

F系列雕刻机使用说明

Operating Instructions for F-Series Engraving Machines

适用机型: CNC3030F / 4010F / 4040F / 4060F | ZH | EN



SERVICE

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-  注意安全!
-  当心触电!
-  注意强磁场!
-  佩戴护目镜!
-  阅读说明书!
-  请勿将用电器丢入垃圾桶!



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使用雕刻机前, 请阅读附带说明书中的安全注意事项, 当心触电。

Before using the engraving machine, read the safety precautions in the supplied manual and beware of electric shock.

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VII. Warranty and Technical Support for the Engraving Machine

Warranty Description: The entire engraving machine, including the frame, control cabinet, and hand-wheel, is covered by a one-year warranty, excluding consumable parts. Consumables include: couplings, spindle collets, spindle collet nuts, cutting tools, and the water spray system pump and nozzles. Additionally, the 300W spindle has a 3-month warranty, while the 800W, 1.5KW, and 2.2KW spindles have a 6-month warranty.

Technical Support Description: Technical support includes machine installation, basic function usage, engraving machine software installation, software programming guidance, and machining process guidance. It does not include drawing lessons or programming services (free learning materials can be provided). Free technical support is provided for six months. After the support period expires, customers can purchase extended technical support.

Any quality issues caused by transportation will be fully borne by us. If you encounter any problems while using this product, you must first contact our after-sales personnel. Please do not attempt repairs yourself, as this will void the warranty. If our after-sales team determines that a faulty part needs replacement, the replacement will be processed only after we have received and inspected the faulty component.

Failures caused by the following reasons will be subject to **chargeable repair**, even during the warranty period:

- ◆ Problems caused by incorrect operation, unauthorized disassembly, repair, or modification.
- ◆ Problems resulting from using the engraving machine beyond standard specifications.
- ◆ Damage caused by impact or improper storage (e.g., water ingress) after purchase.
- ◆ Operational failures caused by unauthorized modifications to the machine.
- ◆ Failures occurring due to use in environments that do not meet the requirements specified in this manual.
- ◆ Damage to the control cabinet caused by incorrect voltage connection or voltage instability.
- ◆ Failures caused by earthquakes, fires, lightning strikes, abnormal voltage, or other force majeure events.
- ◆ Scan the "Jingyan Technology" WeChat Mini Program QR code to obtain after-sales support.

VIII. Disclaimer

The information contained in this manual is for reference only and does not constitute any operational specifications or technical guarantees. Due to differences in actual equipment models, operating environments, and specific working conditions, users must make adjustments and judgments based on the actual status of the equipment during the actual commissioning and use process. For special circumstances or technical issues not covered in the manual, do not handle them on your own; instead, contact the manufacturer or authorized service provider to obtain professional support.

Product specifications and information are subject to change without prior notice, and the manufacturer also reserves the right to improve the products and documents at any time and hold the final right of interpretation. The manufacturer shall not be liable for any consequences directly or indirectly caused by operations not in accordance with this statement.



VI. Common Consumables

Consumable Name	Image	Function
Spindle Collet Nut		Installed on the spindle. Works in conjunction with the tool collet to secure the tool.
Tool Collet		Installed on the spindle. Works in conjunction with the spindle collet nut to clamp and secure the tool.
Cutting Tool		Common consumables such as engraving bits, end mills, and drill bits. Can be replaced when broken or worn.
Spindle Cleaning Solution		Used for spindle maintenance. Cleans the spindle if rust occurs, helping to extend its service life and improve heat dissipation.
Ball Screw Lubricant		Used for lubricating ball screws, bearings, and linear shafts. Extends machine life and helps maintain precision.
Spindle Coolant		Cools the spindle. The high-speed rotation generates heat; coolant removes this heat, provides anti-rust and anti-corrosion properties, and increases spindle lifespan.

一、前言

⚠ WARNING 在使用设备之前请您仔细阅读使用说明书，充分了解设备的相关功能，以确保正确使用雕刻机，防止意外事故的发生。如果您没有遵守安全注意事项和使用说明很可能导致触电、火灾或者其他严重问题的发生。请妥善保管好此说明书，以便随时查阅。

1.1 安全说明

1.1.1 工作区域安全准则

- ◆ 请始终保持工作区域整洁有序、光照充足。杂乱或昏暗的环境易引发意外事故，所有工具与物料应定点存放，及时清理废料与碎屑，确保通道无障碍物。
- ◆ 严禁在易燃、易爆环境下操作设备，包括但不限于存在易燃液体、气体、粉尘（如木屑、金属粉、有机颗粒等）的场所。设备运行可能产生电火花或高温，存在燃爆风险。工作区须配备防火设施，并严禁烟火。
- ◆ 操作期间，所有有关人员——尤其是儿童及旁观者——须与设备保持安全距离。操作者应集中注意力，严禁与他人交谈、使用手机或从事任何可能分散注意力的行为，以防失控引发事故。
- ◆ 工作区应具备良好的通风条件，及时排出加工产生的烟雾与粉尘。同时应确保设备周边留有足够的操作与避险空间，避免在狭小或封闭环境中运行设备。

1.1.2 设备用电安全准则

- ◆ 雕刻机必须使用与电源插座规格完全匹配的原装插头，严禁以任何形式修改、拆除或转接设备原有插头和接线。所有电气连接须确保可靠接地，禁止使用无接地功能的插头或插座。推荐在供电回路中安装漏电保护器（GFCI/RCD），以显著降低触电风险。
- ◆ 严禁在潮湿、淋雨或易接触液体的环境中操作或存放设备。水滴或湿气进入设备内部可能引发严重触电事故。操作时，务必保持手脚及工作环境干燥，避免身体直接接触接地物体（如金属架构、水管等），以防形成回路增加电击危险。
- ◆ 禁止拉扯、缠绕电线或通过拖拽电线的方式移动设备或拔插插头。电源线应远离热源、油污、锐利边缘及设备运动部件，防止绝缘层破损或断线。定期检查电缆状态，如出现老化、裂痕、变形或过热现象应立即停用并联系专业人员进行更换。
- ◆ 非专业人员不得拆卸、改装控制箱及电机部分。任何电气维修和部件更换都必须由具备相应资质的电工完成。如发现设备漏电、异常发热、发出焦味、电弧或断路器频繁跳闸，请立即切断电源，联系售后服务，严禁带故障运行。
- ◆ 建议在设备供电回路中设置独立的过流和短路保护装置。若工作环境存在潜在液体溅射风险，应额外使用防水插座及线缆防护套。长时间不使用时，请断开设备与电源的全部连接。

1.1.3 人员安全准则

- ◆ 请务必保持高度警惕，严格遵守操作规范，并在使用雕刻机前掌握基本使用常识。
- ◆ 在疲劳状态、或曾饮酒、服用药物及可能影响判断力的药品后，严禁操作雕刻机。操作过程中的任何疏忽，哪怕只是片刻，都可能导致严重的人身伤害。
- ◆ 为确保安全，请始终正确使用个人防护装备，操作期间必须佩戴护目镜，防止碎屑溅入眼睛；根据作业环境，合理选用防尘口罩、防滑安全鞋、安全帽及听力保护装置等，以有效降低伤害风险。
- ◆ 接通电源前，确认开关处于“关闭”状态，防止意外启动；及时移除主轴电机旋转部位上的扳手、刀具等物品，避免其飞出造成伤害。
- ◆ 操作时请始终保持稳定站姿和身体平衡，确保在突发情况下能迅速控制设备。
- ◆ 应穿着合适的工作服，避免宽松衣物、首饰等；长发应束起，并远离设备运动部件，防止被卷入。
- ◆ 采取有效的除尘措施，减少粉尘吸入和爆炸风险，并定期检查设备状态，确保所有安全防护装置完好可用。
- ◆ 严禁未经培训的人员操作雕刻机，日常应加强安全演练与风险教育，全面提升事故预防能力。

1.1.4 使用安全准则

- ◆ 请勿强行安装雕刻机。安装时应选用适当的电动工具，规范的工具不仅有助于提高安装效率，更能保障安装过程安全可靠。
- ◆ 注意经常维护雕刻机，检查移动部件是否错位或绑定、部件断裂以及可能影响雕刻机操作的任何其他情况。若设备已损坏，一定要将雕刻机维修好才可使用。许多事故都是由于对设备缺乏维护引起的。
- ◆ 单台设备建议由一人主导操作，他人如需协助或观察，需保持在安全距离外，避免多人同时操作引发误碰。
- ◆ 更换下来的废旧、破损刀具应放入专用的耐刮容器集中处理，严禁随意放置，防止划伤。
- ◆ 任何检修、维护、清洁或调整（包括更换刀具）前，必须严格执行“上锁挂牌”程序，即切断所有能源（电、气），并挂上警示牌，防止他人误启动。
- ◆ 若电源开关无法正常启闭，请立即停止使用该设备。机器失控属于严重安全隐患，必须及时报修并由专业人员

