Mintech TRM Series

Multifunctional CNC Router

User Manual

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1. Device Overview

1.1 Product Introduction

The TRM series CNC Router is a high-precision, multi-functional multi-axis CNC machine designed to meet diverse industrial needs, with excellent automation capabilities and extremely high machining accuracy. In addition to the milling cutter spindle, the machine can be flexibly equipped with a variety of cutting systems, including electric vibrating cutters, pneumatic vibrating cutters, driving wheel cutters, etc., and is suitable for complex processes such as cutting, engraving and drilling of different materials.

The TRM series is equipped with **a CCD camera automatic identification system**, which can realize the automatic identification of marking points on the material, accurately locate the processing path, and ensure the high accuracy and consistency of each processing, especially suitable for the printing and packaging industry that requires high-precision positioning. Combined with an advanced CNC system, the machine can easily cope with the processing tasks of various soft and hard materials.

The equipment supports a wide range of materials, including non-ferrous metals, plastics, composite materials, foam, rubber, leather, fabrics and other materials, which are widely used in the following industries:

- **Advertising** Signage: Cutting and engraving various materials to make high-precision billboards and signs.
- **Plastics processing**: Precision engraving and cutting of plastics and composites for the production of plastic parts and molds.
- **Printing and packaging**: Through the CCD automatic alignment system, the precise cutting of printed matter is realized to meet the high-precision needs of various packaging designs.
- **Interior decoration**: for custom cutting and engraving of wood, acrylic and other materials, suitable for the production of furniture and decorative panels.

With its high efficiency, precision and ease of operation, the TRM series CNC Router has become an indispensable processing equipment in various industries to meet customers' strict requirements for high-quality product processing.

There are two standard models: TR48M and TR510M

1.2 Scope of applicable materials

- **Metal materials**:
  suitable for engraving and cutting non-ferrous metals, such as copper, aluminum and other light metals.
- **Plastics & Polymer Materials**:
  Including a variety of engineering plastics and polymers, such as PMMA, PC, PVC, PS, PP,PA, PE,PET, POM, etc.
- **Composite materials**:
  including MDF and other synthetic wood panels, carbon fiber composite materials, aluminum-plastic panels, honeycomb panels and other new composite materials.
- **Soft materials**:
  foam, rubber, fabric, film, leather, cardboard, felt, sponge and other flexible materials.
- **Wood and hard materials**:
  solid wood, plywood, acrylic, glass fiber (FRP) and other hard materials used for carving and cutting.

1.3 How it works

The TRM series CNC Router works in tandem with a precision CNC and cutting system to complete high-precision cutting, engraving and drilling. The main steps are as follows:

Drawing design and CAM file generation

The user uses CAD software to design the machining drawings, and converts the drawings into G-code files in NC format through CAM software. The G-code contains the machine's machining path, speed, and other parameters, and defines all the motion details of the CNC Router.

G-code transmission and parsing

The generated G-code file is transferred to the CNC Router control system via USB or network. The control system receives and analyzes the instructions, coordinates the movement of the X, Y, and Z axes and the processing module to ensure the accuracy of the processing operation.

Machine movement and machining operations

Three-axis control: The servo motor controls the precise movement of the X, Y, and Z axes to achieve the path accuracy of the tool in two-dimensional or three-dimensional space.

Spindle & Cutting System: The system automatically switches tools and adjusts machining parameters according to the G-code, and the spindle and other modules (e.g. vibrating knives, wheel knives) perform cutting or engraving operations on different materials.

CCD automatic positioning system

Models equipped with a CCD camera automatically identify marked points on the material and adjust the machining path for tasks that require precise positioning. The CCD can also be equipped with an optional QR code scanning function for reading the associated information.

Real-time monitoring and feedback

The CNC Router is equipped with a real-time feedback system that automatically monitors the tool status, machining path, etc., and pauses the operation when abnormalities are detected to protect the safety of equipment and materials. The operator can view the three-axis position, spindle speed and current progress in real time through the control panel to ensure machining accuracy.

Completion & Reset

After all instructions have been executed, the machine automatically resets the tool to a safe position and shuts down the spindle or cutting module for the operator to carry out quality checks and subsequent processing.

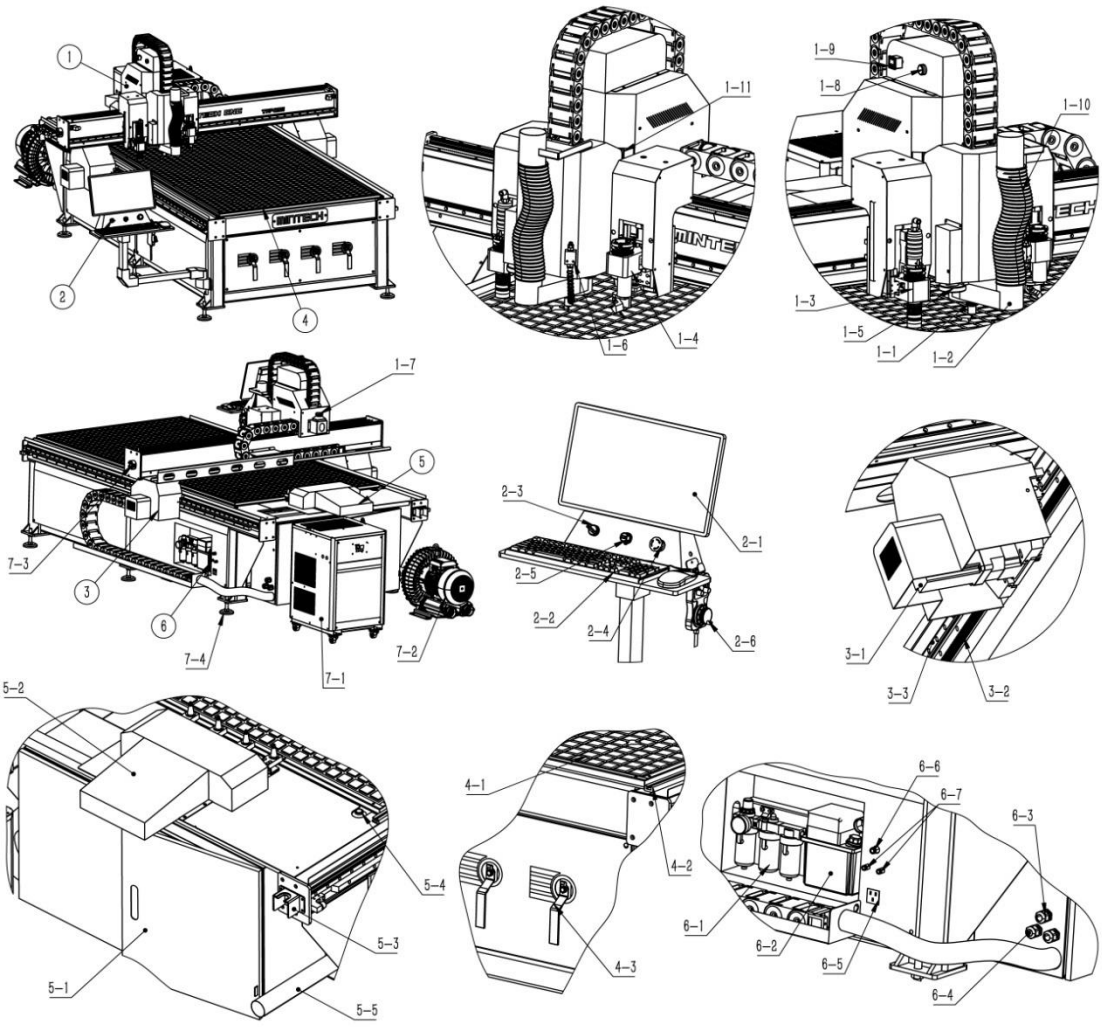
2. Technical Specifications

Machine model	TR48M	TR510M
Machine size L×W×H	133”×87”×69” 3370×2200×1750mm	158“×97“×69” 4000×2450×1750mm
Working dimensions	4'×8'(1250×2500mm)	5'×10'(1530×3060mm)
Net weight of the machine		3861 lbs（1750kg）
Z-axis travel	4 inches(110mm)	
Thickness of the material	≤ 3.5 inches (90mm) is the height from the beam to the countertop	
Maximum cutting thickness	≤ 2 inches (50mm) requires tool fit	
Machine architecture	The square steel pipe is integrally welded, and the stress is relieved by high-temperature aging treatment	
Work surfaces	Phenolic composite sheet is finished milled with grid-shaped vacuum adsorption table, and T-slot aluminum is assembled on both sides	
Numerical control system	MDRCNC Router (supports files such as DXF, AI, CDR, NC, G-code, etc., supports automatic generation of G code, and supports 2D and 3D processing).	
Operator interface	All-in-one industrial-grade computer with handheld motion controller	
CAM software	Overview/Alphacam/Coreo/Engview/Enroute/Pronest/Sigmanest/Vcarve/Aspire etc. compatible	
Drive system	Servo drive	
Transmission system	XY axis helical rack and pinion and linear square guide, Z-axis ball screw and linear square guide	
Milling cutter spindle parameters	5.3HP(4KW),40K RPM, Oil Cooling	
Spindle tool change system	4 tool positions, row type Tool library	
Tool specifications	ISO 20 handle, ER20 nozzle	
Speed of	148 Ft/min(45M/min)	

movement	
Machining accuracy	±0.004 inches(±0.1 mm)
Repeatability	±0.002 inches(±0.05 mm)
Optional cutting system	• Electric Vibrating Knife • Active Wheel Knife • Pointed Knife • Oblique Knife (V CUT) • Spring Knife (Kiss Cut) • Creasing Knife • Pneumatic Knife
Power requirements	• Main unit 208-204V 3-phase 30A (single-phase power supply needs to be customized) • The power supply for vacuum and vacuum systems depends on the model selected
Gas requirements	0.6 - 0.8 MPa(87-116 psi) ≥3-5 CFM(85-140 L/min)
Vacuum requirements	Flow 117.7-176.6 CFM (200-300m³/h), Vacuum degree ≥ 85 mbar(8500 Pa)
Environmental requirements	Temperature range 10-40°C, humidity 40-60%

3. Component Description

1	1-1	Spindle
	1-2	Dust Collection Cover
	1-3	Oscillating Knife
	1-4	Drag Knife
	1-5	CCD Camera
	1-6	Mist Cooling Nozzle
	1-7	Mist Cooling Tank
	1-8	Release Button for Spindle
	1-9	Air Pressure Alarm
	1-10	Dust Extraction Pipe
	1-11	Ball Screw and Linear Guide Rail
2	2-1	Integrated Industrial Computer
	2-2	Computer Keyboard and Mouse
	2-3	CNC ON/OFF Switch
	2-4	Emergency Button
	2-5	USB Port
	2-6	Electronic Handwheel (Pendant)
3	3-1	Servo Motor
	3-2	Helical Rack and Pinion System
	3-3	Linear Actuator Guide Rails
4	4-1	Vacuum Suction Worktable
	4-2	Material Fixing T-Slot Clamps
	4-3	Vacuum Control Valve
5	5-1	Main Control Electrical Cabinet
	5-2	Linear Tool Magazine
	5-3	Tool Holder Rack
	5-4	Automatic Tool Setting Probe
	5-5	Vacuum Pipeline Interface
6	6-1	Air Source Processor
	6-2	Automatic Lubrication Pump
	6-3	Main Power Inlet
	6-4	Vacuum Pump Power Inlet
	6-5	Oil Cooler Power Inlet
	6-6	Compressed Air Connection Port
	6-7	Cooling Oil Inlet and Outlet Ports
7	7-1	Oil Cooler Unit
	7-2	Vacuum Pump
	7-3	Emergency Button
	7-4	Machine Grounding Plate



3.1. Spindle processing unit and cutting tool system

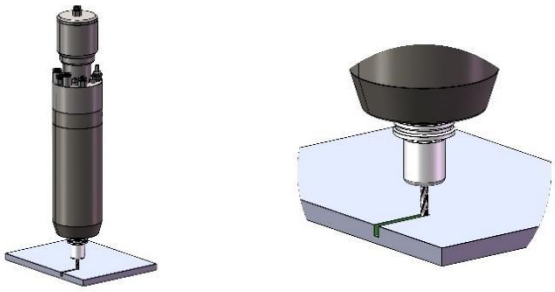
(1) CCD Camera (Standard)

- **Function**: It is used to accurately detect the Mark point on the surface of the material, realize automatic alignment cutting, and is widely used in the cutting operation after flatbed printing. The CCD camera can also scan the QR code and read the associated processing documents to achieve intelligent production.

(2) Milling cutter spindle (standard).

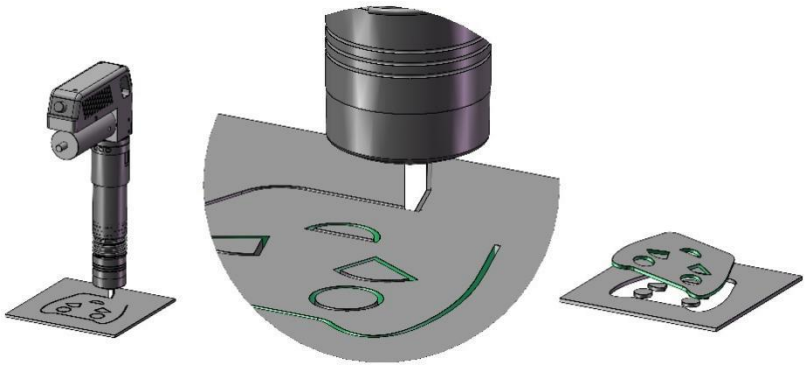
- Power: 5.3 HP (4 kW), with oil cooling system, effective heat dissipation, suitable for long-term continuous operation, ensuring that the spindle is not easy to overheat under high loads.
- **Speed**: Up to 40,000 rpm, supporting a wide range of speed adjustments, suitable for precision engraving and cutting of a wide range of hardness materials.
- **Tool interface**: The spindle taper is ISO 20 and equipped with an ER20 nozzle, which supports a variety of tool clamping specifications and provides flexible machining capabilities.
- **Tool change**: support manual and automatic tool change methods to adapt to different operation needs and improve production efficiency.

