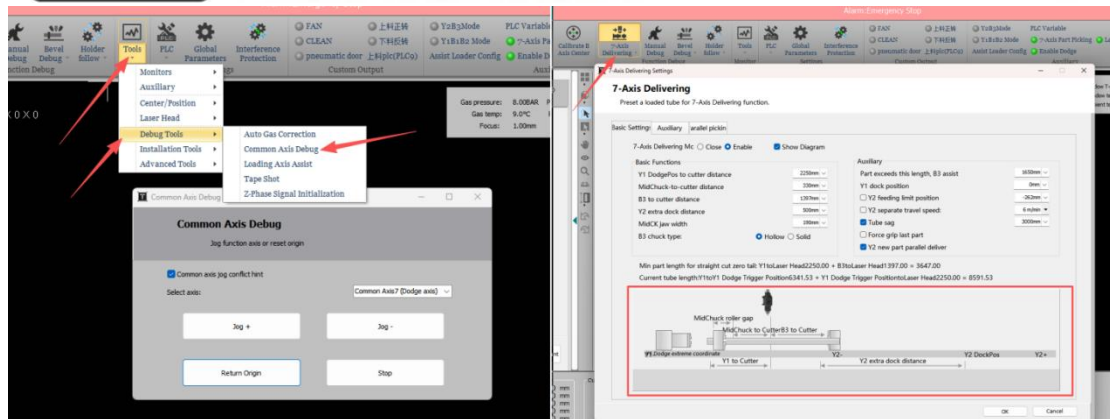
2. B3中空：根据实际卡盘结构勾选；启用后B3可以实现反复拉料动作；

3. Y1的停靠位置：根据实际需求来设定数值；代表进入零尾料之后，B1卡盘松开之后停靠的位置。

1. Y2 feeding critical position: Used for repeated material pulling scenarios. Selection of 'B3 hollow' is required for activation; otherwise, B3's default maximum pulling range defaults to Y2's positive soft limit.

2. B3 Hollow: Select based on the actual chuck structure; when enabled, B3 enables repeated material pulling actions.

3. Y1's docking position: Set the value according to actual requirements; indicates the stopping position after entering the zero tailstock and releasing the B1 chuck.



13. 测量避让距离

13. Obstacle avoidance distance measurement

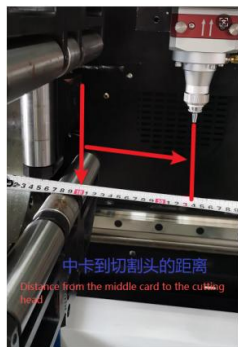
1. 测量方法

1. Measurement methods



测量方法为：先将Y1移动至避让配置中“触发条件：Y1极限坐标”的位置，将切割头下移至方便测量位置，用卷尺测量从主卡卡爪内侧到切割头喷嘴中心的距离；
此参数影响软件对加工能力的判断；
The measurement method is as follows: First, move Y1 to the position of "Trigger Condition: Y1 Limit Coordinates" in the avoidance configuration. Move the cutting head down to a convenient measurement position, and use a measuring tape to measure the distance from the inside of the main chuck jaws to the center of the cutting head nozzle. This parameter affects the software's judgment of processing capability.

切割能力=避让极限坐标+避让位置到切割头的距离
Cutting capability = Avoidance limit coordinates + Distance from the



测量方法：
将切割头下移至方便测量高度，用卷尺从中心卡爪 滚轮外侧测量到切割头喷嘴中心的距离；
中卡到切割头的距离，该值影响卡盘避让时管材是否会被拉出中卡的判断
设置中卡厚度参数，此参数为中卡两组滚轮卡爪的最左侧面到右侧侧面的距离；
(即卡爪的厚度)
Measurement Method:
Lower the cutting head to a convenient measurement height. Use a measuring tape to measure the distance from the outside of the center clamping jaw rollers to the center of the cutting head nozzle.
The distance from the center clamp to the cutting head affects the judgment of whether the pipe will be pulled out of the center clamp during chuck clearance.
Set the center clamp thickness parameter. This parameter is the distance from the leftmost side to the right outer side of the two sets of roller clamping jaws of the center clamp (i.e., the thickness of the jaws).

2. 注意事项

2. Precautions

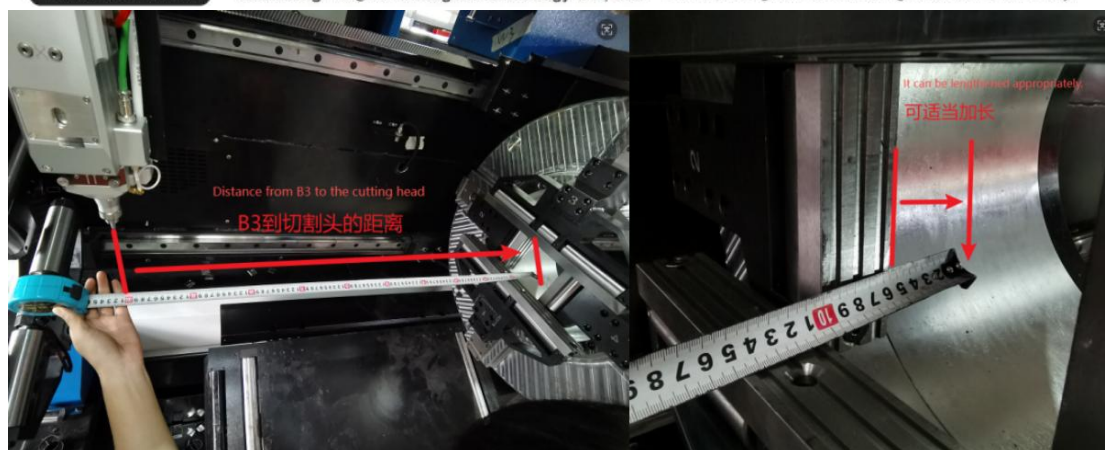
测量方法为：

The measurement method is:

先将Y2移动至负软限位，将切割头下移至方便测量位置，用卷尺测量从尾卡卡爪右侧到切割头喷嘴中心的距离

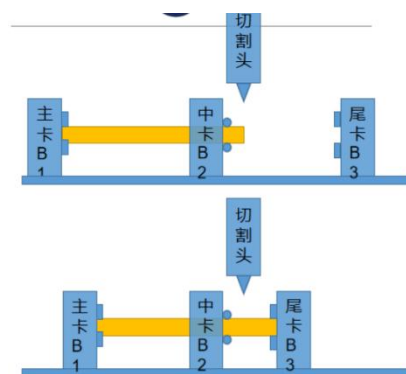
中空卡盘，避免出现类似斜切的切断轨迹导致B3卡爪夹不到的情况，此距离可适当设长一点。

The hollow chuck prevents cutting paths resembling oblique cuts from causing the B3 jaw to fail in engagement, allowing for a slightly longer distance setting.



14. 拉料动作

14. Material Pulling Action



1. 加工前，B3卡盘停靠在Y2行程中的某一位置待命。大于某一长度的零件才会去拉料。拉料时，Y2B3卡盘从停靠点，移动到负软限位处夹持管材。管材加工状态：B1B2夹持加工——B1B2B3夹持加工。

1. Before processing, the B3 chuck is positioned at a certain point in the Y2 stroke, ready to be pulled. Only parts exceeding a certain length will be pulled. During pulling, the Y2B3 chuck moves from the stop point to the negative soft limit position to clamp the tube. Tube processing status: B1B2 clamping processing → B1B2B3 clamping processing.

15. 零尾料动作之切割头避让

15. Cutting head avoidance during zero-tailing material operation

1. 如果下条轨迹超过避让触发坐标则开始避让，Y1即将超过极限坐标时提前松开主卡；

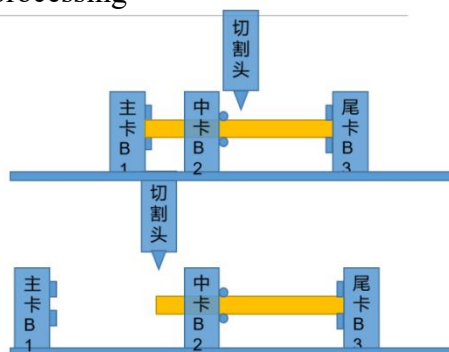
1. If the next trajectory exceeds the avoidance trigger coordinates, the system initiates avoidance. When Y1 approaches the limit coordinates, the master card is released in advance.