检修。在进行任何调整、更换配件或存放设备之前，务必拔掉电源插头。这一预防措施能有效避免设备意外启动。

◆ 闲置的雕刻机应存放于儿童无法接触的区域，严禁未阅读并理解说明书的人员操作设备。未经培训的使用者操作雕刻机极易引发危险。

◆ 请定期对雕刻机进行维护保养，重点关注运动部件是否错位、卡滞或存在断裂等异常情况。一旦发现损坏，必须维修完好后方可继续使用。许多事故源于设备缺乏日常维护。

◆ 保持刀具锋利和清洁也十分重要。维护良好的锋利刀具不易断裂，切削更顺畅、更安全。

◆ 操作前请充分评估加工环境、材料特性及设备能力，严格遵循说明书指引。不规范的操作可能引发严重事故。此外，请在光线充足、通风良好的环境中作业，确保工作区域整洁、无杂乱物品干扰操作视线和动线。

请参考以上安全说明。在使用雕刻机、配件、刀具等工具时，请仔细考虑工作环境和需要加工的产品。**若未按本说明手册操作，可能导致危险发生。**

1.2 设备开箱

在收到雕刻机设备后，请首先检查外包装是否完好无损。拆箱时需小心操作，避免损坏设备。取出主机后，应立即检查机身显眼位置张贴的**安全注意事项标识**，重点阅读设备操作安全规范。

机身侧面贴有“晶智牛云”学习平台二维码，使用手机扫码即可进入教学平台，观看设备操作、维护及故障处理的相关视频教程。

特别提示：首次开机前，请检查并移除运输过程中用于固定设备的保护装置，确保设备处于可正常使用的状态。

设备附带一个配件盒，盒上贴有详细的配件清单。请按照清单内容逐一核对配件，确保所有物品齐全且无损坏。

清点步骤：

① 对照配件清单，逐项检查配件是否齐全。

② 检查配件的外观及功能是否正常，如有损坏或缺失，请记录并拍照留存。

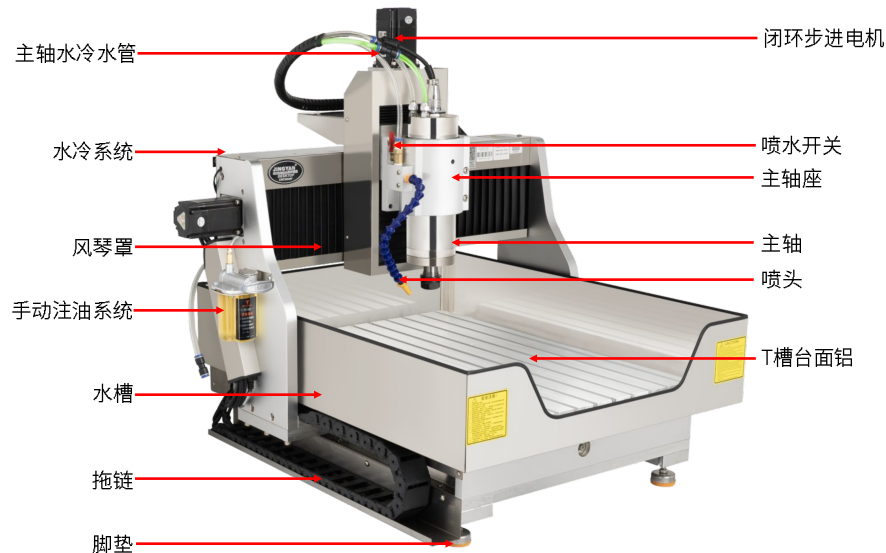
③ 如发现配件缺失或异常，请及时联系售后客服，提供相关照片及设备信息，以便安排补发或更换。

二、设备概述

本小节主要介绍雕刻机的部件、技术参数及安装与调试。

2.1 设备部件介绍

雕刻机外部主要部件示意图如下：



2. Test Engraving: Select a test piece of material identical or similar to the actual working material. Perform a test engraving using a simple pattern (e.g., lines, circles, text) with appropriate parameters (speed, depth, feed rate). During the engraving, closely monitor the machine's status, including motor operation, spindle cutting, and workpiece fixation. After completion, inspect the test piece's accuracy (dimensions, position, surface finish) to confirm the fault is fully resolved and machine performance is restored.

3. Continuous Run Test: If the test engraving is successful, perform a continuous run test. Select a more complex pattern and run the machine continuously for 1-2 hours (adjust based on actual workload). During the test, periodically check the machine's status: motor temperature, bearing temperature, component temperatures inside the electrical cabinet, and the movement accuracy of each axis. After the test, check the quality of the engraved work to ensure stable performance and no fault recurrence during extended operation.

V. Maintenance of the Engraving Machine

5.1 Ball Screw, Guide Rail, and Bearing Maintenance

Developing good machine usage habits is crucial. It is recommended to perform a cleaning and maintenance session approximately once a month, focusing particularly on the ball screws, linear shafts (rods), and bearings. During cleaning, first manually wipe the surfaces of the ball screws and linear shafts with a clean cloth. For hard-to-reach areas like bearings, use a small brush for careful cleaning. After cleaning, evenly apply an appropriate amount of lubricating oil to the ball screws, linear shafts, and bearings using an oil can. Next, start the machine and command it to move back and forth several times to ensure even distribution of the lubricant. If black residue continues to appear on the ball screws, wipe them clean again with a cloth. Repeat this "lubricate-wipe" process until the ball screw surfaces are restored to a bright and oily condition.

5.2 Spindle and Water Cooling System Maintenance

During machining, the spindle collet, collet nut, and threads are prone to dust accumulation or rust. It is recommended to regularly apply anti-rust oil to these areas and promptly remove any rust from the threads. If the collet or nut is severely rusted, they should be replaced immediately to ensure clamping accuracy and spindle concentricity. For 800W and 1.5KW water-cooled spindles, the internal bore and cooling chamber can also rust due to the internal water cooling structure. For cleaning, first completely drain the existing coolant. Then, fill the reservoir with a dedicated cleaning fluid, start the pump, and circulate it for 1-2 hours for cleaning. If the spindle has been idle for an extended period, consider extending the cleaning time to 4-5 hours. After cleaning, drain the cleaning fluid completely, refill with standard spindle coolant, and the spindle can resume normal operation.

5.3 Electrical Control Cabinet Maintenance

Dust can easily accumulate inside the control cabinet and machine during use, especially when processing metal materials. Conductive metal dust entering the control cabinet can cause short circuits or burn out circuits. Therefore, regular internal cleaning of the control cabinet is recommended. For this operation, first open the control cabinet cover. Use a blower set to the cool air setting or a cold air gun. Tilt the cabinet upside down and blow away dust from the surfaces of circuit boards and components. For corners that are difficult to clean, use a small brush to gently remove dust, ensuring all conductive particles are eliminated. After cleaning, ensure the interior is completely dry before closing the cover and restarting the equipment.

the fault follows the driver, replace the driver.

③ **Abnormal Motor Operation (Noise, Overheating, Not Rotating)**
Symptom: The motor produces abnormal noise (e.g., screeching, grinding), the motor casing is overheated (exceeding normal operating temperature, typically 60-70°C), or the motor does not rotate at all.
Possible Causes: (The original text ends here. Common causes for these symptoms include:)
Noise: Bearing failure, misalignment, loose components, foreign debris inside motor.
Overheating: Overloading, incorrect driver current settings, poor ventilation, failing bearings, high ambient temperature.
Not Rotating: Power supply issue, driver fault, brake failure (Z-axis), motor winding failure, severe mechanical binding.
Possible Causes:
◆ Unstable motor supply voltage (too high or too low).
◆ Motor winding short circuit or open circuit, preventing normal operation.
◆ Severely worn or damaged motor bearings, causing noise and heat during operation.
◆ Motor overload, exceeding its rated load capacity.
◆ Incorrect motor driver parameter settings, or driver malfunction.

Troubleshooting Steps:
1. Use a multimeter to measure the motor supply voltage and compare it to the motor's rated voltage (typically 220V or 380V for engraving machines). If the voltage is too high or too low, inspect the power supply circuit to resolve the instability issue (e.g., install a voltage stabilizer).
2. Disconnect the motor power and remove the power cables. Use a multimeter to measure the resistance of the motor windings. A reading of zero indicates a short circuit; an infinite reading indicates an open circuit. In either case, the motor windings need to be replaced, or the entire motor must be replaced.
3. Check the motor bearings. Manually rotate the motor shaft. If rotation is not smooth, feels sticky, or produces noise, the bearings are likely worn or damaged. Disassemble the motor end cover, remove the old bearings, and replace them with new bearings of the same specification. After replacement, apply an appropriate amount of bearing grease, and reassemble the motor end cover.
4. Check the motor load. Review the current machining parameters (e.g., engraving speed, depth) to see if they exceed the motor's rated load capacity. If overloaded, adjust the parameters (reduce speed/depth) or complete the engraving in multiple passes. If the overload is caused by mechanical binding (e.g., obstructed guides, stuck ball screw), resolve the mechanical fault to restore normal load.
5. Check the motor driver parameters. Refer to the equipment manual to verify that the driver parameters (e.g., motor model, current limit, micro stepping settings) are correct. If parameters are wrong, readjust them. If parameters are correct, operate the motor and use a multimeter to measure the driver's output current and voltage. If the output is abnormal, the driver is faulty and needs replacement.