- **Function**: Suitable for high-precision engraving, cutting and drilling, especially for high-quality processing of hard materials (such as metals, plastics, composite materials, etc.), to ensure excellent machining surface quality and stable processing performance.



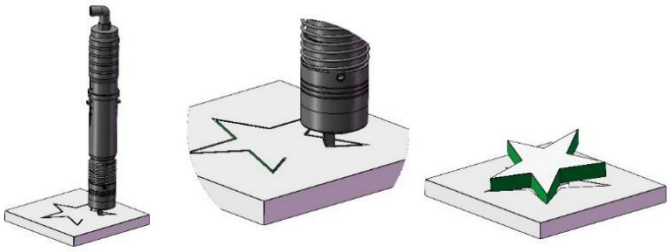
(3) Pneumatic Knife-CCT (standard).

- **Function**: The high-speed motor is used to drive the blade to vibrate up and down at high frequency to ensure a smooth and efficient cutting process. The tool is designed for precise cutting of medium-density materials, and can be adapted to the processing needs of a variety of flexible materials, including foam, rubber, leather, fabric, etc., by changing different blades. Its versatility allows it to provide efficient and clean cutting results in cutting applications of different materials, especially for machining tasks that require fine edge handling.



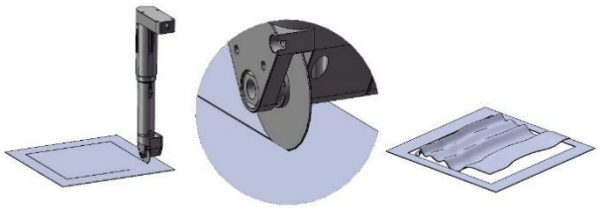
（4）Electric Vibrating Knife-EOT(optional)

- **Function**: The blade is driven by compressed air to vibrate up and down at high frequency, with an amplitude of up to 8mm, which is suitable for cutting tough and high-density materials. Compared with electric vibrating knives, pneumatic vibrating knives have a stronger cutting capacity and are able to cut materials up to 60mm thick with special knives. The tool is particularly suitable for demanding cutting tasks, especially when working with thick or hard materials such as composites, rubber, foam, etc., ensuring efficient and precise cutting results.



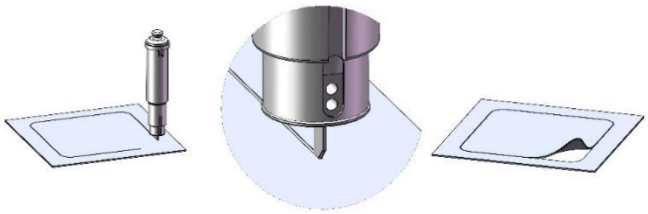
（5）Active Wheel Knife-DRT(optional)

- **Function**: The blade is driven by a high-speed motor for high-speed rotary cutting, ensuring that the cutting edge is clean and tidy, without hanging wire and burr. The tool can be equipped with round blades or decagonal blades to adapt to different types of materials, especially for cutting various woven materials (such as fabrics, carbon fibers, etc.). With their excellent cutting accuracy and clean edge treatment, the drive wheel cutter is particularly good for complex materials, especially for flexible and textile materials that require efficient, high-quality edge treatment.



（6）Pointed Knife-UCT(optional)

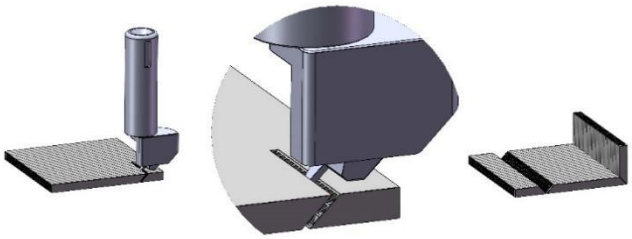
- **Function**: Suitable for cutting materials up to 5mm thick, with its design, the sharp knife can be cut efficiently at a fast speed, the tool is not easy to break, and the processing process is stable. The tool has a high cost performance and low maintenance cost, especially suitable for application scenarios with low requirements for cutting quality, such as simple material cutting, low-precision machining, etc. Its durability and economy make it ideal for routine cutting tasks.



（7）Oblique Knife-V CUT(optional)

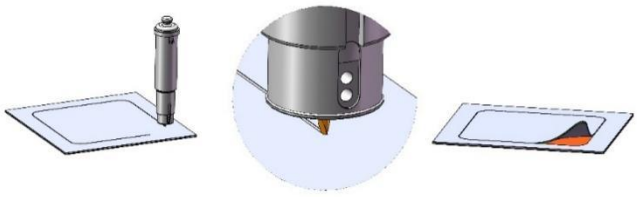
- **Function**: Specially designed for V-groove processing of honeycomb cardboard and other composite sandwich materials, suitable for precise cutting and folding of materials. The blade

angle of the oblique knife is adjustable, and a variety of optional angles (0°, 15°, 22.5°, 30°, 45°) are available to flexibly adapt to different cutting needs. The tool can quickly cut into precise V-grooves for subsequent folding and forming, and is widely used in packaging, display racks and other applications that require folding processing.



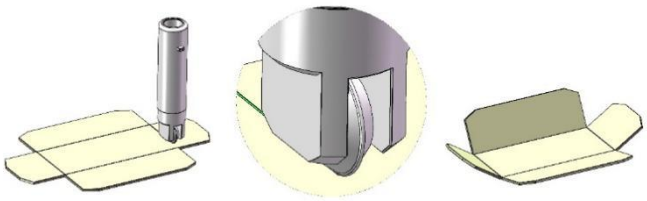
（8）Spring Knife-Kiss CUT(optional)

- **Function**: Specially designed for precision cutting of layered materials such as self-adhesive, by adjusting the position of the knife tip, the cutting depth is fixed, and only the upper layer of material is cut through without damaging the lower substrate. The tool is suitable for processes that require strict cutting depths, such as films, labels, etc., to ensure precise cutting while protecting the underlying material. The high sensitivity and control of spring knives make them ideal for high-precision layered cutting.



(9) Creasing Knife(optional)

- **Function**: Specially designed for the indentation processing of corrugated cardboard and other materials, by selecting different types of pressure wheels, a variety of indentation effects can be generated to meet different process needs. The tool is particularly suitable for packaging and other molding processes, allowing materials to be easily folded and formed, ensuring efficient and consistent indentation quality. Its flexibility and precision make it an ideal tool in packaging production and paper product processing.



3.2 Workbench and vacuum adsorption system

The work surface of the TRM series CNC Router is equipped with an efficient vacuum adsorption system, which is specially designed for precision machining, which can ensure that the material is stably and firmly fixed on the work surface during the processing process, effectively improving the accuracy and efficiency of cutting, engraving and other operations. The vacuum system consists of a high-performance vacuum table and a vacuum pump, which can adapt to the fixed needs of different types of materials, and is suitable for the processing of large and medium-sized plates and a variety of soft and hard materials.

Vacuum table design

- **Table size and adsorption area**: The vacuum table provides different specifications according to the equipment model, which is suitable for a variety of processing size needs
    - **TR48M**:4' x 8'(1300mm x 2500mm)
    - **TR510M**:5' x 10'(1530mm x 3060mm)

  Each model is equipped with multiple independent adsorption zones:

    - **TR48M**: 4 independent adsorption zones, adaptable to different material sizes and processing needs.
    - **TR510M**: 6 independent adsorption zones to ensure efficient fixation of large-format materials.
- **High wear resistant table top material**: The table top is made of high-quality phenolic resin composite panels, which have extremely high wear resistance and stability, can withstand long-term machining operations, and effectively resist mechanical damage during tool cutting. The table top is precision milled to ensure that the adsorption grid structure is evenly distributed, and the air flow is smooth, which enhances the adsorption effect.
- **Adsorption tank and T-groove design**: The vacuum table has a precision-milled grid-like adsorption tank structure, which can effectively direct the air flow to cover the entire processing area and ensure that the material fits snugly to the table. At the same time, the left and right sides of the table are also equipped with T-slot aluminum profiles, which are suitable for mechanical clamping of special materials and further improve the flexibility of material fixing.

High-performance vacuum pumps

The vacuum pump is the core component of the CNC Router vacuum system, providing strong adsorption force to ensure the stable fixation of various materials and avoid material displacement or loosening during processing. Depending on the processing needs, we offer two types of options: high-pressure air pump and dry vacuum pump.

- **Pumping rate**: The vacuum pump has an efficient pumping rate, which can adapt to the fixed needs of materials of different areas and thicknesses
    - **High-pressure air pump**: suitable for the adsorption of large-format materials, the flow rate can reach 200-300 m^3/h, to ensure that sufficient adsorption force is generated quickly.

    - **Dry vacuum pumps**: suitable for material adsorption for high-precision machining, with a flow range of 160-250 m³/h, suitable for processing small or complex materials.
- **Vacuum**:
  Vacuum pumps provide strong vacuum adsorption, with a typical vacuum range of -85 mbar to -95 mbar, ensuring that the material remains stable under high loads. This vacuum level can provide a stronger adsorption effect when cutting heavy or low-air tightness materials.
- **Power & Stability**:
  Vacuum pumps are available in a power range from 5.5 kW to 7.5 kW to meet different processing needs, ensuring efficient pumping and stable adsorption. The high power ensures continuous operation during long-term processing or high-volume production.
- **Noise Control & Maintenance**: The
  vacuum pump is equipped with a low-noise design that operates with a noise level of less than 75 dB, reducing the impact on the operating environment. The built-in self-cleaning filtration system effectively prevents dust and impurities from entering the pump body, extending equipment life and reducing maintenance frequency.

Vacuum system advantages and application scenarios

- **Precise material fixation**:
  The CNC Router vacuum system can ensure that the material does not shift during processing, especially suitable for high-precision processing such as cutting and engraving of large panel materials (such as wood, plastic, aluminum plate, etc.). Even in high-speed cutting and complex processes, the material is stable and the machining accuracy is ensured.
- **Adaptable to different materials**:
  Vacuum countertops and vacuum pumps can handle various types of materials, including hard materials with good air tightness (such as wood, acrylic sheet) and materials with low air tightness (such as foam, sponge, etc.). The system's multi-zone control capability allows for greater flexibility in fixing different sizes of materials on the same work surface.
- **Efficient production capacity**:
  Thanks to fast pumping and strong adsorption force, the vacuum system significantly reduces the set-up time of the work piece and increases the processing efficiency. In addition, the independent adsorption zone design allows for the simultaneous processing of different sizes and types of materials, making it suitable for high-volume, diverse production tasks.

3.3 Tool library

The TRM series is equipped with a 4-position in-line tool changer for the milling spindle and has a compact and efficient design that enables fast tool changes in limited spaces, significantly increasing machining efficiency. The Tool library is equipped with an automatic dust cover mechanism, which effectively prevents dust, chips and other impurities from entering the Tool library, ensuring that the tool is kept clean and prolonging its service life. When the system receives the tool change instruction, the Tool library will automatically stretch out to the working area for tool change operation, and the Tool library will be quickly retracted after the tool change is completed to avoid interference with the processing area. This design not only improves production efficiency, but also reduces the risk of equipment failure caused by environmental pollution, ensuring the stable operation of the system.

3.4 XYZ Linear Drive System

- **X/Y axis transmission**:
  The X/Y axis adopts a helical rack and pinion transmission system, which has excellent stability and high-efficiency transmission characteristics. The helical tooth design ensures high-

precision positioning control and smooth movement by optimizing the contact surface, reducing friction and noise, and is suitable for high-speed machining needs while maintaining machining accuracy.

- **Z-axis transmission**:
  The Z-axis adopts a ball screw structure to achieve high-precision vertical motion control. Ball screws provide excellent positioning accuracy and repeatability through a low-friction ball drive method, especially in scenarios where high Z-axis movement accuracy is required in fine machining.
- **Three-axis linear guide:**
  The X, Y, and Z axes all adopt a high-rigidity linear guide structure to ensure excellent stability and load capacity under high-speed movement. The linear guide effectively reduces the resistance and wear in motion, improves the overall dynamic response and machining accuracy of the machine, and prolongs the service life of the equipment.
- **Lubrication system**:
  Equipped with automatic pump oil lubrication system, it can lubricate key moving parts according to the set timing, ensure the long-lasting lubrication of ball screws and guide rails, and reduce friction and wear. It is recommended to use an ISO VG 32 to ISO VG 68 viscosity grade to ensure that the system maintains good lubrication and operating efficiency under different operating conditions. The system not only reduces the frequency of manual maintenance, but also improves the reliability and service life of the equipment.

3.5 Control Panel

- **Launch Control Button**:
  Used to turn on the power system of the CNC Router. Once this button is pressed, the device will go into standby and be ready to perform further operations
- **Emergency stop button**:
  The emergency stop button is an independent design, the emergency stop button is located in a conspicuous position, directly connected to the control system, once triggered, immediately cut off the power supply of the equipment, fully protect personnel and equipment, and avoid sudden failures or accidents.
- **Industrial computer control**:
  Equipped with high-performance industrial-grade computer, it supports real-time monitoring and operation, and the digital display screen clearly displays the real-time coordinates of the XYZ axis, spindle speed, processing status and operation mode, helping the operator to fully grasp the operation status of the equipment. The system interface is designed to be user-friendly, easy to operate, and has both functionality and ease of use.
- **Data transmission interface**:
  The device supports USB and Ethernet data transmission methods, and users can quickly and securely transfer G-code files to the device through USB storage devices or Ethernet networks, ensuring seamless connection with external systems and improving the flexibility and efficiency of data transmission.
- **Hand Controller:** The Hand Crank Controller is a hand-held operation box designed for CNC Router and hangs on the console for the operator to manually adjust and set up the machine. Its main function is the precise manual movement of the three axes (X, Y, Z), which helps the operator to easily set the origin and tool position of the machining.