2. 避让后Y1行程变小，Y2行程不受影响；

2. After yielding, the stroke of Y1 decreases, while the stroke of Y2 remains unaffected.

3. 管材加工状态：B1B2B3夹持加工——B2B3夹持加工

3. Pipe processing status: B1B2B3 clamping processing → B2B3 clamping processing

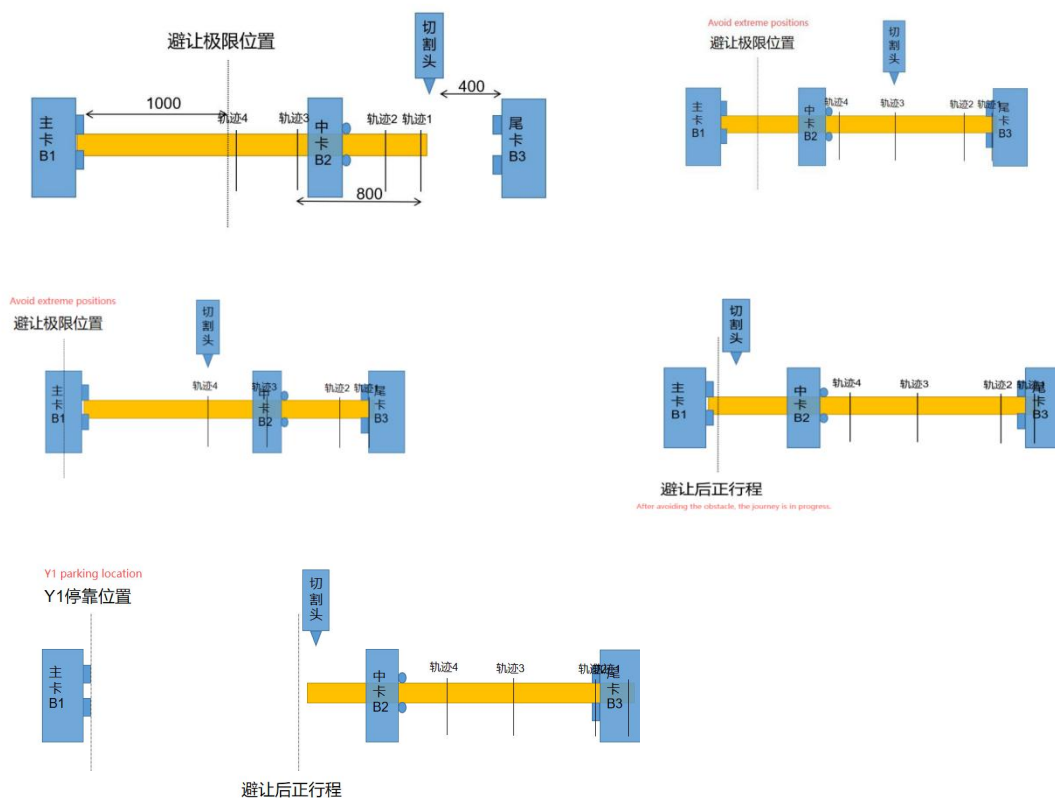


16. 零尾料动作之避让

16. Avoidance of Zero-Waste Material Movements

1. 如果下条轨迹超过避让触发坐标则开始避让, Y1即将超过极限坐标时提前松开主卡, 避让可能发生在B3夹持前也可能发生在B3夹持后, 但B1松开一定在B3夹持之后, 否则无法零尾料.

1. If the next trajectory exceeds the avoidance trigger coordinates, the system initiates avoidance. When Y1 approaches the limit coordinates, the main card is released prematurely. The avoidance may occur either before or after B3 clamping, but B1 must be released after B3 clamping to ensure zero tail material.

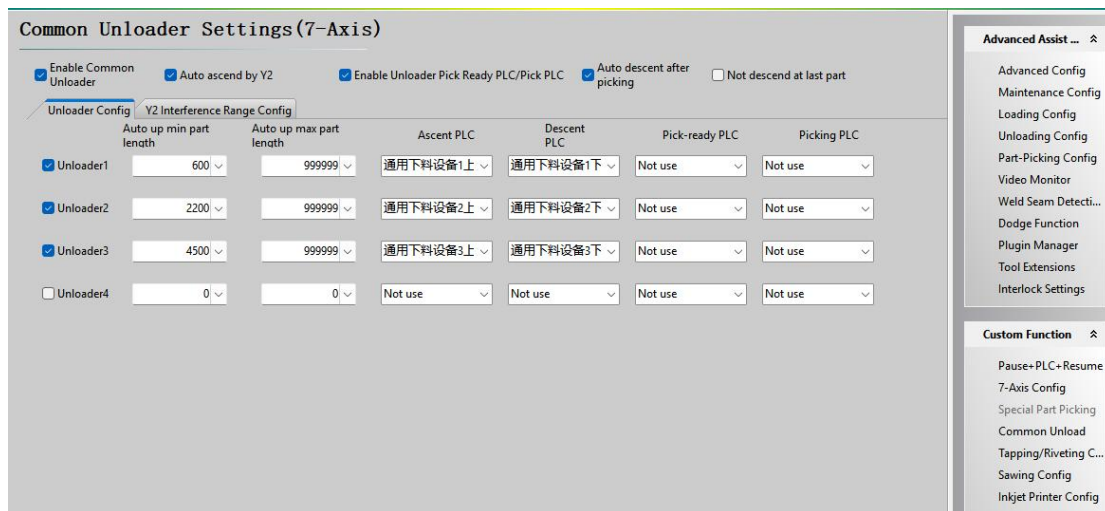


17. 七轴通用下料

17. Seven-axis universal blanking

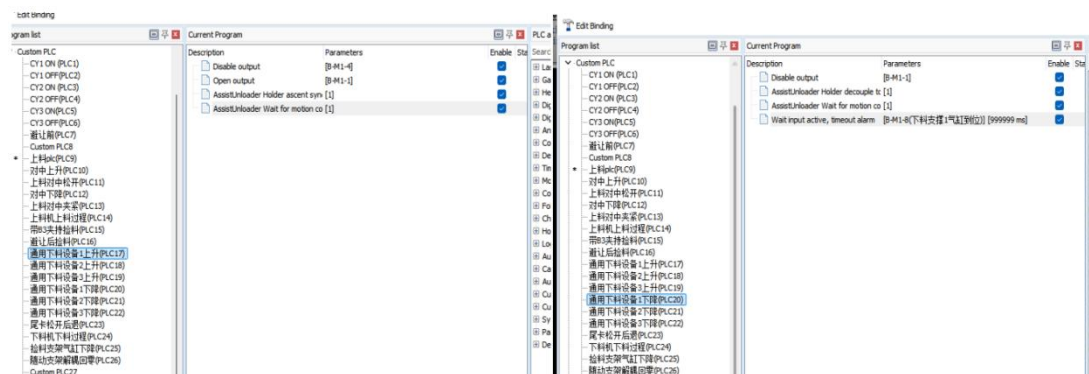
1. 新版TubePro新增了七轴通用下料功能；相对与【并行PLC捡料】功能配置更为简单，在配置七轴下料支架时可根据支架结构选择用【并行PLC捡料】或者【七轴通用下料】的方式

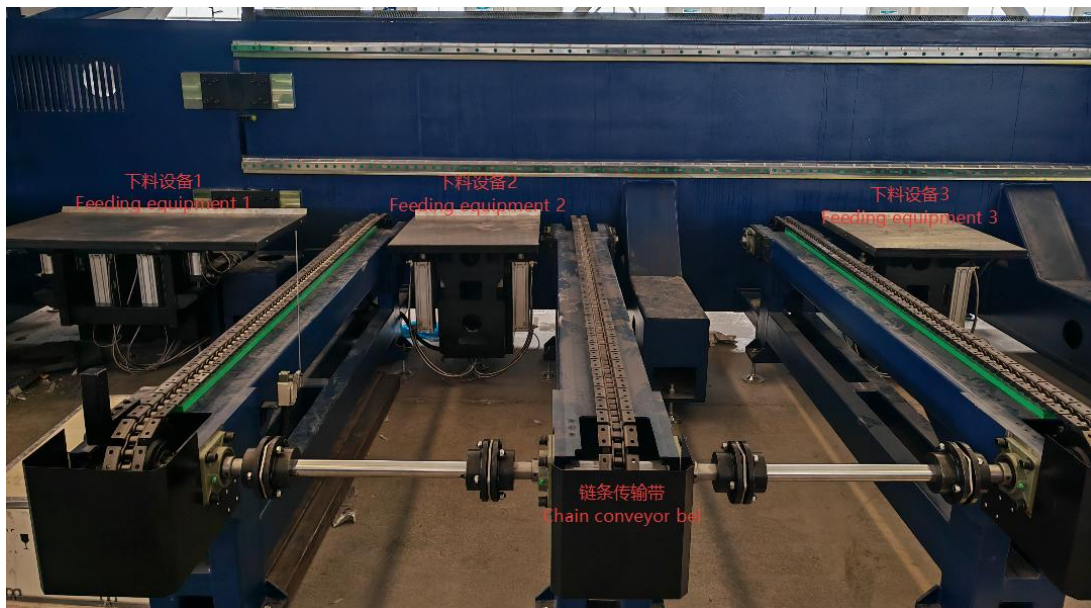
1. The new version of TubePro adds a seven-axis universal loading function; it is simpler to configure than the parallel PLC picking function. When configuring the seven-axis loading bracket, you can choose between parallel PLC picking or seven-axis universal loading depending on the bracket structure.



2. 辅助上升PLC气缸翻版和辅助下降PLC气缸动作需要通过自定义PLC调用完成，图一是辅助上升PLC，图二是辅助下料PLC。

2. The actions of the auxiliary lifting PLC cylinder flipping mechanism and the auxiliary lowering PLC cylinder need to be completed through custom PLC calls. Figure 1 shows the auxiliary lifting PLC, and Figure 2 shows the auxiliary unloading PLC.





18. 配置Y2干涉区间

18. Configure Y2 interference interval

1. 设置参数

1. Set up parameters

1. 移动Y2至支架干涉位置，记录坐标，分别设置极限位置、开始下降位置、默认到位时间；

1. Move Y2 to the interference position of the bracket, record the coordinates, and set the limit position, starting descent position, and default arrival time respectively.

Common Unloader Settings (7-Axis)

☒ Enable Common Unloader
 ☒ Auto ascend by Y2
 ☒ Enable Unloader Pick Ready PLC/Pick PLC
 ☒ Auto descent after picking
 ☐ Not descend at last part

Unloader Config: **Y2 Interference Range Config**

Unloader	Y2 conflict zone	Y2 coordinates < Ext...	Start descent ...	OK time:
Unloader1	-99999mm	-5560mm	-5160mm	0ms
Unloader2	-99999mm	-4280mm	-3880mm	0ms
Unloader3	-99999mm	-2000mm	-1600mm	0ms

Y2坐标小于此值时支架允许上升;按需要配置;
 The support frame is allowed to rise when the Y2 coordinate is less than this value; configure as needed.