④ **Engraving Pattern Deviation or Misalignment**
Symptom: The finished engraving pattern is misaligned (e.g., shifted left/right, up/down), has size inaccuracies (enlarged/shrunk), or has internal misalignment between pattern parts, preventing proper registration.
Possible Causes:
◆ Incorrect machining origin setting, causing misalignment.
◆ Mechanical fault causing loss of position during machining.
◆ Workpiece not securely clamped or fixtured.
◆ G-code error causing incorrect machine movement.

Troubleshooting Steps:
1. Check if the workpiece is placed upside down or mispositioned. The system can automatically correct positional deviations of less than 2mm.
2. Check for abnormal parameter values. If found, restore factory default parameters and then fine-tune as needed.
3. Check for backlash in mechanical transmission components (e.g., ball screw backlash, gear backlash). For ball screw backlash, adjust the nut's preload mechanism to reduce it. For excessive gear backlash, adjust the gear mesh or replace the gears. After adjustment, perform a reversal movement test to check for remaining backlash error.
4. Check the clamping of the engraving material, ensuring it is firmly secured to the worktable. If not secure, readjust the clamps or use a more reliable method (e.g., add clamping points, use vacuum table). After securing the material, re-run the engraving to check for deviations.

4.3 Post-Troubleshooting Testing and Verification

1. **No-Load Test:** After resolving the fault, first conduct a no-load operation test. Start the machine and command each axis (X, Y, Z) to move back and forth. Observe if the motors run smoothly without abnormal noise and if the movement accuracy meets requirements (check via scales or a dial indicator). Also, test functions like spindle raising/lowering and the emergency stop button to ensure they work correctly.

F系列雕刻机适配的控制系统有JYH04脱机手柄系统、Mach3控制系统、JYS4脱机电控系统、JYSE4脱机电控系统、JYX4脱机电控系统。操作前，请参阅实际配套控制系统的使用说明，以确保功能兼容与操作正确。

系统名称	Mach3控制系统	JYH04脱机手柄系统	JYS4脱机电控系统	JYSE4脱机电控系统	JYX4脱机电控系统
智能手柄					
电控箱					

2.2 设备参数

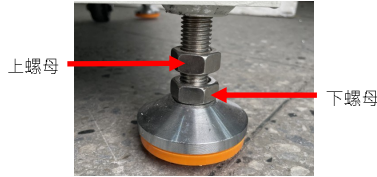
产品型号	CNC4010F-2.2KW	CNC3030F-2.2KW	CNC4040F-2.2KW	CNC4060F-2.2KW
电控系统	Mach3 / JYH04 / JYS4 / JYSE4 / JYX4			
加工尺寸	Y400*X100*Z120 (mm)	Y300*X300*Z120 (mm)	Y400*X400*Z120 (mm)	Y600*X400*Z120 (mm)
台面尺寸	Y620*X240(mm)	Y520*X400(mm)	Y620*X480(mm)	Y800*X480(mm)
外形尺寸	Y730*X420*Z760 (mm)	Y690*X660*Z760 (mm)	Y790*X740*Z760 (mm)	Y970*X730*Z760 (mm)
主轴功率	2.2KW 水冷模具主轴			
主轴转速	24000rpm			
驱动电机	雷赛闭环电机 / 升级雷赛伺服电机			
滑动单元	工业级方形导轨 / 升级P级方形导轨			
运动单元	高精度滚珠丝杆 / 升级C5级滚珠丝杆			
进给速度	≤6000mm/min (升级伺服8000mm/min)			
进料高度	150mm			
刀具安装直径	ER20 1-13mm			
重复定位精度	0.01mm			
文件格式	NC/TAP/TXT/G代码			
工作电压	AC 220V			
整机重量	78kg	97kg	120kg	145kg
*以上数据根据工厂内部检测标准试验结果				

2.3 安装与调试

2.3.1 设备安装

①设备水平校准

将机器搬运至平坦且稳固的地面，确保地面能够承受设备重量。调节脚垫，使设备整体保持水平。首先松掉脚垫的上螺母，即解锁脚垫；接着调节下螺母使设备水平；最后将上螺母拧至最顶端固定，即上锁，确保设备稳固。可使用水平仪测量设备各方位水平度。



②运输安全装置解除

使用配套工具松开设备前端的运输固定螺丝，确保所有运输保护部件（如主轴锁紧块、Z轴防坠螺母等）均已拆除。解除后，手动检查各运动轴是否移动顺畅，无机械干涉。

③电气接地系统安装

确保设备可靠接地。若供电系统无接地，需使用设备附带的接地线，一端连接至设备接地端子，另一端连接至符合安全标准的接地装置（如建筑接地网）。接地完成后，检查接地可靠性。

④冷却系统灌注

打开冷却液箱盖，使用专用工具添加指定型号的冷却液。注意液位不得超过标称容量的80%，预留膨胀空间。首次灌注后，启动冷却液循环泵，排除管路空气。

⑤主轴单元安装

从包装中取出主轴，清洁安装面后，垂直放入主轴座。调整至合适高度后，使用工具锁紧固定螺丝。安装完成后，手动旋转主轴，确认运转顺畅。

⑥电气线路连接

在断电状态下，将设备各接口的航空插头插入对应插座，并锁紧固定环。确保所有连接牢固可靠，线束整理整齐，避免与运动部件干涉。

⚠️注意事项：安装过程需由专业人员进行，确保操作规范。

2.3.2 设备调试

①顺时针旋起急停按钮，按下电源按键将机器通电，等待系统界面加载完成。

②载入系统后会提示“是否返回机床原点”，点击操作面板确定按键返回机床原点。

③点击模式切换按键切换移动模式为手轮模式，将切换手轮上的XYZ旋钮后，切换X1、X10、X100的倍率来控制相应轴的移动，检查相应轴的移动功能是否正常。后再进行反向移动即可。

④移动相应轴到机器行程最大和最小的位置检查机器行程保护功能是否正常。

⑤点击面板主轴按键进行主轴的启停，检测主轴转动功能是否正常。

⑥检查主轴水冷风扇、冷却水泵工作是否正常，检查机器开机油泵润滑功能是否正常，检查机器切削液开关功能是否正常。

经以上简单调试后说明机器各项基础功能均正常，如在调试过程中遇到任何问题可咨询售后进行解决。

三、设备操作流程

3.1 设备开机与调试

①开机前检查机器所有接线、外接器设备是否正常，检查正常后顺时针旋起急停按钮，按下电源按键将机器通电，等待系统界面加载完成。

②载入CNC系统后会提示“是否返回机床原点？”，点击操作系统中的【确定】按键返回机床原点。

③通过操作系统中的【X-】、【X+】、【Y+】、【Y-】、【Z+】、【Z-】、【A+】和【A-】或通过手轮来控制相应轴的移动，检测相应轴的移动功能是否正常。

④移动各轴至机器行程的最大值和最小值，检测机器的行程限位保护功能是否正常。

⑤按下操作系统中主轴开关来控制主轴的启停，检测主轴功能是否正常。（注意主轴上是否装夹刀具，如有装刀，务必确保刀具夹稳，防止刀具飞出造成伤害。）

⑥开机后检查主轴水冷风扇、冷却水泵工作是否正常启动。

3.2 安装刀具

⚠️为了防止造成人身伤害，在拆卸或安装刀具和配件时，务必确保主轴已停止转动，并确认在安装时身边无人开启主轴。



要拧紧夹头和螺母时，紧握两个扳手分别向外拧紧；

要松开夹头和螺母时，紧握两个扳手分别向内拧松。

IV. Fault Diagnosis and Troubleshooting

4.1 Pre-Troubleshooting Preparations

Before starting to troubleshoot faults with the engraving machine, the following preparations must be made to ensure the process is safe and efficient:

①Safety Precautions: Operators must wear insulated gloves, safety goggles, and anti-slip work shoes. Disconnect the engraving machine's main power supply to prevent electric shock. If the machine was in operation, first press the emergency stop button and wait for all movement to cease completely before proceeding.