3.6 Cooling System

The spindle motor of the TRM series CNC Router adopts a high-efficiency oil cooling system and is equipped with an industrial-grade automatic temperature control cooler, which can monitor and adjust

the coolant temperature in real time to ensure that the equipment maintains a stable temperature during long-term continuous operation, and prevent the spindle motor from degrading or damaging due to overheating. The cooling system is designed with extreme environmental conditions in mind, ensuring that the coolant does not freeze even when ambient temperatures are close to freezing or lower, ensuring that the machine continues to operate efficiently in a variety of operating environments.

- **Cooling oil viscosity requirements**: According to different working temperatures and load conditions, it is recommended to choose the appropriate cooling oil viscosity to ensure the cooling effect and the long-term stability of the system
    - **ISO VG 2:** is a very low viscosity lubricant with the following properties:

      1. Viscosity: The kinematic viscosity at 40°C is about 1.98 to 2.42 cSt, which is ideal for lubrication applications that require low resistance.

      2. Fluidity: Due to its low viscosity, ISO VG 2 has good fluidity and is suitable for the lubrication of precision equipment and small gaps, such as precision instruments, pneumatic tools, etc.

      3. Low temperature performance: It still maintains good fluidity at low temperature, and is suitable for use in low temperature environment.

      4. Heat dissipation capacity: The low viscosity makes it easy to flow, which can quickly dissipate heat and effectively reduce the heat accumulation generated by friction of the equipment.

      5. Uses: Mainly used for lubrication of light load, precision machinery and low friction and low temperature applications, such as microscopes, clocks and other precision instruments.

The system not only extends the service life of the spindle motor, but also greatly reduces the need for manual monitoring and maintenance, and improves the overall operational reliability of the equipment.

3.7 Vacuum system

Equipped with an efficient spindle-following dust collection system, the TRM-Series CNC Router is designed to be advanced and flexible, ensuring that chips and dust generated during machining are removed in a timely manner, keeping the working environment clean and tidy. The dust collection cover has an automatic lifting function, which can intelligently adjust the height according to the thickness and processing status of the processed material to ensure the best dust collection effect and reduce the impact of dust on cutting accuracy.

- **Dust collection interface**: The
  system integrates a standardized dust collection interface, which can be easily connected to an industrial vacuum cleaner or a central dust collection system. Whether it is a small workshop or a large production line, the equipment can efficiently cooperate with all kinds of dust removal equipment to ensure the cleanliness of the equipment working area, and effectively improve the processing quality and the stability of equipment operation. The suction system not only reduces dust interference on the processing surface, but also extends the maintenance interval of the equipment.

The dust collection system is an indispensable part of an efficient production process while ensuring precise cutting and providing a cleaner and safer working environment for the operator.

3.8 Compressed air handling systems

The TRM series CNC Router is equipped with a high-efficiency compressed air handling system to ensure that the compressed air used during the operation of the equipment is clean and stable, thereby improving the reliability and working life of the equipment. The system has a built-in compressed air processor, which can filter moisture and oil in the compressed air, preventing impurities from entering the pneumatic system and causing damage to the equipment. In order to ensure the long-term stable operation of the system, users need to regularly check and discharge the accumulated oil and water in the filter in time to avoid the impact on the performance of the system.

- **Air compression filtration**:
  The air service processor effectively filters moisture and oil in the air, ensures the purity of the compressed air, prevents the wear or blockage of the pneumatic parts by pollutants, and ensures the stable operation of the system.
- **Air pressure monitoring and alarm system**:
  Equipped with air pressure alarm, when the air pressure is lower than the preset safety value (usually 0.3Mpa or 43.5psi), the alarm will send out an alarm, and the machine will automatically stop to avoid unstable or damaged equipment operation caused by insufficient air pressure. The system provides an additional layer of safety to ensure that the equipment is stopped in time to avoid damage in the event of abnormal air pressure.
- **Optimization suggestion**:
  In order to further improve the quality of the air source, it is recommended to install an air dryer at the output end of the air compressor to remove the moisture in the compressed air more effectively, ensure the operation of the pneumatic system more stable and efficient, and prolong the service life of the equipment.

3.9 Electric control box

The electrical control box is designed to be placed at the rear of the machine, which is positioned to facilitate maintenance and overhaul while ensuring operational safety. All the key electrical components and control systems are integrated inside the electric control box, including the driver, frequency converter, PLC control unit and power module, which are carefully laid out to ensure the stable operation of the circuit. All electrical components comply with international standards to ensure long-term and efficient operation of the equipment.

- **Heat dissipation design**: The electric control box adopts an efficient heat dissipation design, equipped with an industrial-grade cooling fan and air circulation system to avoid overheating of electrical components due to long-term work, and ensure that the internal temperature of the electric control box is maintained within a safe range.
- **Safety protection**: The electric control box is equipped with overload protection, short circuit protection and voltage monitoring system to ensure that the equipment will automatically power off in the case of electrical failure or unstable voltage, prevent component damage and ensure the safety of operators.
- **Convenient maintenance**: The electric control box door is designed to be easy to open, and is equipped with clearly marked terminal blocks and component layout diagrams, which is convenient for technicians to carry out daily maintenance and overhaul work, and ensures that equipment troubleshooting is fast and efficient.

The design of the electric control box fully considers safety, stability and maintainability, and provides a reliable guarantee for the long-term stable operation of the equipment.

4. Equipment Installation

4.1 Installation Environment Requirements

- **Space**:
  To ensure proper operation and ease of operation, it is recommended that the workspace be kept sufficient.
  - TR48M: Requires a minimum of 16 ft x 10 ft (5 m x 3 m) of workspace.
  - TR510M: Requires a minimum of 20 ft x 13 ft (6 m x 4 m) of workspace.
    The sufficient space not only facilitates the operation and maintenance of the equipment, but also ensures the unobstructed operation of the processing area.
- **Power requirements**: The
  operation of the equipment requires a stable three-phase power supply (**single-phase power supply is a customized option**), the host 208-240V 50/60Hz 3-phase 30A (vacuum and dust collection system depends on the selected model specifications), it is recommended to ensure that the power supply is stable, In order to avoid the impact of voltage fluctuations on the operation of the equipment and prolong the service life of the equipment.
- **Air source requirements**: The
  equipment requires a compressed air supply of 0.6 - 0.8 MPa (87-116 psi) pressure and a flow rate of ≥85-140 L/min (3-5 CFM), and an air dryer is recommended; The stable compressed air system can ensure the normal operation of the pneumatic device and improve the processing efficiency.
- **Ventilation conditions**:
  The working area should be well ventilated to avoid the performance of the equipment due to overheating or poor air circulation. The ideal operating temperature range is 10-40°C (50-104°F), and humidity is recommended to be controlled at 40-60% to prevent excessive or low humidity from adversely affecting equipment and processing materials.
- **Ground requirements**:
  The equipment should be installed on a solid, level ground to ensure that the ground can effectively support the weight of the equipment and reduce vibration transmission. A smooth foundation helps to reduce mechanical vibration during operation, ensure machining accuracy, and improve machining quality.

4.2 Unpacking and assembly

(1) Unpacking inspection

- **Unboxing**: Carefully unpack the CNC Router and all accessories, using the appropriate tools to ensure that no damage is done to the equipment or accessories. Always inspect all outer packaging for visible signs of damage. If you find that the packaging is damaged or the equipment is damaged, contact the logistics company or supplier in time.
- **Check the status of your equipment**:
  After unpacking, check the list of equipment and accessories to make sure all parts are intact. Focus on checking key components (such as spindles, Tool librarys, control panels, linear guides, etc.) for damage or looseness during transportation. Any anomalies should be reported

as soon as they are recorded, ensuring that all issues are resolved before the device is in normal use.

- **Loosen the set screws**:
  The device is usually secured on a pallet for easy transport. Use the appropriate tools to loosen and remove the locking screws that connect the device to the pallet. Pay attention to maintaining the stability of the equipment to prevent the equipment from tipping over or other accidents due to the removal of screws.

(2) Assembly and positioning

- **Placing the device**:
  Remove the equipment from the pallet and carry it to the designated installation location with a forklift or other specialized handling tool. Please ensure that the installation area meets the requirements of the installation environment mentioned above, especially the requirements for working space, ground strength and flatness.
- **Install the** anchors:
  Install the adjustable anchor bolts of the device to the corresponding position of the base. Make sure that the corners of the device are evenly touched to the ground to achieve an initial stable state.
- **Adjust the level of the equipment**:
  Use a professional level to adjust the level of the equipment to ensure that the X, Y, and Z axes are all in a horizontal state. This is essential to ensure the machining accuracy of the equipment. By adjusting the anchor bolts, gradually adjust the levelness of the device until the device is completely level.
- **Fix the equipment**:
  Once the equipment is leveled, lock the anchor bolts to ensure that the equipment is firmly fixed on the ground to prevent the vibration during operation from affecting the machining accuracy. Check the robustness of the equipment to ensure that no displacement occurs during operation.

(3) Electrical and air source connection

- **Power Connection**:
  Securely connect the CNC Router to a 208-240V, 50/60Hz three-phase power supply using a cable that meets the requirements of the equipment. Ensure that the power wiring complies with national or local electrical standards and that power regulator equipment, circuit breakers, or other safety devices are properly installed. In areas where the supply voltage is unstable, it is recommended to use a voltage regulator to protect the equipment to avoid voltage fluctuations.
- **Compressed Air** Connection:
  Connect the compressed air system to the unit air connection to ensure that the compressed air pressure is in the range of 0.6 - 0.8 MPa (87-116 psi) and the flow rate reaches ≥ 85-140 L/min (3-5 CFM). Check that the connecting pipes and joints are well sealed to ensure that there are no air leaks. It is recommended to install an air dryer to ensure the cleanliness of the air source, so as to prolong the service life of the pneumatic parts of the equipment.
- **Cooling system connection**:
  If the unit has an oil cooling system, make sure the cooler is properly installed. Connect the inlet and outlet of the cooling system piping, add the appropriate cooling oil (ISO VG 2) and check the tightness of the cooling system piping. Confirm that the coolant can be circulated to ensure that the cooling system can effectively dissipate heat during machining and prevent the spindle from overheating.

- **Suction System Connection**:
  Connect the equipment suction interface to an industrial vacuum cleaner or central dust collection system to ensure that there are no blockages or air leaks in the dust collection pipes. Check that the suction system is working smoothly to ensure that chips and dust are sucked away in time during processing, thus keeping the work area clean and improving the precision of cutting and engraving.

5. Operating Instructions

5.1 Check before booting

Before starting the CNC Router, it is essential to carry out a comprehensive inspection to ensure that the equipment is operating safely and properly and to avoid possible failures or operational errors. Please complete the following checks carefully:

(1) Electrical system inspection

- Electrical Connections:
  Double-check that all electrical connections are firm and correct, and that the power, control, signal, and other relevant cables are intact. Any loose or damaged cable may result in electrical failure or damage to the equipment and must be repaired or replaced before turning it on.
- **Device Grounding**:
  Make sure the device is properly grounded. Poor grounding can lead to static build-up or electrical short circuits, which can damage equipment or endanger operator safety in severe cases. Use a multimeter to measure the ground resistance to ensure that the ground resistance meets the specifications.
- **Power supply stability**:
  Check whether the power supply voltage is stable, and confirm that the power supply voltage required by the device (208-220V, 50/60Hz, three-phase) is consistent with the on-site power supply. It is recommended to use a voltage regulator or UPS device to prevent voltage fluctuations from affecting the normal operation of the device.

(2) Cooling system inspection

- **Coolant level**:
  For CNC Router with water or oil cooling, check if the coolant level of the cooling system is within the normal range. Insufficient coolant can cause the spindle to overheat, shortening its service life. If necessary, replenish the appropriate amount of coolant or cooling oil (ISO VG 2) to ensure that the cooling system can circulate properly.
- **Cooling System Piping**: Check
  the cooling system's piping for leaks, blockages, or bends to ensure that the coolant passes through smoothly. If a leak or blockage is found in the pipe, it must be repaired before starting the machine to prevent cooling failure or overheating of the spindle.
- **Cooling pump operating status**:
  Confirm that the cooling pump is working properly and can provide sufficient flow to ensure the cooling effect. It is recommended to start the cooling system and observe the flow of coolant to ensure that there is no abnormality.

(3) Air source inspection

- **Air Stability**: Check
  that the compressed air pressure is within the range required by the equipment (0.6 - 0.8 MPa / 87-116 psi). Use the pressure gauge to confirm whether the air source provides sufficient air pressure to avoid affecting the pneumatic operation of the equipment (such as automatic tool change, pneumatic tools, etc.) due to insufficient air pressure.
- **Air source cleanliness**:
  Ensure that the air source is clean and free of impurities such as oil and moisture. Check that the air service processor is working properly and drain the water and oil from the filter in time. If necessary, in the use environment of high humidity, it is recommended to install an air dryer at the output end of the air compressor to further improve the quality of the air source and prevent damage to the pneumatic system of the equipment.

(4) Workbench and material inspection

- **Table Status**:
  Check the workbench for any foreign objects or obstructions to ensure that the processing area is clean and tidy. Any debris, tools, or materials left on the table may interfere with the machining process, resulting in tool damage or inaccurate work piece positioning.
- **Material clamping**: Confirm
  that the material to be processed is securely fixed. Depending on the size and shape of the material and the processing requirements, the material is fixed on the table using vacuum adsorption or mechanical fixtures. Check that the fixation is secure to avoid material movement during machining, which can cause cutting errors or damage to the tool.
- **Fixture status**:
  Check whether the fixture or adsorption system is intact to ensure that the fixture operation is smooth and the vacuum adsorption system can provide sufficient adsorption force. Clean up the adsorption area when necessary to avoid affecting the processing accuracy due to poor adsorption effect.