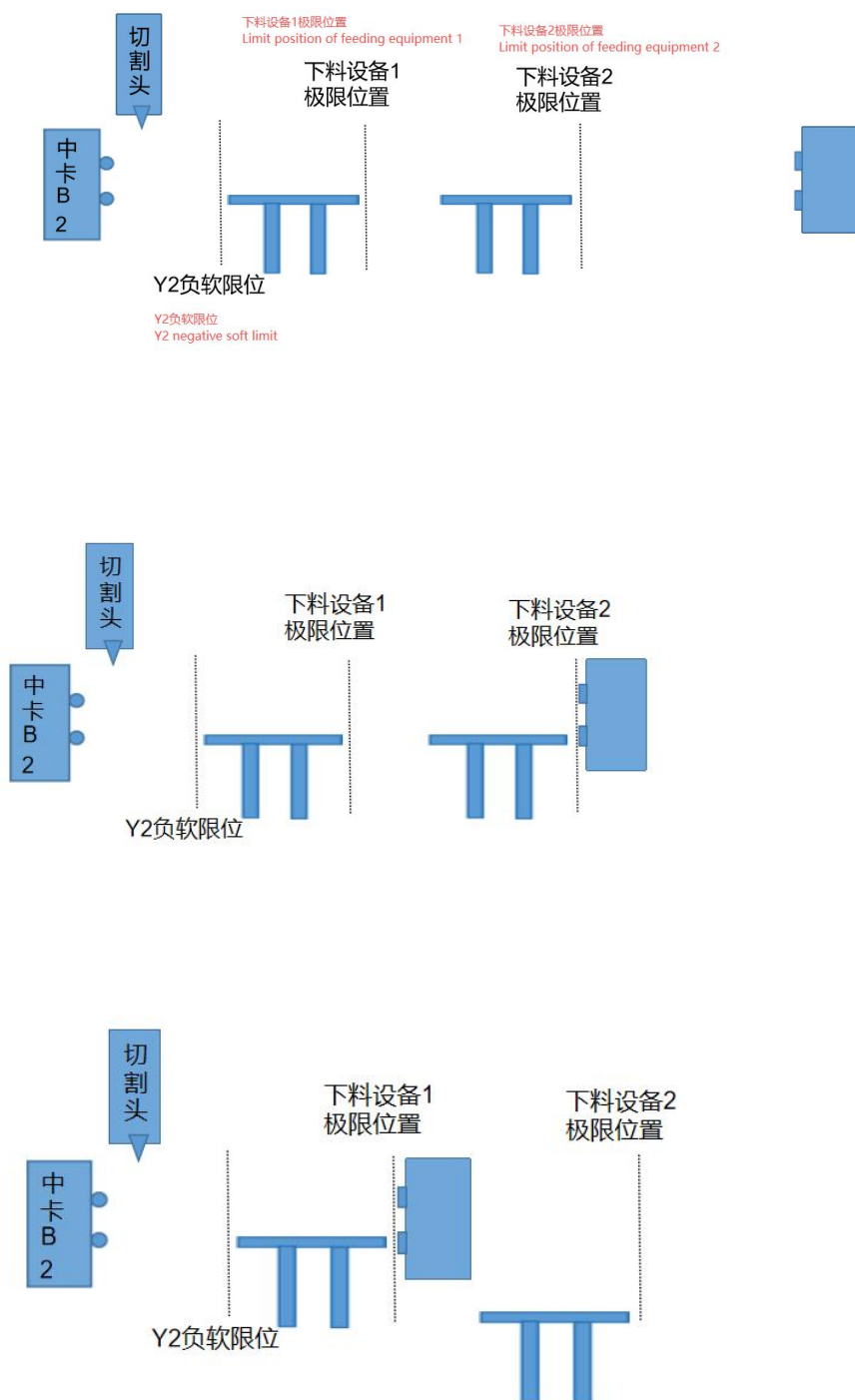
Y2与支架在不干涉时的极限位置, 超过此位置支架禁止上升
 Y2 represents the limit position of the support without interference; the support must not be raised beyond this position.

支架下降位置
 Stent descent position

执行下降下降PLC所需要的时间;系统会根据时间限制Y2空移速度
 The system will limit the Y2 idle speed based on the time required for the PLC to execute the descent.

2. 示意图

2. Schematic diagram



19. 开机运行

19. Power on and run

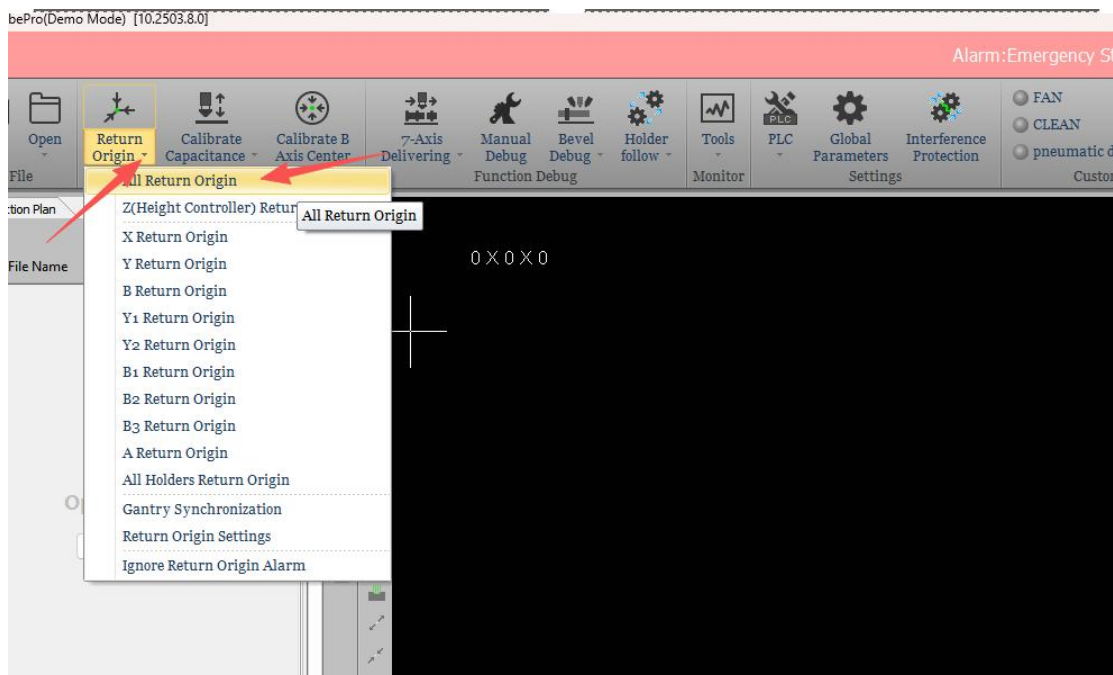
1. 回原点

1. Back to the origin

1. 设备上电以后点击电脑桌面TubePro进入系统，在确保设备没有干涉跟夹持管材，支撑全部下降的安全情况下首次开机可以分别依次点

A, Z, X, Y1, Y2, B1, B2, B3返回原点，然后在点击全部支架回原点，全部成功以后，就可以在以后的开机使用全部返回原点选项（B轴回原点必须确保没有管材夹持）

1. After powering on the device, click the TubePro interface on the computer desktop to access the system. Ensure the equipment is free from interference with or clamping of tubing materials and that all supports have fully descended. During the initial startup, sequentially press A, Z, X, Y1, Y2, B1, B2, and B3 to return to the origin. Then click to reset all supports to the origin. Once all operations are completed successfully, the 'Return to Origin' function can be used for subsequent startups (note: The B-axis reset must be performed without any tubing clamping).



2. 上下料支架标定

2. Loading and unloading bracket calibration

1. 支撑全部返回原点，B1主卡单独夹持一根管子，在工具下拉菜单里面，选择CAD画一根夹持管材的尺寸，点击支撑上箭头，让随动支撑贴近管材表面，点击标定

1. All supports return to their original positions. The main clamp holds a single pipe. In the tools drop-down menu, select CAD to draw the dimensions of a pipe clamp. Click the arrow on the support to bring the follower support close to the pipe surface, and then click Calibration.