②Tool Preparation: Prepare the necessary tools, including: Multimeter (for checking circuit voltage, current, resistance), Set of hex key wrenches (various sizes to fit screws on different machine components), Screwdrivers (Phillips and flat-head, with insulated handles), Clamp meter (for measuring motor current), Spirit level (for checking worktable levelness), Feeler gauge (for measuring component gaps), Brush (for dusting), Compressed air gun (for blowing out dust from components)

③Documentation Preparation: Have the machine's instruction manual (containing electrical diagrams, mechanical drawings, parameter settings) and operational logs (recording daily operation status, past faults, and maintenance history) ready for reference during troubleshooting.

4.2 Common Fault Classification and Troubleshooting Methods

① Carving Head Does Not Move Normally

Symptom: No response, abnormally slow movement, or stuttering when attempting to move the carving head.

Possible Causes:

◆ Motor power circuit fault (e.g., broken wire, loose connection).

◆ Motor driver fault, unable to drive the motor properly.

◆ Poor ball screw and nut engagement (e.g., rusted screw, debris jam, severe nut wear).

◆ Guide rail obstructed by foreign object or damaged guide rail block.

◆ Z-axis brake relay or contactor fault, failing to release the brake.

Troubleshooting Steps:

1.Disconnect power. Use a multimeter to check the motor power circuit. Look for broken wires, then measure circuit resistance. Infinite resistance indicates a break (replace wire/reconnect). If wires are OK, check for loose connections, reseal and tighten.

2.Reconnect power. Command movement and measure the driver's output voltage with a multimeter. Zero or abnormal voltage indicates driver fault (replace driver). If voltage is OK, proceed.

3.Remove protective covers. Inspect the ball screw and guide rails. Clean screw with a brush; if rusty, polish lightly with fine sandpaper and apply special screw grease. Check the ball nut for excessive wear (scoring, large backlash) and replace if necessary.

4.Inspect guide rails for obstructions; clear with compressed air. Check guide blocks for damage (e.g., fallen balls, deformation) and replace if necessary.

5.Open the electrical cabinet. Locate the Z-axis brake relay/contactor. Check contacts for burning/oxidation. Test contact operation with a multimeter. Replace faulty relay/contactor. If contacts are OK, check coil voltage. If no voltage, check control circuit; if coil is faulty, replace the component.

② Driver Alarm

Symptom: Control software shows X/Y/Z axis driver alarm; driver displays a specific fault code.

Possible Causes:

◆ Machine was not properly homed on startup, soft limits inactive, movement exceeded allowable range causing motor stall.

◆ Mechanical fault (e.g., ball screw, guide rail, bearing) preventing motor rotation, causing stall. Faulty connection between motor and driver or broken encoder cable, preventing proper motor control.

◆ Motor fault causing driver alarm.

◆ Driver fault causing driver alarm.

Troubleshooting Steps:

1.Power cycle the machine. Home the machine as prompted upon startup. Check if movement is normal within the travel range.

2.Disconnect the motor from the load (e.g., via coupling). Run the motor unloaded. If it runs normally, the alarm is caused by a mechanical fault; check the ball screw, guides, bearings etc., for that axis. If it still fails, proceed.

3.Check the driver alarm code against the Panasonic A6 servo drive fault code table. If the code indicates a motor wiring issue, check corresponding motor cables for breaks or poor contact. If an encoder fault is indicated, check encoder cables.

4.Check the alarm code. To isolate a motor fault, temporarily swap motors between axes (if possible). If the fault follows the motor, replace the motor.

Check the alarm code. To isolate a driver fault, temporarily swap drivers between axes (if possible). If

The "Center Finding" function is used to set the coordinate value to half of the current coordinate value. This function is typically used for setting the workpiece origin.

For convenience when programming, the machining origin is usually set at the lower-left corner of the material or at the center of the material.

If the origin is set at the lower-left corner in the program, use the "Set Work Zero" function. Move the spindle so the tool tip coincides with the desired origin, then execute "Set Work Zero" to save this point. If the origin is set at the center of the material, use both the "Set Work Zero" and "Center Finding" functions. X-axis: Touch off the left side of the material and set X to zero. Then touch off the right side and use the "X-Axis Center Finding" function. Y-axis: Similarly, touch off the front side (set Y zero), then the back side, and use "Y-Axis Center Finding". Z-axis: Finally, move the spindle to touch the top surface of the material and set the Z zero.

Consider the tool diameter when setting the origin. For pointed tools, zero directly. For tools like end mills, offset the zero point by half the tool diameter after touching off.

3.5 Loading the Program

After setting the workpiece zero, select the machining program. Copy the program to a USB drive, save the code to the system's local disk, and then load it into the control system.

3.6 Starting Machining

Once the program is loaded, click the **【Start】** button to begin machining.

3.7 Tool Changing and Tool Setting

When a tool breaks, wears out, or other situations require a tool change, proceed according to the following scenarios:

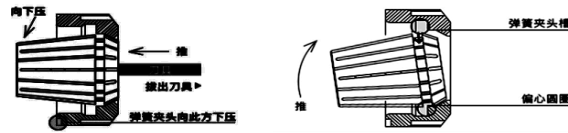
① No Tool Changer, No Tool Setter:

Engage the spindle wrench on the spindle flats and the collet wrench on the collet nut. Turn the collet wrench counterclockwise (inward towards the spindle wrench) to loosen the collet nut.

Continue unscrewing the collet nut until it is completely removed. Withdraw the old tool (push it out as shown in the left diagram) and place it in a safe area to avoid scratches.

If the new tool has a different diameter than the old one, or requires a different collet size, the collet must also be replaced. To replace the collet, gently push it to one side to loosen it (as shown in the right diagram), remove it, place the new collet into the nut, and press it down firmly. Finally, insert the new tool into the collet (as shown in the left diagram), with the tool tip facing down (towards the right side in the diagram).

△The collet nut and collet use a self-locking design. Do not attempt to remove the collet by forcibly knocking it out.



After replacing the tool, the workpiece zero point for the X and Y axes remains unchanged. However, the Z-axis workpiece zero point must be reset. Move the spindle so the tool tip approaches the material surface. Just as the tip is about to contact the surface, click **【Z Zero】** and then confirm by clicking **【OK】**. This establishes the new workpiece zero point after the tool change.

② No Tool Changer, With Tool Setter:

First, return the machine to its home position. Change the tool using the method described in scenario ① above. After the new tool is installed and tightened, perform a fixed tool setting operation. The engraving machine will automatically move to a position above the tool setter for automatic tool measurement. Finally, reset the workpiece Z-axis zero point on the material surface. The specific operation is the same as the zero-setting method described in step 4 of scenario ①.

③ With Tool Changer, No Tool Setter:

First, return the machine to its home position. Change the tool using the tool changer, following the appropriate method for your machine. After the new tool is installed and tightened, perform a one-touch tool setting operation. The engraving machine will automatically move to a position above the tool setter for automatic tool measurement. Finally, use any tool from the tool changer to reset the workpiece Z-axis zero point on the material surface. The specific operation is the same as the zero-setting method described in step 4 of scenario ①.

①首先，将主轴移动到方便换刀处，然后使用主轴扳手和螺帽扳手分别卡住主轴刀具装夹卡位和螺帽卡位。

②使用主轴扳手和螺帽扳手分别向内拧松螺帽组件。

③确认装夹的刀柄直径和夹头直径是相互匹配的，然后将夹头装入螺帽中，再将刀具的2/3柄柄插入夹头中。

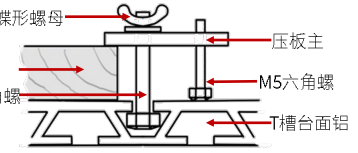
④将装好刀具的夹头螺帽组件用两个扳手向外拧紧固定到主轴上。为了确保刀具能进行正常的切削，刀刃不可插入夹头里。

3.3 固定工件材料

固定工件材料需要根据工件形状、材料特性、加工工序和加工精度要求来选择合适的固定方式，一般薄板采用双面胶固定、46牌子采用台钳固定、异形工件采用专用夹具进行固定。可参考以下表格选择合适的夹具。

(△注意：务必确保工件装夹牢固，防止工件飞出造成人身伤害！) M6六角螺

使用M5六角螺钉作为支撑，M6的六角螺钉来压住工件。将M6的六角螺钉放入T槽台面的T槽中，将M5的支撑螺钉放在T槽台面的表面。顺时针方向锁紧蝶形螺母来将工件压住。



3.4 定工件零点

清工件零即将工件坐标清零，是指将雕刻机控制系统当前记录的工件坐标系（通常是G54）的原点（0,0,0）位置，重置或重新定义到新的物理位置上。清工件零除了定工件原点之外，还能让中断恢复、多任务加工和批量生产变得简单高效。