(5) Tool and spindle inspection

- **Tool Installation**: Check
  that the tool is properly mounted and securely fastened to the spindle. Loose knives can come off when rotating at high speeds, causing safety accidents or equipment damage.
- **Tool status**:
  check whether the tool is worn or damaged, and replace the tool in time if necessary to ensure cutting accuracy and machining surface quality.
- **Spindle status**:
  Check whether the spindle is running normally, and make sure that it rotates freely before starting, without blockage or abnormal sound. After the spindle is started, its operating status is monitored to ensure that there is no abnormal vibration or noise.

(6) Safety device inspection

- **Emergency stop button**:
  Check whether the emergency stop button is working properly to ensure that the operator can quickly stop the machine in an emergency to avoid accidents. Test the function of the emergency stop button and confirm that the device can stop working immediately after pressing it.

- **Guards**:
  Ensure that all safety guards on the equipment, such as protective covers, door locks, etc., are in normal working condition. Do not run the appliance with guards missing or damaged.

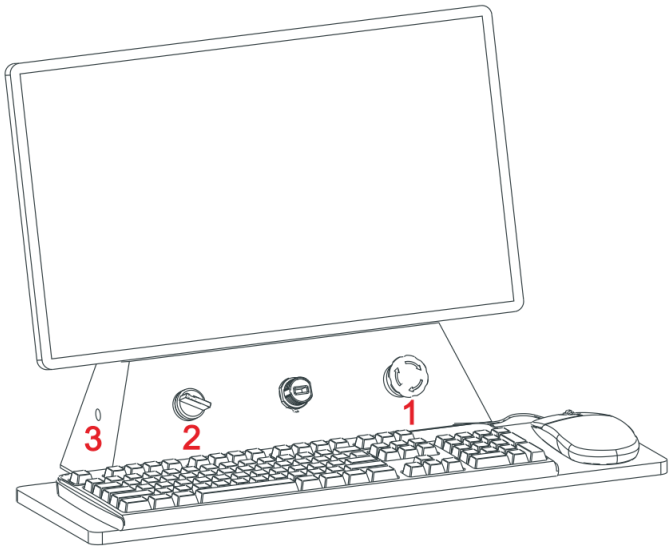
Vacuum system check

- **Suction connections and ducts**: Confirm
  that the suction system is connected and that there are no leaks or blockages in the suction ducts. Make sure the vacuum cleaner or central dust collection system is working properly to avoid dust and debris from the process from accumulating on the bench.
- **Dust collection system operating status**:
  Start the dust collection system to ensure that it can generate sufficient suction power during operation, maintain the cleanliness of the processing area, and reduce the impact of dust on the processing accuracy and equipment life.

5.2 Initial Setup

(1) Power on

- **Release the emergency stop switch 1**:
  Confirm that the emergency stop switch is in the released state and the device enters standby mode. Check that the E-STOP button is pressed, and if so, rotate it to release it to ensure that the device can start properly.
- **Turn on the power of the device 2**:
  Turn on the start switch to make sure the power indicator is on and the device is powered on normally. After the device is powered on, wait for the system to perform a self-test to ensure that there are no alarm prompts or abnormal conditions.
- **Start Control PC 3**:
  Turn on the power of the control PC. Start the CNC control software. Confirm that the communication between the computer and the device is normal, and after the software is loaded, check the device status to ensure that all connections are normal and there are no error messages.

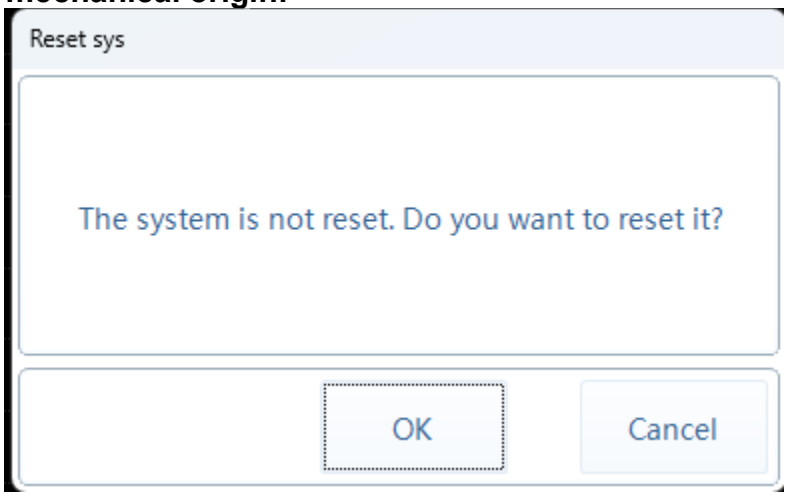


(2) Software startup

- Click to start the CNC control software iCut; Confirm that the communication between the computer and the device is normal, and after the software is loaded, check the device status to ensure that all connections are normal and there are no error messages.

(3) Zero operation: move the machine to the mechanical origin position (X0, Y0, Z0)

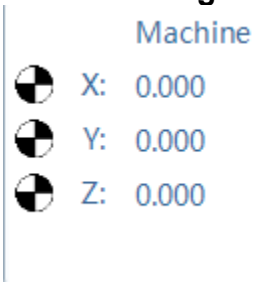
- **After opening the control software, the software will pop up a prompt box, press "OK" to return to the mechanical origin:**



- **You can also press "**  **" to return to the mechanical origin:**

- **When all mechanical coordinate values are displayed as "0", and "" is displayed before the**

coordinates  **, it means that the mechanical origin has been returned.**



5.3 tool installation instructions (tool number T0 represents the use of soft material cutting head, T1-T4 represents the four tool numbers of the milling cutter spindle Tool library).

(1) Description of the tools used for the installation of the milling cutter spindle tool:

As shown in the figure: 1 cutter 2 collet 3 high-speed tool holder 4 special wrench 5 tool clamping bracket

(2) Milling cutter spindle cutter installation steps and methods (as shown in figure):

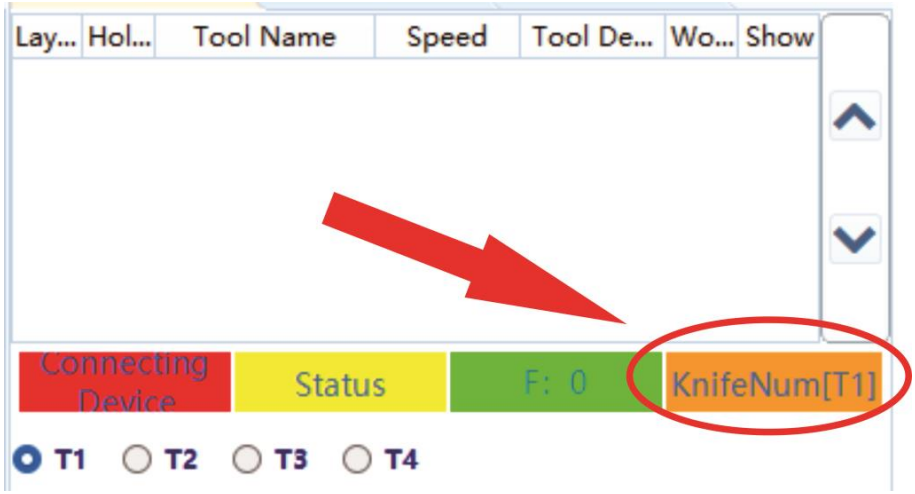
I. **Install the collet 2 into the nut 3**:
Gently insert the collet 2 into the nut 3 of the high-speed tool holder, and ensure that the collet is correctly snapped into the card slot of the nut and is stably fixed.

II. **Insert the tool**:
Put the tool 1 into the collet 2, and note that the blade part cannot enter the collet. To ensure stability, the tool should be loaded into the collet as deep as possible, but the appropriate cutting length must be allowed to avoid unstable clamping or over-extension.

III. **Locking cutter**:
the high-speed tool holder that is equipped with cutter is placed on the cutter clamping bracket 5, and the nut is tightened clockwise with a special wrench 4, and the cutter is guaranteed to be firmly locked. Check whether the tool is firm and not loose to ensure safety and cutting accuracy.

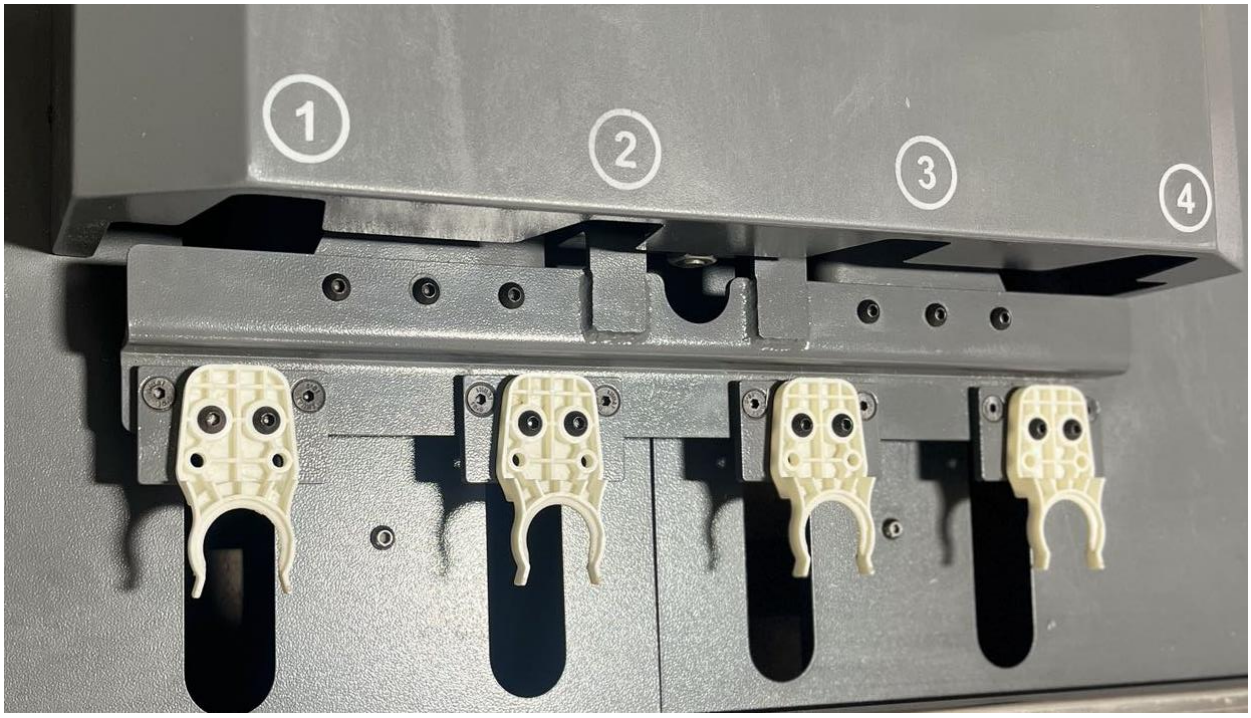
IV. **Cutter warehousing: the tool holder 3 that is loaded with cutter is installed on the row Tool library according to the required order**

- If the control system screen shows that the current tool number is T0 **(note: the displayed tool number is the last tool number used in the last machining is T0),** you need to put all the tools T1-T4 into the corresponding position of the Tool library in the machining order