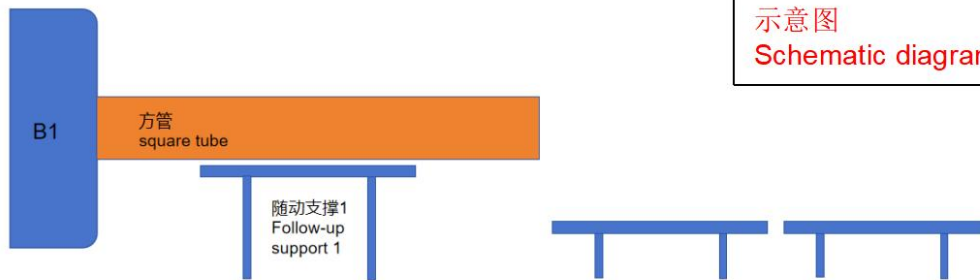
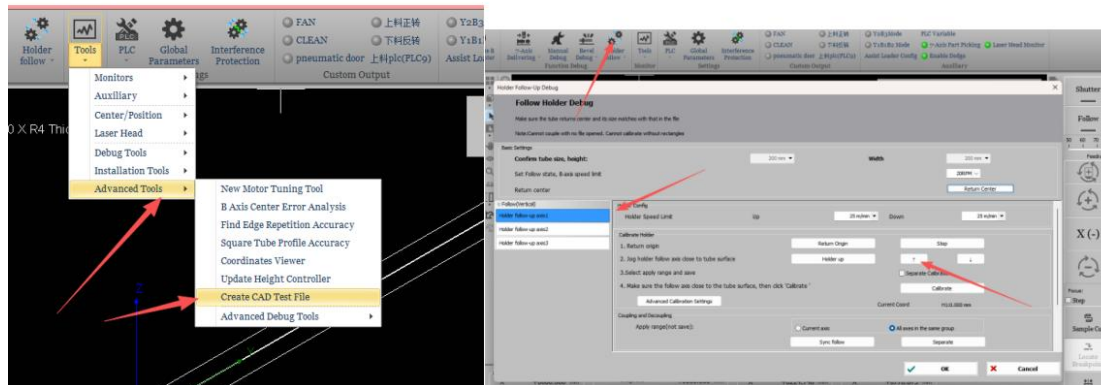


示意图
Schematic diagram



2. B2中卡夹持一根管材，管材尺寸跟图纸一样，使用方管，选择下料支撑；
2. The B2 medium clamp holds a pipe with dimensions matching the drawings, using square tubes and selecting a cutting support.

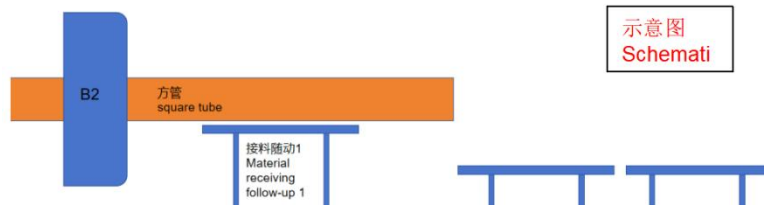
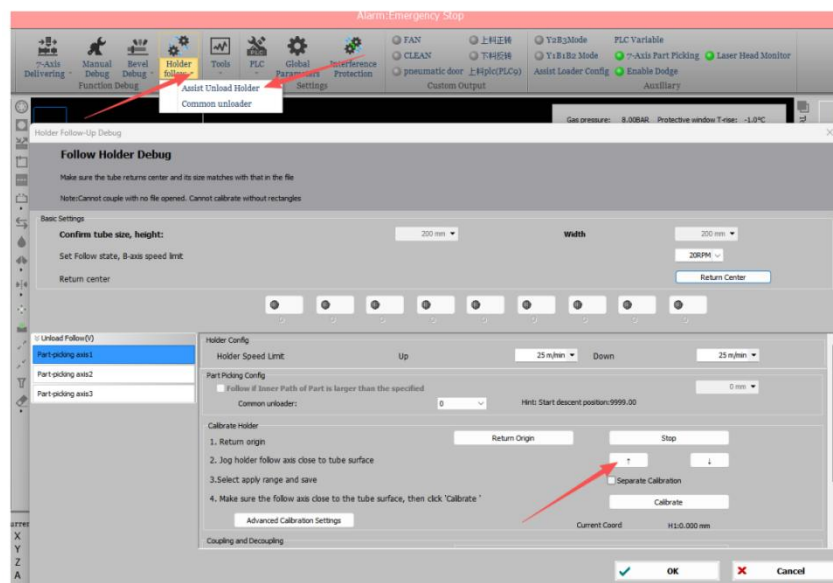


示意图
Schematic

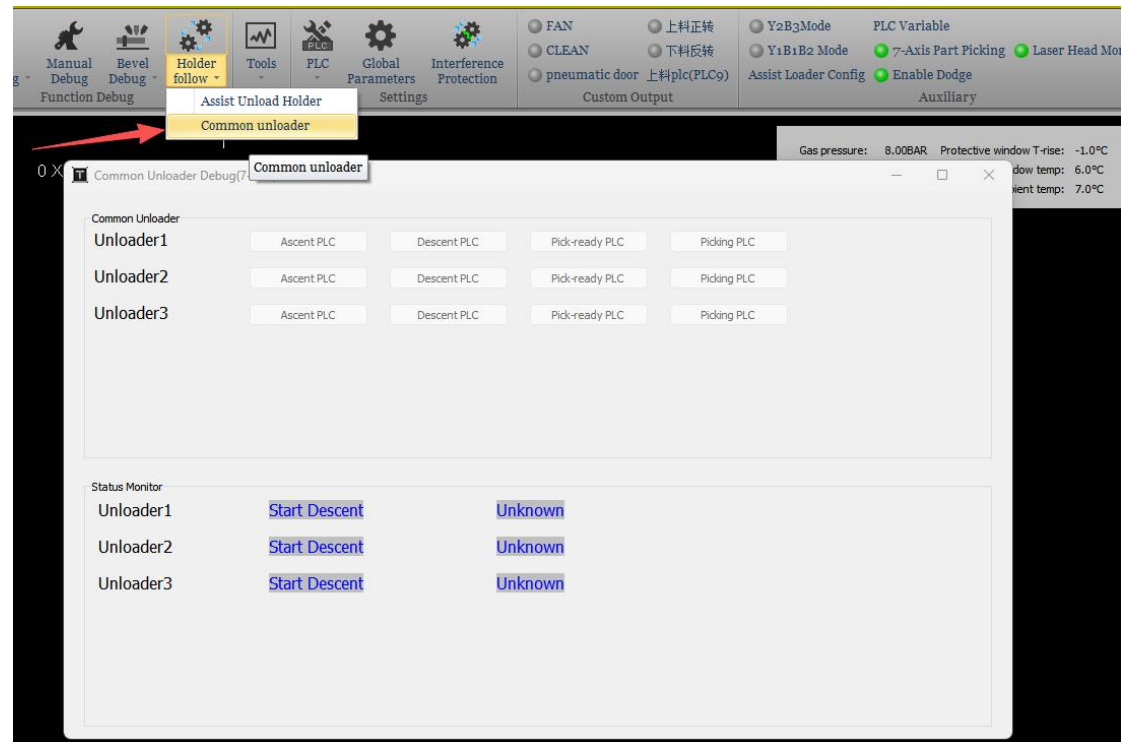


20. 通用下料操作

20. General material cutting operation

1. 在通用下料中可对支架进行上升、下降等操作；如Y2坐标干涉时，相应功能按钮将会置灰，状态监控区可查看当前下料设备的状态；

1. In general unloading, the support can be raised and lowered; if Y2 coordinate interference occurs, the corresponding function button will be grayed out; the status monitoring area allows you to view the current status of the unloading equipment;



21. B轴中心标定

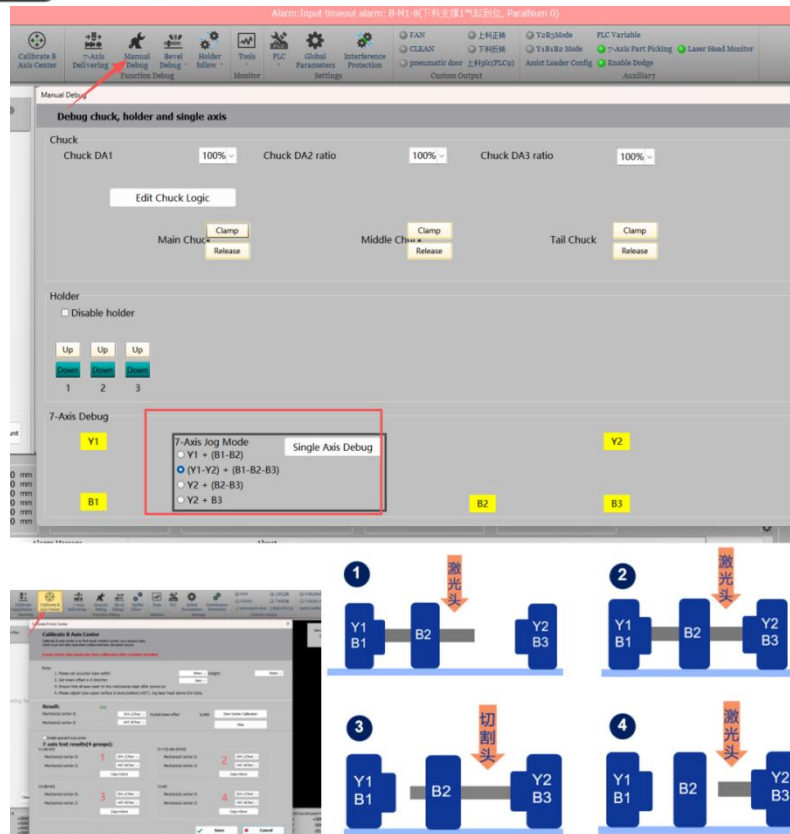
21. Axis center calibration

1. 标定B轴前需将各轴回原点；

1. Before calibrating the B-axis, all axes must be reset to their origin points.

2. 七轴机型需标定四组B轴中心，分别对应B1B2夹持、B1B2B3夹持、B2B3夹持、B3单独夹持四种状态；先观察3个卡盘是否同步，不是需要切换模式进行标定，否则会出现一个卡盘不转，导致管材受损，打开手动调试，选择模式如下图：

2. For seven-axis models, calibrate four sets of B-axis centers corresponding to four clamping configurations: B1B2, B1B2B3, B2B3, and B3 single clamping. First verify synchronization among three chucks. If not, switch modes for calibration to prevent one chuck from failing to rotate and causing pipe damage. Enable manual debugging mode as shown in the diagram below:

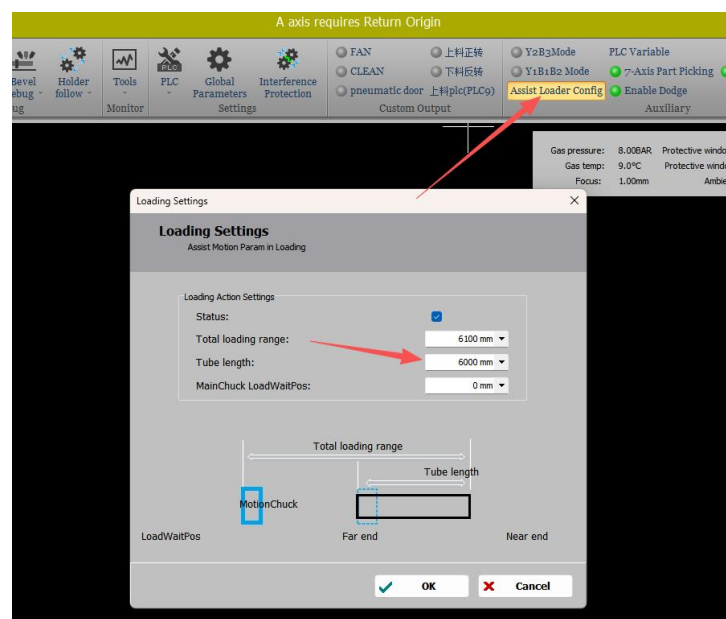


22. 上料辅助配置

22. Material feeding auxiliary configuration

1. 可以根据上料的管材填写尺寸，点击上料以后Y1会根据此项计算上料等待的位置。

1. You can fill in the dimensions based on the pipe material being loaded. After clicking "Load Material," Y1 will calculate the loading waiting position based on this information.



23. 上料PLC调整

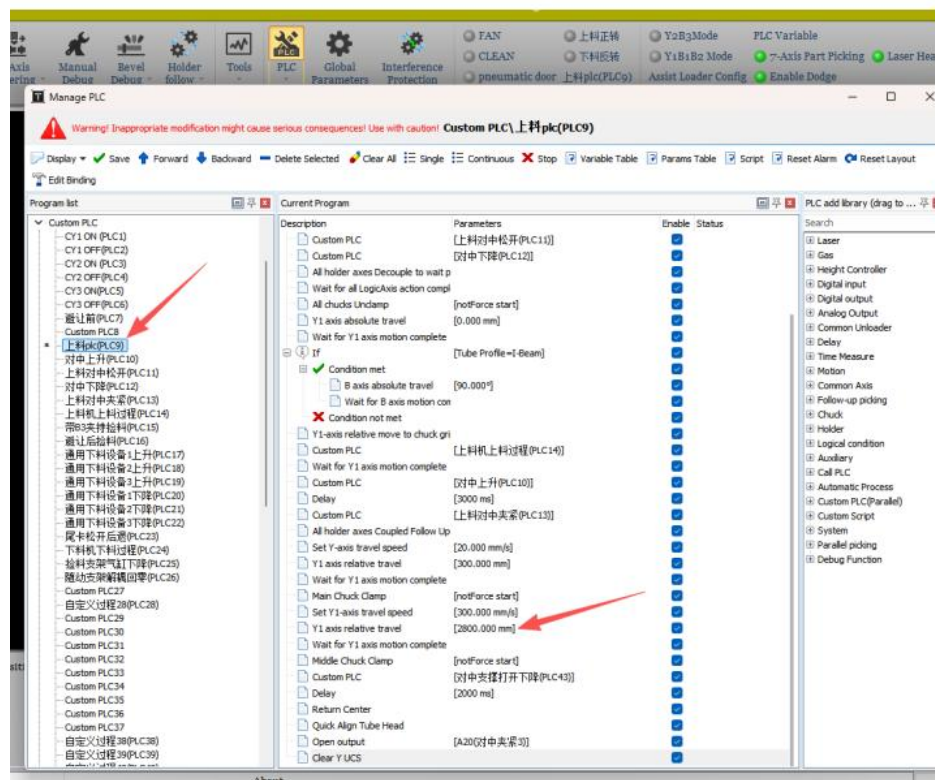
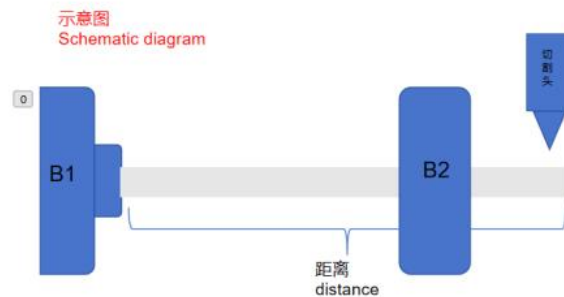
23. PLC adjustment for feeding

1. 可以根据实际情况，执行上料以后，管材夹持以后是否管头在切割头下面，以免在执行一键对齐管头的时候发生碰撞，可以调整图片箭头指示的，Y1轴空移距离，来调整上料Y1运行的行程

(注意：PLC不要随意修改，非专业人士不得乱动，否则会发生撞击风险，甚至带来人身伤害)

1. Depending on the actual situation, after the pipe is clamped, you can adjust the Y1 axis idle distance (as indicated by the arrow in the image) to adjust the travel of the Y1 axis during loading, to prevent collisions during one-click alignment of the pipe ends.

(Note: Do not modify the PLC arbitrarily. Non-professionals should not tamper with it, otherwise there is a risk of impact and even personal injury.)



24. 捡料原理

24. Material inspection principle

1. 七轴拉料机型的几种捡料状态；不同的状态则执行相应的捡料程序。

1. The seven-axis material handling machine has several material picking states; different states will execute corresponding material picking programs.

1. 准备捡料：准备捡料，意思是在加工零件最后一条切断轨迹前需要执行的动作。

1. Preparing to pick up the material: This refers to the action that needs to be performed before the last cutting trajectory of the processed part.

2. 捡料PLC（非七轴）：不启用七轴加工模式，使用B1B2加工时执行的捡料。
注意：关闭七轴拉料模式，才能在PLC过程-加工流程中显示编辑“捡料PLC（非七轴）”

2. Pick-up PLC (Non-7-axis): Pick-up is performed when B1B2 machining is used without enabling 7-axis machining mode.

Note: The 7-axis pull mode must be disabled for "Pick-up PLC (Non-7-axis)" to be displayed and editable in the PLC process - machining flow.

3. 捡料PLC（不带B3夹持）：启用七轴加工模式，在零件长度还不满足B3夹持切割，由B1B2夹持切割执行的捡料。

3. Pick-up PLC (without B3 clamping): When the seven-axis machining mode is enabled, if the part length does not meet the requirements for B3 clamping and cutting, the picking is performed by B1 and B2 clamping and cutting.

4. 捡料PLC（带B3夹持）：启用七轴加工模式，B3参与夹持切割时执行的捡料。

4. Pick-up PLC (with B3 clamping): When the seven-axis machining mode is enabled, B3 participates in the picking-up process during clamping and cutting.

5. 捡料PLC（避让后）：避让状态加工时执行的捡料，启用七轴或关闭七轴模式，避让加工状态均执行此捡料。

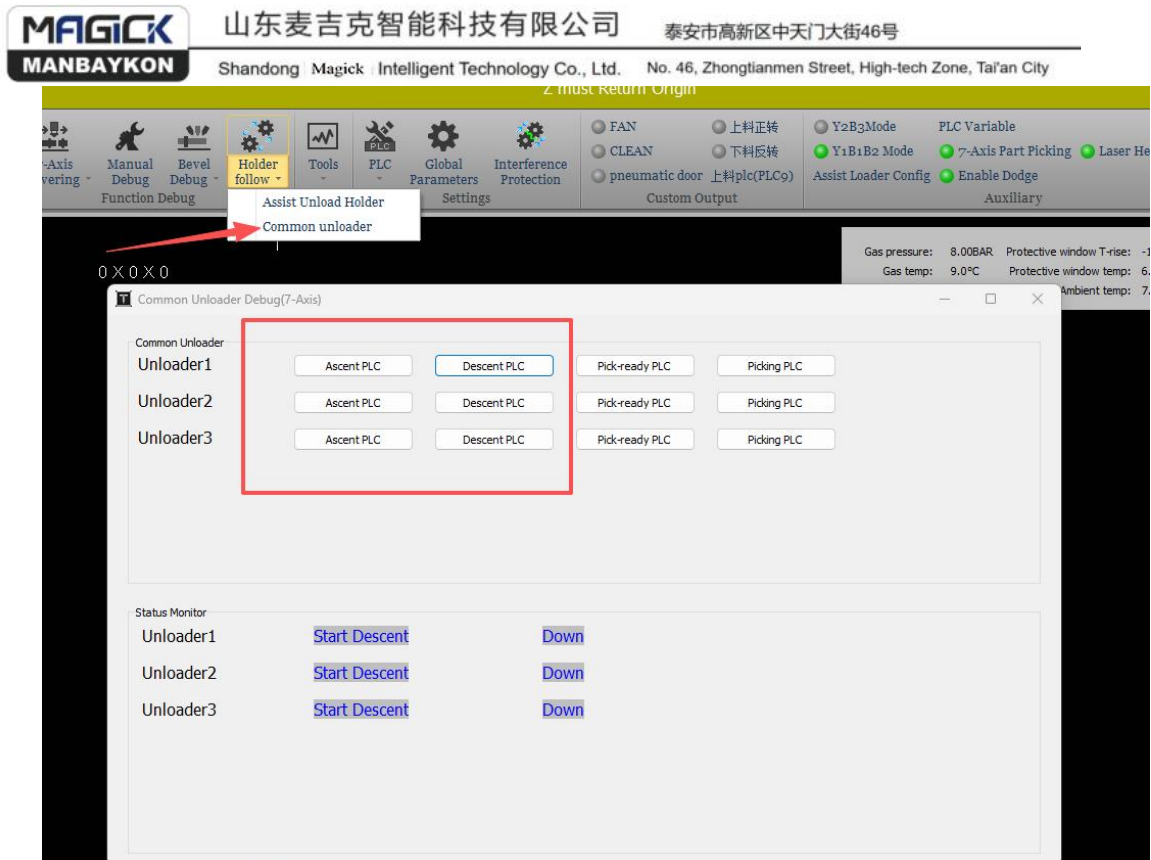
5. Pick-up PLC (after avoidance): Pick-up is performed during machining in avoidance mode. This pick-up is performed whether the seven-axis mode is enabled or disabled in the avoidance machining mode.