分中是指将坐标值修改为当前坐标值的一半。分中功能通常用于定工件原点。

为方便定工件原点，编程时一般将加工原点设定在材料的左下角或者材料中心位置。

若编程时将工件原点设置在材料左下角，可通过清工件零功能确定工件原点。移动主轴，使刀尖与工件原点重合，再清工件零，即可将工件原点存入系统。在移动过程中，可先高速移动至原点附近位置，再切换至低速、寸动或手轮移动模式，缓慢调节，避免刀具撞到材料造成损耗。

若编程时将工件原点设置在材料正中心，可通过清工件零功能和分中功能确定工件原点。先将主轴移到材料左侧，再逐渐靠近材料左侧边，刀尖即将碰到材料左边时切换到寸动模式，可设置寸动距离如0.01，或切换至手轮模式x1倍率，逐步调节，当刀尖刚好碰到材料左边后选择**【X清零】**使X轴工件坐标清零。接着，将主轴抬起移到材料右边，即将碰到材料右边时切换到寸动模式，逐步调节，刀尖刚好碰到材料右边时，将Z轴抬至安全高度，点击**【X轴分中】**并**【确定】**，至此X轴分中完毕。

Y轴同理，即将碰到材料前端时点击**【Y清零】**并按下**【确定】**使Y轴工件坐标清零。接着，将主轴抬起移到材料后端，再逐渐靠近材料，刀尖即将碰到材料后端时，将Z轴抬至安全高度，点击**【Y轴分中】**并**【确定】**，至此Y轴分中完毕。

在此过程中，清工件零时需考虑刀具直径对位置确定的影响。若使用尖刀，可直接清零；若使用铣刀等其它直径较大的刀具，需在清零后将工件原点值输入为刀具直径的半值，注意数值正负。

确定好X轴和Y轴的工作坐标原点后，将主轴移动到材料上表面，即将碰到材料上表面时，切换为寸动模式，逐步调节，刀尖碰到材料上表面时点击**【Z清零】**并**【确定】**，至此工件零点确定完毕。

若编程时工件原点设置在其它位置，请结合实际情况定工件原点。

3.5 加载程序

找好工件原点后，选择需要加工的程序，将加工程序拷贝到U盘上，将需要加工的代码保存至系统本地磁盘，再加载至控制系统。

3.6 开始加工

加工程序加载好后，点击**【启动】**按键，机器便会开始运行程序。

3.7 换刀对刀

当出现断刀、刀具磨损缺损或其它需要需要换刀时，请按以下不同情况进行操作：

①无刀库、无对刀仪：

将主轴扳手和夹头扳手卡住主轴位置和夹头位置，逆时针向内旋转夹头扳手，当主轴螺帽松动以后，继续旋转主轴螺帽直到螺帽完全取下后，拔出其中刀具（如左图推出刀具即可）并将刀具放置于安全的区域，避免划伤。

若新刀具与原刀具的直径不同、所使用的夹头规格不同，则也需要更换夹头。更换夹头时，向一侧轻推夹头使夹头松动（如图1），取出夹头后将新夹头放入螺帽并向下压紧，最后，将新刀具推入夹头中（如图2），刀尖应朝下即为图中右侧。

△螺帽与夹头采用的是自锁结构，请勿强行用敲击的方式将夹头取出。

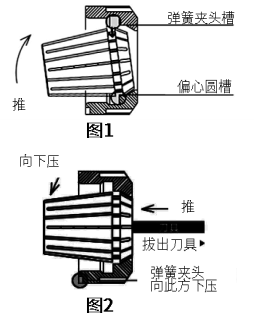
刀具更换完成后，XY轴的工件原点不变，但需要重新定工件原点的Z轴，移动主轴使刀尖靠近材料表面，刀尖即将接触到材料上表面时，点击**【Z清零】**并点击**【确定】**按键，至此就获得了换刀后的工件零点。

②无刀库、有对刀仪：

首先返回机床原点，接着按照上述方法更换刀具，刀具换好锁紧后，应进行固定对刀，此时雕刻机将移动至对刀仪上方进行自动对刀。最后，在材料表面重新对工件Z轴零点，具体操作与①中更换刀具后的对零点方法相同。

③有刀库、无对刀仪：

首先返回机床原点，接着按照上述方法更换刀具，刀具换好锁紧后，应进行一键对刀，此时雕刻机将移动至对刀仪上方进行自动对刀。最后，使用刀库中的任意一把刀具在材料表面重新对工件Z轴零点即可，具体操作与①中更换刀具后的对零点方法相同。



四、故障排查

4.1 故障排查前准备工作

在开始排查雕刻机故障前，需做好以下准备，以确保排查过程安全、高效：

- ①**安全防护措施：**操作人员需佩戴绝缘手套、护目镜，穿着防滑工作鞋。断开雕刻机总电源，防止触电事故；若雕刻机处于工作状态，需先按下急停按钮，待设备完全停止运转后再进行后续操作。
- ②**工具准备：**准备好万用表（用于检测电路电压、电流、电阻）、内六角扳手套装（不同规格，适配雕刻机各部件螺丝）、螺丝刀（十字、一字，含绝缘柄）、钳形电流表（检测电机电流）、水平仪（检测工作台面水平度）、塞尺（测量部件间隙）、毛刷（清理灰尘）、压缩空气枪（吹除部件内部灰尘）等工具。
- ③**资料准备：**提前准备雕刻机的设备说明书（包含电气原理图、机械结构图、参数设置说明）、设备运行日志（记录设备日常运行状态、之前故障及维修情况），以便在排查过程中对照参考。

4.2 常见故障分类及排除方法

① 雕刻无法正常移动

故障现象：操作雕刻头进行移动时，雕刻头无反应，或移动速度异常缓慢、卡顿。

可能原因：

- ◆ 电机电源线路故障，如电线断裂、接头松动。
- ◆ 电机驱动器故障，无法正常驱动电机运行。
- ◆ 丝杠与螺母配合不良，如丝杠生锈、有杂物堵塞，或螺母磨损严重。
- ◆ 导轨被异物卡住，或导轨滑块损坏。
- ◆ Z轴抱闸继电器或接触器故障，无法正常吸合打开抱闸。

排除步骤：

- 1.断开雕刻机电源，用万用表检测电机电源线路。先检查电源线是否有明显断裂痕迹，再测量线路电阻，若电阻无穷大，说明线路断裂，需更换电线或重新连接接头；若线路正常，检查电源接头是否松动，重新插拔并拧紧接头。
- 2.接通雕刻机电源，移动雕刻机，用万用表测量电机驱动器的输出电压。若输出电压为零或异常，说明驱动器故障，需更换驱动器；若输出电压正常，进入下一步排查。
- 3.拆卸雕刻机防护罩，检查丝杠导轨。用毛刷清理丝杠表面的灰尘和杂物，若丝杠生锈，用细砂纸轻轻打磨除锈，然后涂抹专用丝杠润滑油；检查丝杠螺母，若螺母磨损严重（如出现明显划痕、间隙过大），需更换螺母。
- 4.检查丝杠导轨，观察导轨表面是否有异物卡住，若有，用压缩空气枪吹除异物；检查导轨滑块，若滑块损坏（如滚珠脱落、滑块变形），需更换滑块。
- 5.打开雕刻机电气控制柜，找到控制Z轴抱闸的继电器或接触器。观察继电器或接触器的触点是否有烧蚀、氧化现象，用万用表测量触点通断情况。若触点损坏，更换继电器或接触器；若触点正常，检查继电器或接触器的线圈电压，若线圈无电压，检查控制线路，若线圈损坏，更换相应部件。

② 驱动器报警

故障现象：控制软件提示XYZ轴驱动器报警，驱动器显示相应故障码

可能原因：

- ◆ 开机未正常返回机床原点，软限位无法正常开启，移动超过最大允许范围导致电机卡死。
- ◆ 机器出现丝杠、导轨或轴承等机械故障导致电机无法转动卡死。电机和驱动器连接异常或编码器线断开，导致驱动器无法正常控制电机。
- ◆ 电机工作故障导致驱动器报警。
- ◆ 驱动器异常导致驱动器报警。

排除步骤：

- 1.机床断电后重新开机，根据开机提示返回机床原点，机器在允许行程范围内正常移动。
- 2.松开电机与丝杠连接的联轴器部件，让电机不带负载空运行，若电机能正常运转说明为其他机械故障引起的驱动器报警，请检查相应轴的丝杠、导轨、轴承等其他机械部件。若依然无法运转则进入下一步排查。
- 3.检查驱动器报警代码，对应闭环/伺服电机故障代码查询，若检查代码为电机接线异常则检查相应的电机接线是否断开或接口接触不良。若检查代码为编码器接线异常则检查相应的编码器接线是否断开或接口接触不良。
- 4.检查驱动器报警代码，对应闭环/伺服电机故障代码查询，可临时更换其他轴电机进行故障排除，确认为电机故障后更换电机即可。
- 5.检查驱动器报警代码，对应闭环/伺服电机故障代码查询，可临时更换其他轴驱动器进行故障排除，确认为驱动器故障后更换电机即可。