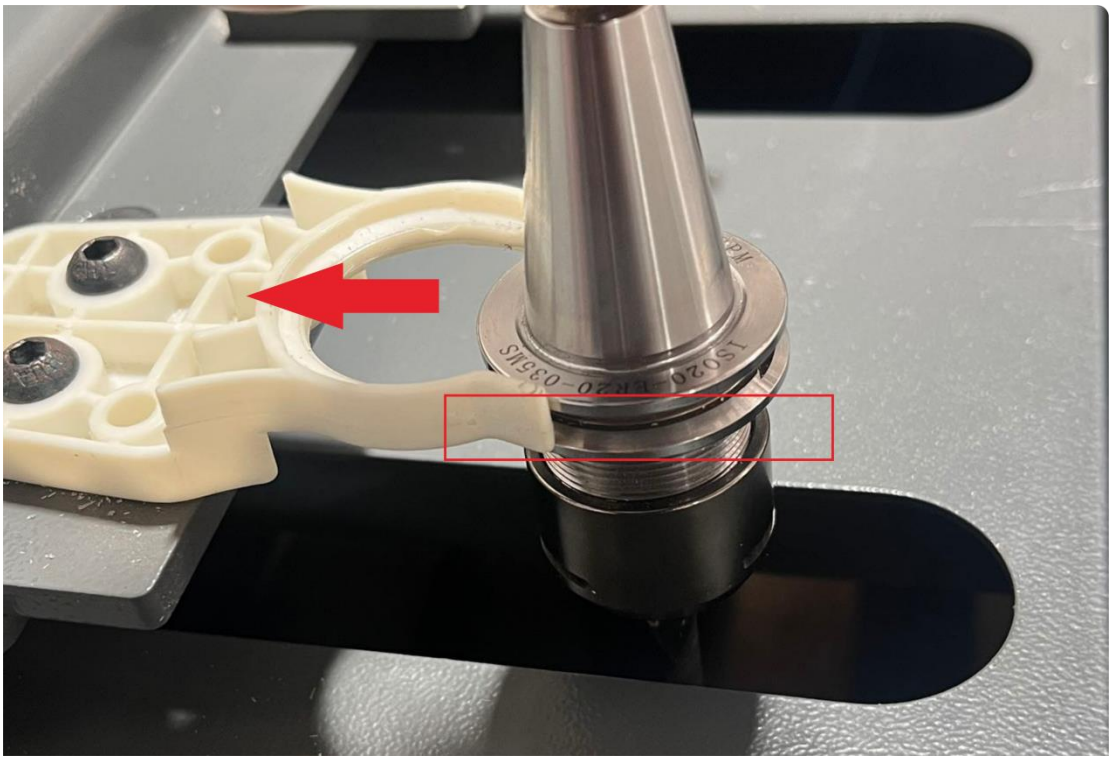


Press the magazine button Tool Library Launch to extend the magazine

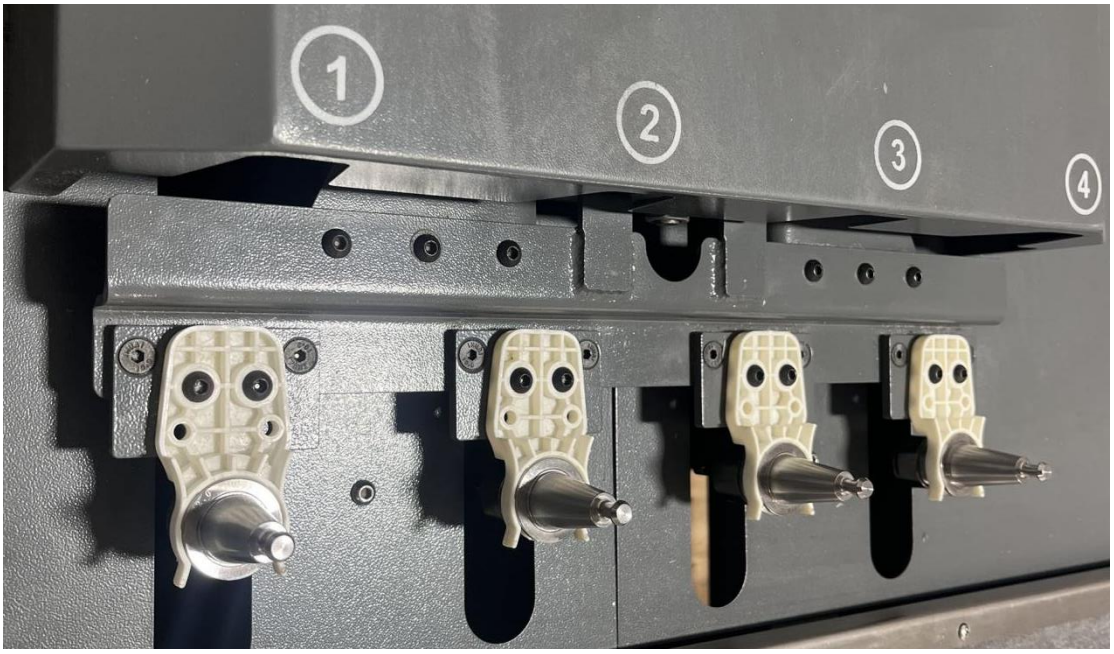

Common
Zone adsorption
Nesting
Lay...
Hol...
Tool Name
Speed
Tool De...
Wo...
Show
Status
F: 0
KnifeNum[T1]
T1
T2
T3
T4
Continue
Hand wheel
0.01
0.1
1
10
100
L
Process selected graphics
G Code
Hand wheel guide
Feed
100%
3000
Idle
100%
20000
Spin
100%
24000
Run
Pause
Stop
New Origin
Go Origin
Frame
Reset
Send
Spindle
冷却
X->0
Y->0
Z->0
Tool Library Launch
Cylinder



Place the shank into the tool holder (the groove position of the shank corresponds to the convex position of the tool holder)

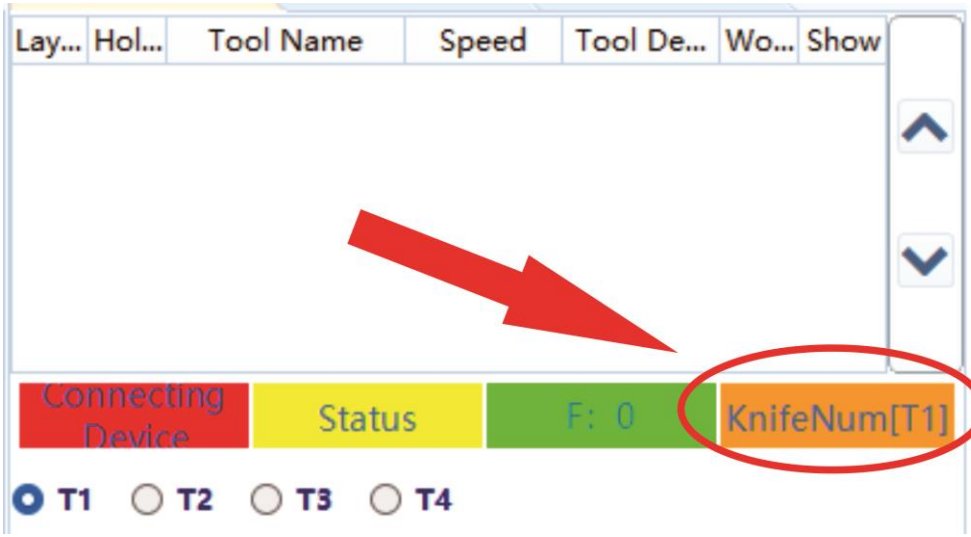


As shown in the figure, install the tool holder on the Tool library



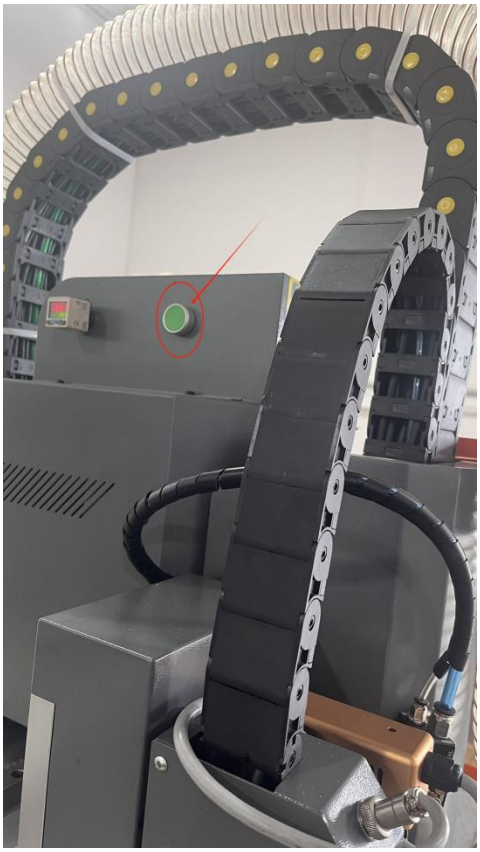
Press the Tool library button on the control system screen to Tool Library Launch retract the Tool library, as shown in the figure

- If the control system screen shows that the current tool number is one of the tool numbers in T1-T4, as shown in the figure T1 (note: the last tool number used in the last machining is T1), then be sure to install the T1 tool holder into the spindle taper.



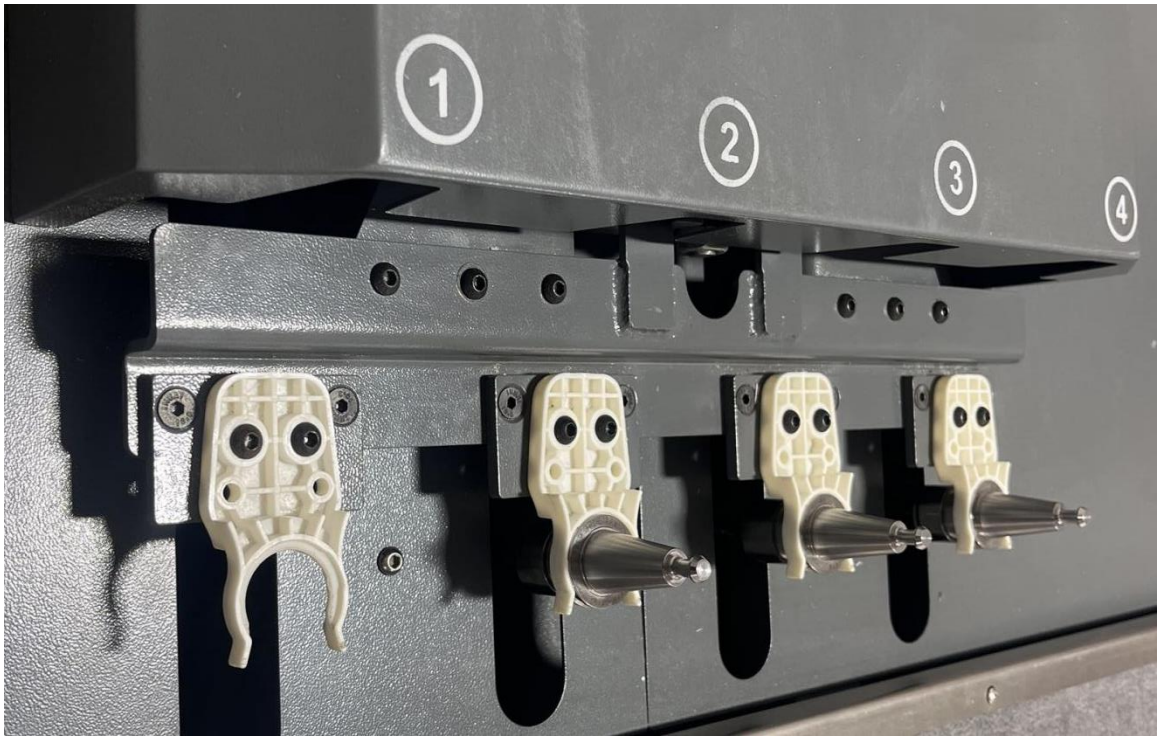
As shown in the figure, gently place the shank into the spindle taper

Press the green button at the upper end of the spindle unit to tighten the pneumatic chuck in the spindle taper··



Release the green button, the pneumatic chuck in the spindle taper hole automatically locks the tool holder, and the tool holder can be manually rotated to check whether the tool holder is tightened

Note: The tool number installed on the spindle cannot be placed in the position of the tool number corresponding to the tool number in the Tool library (the control screen shows that the current tool is T1, that is, the tool cannot be placed in the No. 1 tool position in the Tool library).



(3) Automatic tool setting:

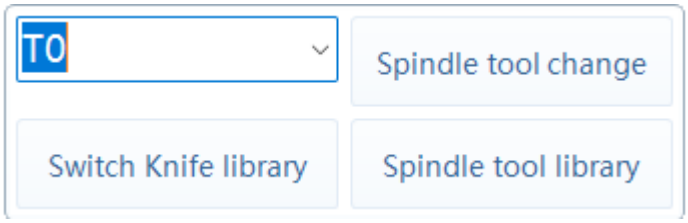
After the tool is installed, the automatic tool setting function is activated

- Make sure that the CNC Router's tool setter is in working order and that it is properly connected to the system.

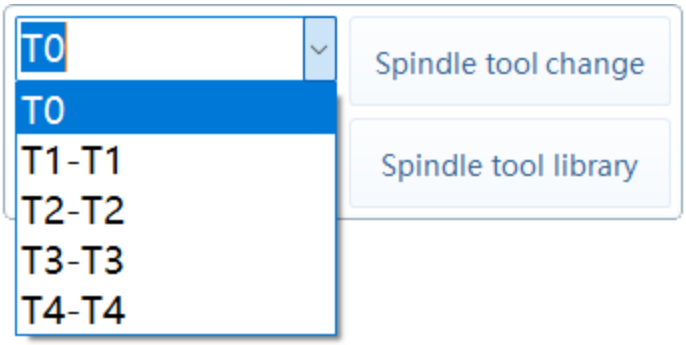
The control interface of the tool setting function is in 

the menu

- Select a tool:

In the 

selection tool, select T1-T4 tools (the system screen shows T0, which means that there is no tool on the milling cutter spindle, T1-T4 are optional).

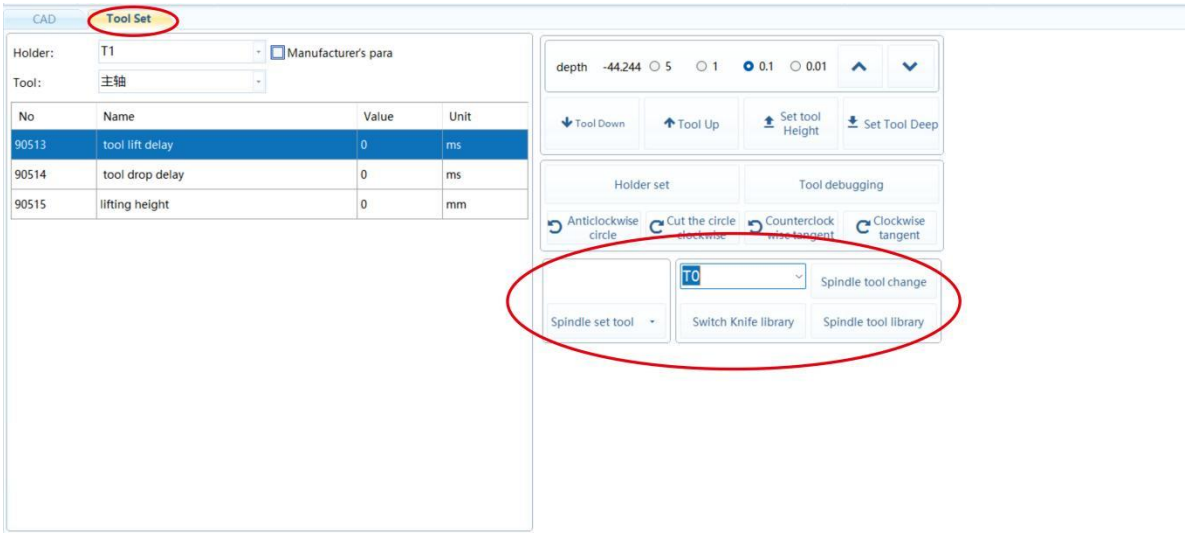


Press Spindle tool change, the system will perform an automatic tool change action, and the spindle will automatically grab the selected tool.

- After the automatic tool change is complete, select "Automatic tool set" Spindle set tool function, the spindle automatically moves to the position of the tool setter for automatic tool setting.
- Start the automatic tool setting program and the system will slowly lower the tool to contact the tool setting meter face.
- When the tool setter detects that the tool is touching, the system automatically records the Z-axis height value of the tool and stores this information in the system as the Z-axis origin position of the current tool.

Automatic Homing:

- Once the tool setting is complete, the system automatically moves the spindle back to a safe position or standby in preparation for subsequent machining operations.