25. 通用下料操作

25. General material cutting operation

1. 在通用下料中可对支架进行上升、下降等操作；如Y2坐标干涉时，相应功能按钮将会置灰；状态监控区可查看当前下料设备的状态；

1. In the general material feeding system, operations such as lifting and lowering the support frame can be performed. When Y2 coordinate interference occurs, the corresponding function buttons will turn gray. The status monitoring area displays the current status of the material feeding equipment.



26. 轴控制模式切换

26. Axis control mode switching

1. 切换模式来切换遥控器的控制方式，在Y1B1B2模式下，点击遥控器的上下箭头移动的是Y1轴的方向，切换到Y2B3模式移动的是Y2的移动方向，请一定要注意模式，以免发生错误运动

1. Switch modes to change the control method of the remote control. In Y1B1B2 mode, clicking the up and down arrows on the remote control moves the device along the Y1 axis. Switching to Y2B3 mode moves the device along the Y2 axis. Please pay close attention to the mode to avoid incorrect movement.

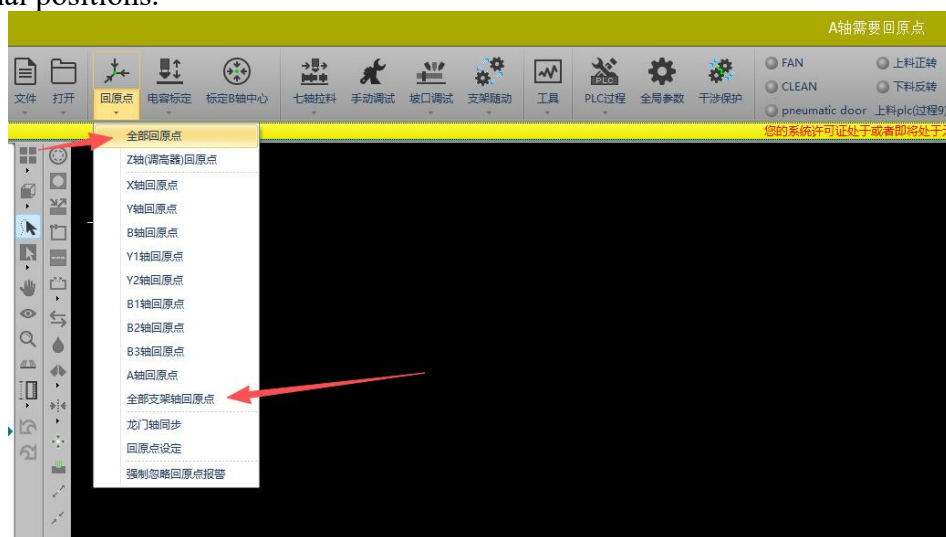


27. 重启设备操作

27. Restart the device

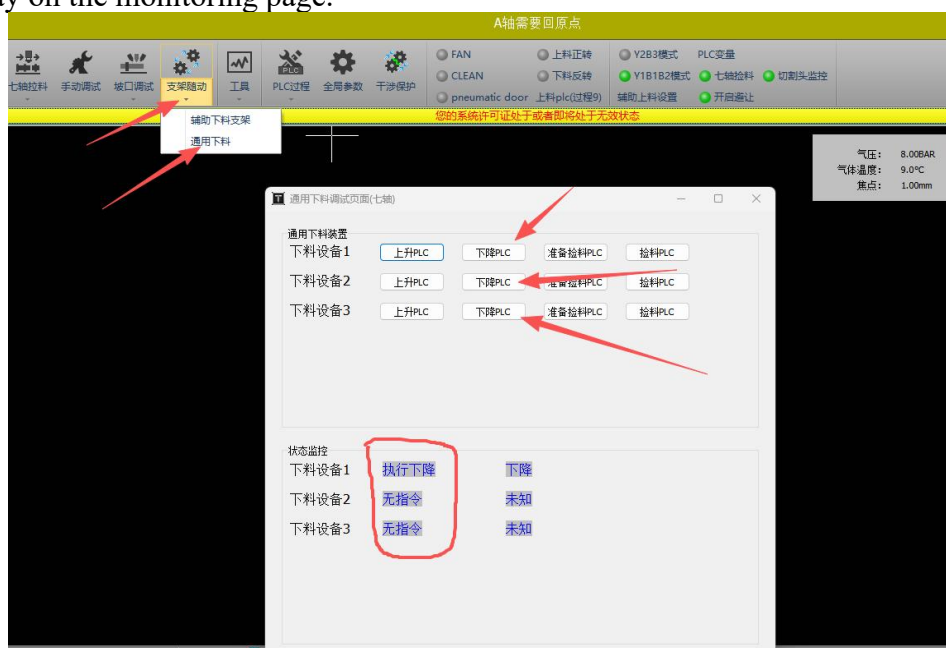
1. 每天开机第一件事情，必须执行全部回原点，（保证卡盘没有夹持任何管材，如果有请先去掉管材，否则会发生危险，卡盘回原点的方向是相反的会扭动管材）全部回原点结束以后，在执行全部支撑轴回原点。

1. The first step upon system startup is to perform a full return to origin maneuver (ensure the chuck does not hold any tubing; if present, remove the tubing prior to operation to prevent hazards, as reverse rotation may twist the tubing). After completing the full return to origin, proceed with returning all support shafts to their original positions.



2. 选择支架随动下箭头——通用轴下料——把下降PLC的3个选项都点击一下，确保监控页面显示执行下降。

2. Select the arrow under the bracket follower → General shaft discharging → Click all three options on the descending PLC to confirm the execution of descent display on the monitoring page.

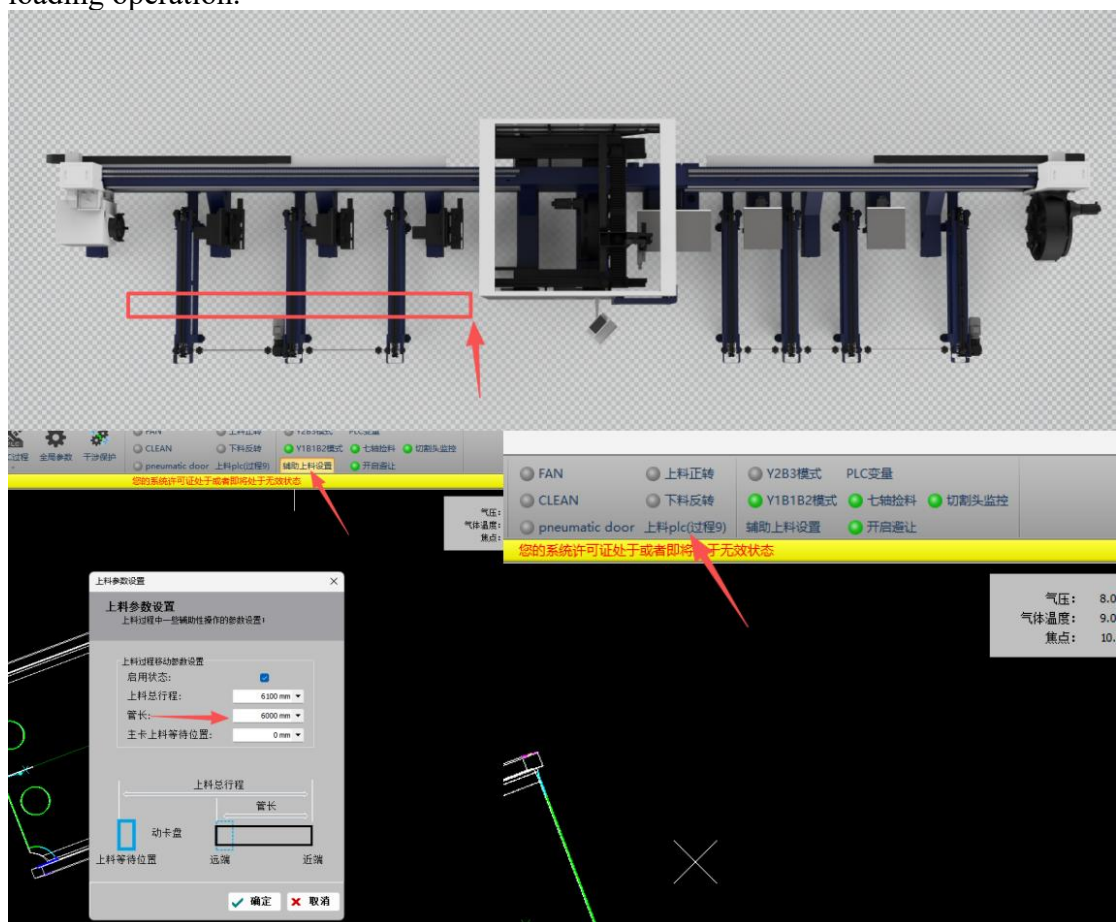


28. 上料过程

28. Material feeding process

1. 管材放置以前方对齐，设置管材上料尺寸，点击屏幕上方的（上料PLC过程9）设备执行上料动作。

1. Align the pipe materials before placement, set the loading dimensions, and click the device labeled 'Loading PLC Process 9' at the top of the screen to initiate the loading operation.