③ 电机运行异常（异响、发热、不转）

故障现象：雕刻机电机在运行过程中，发出异常噪音（如刺耳的尖叫声、沉闷的轰鸣声），电机外壳温度过高（超过正常工作温度，一般电机正常工作温度不超过 60 - 70℃），或电机完全不转动。

III. Equipment Operation Process

3.1 Startup and Preliminary Checks

- ① Before starting, check all machine connections and external equipment for normal condition. After verification, turn the emergency stop button clockwise to release it, press the power button to energize the machine, and wait for the system interface to load completely.
- ② After the CNC system loads, a prompt "Return to Machine Origin?" will appear. Click **【OK】** in the operating system to return to the machine origin.
- ③ Use the **【X-】**, **【X+】**, **【Y+】**, **【Y-】**, **【Z+】**, **【Z-】**, **【A+】**, and **【A-】** buttons in the operating system or use the handwheel to move the respective axes. Check the movement function of each axis.
- ④ Move each axis to its maximum and minimum travel limits to test the machine's travel limit protection function.
- ⑤ Press the spindle ON/OFF button in the operating system to control the spindle start/stop, testing the spindle function. (**Caution:** If a tool is installed on the spindle, ensure it is securely clamped to prevent the tool from flying out and causing injury.)
- ⑥ After startup, check if the spindle water cooling fan and coolant pump start and operate normally.

3.2 Tool Installation

⚠To prevent personal injury, always ensure the spindle has completely stopped rotating before installing or removing tools and accessories. Confirm that no one can start the spindle during the installation process.

To tighten the collet and nut: Hold the two wrenches firmly and twist them outward away from each other to tighten.

To loosen the collet and nut: Hold the two wrenches firmly and twist them inward towards each other to loosen.

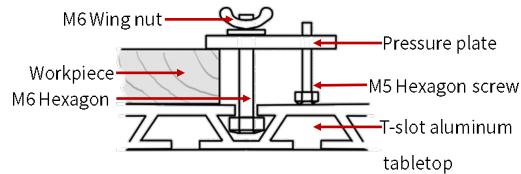


- ① First, move the spindle to a position convenient for tool changing. Then, use the spindle wrench and the collet nut wrench to engage the spindle's tool mounting slot and the collet nut slot, respectively.
- ② Using the spindle wrench and the collet nut wrench, turn them inward (towards each other) to loosen the collet nut assembly.
- ③ Confirm that the shank diameter of the tool to be installed matches the collet diameter. Then, insert the collet into the collet nut, and insert approximately two-thirds of the tool's shank into the collet.
- ④ Tighten the collet nut assembly (with the tool installed) onto the spindle using the two wrenches, turning them outward (away from each other). To ensure normal cutting performance, ensure the cutting edges are not inserted into the collet.

3.3 Securing the Workpiece Material

The method for securing the workpiece should be chosen based on the workpiece shape, material characteristics, machining operations, and required precision. Typically, thin sheets are fixed using double-sided tape; and irregularly shaped workpieces are fixed with custom fixtures. Refer to the table below to select the appropriate fixture. (**⚠Caution: Always ensure the workpiece is securely clamped to prevent it from coming loose and causing personal injury!**)

Use M5 hexagon screws for support and M6 hexagon screws to clamp the workpiece. Place the M6 hexagon screws into the T-slots of the T-slot tabletop, and position the M5 support screws on the surface of the T-slot tabletop. Tighten the wing nuts clockwise to clamp the workpiece in place.



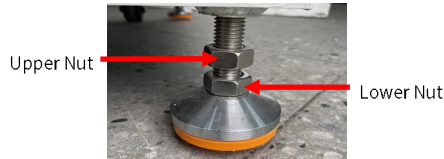
3.4 Setting the Workpiece Zero Point

Setting the workpiece zero, also known as zeroing the workpiece coordinates, refers to **resetting or redefining the origin point (0,0,0) of the workpiece coordinate system (typically G54) currently recorded by the engraving machine's control system to a new physical location.** Besides defining the workpiece origin, this function simplifies resume-after-interrupt operations, multi-task machining, and batch production, making them more efficient.

2.3 Installation and Commissioning

2.3.1 Equipment Installation

① **Equipment Leveling** Move the machine to a flat and solid floor that can support its weight. Adjust the leveling feet to ensure the machine is perfectly level. First, loosen the upper nut of each foot to unlock it. Then, adjust the lower nut to level the machine. Finally, tighten the upper nut against the machine base to lock the foot in place, ensuring stability. Use a spirit level to measure the levelness of the machine from all directions.



② **Removal of Shipping Safety Devices** Use the provided tools to loosen the shipping fixation screws at the front of the machine. Ensure all shipping protection components (e.g., spindle locking block, Z-axis anti-fall nut) have been removed. After removal, manually check that all motion axes move smoothly without mechanical obstruction.

③ **Electrical Grounding System Installation** Ensure the equipment is reliably grounded. If the power supply system lacks grounding, use the provided grounding wire. Connect one end to the equipment's grounding terminal and the other end to a safety-standard compliant grounding device (e.g., building grounding network). After grounding, verify its reliability.

④ **Cooling System Filling** Open the coolant tank cap. Use dedicated tools to add the specified type of coolant. Note: The fluid level should not exceed 80% of the nominal capacity, leaving expansion space. After initial filling, start the coolant circulation pump to bleed air from the lines.

⑤ **Spindle Unit Installation** Remove the spindle from its packaging. Clean the mounting surface, then vertically lower the spindle into the spindle holder. After adjusting to the appropriate height, use tools to tighten the fixation screws. After installation, manually rotate the spindle to confirm smooth operation.

⑥ **Electrical Connection** With the power OFF, connect all the equipment's aviation plugs to their corresponding sockets and tighten the locking rings. Ensure all connections are secure, and organize the wiring harness neatly to avoid interference with moving parts.

Note: The installation process must be performed by qualified personnel to ensure standard procedures are followed.

2.3.2 Equipment Commissioning

① Turn the emergency stop button clockwise to release it. Press the power button to switch on the machine. Wait for the system interface to load completely.

② After the system loads, a prompt "Return to Machine Origin?" will appear. Click the confirm button on the operation panel to return to the machine origin.

③ Click the mode switch button to change the movement mode to the handwheel mode. After selecting the X, Y, or Z axis on the handwheel, use the X1, X10, X100 multiplier switches to control the movement of the respective axis. Check if the movement function for each axis is normal. Then perform a reverse movement.

④ Move each axis to its maximum and minimum travel limits to check if the travel limit protection function is working correctly.

⑤ Click the spindle button on the panel to turn the spindle on/off, testing whether the spindle rotation function is normal.

⑥ Check if the spindle water cooling fan and coolant pump are working normally. Check if the automatic lubrication pump functions correctly upon startup. Verify the operation of the coolant switch function. After the above basic checks, the machine's fundamental functions should be confirmed normal. If any issues are encountered during commissioning, please contact after-sales service for resolution.

可能原因:

- ◆ 电机电源电压不稳定，过高或过低。
- ◆ 电机绕组短路或断路，导致电机无法正常工作。
- ◆ 电机轴承磨损严重或损坏，运转时产生异响和发热。
- ◆ 电机负载过大，超过电机额定负载能力。
- ◆ 电机驱动器参数设置错误，或驱动器故障。

排除步骤:

1. 用万用表测量电机电源电压，对比电机额定电压（一般雕刻机电机额定电压为 220V 或 380V）。若电压过高或过低，检查供电线路，排除电压不稳定故障（如加装稳压器）。
2. 断开电机电源，拆除电机电源线，用万用表测量电机绕组的电阻值。若测量结果为零，说明绕组短路；若电阻值无穷大，说明绕组断路。无论是短路还是断路，均需更换电机绕组或更换电机。
3. 检查电机轴承，用手转动电机轴，若感觉转动不顺畅、有卡顿或异响，说明轴承磨损严重或损坏。拆卸电机端盖，取出旧轴承，更换相同型号的新轴承，更换后添加适量轴承润滑脂，然后重新安装电机端盖。
4. 检查电机负载情况，查看雕刻机当前的工作参数（如雕刻速度、雕刻深度），是否超过电机额定负载。若负载过大，调整工作参数，降低雕刻速度、减小雕刻深度，或分多次进行雕刻；若负载是由于机械部件卡滞导致（如导轨堵塞、丝杠卡顿），排除机械故障后，电机负载即可恢复正常。
5. 检查电机驱动器参数，对照设备说明书，确认驱动器参数设置是否正确（如电机型号、电流限制、细分设置等）。若参数设置错误，重新调整参数；若参数设置正确，操作电机运行，用万用表测量驱动器输出电流和电压，若输出异常，说明驱动器故障，需更换驱动器。