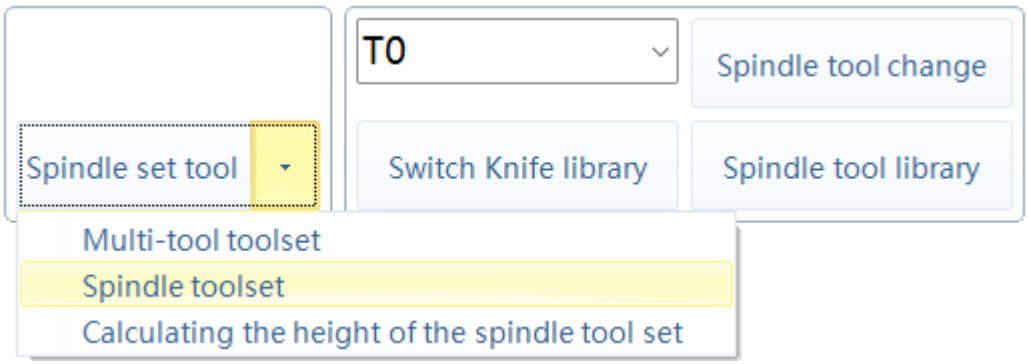


- Tool setting sequence: select tool - automatic tool change - automatic tool setting.

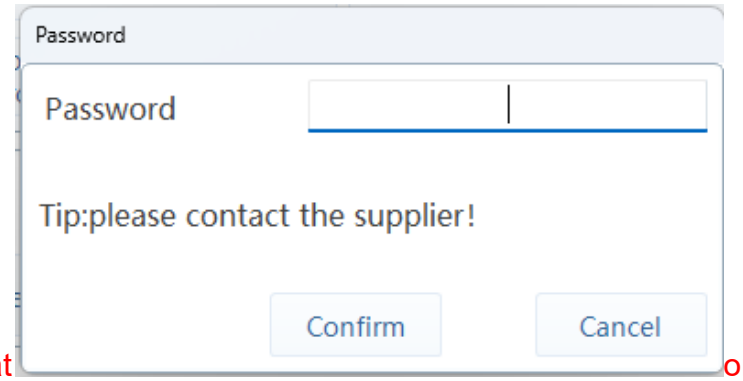
- Repeat this action to set the T1-T4 tools in turn

(4) Calibration of the position of the tool setter:

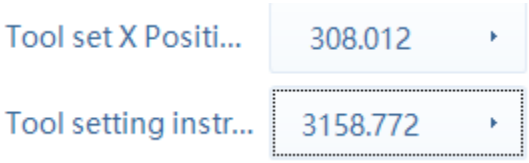
- When the factory setting, the position of the tool setter has been calibrated, if it is found that the tip of the tool and the position of the tool setter deviate from the position of the tool setter when the tool is set up automatically, the position of the tool setter can be calibrated;



- at middle
- choose Spindle toolset .



- at on your Mac, enter the password "1992"
- Set the X and Y position coordinates of the tool setter to ensure that the tool center is aligned with the tool setter.



(5) Instructions for the installation tool of the cutting head blade:

As shown in the figure: 1 vibrating blade and 2 hex wrench

1 2

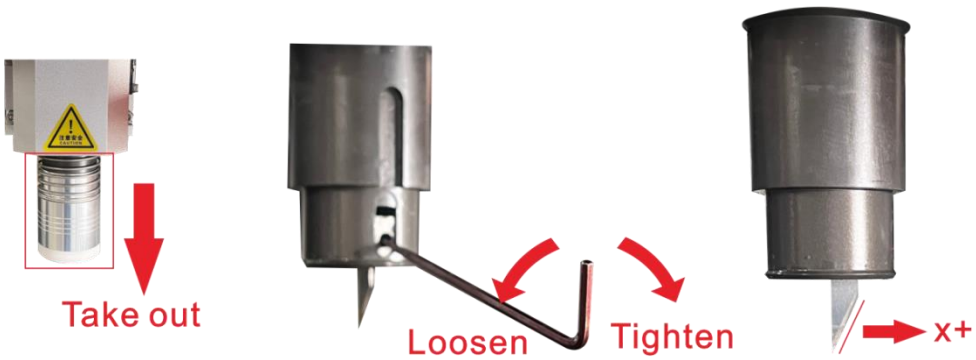
(6) Installation method of cutting head blade (as shown in figure):

I. **Remove the Cutting Head Cover**:
Carefully remove the cover of the cutting head downwards to ensure that it is unobstructed and placed in a safe location to prevent damage or loss.

II. **Insert the blade**:
Insert the vibrating blade into the cutting head while ensuring that the cutting head is at the mechanical origin. Note that the blade should be facing the X+ direction, making sure the blades are properly aligned and securely inserted into the cutting head.

III. **Locking the set screws**:
Use a hex wrench to rotate clockwise to tighten the set screws on the cutting head. Make sure the screws are tightened until the blades are secure and not loose, but avoid over tightening them to prevent damage to the screws or blades.

IV. **Reinstall the cutting head cover**:
After confirming that the blade is properly installed and secure, carefully replace the cover back on the cutting head, making sure it is securely stuck to prevent the blade from being exposed and ensure safe operation.



(7) The method of cutting the blade

The automatic tool setting instrument is not suitable for the knife setting of cutting blades, the following are the detailed steps of manual tool setting of cutting blades to ensure that the blades are accurately aligned with the material to ensure machining accuracy.

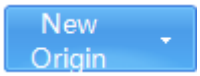
Prepare for knife pairing

Check the condition of the blade: Make sure that the blade is not damaged or worn in any way, and that the blade is sharp and in good condition. Make sure the vibrating blade is suitable for the current material for the best cutting results.

Move the cutter to the knife setting position

Manual movement to the tool setting position:

- Using the hand crank controller or control screen operating software, move the cutting head above the origin position of the material processing area.
- By manually fine-tuning the X and Y axes, ensure that the center of the insert is aligned with the material origin of the machining design (the material origin is usually located in the lower left corner, lower right corner or the center of the material, and this position is set according to the actual machining needs).

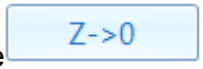
Set XY Axis Origin: When the center of the insert is aligned with the material origin of the machining design, press the "Set X,Y Axis Origin" button on the control interface 

to set the current X,Y axis work coordinate position to zero. In this case, the origin of the X and Y axes is successfully set.

Adjust the Z-axis position: Manually control the Z-axis and slowly lower the vibrating blade so that it is close to the surface of the material (or close to the surface of the table according to the parameter requirements set by the G-file). Adjust carefully to ensure that the blade remains stable as it moves down and that the blade does not hit the material surface (or countertop surface) too quickly.

Sets the Z-axis origin

Manually set the Z-axis:

- Touch the surface of the material (or the surface of the countertop): Slowly adjust the Z-axis with the hand crank controller until the blade gently touches the surface of the material (or the surface of the countertop). Make sure the blade is in light contact with the surface of the material (or the surface of the countertop) and not cutting into the material (or the surface of the countertop), maintaining the precise height of the Z-axis.
- Set Z-Axis Origin: When the blade touches the material surface (or table surface), press the "Set Z-Axis Origin" button on the control interface 

to set the current Z-axis work coordinate position to zero. At this point, the Z-axis origin is successfully set.

Confirm the tool setting result

Check the Z-axis height: After completing the tool setting, check the Z-axis working coordinate display in the control software to make sure that the Z-axis is set to "0.000". If the display is correct, the Z-axis origin is set successfully.

Test cutting: It is recommended to perform a test cutting before formal processing to check whether the cutting depth is consistent with the design requirements. Test cut can help confirm that the Z-axis origin is set correctly. If a problem is found, readjust and align the knife.

Prepare for machining after tool setting

Save tool setups: If you are using the same material and tool for multiple machining, it is recommended to save the current Z-axis origin settings to avoid having to re-set the tool settings each time, saving time and ensuring consistency.

Confirm the machining path: Before starting the formal machining, check the cutting path in the G-code to ensure that it is aligned with the material and design file to avoid deviations during machining.

Precautions

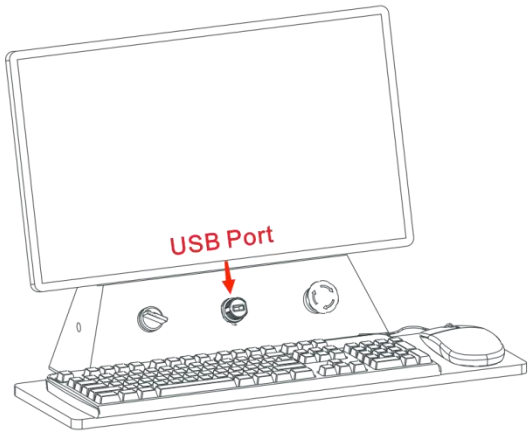
- Check the condition of the blade regularly: Check the condition of the blade before each machining or tool setting to ensure that the blade is sharp and undamaged. If the blade is severely worn, it should be replaced in time to ensure cutting accuracy.
- Precise tool setting: After each blade or material change, the tool must be manually set again to ensure that the Z-axis height is correct to prevent inaccurate cutting depth.
- Avoid multiple contacts with the surface of the material: When setting the tool, avoid repeated contact with the surface of the material to prevent damage to the accuracy of the knife setting or damage to the blade.

5.4 Load the G-code file

(1) Transfer files via USB or Ethernet

To transfer files via USB:

- **Save the file to a USB flash drive**:
  Use the CAM software on your computer to generate the required processing file and save the file in a format supported by the device (such as G-code or NC file). Make sure the files are properly named and stored in the root directory of the USB flash drive or in a folder that is easy to find.
- **Insert the USB flash drive**:
  Insert the USB flash drive into the USB port of the CNC Router (as shown in the figure) to ensure that the USB flash drive connection is stable. Wait for the device to recognize the USB flash drive, and there will usually be a prompt or show that it is connected.
- **Read the file**:
  Through the device's control panel or operating software, go to the "File Management" or "File Transfer" menu, and select the USB device as the file source. Browse the files in the USB flash drive, find the required processing file, select it, load it into the device memory or call it directly for processing.
- **Safely remove the USB flash drive**:
  After the file is successfully loaded to the device, confirm that the USB flash drive file is no longer in use, and use the "Secure Removal" function on the device to safely unplug the USB flash drive to prevent file damage or data loss.



(2) Set up a shared folder over a local area network (LAN) to transfer files

Step 1: Set up a shared folder on your primary computer

I. **Select the folder you want to share**:
   a. Open File Explorer and find the folder you want to share.
   b. Right-click the folder and select Properties.
   c. **Enable folder sharing**:
   d. In the properties window, click the "Share" tab.
   e. Click the "Share" button to enter the sharing settings interface.

II. **Select Users**:
   a. In the pop-up window, select the user who is sharing permissions.
   b. If you want all LAN users to be able to access, select "Everyone".
   c. Click the Permission drop-down menu on the right to set sharing permissions
      i. **Read**: Other users can only view the file and cannot change it.
      ii. **Read/Write**: Other users can view, modify, and delete files.
   d. Once the settings are complete, click on the "Share" button.

III. **View Network Path**:
   a. When you're done setting up the sharing, you'll see the network path to the shared folder (for example: \YourComputerName\SharedFolder).
   b. Make a note of this path to use later for other computers to access the shared file.

IV. **Set advanced sharing permissions (optional):**
   a. For more granular permission control, in the "Sharing" tab, click "Advanced Sharing".
   b. Select "Share this folder" and use the "Permissions" button to set the access rights of specific users to allow or restrict them from reading and modifying files.

Step 2: Review your network discovery and file sharing settings

I. **Open the Network and Sharing Center**:
   a. Open the Control Panel and go to the Network and Sharing Center.
   b. Click "Change advanced sharing settings" on the left.

II. **Enable network discovery and file sharing**:
   a. Make sure that the "Enable Network Discovery" and "Enable File and Printer Sharing" options are selected.
   b. This will allow other devices on your LAN to discover and access your shared folders.

III. **Set up password-protected sharing**:
   a. **Enable password-protected sharing**: Keep this option enabled if you want only users who know the username and password to access the shared folder.
   b. **Turn off password-protected sharing**: If you want all LAN users to be able to access without a password, select Turn off password-protected sharing.

Step 3: Access the shared folder on your second computer

I. **Open File Explorer**:
   a. On the second computer, press **Win + E** to open File Explorer.
II. **Enter the network path**:
   a. In the address bar of File Explorer, enter the network path to the shared folder on your primary computer (for example: \YourComputerName\SharedFolder) and press Enter.
III. **Enter your username and password (if password-protected sharing is enabled).**
   a. If password-protected sharing is enabled, you'll be prompted to enter the username and password for the primary computer. Once you enter your credentials, you will be able to access the shared folder.
IV. **Map network drives (optional):**
   a. For easy access in the future, you can map shared folders to local drives.
   b. In File Explorer, click This PC, and then select Map Network Drives.
   c. Select a drive letter (e.g. Z:) and enter the path to the shared folder (\YourComputerName\SharedFolder).
   d. Click "Done" and the shared folder will appear as a virtual disk for quick access.

Precautions

- **Make sure both computers are connected to the same LAN**:
  Both computers sharing a folder must be on the same LAN (for example, connected to the same Wi-Fi network or connected via Ethernet).
- **Check shared permissions**:
  If you're having permission issues accessing them, check the Security tab of the shared folder to make sure that Read or Modify permissions are granted to Everyone or a specific user.