29. 敬告

29. Notice

1. 关于切割工艺参数的调试及常见的问题处理方法见我司发布的工艺手册

1. For debugging cutting process parameters and troubleshooting common issues, please refer to our company's published process manual.

八、常见故障排除

八、Common Troubleshooting

1. 激光器报警

1. Laser alarm

锐科激光器

Raycus Laser

锐科激光器在发生报警时不会发出蜂鸣声，也不会有任何提示，只会停止出光，报警灯常亮，报警内容五花八门，具体原因需要链接内控软件查看信息。目前为止：锐科CE版使用399内控锐科3000w使用399内控其他功率段非CE版本需要咨询激光器的售后需要使用哪个版本/版本不固定以下为锐科常用的内控软件。

Ruike lasers emit no audible alerts or visual indicators during alarms; they simply cease light output while keeping the alarm light on. Alarm messages vary widely, and specific causes require checking the internal control software. As of now: Ruike CE version uses 399 internal control, Ruike 3000w uses 399 internal control, other power segments use non-CE versions. Consult the laser's after-sales service for which version to use (version not fixed). Below are the commonly used internal control software for Ruike.

创鑫激光器

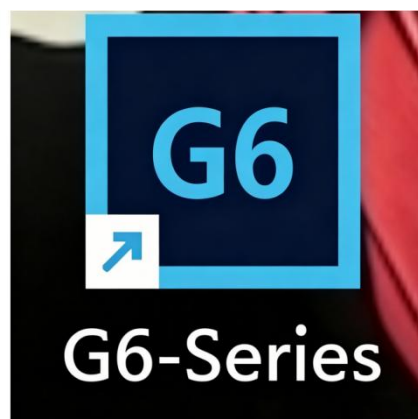
Max Laser

创鑫激光器在发生报警时，激光器会持续发出蜂鸣声，并且报警指示灯常亮，通常创鑫激光器出现报警绝大多数的问题是QBH松动未锁紧/水温过高或者过低/授权到期需要链接内控软件来查看报警内容并且解决问题。

内控软件：G3/G6

When an alarm occurs with Chuangxin Laser, the device continuously emits a beeping sound and the alarm indicator light remains illuminated. The majority of alarm issues with Chuangxin Laser typically involve QBH (Quasi-Ballistic Head) loosening or failure to secure, excessively high or low water temperature, or expired authorization. To diagnose and resolve the alarm, connecting to the internal control software is required to view the alarm details and implement corrective measures.

Internal control software: G3/G6



2. 水冷机报警

2. Water-cooled machine alarm

1. 如果发现水冷机有异常，报警或者高温低温，应该首先检查一下是否存在报警代码，如果有报警代码，按照报警代码查看水冷机说明书来检查问题，如果没有报警代码，需要先检查温度是否处于正常水温。

1. If you notice any abnormalities in the water-cooled machine, such as alarms or extreme temperatures, first check for any alarm codes. If present, refer to the machine manual to identify the issue. If no alarm codes are detected, verify the temperature is within normal range.

2. 出厂设置温度：低温25° 高温28° 温度会维持在25-28度之间，在此范围内属于正常值。

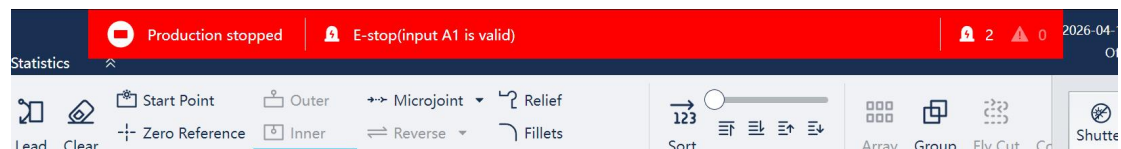
2. Factory temperature settings: 25°C for low temperature and 28°C for high temperature. The temperature will stabilize within the normal range of 25-28°C.

3. 软件警报

3. Software Alert

1. 切割软件的报警信息通常都在切割软件的上方，如果发生报警请查看报警内容，然后根据报警内容来检查哪个部位报警，然后进行逐步排查。

1. The alarm message in the cutting software is usually displayed at the top. If an alarm occurs, check the alarm content, identify the affected area, and then conduct a step-by-step troubleshooting.



4. 伺服驱动器报警

4. Servo driver alarm



1. 当伺服驱动器报警时，首先会在切割软件当中以报警的形式展现出来，所以当切割软件当中发出伺服驱动器报警时，请打开机器的配电柜，检查伺服驱动器是否有报警代码，如果有报警，请检查伺服品牌，查阅相对应的伺服驱动器说明书检查报警信息的原因，并逐步排查问题所在。

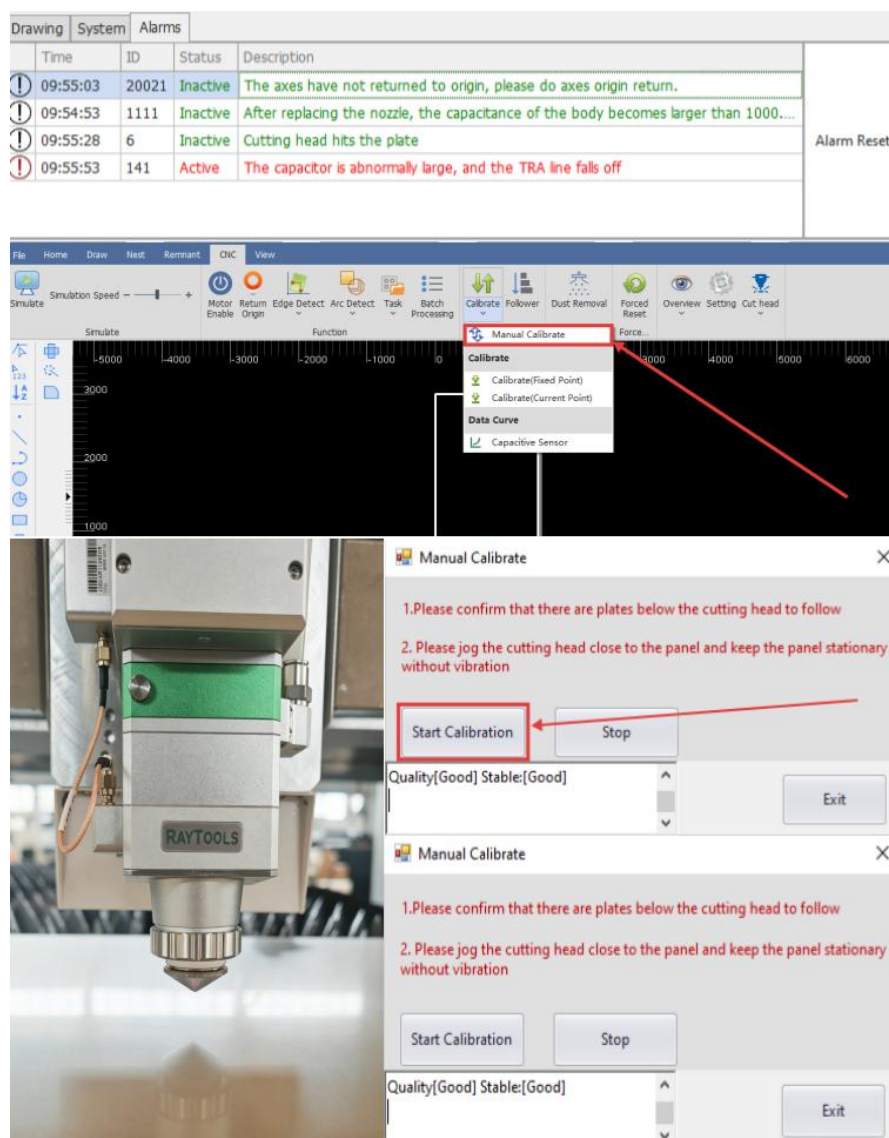
1. When a servo drive alarm occurs, it will first appear as an alert in the cutting software. If the software displays a servo drive alarm, open the machine's power distribution cabinet to check for any alarm codes. If detected, verify the servo drive's brand and consult the corresponding manual to identify the cause of the alarm, then systematically troubleshoot the issue.

5. 电容报警

5. Capacitance alarm

1. 问题：使用过程中出现电容变小或者变大的时候通过以下方法解决.：

1. Solution: If the capacitance decreases or increases during use, follow these steps:



2. 夹上管材，确保管材平行，如果不平行点击回中按钮，使管材平行，点开工具-监控工具-调高器-点击标定-通过下键使喷嘴离管材1CM，点击电容标定，标定完成Z轴会自动抬起，并提示电容标定成功，退出调高器页面，标定完成。

2. Align the pipe materials. If misaligned, click the center button to adjust. Navigate to Tools> Monitoring Tools> Height Adjuster, then select Calibration. Position the nozzle 1cm away from the pipe by pressing the down button. Click Capacitor Calibration. Upon completion, the Z-axis will automatically lift and display 'Capacitor Calibration Successful.' Exit the Height Adjuster interface to finalize the calibration.