④ 雕刻图案出现偏差、错位

故障现象: 雕刻完成的图案与设计图案相比，出现位置偏差（如左右偏移、上下偏移）、尺寸偏差（如图案变大或变小），或图案各部分之间错位，无法正常拼接。

可能原因:

- ◆ 加工原点设置不对，引起加工错位。
- ◆ 机械故障导致加工过程中机器错位。
- ◆ 工件装夹不牢靠或者未进行可靠装夹。
- ◆ G代码错误导致机器移动位置错误。

排除步骤:

1. 检查工件位置是否放反或者放偏，低于 2mm 的位置偏差视觉会对位置进行修正。
2. 检查是否有异常数值，若有异常数值可先恢复出厂数值后再进行微调。
3. 检查机械传动部件的间隙，如丝杠间隙、齿轮间隙。对于丝杠间隙，可通过调整丝杠螺母的预紧装置来减小间隙；对于齿轮间隙，若间隙过大，需调整齿轮啮合间隙或更换齿轮。调整后，进行反向运动测试，观察是否仍有空程误差。
4. 检查雕刻材料的固定情况，确保材料被牢固夹紧在工作台上。若材料固定不牢固，重新调整固定夹具，或使用更可靠的固定方式（如增加夹紧点、使用真空吸附装置）。固定好材料后，重新进行雕刻，查看图案是否还会出现偏差。

4.3 故障排除后的测试与验证

① **空载测试:** 在排除故障后，先进行雕刻机空载运行测试。启动雕刻机，操作各运动轴（X 轴、Y 轴、Z 轴）进行往复运动，观察电机运行是否平稳、无异常噪音，各运动轴的运动精度是否符合要求（可通过观察刻度或使用百分表测量）。同时，测试雕刻头升降功能、急停按钮功能等，确保各功能正常。

② **试雕刻测试:** 选择一块与实际加工材料相同或类似的测试材料，进行试雕刻。设定简单的雕刻图案（如直线、圆形、文字），设置合适的雕刻参数（如雕刻速度、雕刻深度、进给速度），启动雕刻程序。在雕刻过程中，密切观察雕刻机的运行状态，包括电机运行情况、雕刻头切削情况、材料固定情况等。雕刻完成后，检查试雕刻作品的精度，如图案尺寸、位置、表面光洁度等，确认故障已完全排除，雕刻机性能恢复正常。

③ **连续运行测试:** 若试雕刻测试合格，进行雕刻机连续运行测试。选择一个相对复杂的雕刻图案，让雕刻机连续运行 1-2 小时（根据实际工作情况调整运行时间）。在连续运行过程中，定期检查雕刻机的运行状态，如电机温度、轴承温度、电气控制柜内各部件温度，以及各运动轴的运行精度。运行结束后，检查雕刻作品的质量，确保雕刻机在长时间运行过程中性能稳定，无故障复发。

五、雕刻机的保养

5.1 丝杆导轨及轴承的保养

养成良好的机器使用习惯非常重要。建议您大约每个月对设备进行一次清洁保养，特别是丝杆、光轴和轴承部分。

清洁时，请先用干净的抹布手动擦拭丝杆和光轴表面。对于轴承等不易触及的部位，可以使用小刷子仔细清理。完成清洁后，用油壶向丝杆、光轴和轴承均匀喷洒适量的润滑油。

随后，启动设备并控制其来回移动数次，确保润滑油均匀分布。此时若发现丝杆上仍有黑色污垢析出，请再次用抹布擦拭干净。重复“润滑—擦拭”的过程，直至丝杆表面恢复光亮油润的状态。

5.2 主轴及水冷系统的保养

在加工过程中，主轴夹头、螺帽和螺纹部分容易积聚灰尘或发生锈蚀，建议定期在这些部位涂抹防锈油，并及时清除螺纹处的铁锈。如果夹头或螺帽锈蚀严重，应及时更换，以确保装夹精度和主轴运行的同心度。

对于800W和1.5KW水冷主轴，由于其内部为水冷结构，主轴内孔及冷却腔体也可能出现锈蚀。清洗时，请先将原有的冷却液彻底排出，然后将专用清洗液注入水箱，启动水泵循环清洗1-2小时。若主轴长时间未使用，建议延长清洗时间至4-5小时。清洗完成后，排尽清洗液，重新注入标准主轴冷却液，即可恢复正常使用。

5.3 电控箱的保养

在使用控制箱和机器过程中，内部容易积聚粉尘，尤其在加工金属材料时，金属导电粉尘一旦进入控制箱，可能引发短路或烧毁电路。因此，建议定期对控制箱内部进行清洁。

操作时，可先打开控制箱外壳，使用吹风机调至冷风档或使用冷风枪，将箱体倒置，吹除电路板及元件表面的粉尘。对于不易清理的角落，可用小刷子轻柔擦拭，确保彻底清除导电尘埃。清洁完成后，确认内部完全干燥再合盖并重新启动设备。

六、常用耗材

耗材名称	耗材图片	耗材功能
主轴螺帽		装夹于主轴螺纹处的，与刀具夹头配合使用锁紧刀具。
刀具夹头		装夹于主轴螺帽中，与刀具螺帽配合使用锁紧刀具。
刀具		常用雕刻刀，铣刀，钻头耗材。断刀、磨损需更换刀具以保证加工效果。
主轴清洗液		主轴后期保养。若有生锈，可以用主轴清洗液清洗主轴，延长主轴使用寿命，增强散热性能。
丝杆润滑油		用于丝杆、轴承、光轴润滑保养。延长机器使用寿命，保证精度。
主轴冷却液		用于冷却主轴。在主轴转动时，带走部分主轴热量；防锈；防腐蚀；延长主轴使用寿命。

The electronic control system of the engraving machine is compatible with the following control systems: JYH04 Offline Handheld Controller System, Mach3 Control System, JYS4 Offline Electronic Control System, JYSE4 Offline Electronic Control System, JYX4 Offline Electronic Control System. Before operation, please refer to the user manual of the actual supporting control system to ensure functional compatibility and proper operation.

System	Mach3	JYH04	JYS4	JYSE4	JYX4
MPG					
Electrical Control Cabinet					

2.2 Equipment Parameter

Product Model	CNC4010F-2.2KW	CNC3030F-2.2KW	CNC4040F-2.2KW	CNC4060F-2.2KW
Control System	Mach3 / JYH04 / JYS4 / JYSE4 / JYX4			
Processing Dimensions	Y400*X100*Z120 (mm)	Y300*X300*Z120 (mm)	Y400*X400*Z120 (mm)	Y600*X400*Z120 (mm)
Worktable Dimensions	Y620*X240(mm)	Y520*X400(mm)	Y620*X480(mm)	Y800*X480(mm)
Overall Dimensions	Y730*X420*Z760 (mm)	Y690*X660*Z760 (mm)	Y790*X740*Z760 (mm)	Y970*X730*Z760 (mm)
Spindle Power	2.2kW Water-Cooled Spindle			
Spindle Speed	24000rpm			
Drive Motor	Leisai Closed-Loop Stepper Motor / Upgraded to Leisai Servo Motor			
Slide Unit	Industrial-Grade Square Rail / Upgraded to Precision Grade (P-Grade) Square Rail			
Motion Unit	High-Precision Ball Screw / Upgraded to C5-Grade Ball Screw			
Feed Rate	≤6000mm/min (Update Servo 8000mm/min)			
Feed Height	150mm			
Tool Shank Diameter	ER20 1-13mm			
Repeatability	0.01mm			
File Format	NC/TAP/TXT/G code			
Working Voltage	AC 220V			
Machine weight	78kg	97kg	120kg	145kg
The above specifications are based on factory internal testing standards				

◆ It is recommended that a single operator take the lead in operating the equipment. Others assisting or observing should maintain a safe distance to avoid accidental contact caused by multiple people operating simultaneously.

◆ The working area of the engraving machine (especially for wood and plastic processing) must be a no open flame zone. Ensure an adequate number of dry powder or carbon dioxide fire extinguishers are available. Never use water-based extinguishers for electrical fires.

◆ The work area must be well-lit, with sufficient safe operating space around the equipment and clear emergency evacuation routes. Flammable or explosive materials are strictly prohibited.

◆ Discarded or damaged tools must be placed in a dedicated cut-resistant container for centralized disposal. Do not leave them scattered to prevent injuries.

Before any inspection, maintenance, cleaning, or adjustment (including tool replacement), a lockout-tagout (LOTO) procedure must be strictly followed: disconnect all energy sources (electrical, pneumatic) and attach warning tags to prevent accidental startup by others.