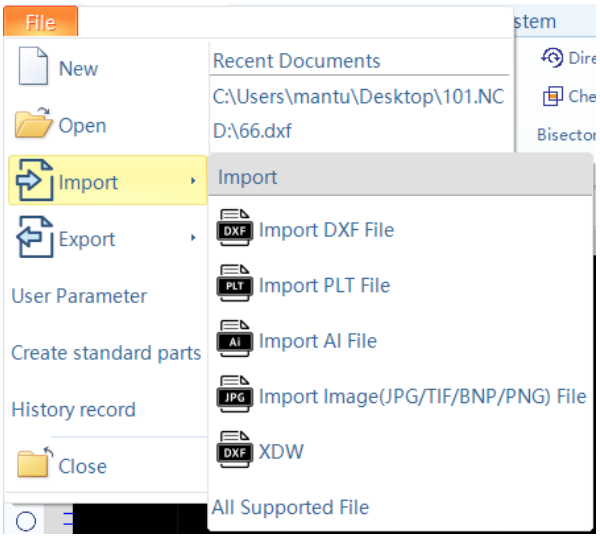
5.5 Loading vector graphics file processing (suitable for simple processing graphics that do not generate G-code documents through CAM software)

(1) Load vector graphics files:

- Open the control software 

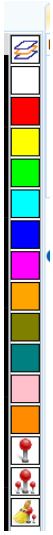
.
- Select the File or Import option from the main menu, then browse and load the supported vector graphics file types (e.g., **.dxf**, **.ai**, **.plt** etc.).

- Make sure that the vector graphics file is a 2D design and contains the paths or outlines to be machined. Check that the file format is imported correctly and that the graphics are displayed properly.

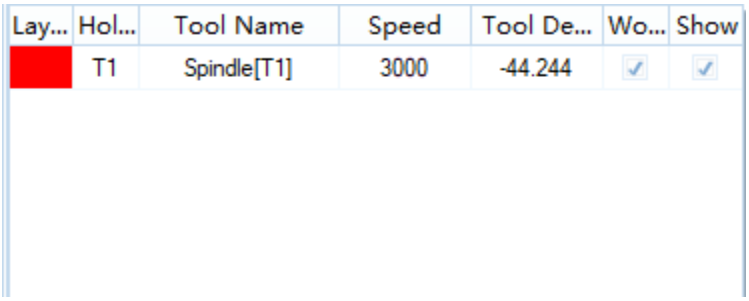


(2) Layer management:

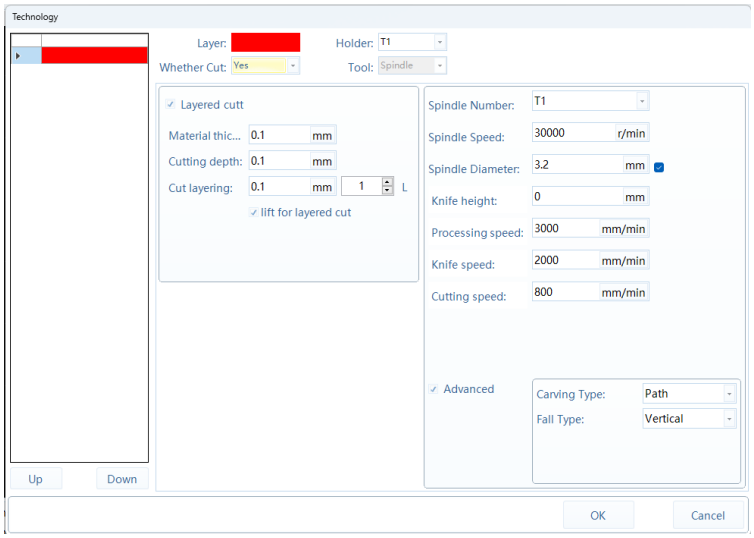
- Layer management is key to controlling different machining operations. Open the Layers or Layer Management panel in your control software to view the layer settings for the current drawing.
- Depending on the processing needs, different operations (such as cutting, engraving, drilling, etc.) can be assigned to different layers. Different layers can represent different processing steps, making it easy to set machining parameters independently.



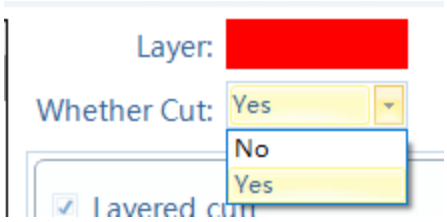
(3) **Set layer properties**:



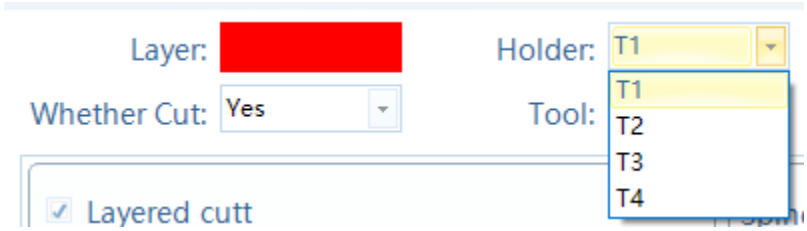
- Colors are used to distinguish between different layers, making it easy to identify individual processing steps.
- Check whether the processing order of the layers is reasonable. In general, the engraving or marking layer should be finished before cutting the layer to ensure that the material does not move after the cut is complete.
- Adjust the priority of the layer to ensure that the machining process is as expected and avoid machining failures due to sequence errors.
- Set the corresponding machining properties for each layer, including tool type, cutting depth, feed rate, and so on
- You can set different machining sequences or cutting directions for specific layers to ensure that machining operations are performed in the expected order.



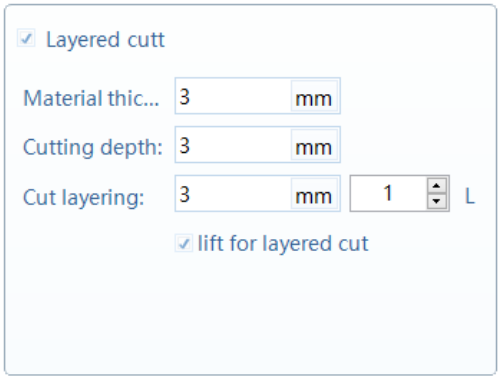
- Whether Cut: Specifies whether the layer is processed.



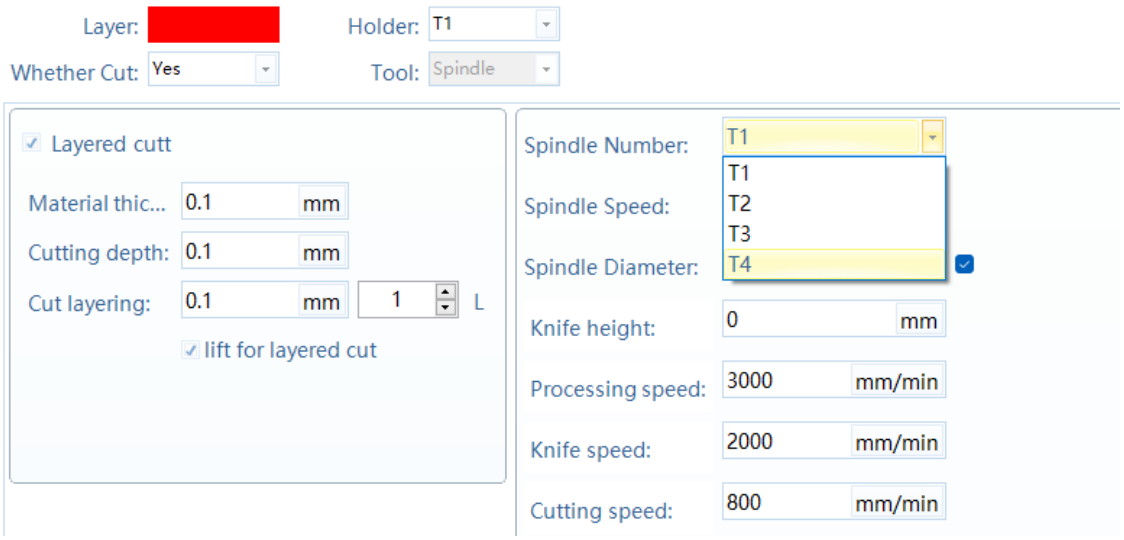
- Holder: Select the machining axis (T1: spindle, T2: vibrating knife, T3: drag knife, T4: red light).



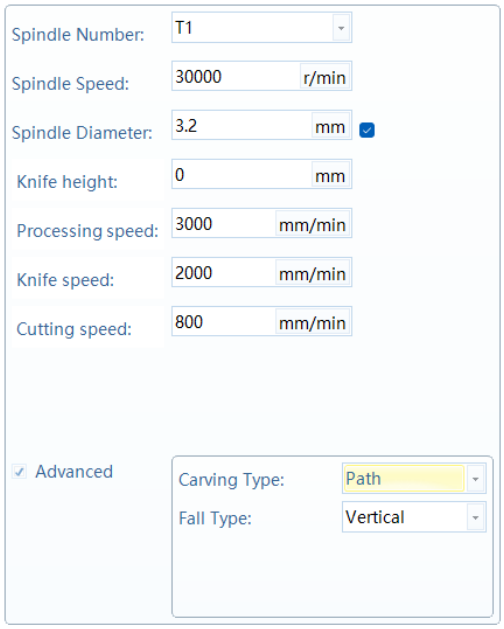
- Material Thickness: Sets the thickness of the material to be processed.
- Cutting depth: Sets the total machining depth.
- Cut layering: Sets the depth of each machining.
- L: Number of processing layers.



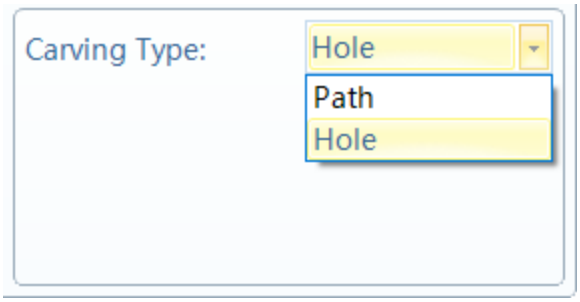
- Spindle Number: When the spindle is selected, the machining tool number (T1-T4: spindle 1-4 tools).



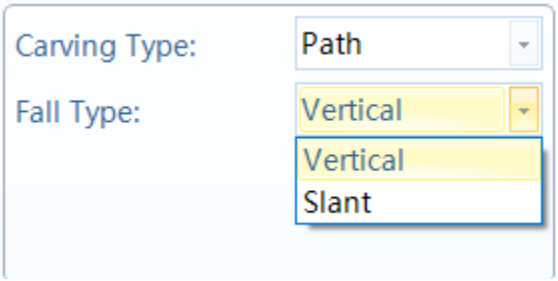
- Spindle Speed:
- Spindle Diameter: The diameter of the tool (needs to be checked to take effect).
- Knife height:
- Processing speed:
- Knife speed:
- Cutting speed:



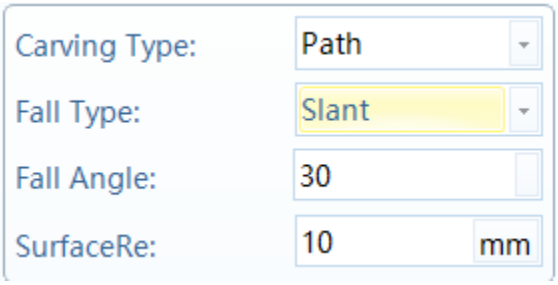
- Carving Type: Set the cutting method when selecting machining (hole: vertical cutting, path: cutting according to the setting method)

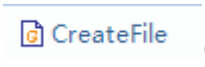


- Fall Type: Set the type of cutting when selecting machining (vertical: vertical cutting, slant: cutting at the set angle)



- Fall Angle: Sets the angle at which the knife is dropped, Surface Re: Sets the distance from the material when the tool is dropped.



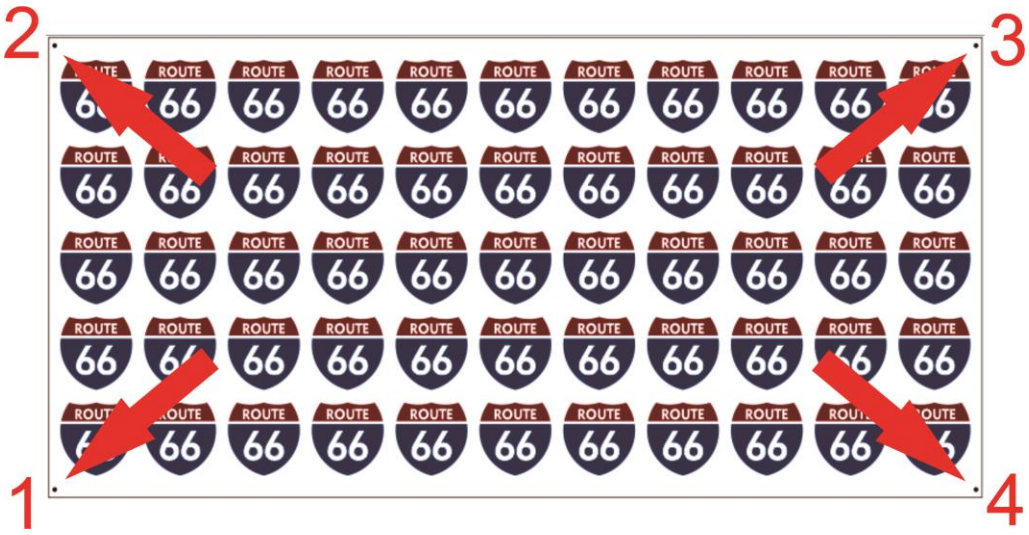
（4） Press 

Create to load the G-code file.