6. 参数备份与还原

6. Backup and Restore Parameters

1. 参数备份功能，可以将用户配置、 PLC过程等参数备份和还原。

注意事项：

如果是更换版本，只要不卸载并删除用户数据，覆盖安装并不会改动原有的参数。

如果需要卸载重装，或者担心使用者误卸载软件导致参数丢失，可以事先做好参数备份并保存好参数包。

使用方法：

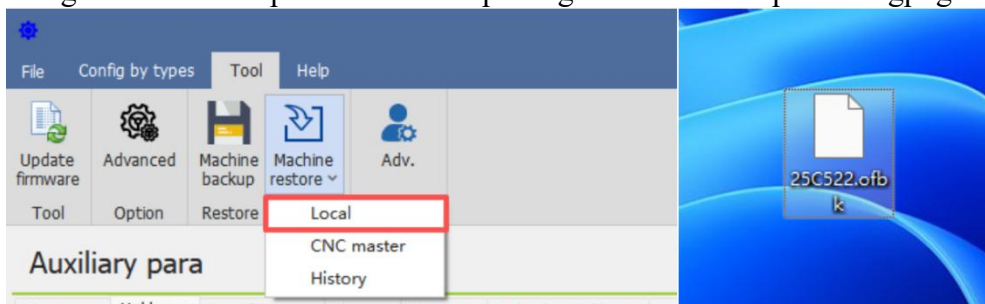
通过 <文件><参数备份>可以生成备份文件*.cfgpkg文件

1. The parameter backup feature enables users to save and restore configurations, PLC processes, and other parameters.

Note: If you upgrade the version, the overwrite installation will not change the original parameters as long as you do not uninstall or delete user data.

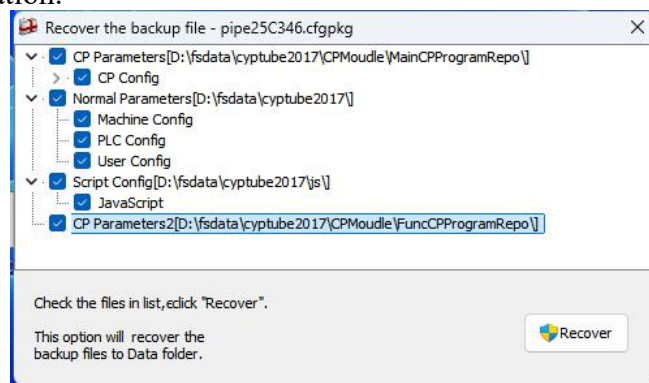
If you need to uninstall and reinstall the software, or are concerned that users might accidentally uninstall it and lose parameters, you can back up the parameters in advance and save the parameter package.

Usage: Use <file> <parameter backup> to generate a backup file*.cfgpkg file



2. 需要恢复参数的时候，关闭软件 and 平台配置工具，双击备份文件*.cfgpkg，会弹出恢复参数备份文件对话框；选需要恢复的文件列表，点击恢复即可完成参数恢复。

2. To restore parameters, close the software and platform configuration tool, then double-click the backup file *.cfgpkg. A dialog box will appear to restore the parameter backup file; Select the file list to restore and click Restore to complete the parameter restoration.



九、维护保养

九、Maintenance

1. 使用的注意事项

1. Usage Notes

上文的介绍中，需要注意的地方已有所提及，请操作者仔细查阅。未尽事项补录如下：

1. 操作者必须严格遵守激光切割机的安全操作规程。
1. The operator must strictly comply with the safety operation procedures of the laser cutting machine.
2. 操作者须查阅随机附带的所有说明书或接受过我司客服人员的培训，熟悉设备结构、性能掌握操作系统有关知识。
2. Operators must review all included manuals or complete training from our customer service team, with proficiency in equipment structure, performance, and operating system knowledge.
3. 按规定穿戴好劳动防护用品，在激光束附近必须佩带符合规定的防护眼镜。
3. Wear protective equipment as required, and wear protective glasses that meet the requirements near the laser beam.
4. 在未弄清某一材料是否能用激光照射或加热前，不要对其加工，以免产生烟雾和蒸气的潜在危险。
4. Do not process a material before it is known whether it can be exposed to laser or heated, to avoid the potential risk of smoke and vapour.
5. 设备开动时操作人员不得擅自离开岗位或托人待管。
5. The operator must not leave the post or entrust the equipment to others for management when it is in operation.
6. 要将灭火器放在随手可及的地方；不加工时要关掉激光器或光闸；不要在未加防护的激光束附近放置纸张、布或其他易燃物。
6. Keep fire extinguishers within easy reach; turn off the laser or shutter when not in use; do not place paper, cloth or other flammable materials near unprotected laser beams.
7. 在加工过程中发现异常时，应立即停机，及时排除故障或上报主管人员。
7. If any abnormality is detected during processing, immediately stop the machine and either troubleshoot or report to the supervisor.
8. 保持激光器、床身及周围场地整洁、有序、无油污，工件、板材、废料按规定堆。
8. Keep the laser, machine bed and surrounding area clean, orderly and free from oil stains. Stack workpieces, plates and waste materials as required.
9. 使用气瓶时，应避免压坏电线、水管和气管，以免漏电、漏水和漏气的发生。气瓶的使用、运输应遵守气瓶监察规程。禁止气瓶在阳光下爆晒或靠近热源。开启瓶阀时，操作者必须站在瓶嘴侧面。
9. When using gas cylinders, avoid damaging wires, water pipes, and gas pipes to prevent electric, water, or gas leaks. The use and transportation of gas cylinders must comply with the Gas Cylinder Supervision Regulations. Do not expose gas

cylinders to direct sunlight or heat sources. When opening the valve, the operator must stand beside the nozzle.

10. 打开水冷机电源前，应检查水冷机水位，严禁无水或水位过低时开启水冷机，以免造成 水冷设备损坏。水冷机进出水管严禁挤压、踩踏，保持水路畅通。

10. Before powering on the water-cooled machine, check the water level. Never operate it without water or when the water level is too low, as this may damage the equipment. Do not squeeze or step on the inlet and outlet pipes to ensure the water flow remains unobstructed.

11. 本产品产生的激光波长为1064nm，照射至人体皮肤会造成灼伤，长时间注视激光束时 会对眼睛视网膜造成严重伤害（如白内障），操作人员必须佩戴1064nm防护眼睛。

11. This product emits a laser with a wavelength of 1064nm. Exposure to human skin may cause burns, and prolonged exposure to the laser beam can lead to serious retinal damage (e.g., cataracts). Operators must wear 1064nm protective goggles.

12. 设备在切割某些板材时会产生大量烟尘，应将风机的出风管引至室外，或另加空气净化装置。另外操作人员应佩戴防尘口罩，防止职业病的发生。

12. When cutting certain plates, the equipment will produce a lot of smoke and dust. The exhaust pipe of the fan should be led to the outside or an air purification device should be added. In addition, the operator should wear a dust mask to prevent occupational diseases.

13. 激光切割头内保护镜片每天检查一次。准直镜或聚焦镜需要拆卸时，记录拆卸过程，尤其注意镜片的安装方向，不要装错。

13. The protective lens inside the laser cutting head should be checked daily. When removing the collimator or focusing lens, document the process and ensure the lens is installed correctly.

十、运输与安装

十、Transportation and installation

1. 拆卸固定装置：打开集装箱车门后，工人先进集装箱，拆掉设备和集装箱之间固定的钢丝和紧固器等装置。

1. Dismantling the fixing device: after opening the container door, the workers enter the container first and remove the steel wires and fasteners that are fixed between the equipment and the container.



2. 叉车叉出床身：为方便叉住更多的托盘，可以先叉起托盘一角，在托盘底部垫上一块木头或者其他垫板，使叉车的货叉完全插进托盘底部，开始往外挪床身；

2. Lifting the pallet from the bed: To facilitate handling more pallets, start by lifting one corner of the pallet. Place a piece of wood or other padding at the bottom to ensure the forklift's forks fully penetrate the pallet. Then begin moving the pallet outward.



3. 设备脱离集装箱：

3. 1. 当床身有2/3在外面的时候，使用另一台叉车从侧面中间托住床身，使床身脱离集装箱底部；（注意：叉车的货叉一定完全叉住设备，货叉长度不够一定加延长货叉装置，以免设备从叉车掉到地上）

3. 1. When two-thirds of the bed is exposed, use another forklift to support it from the side center, lifting the bed off the container bottom. (Note: The forklift's forks must fully engage the equipment. If the forks are too short, extend them with a fork extension device to prevent the equipment from falling to the ground.)

3. 2. 集装箱开始往前移动，注意是直线移动，直到设备完全离开集装箱

3. Device out of container:

3. 2. The container begins moving forward in a straight line until the device is fully removed.



4. 侧面托住床身的叉车开始缓慢下降，直至托盘接触地面。

4. The forklift supporting the bed begins to descend slowly until the pallet touches the ground.



5. 工人拆掉固定托盘和设备之间固定的螺栓。

5. The worker removed the bolts that secured the fixed pallet to the equipment.



6. 用叉车叉住设备，移动安装的位置，摆放好地脚后，完全降下来，接下来开始安装设备及辅助配件。

6. Hold the equipment with a forklift, move it to the installation site, place the feet, then lower it completely. Next, begin installing the equipment and auxiliary accessories.



十一、结束函

十一、End of Letter

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