1.2 Equipment Unpacking

Upon receipt of the engraving machine, first check if the outer packaging is intact. Use caution when unpacking to avoid damaging the equipment. After removing the main unit, immediately inspect the **Safety Precautions** label posted in a conspicuous location on the machine. Carefully read the equipment operation safety regulations.

A QR code for the "JingZhiNiuYun" learning platform is affixed to the side of the machine. Scan this code with a mobile phone to access the tutorial platform and watch video guides on equipment operation, maintenance, and fault handling.

Special Note: Before initial startup, check for and remove any protective devices used to secure the equipment during transportation. Ensure the machine is in a ready-to-use state. The equipment includes an accessory box with a detailed parts list attached. Verify all accessories against this list to ensure all items are complete and undamaged.

Checking Procedure:

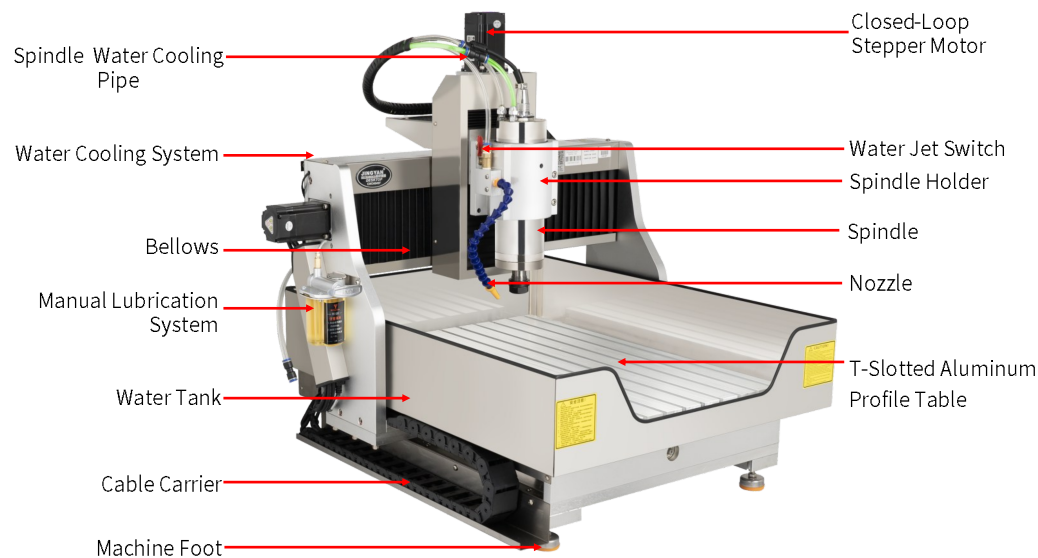
- ① Cross-reference the accessory list and check each item for completeness.
- ② Inspect the appearance and functionality of all accessories. If any damage or missing parts are found, record and take photos for documentation.
- ③ If any accessories are missing or abnormal, promptly contact after-sales support. Provide relevant photos and equipment information to facilitate the arrangement for replenishment or replacement.

II. Equipment Overview

This section primarily introduces the components, technical parameters, installation, and debugging of the engraving machine.

2.1 Equipment Components Introduction

A schematic diagram of the main external components of the engraving machine is as follows:



七、雕刻机的保修及技术支持

质保说明: 雕刻机整机包括机架部分、控制箱及手轮保修一年易损品除外。易损品包括：联轴器、主轴夹头、主轴螺帽、刀具、喷水系统水泵及喷头。此外300W主轴保修三个月，800W、1.5KW及2.2KW主轴保修六个月。

技术支持说明: 技术支持包含机器安装、基本功能使用、雕刻机软件安装、软件编程指导、加工工艺指导等，不包含制图教学和编程服务（可免费学习资料）。免费技术支持时间为六个月，若需在服务到期后继续获得技术支持，您可以购买延长服务。

由于运输引起的质量问题均由我方一律承担。如果在使用本产品过程中有任何问题，务必先联系我方售后人员，请勿自行修理，失去保修资格。经售后判断后需要更换有故障配件的，需待我方收到有故障的配件并检测后才能进行更换。

如有以下原因引起的故障，在保修期内实行有偿维修：

- ◆ 不正确操作或未经允许自行拆卸修理及改造所引起的问题。
 - ◆ 超出标准规范要求使用雕刻机造成的问题。
 - ◆ 购买后碰撞或放置不当（如进水等）造成的问题。
 - ◆ 由于私自改装造成机器出现使用故障。
 - ◆ 在不符合本说明书要求的环境下使用所产生的故障。
 - ◆ 因电压接错或电压不稳引起的控制箱损坏。
 - ◆ 因地震，火灾，雷击，异常电压或其他人力不可抗拒引起的故障。
- 扫描“晶研科技”微信小程序二维码，获得售后支持。

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I. Introduction

Before using the equipment, please read the instruction manual carefully to fully understand the relevant functions of the equipment. This ensures the correct use of the engraving machine and prevents accidents. Failure to comply with safety precautions and the instruction manual may result in electric shock, fire, or other dangers. Please keep the manual properly for future reference.

1.1 Safety Instructions

1.1.1 Electrical Safety Guidelines

- ◆ Do not connect the power supply during installation.
- ◆ Do not misuse power cords; never use them for carrying, pulling, or unplugging the controller by pulling the cord directly.
- ◆ This machine operates on 220V household power supply. Do not disassemble it without authorization to avoid hazards.
- ◆ Regularly inspect power cords, extension cords, and equipment cables for signs of aging, damage, overheating, or hardening. Replace immediately if any abnormality is found.
- ◆ Always hold the plug body when unplugging, rather than pulling the cord directly.
- ◆ Ensure the emergency power switch is unobstructed and located near the equipment. All operators must be familiar with its location and usage.
- ◆ Completely disconnect the power supply (not only turning off the equipment switch but preferably unplugging from the wall outlet) when the equipment is idle for extended periods, during maintenance, or before cleaning.
- ◆ Do not expose the control box to rain or moisture. Liquid ingress increases the risk of electric shock.
- ◆ Do not modify the wiring or plug of the control box in any way. The plug used must match the power outlet.
- ◆ Ensure the power outlet for the equipment is properly grounded. It is strongly recommended to use a Ground Fault Circuit Interrupter (GFCI) to reduce the risk of electric shock.
- ◆ Keep cords away from high temperatures, oily areas, and sharp edges. Do not place them near moving parts. Damaged or tangled cords increase the risk of electric shock.
- ◆ Immediately stop use and disconnect the power if severe overheating of motors, sockets, or cables is observed, or if the protective covering of wires is damaged. Contact the after-sales department for repair of damaged components.

1.1.2 Personnel Safety Guidelines

- ◆ Avoid accidental machine startup: Ensure the machine switch is in the OFF position before connecting the power supply.
- ◆ Maintain high vigilance and adhere strictly to operational procedures and safety knowledge for engraving machines. Do not operate the equipment while fatigued or under the influence of alcohol, drugs, etc. Momentary negligence may cause serious personal injury.
- ◆ Personal protective equipment (PPE) must be worn during operation. Safety goggles should always be used, along with dust masks, anti-slip safety shoes, helmets, and hearing protection as needed to effectively reduce injury risks. Before connecting the power, ensure the machine switch is OFF to prevent accidental activation.
- ◆ Wear appropriate work clothing. Avoid loose garments or accessories. Keep hair, clothing, and gloves away from moving parts to prevent entanglement. The use of dust extraction equipment is recommended to minimize health hazards from dust.
- ◆ Do not leave wrenches, cutting tools, or other items near the rotating spindle motor during operation to avoid hazards. Always work within safe boundaries, maintaining stability and balance to ensure effective control of the equipment in case of emergencies.
- ◆ Use dust removal tools to reduce exposure to dust-related hazards.

1.1.3 Operational Safety Guidelines

- ◆ Engraving tools are extremely sharp. Do not touch them during operation to prevent injury. Avoid contact with cloths, scarves, or similar items to prevent entanglement, injury, or equipment damage. Never touch a rotating tool.
- ◆ Secure the workpiece using clamps or other methods to stabilize it on a firm platform. Hand-holding or body-contact machining may cause instability and loss of control.
- ◆ After replacing parts or making adjustments, ensure the collet nut and all other adjustment devices are securely tightened. Loose adjustments may lead to movement, loss of control, or violent ejection of rotating components.
- ◆ Do not use this product in environments with strong interference or strong magnetic fields.
- ◆ Prevent conductive materials (e.g., metals) from entering the control box.
- ◆ Insert or remove USB drives and other connections with moderate force.
- ◆ Store the machine out of reach of children.
- ◆ Regularly maintain the engraving machine. Check moving parts for misalignment, binding, breakage, or any other issues that may affect operation. Do not use the machine if damaged; repair must be completed before operation. Many accidents are caused by inadequate maintenance.