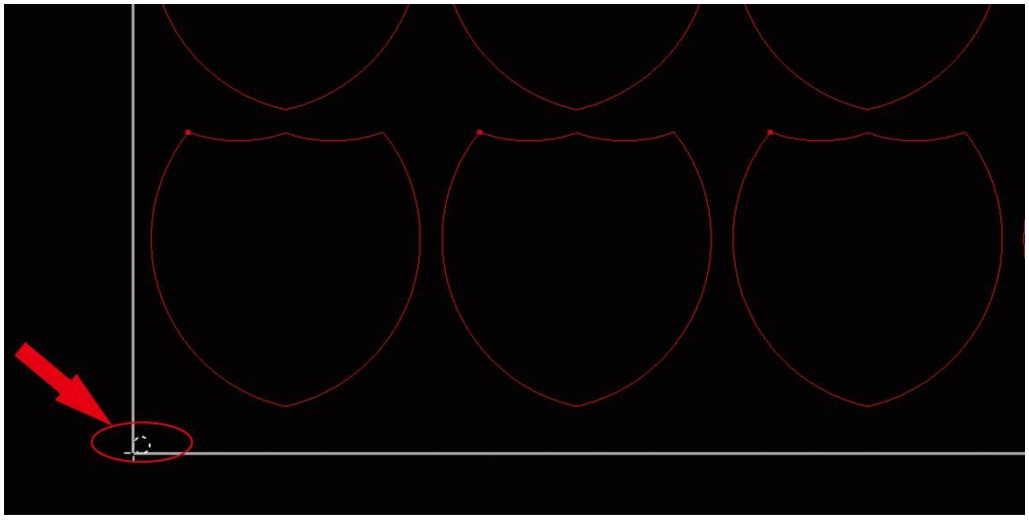
- CCD machining

（1） Set the Mark point:

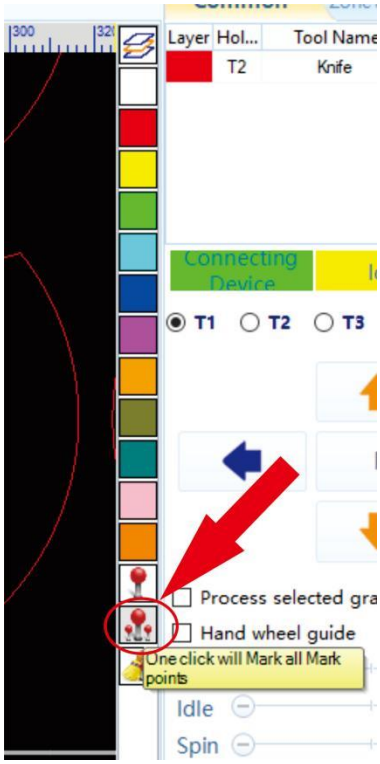
- The Mark is a circle, and 4 Mark points are required to be drawn in the print file and cut the file at the same time.



- Select the Mark dot in the lower left corner:



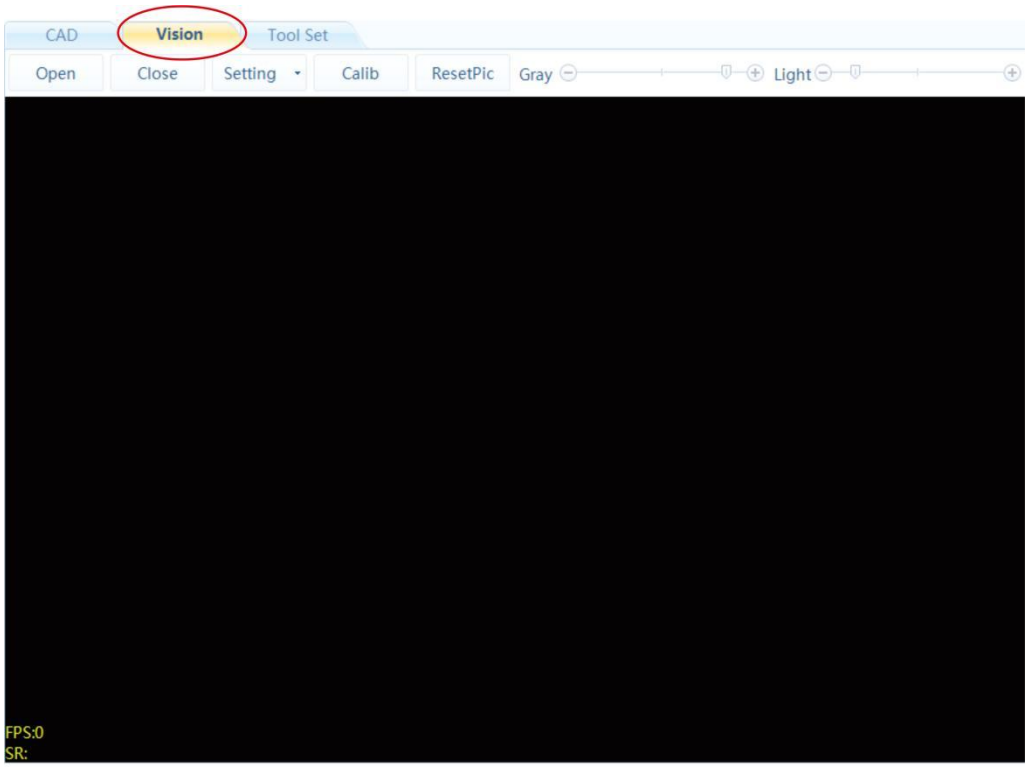
- 选择“  ”One click will Mark all Mark points，完成 Mark 点设置：



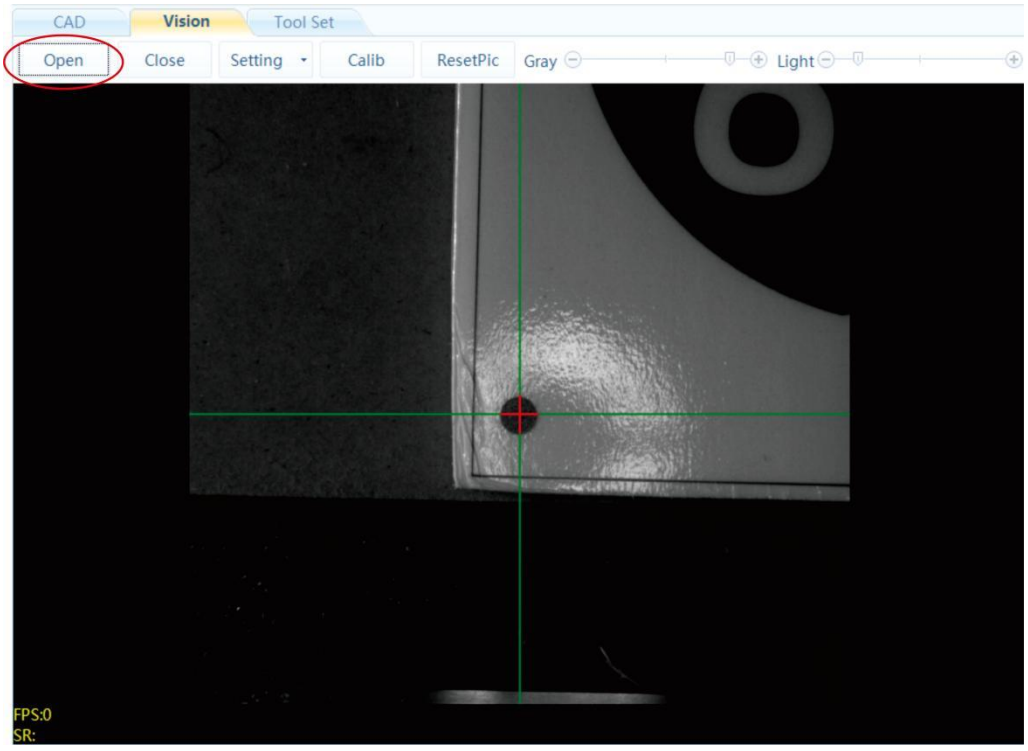
- The Mark point is set, and M1-M4 is displayed:

（2） Set up the vision:

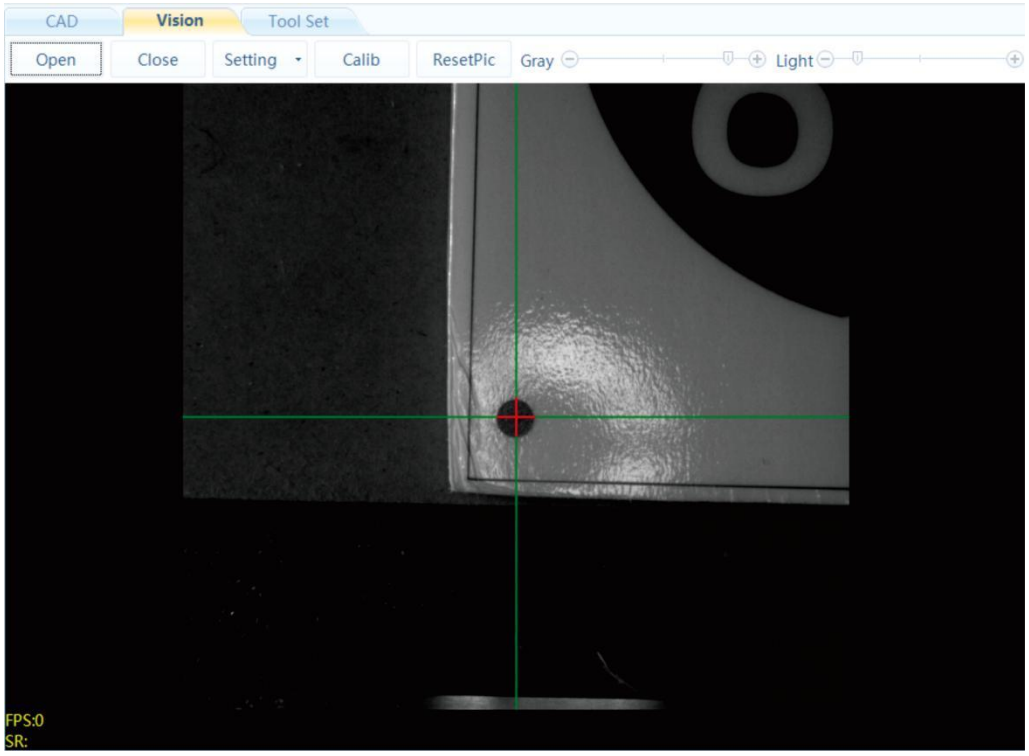
- Press "Vision" to open the visual interface:

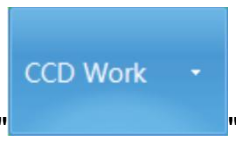


- Press "Open" to turn on the camera:

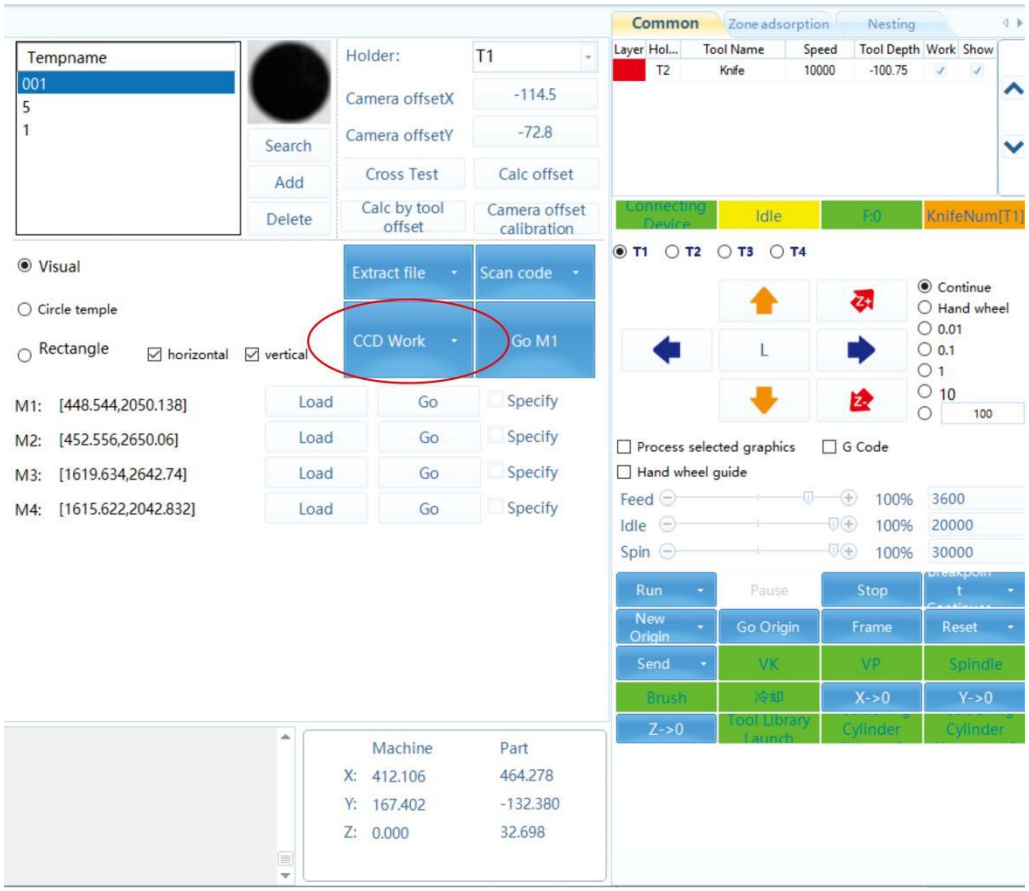


- Move the camera lens to the Mark point in the lower left corner and align it at:

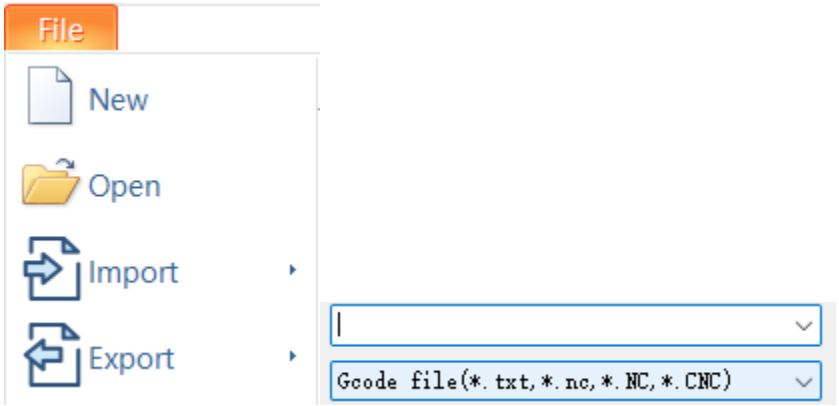


（3） Press " 

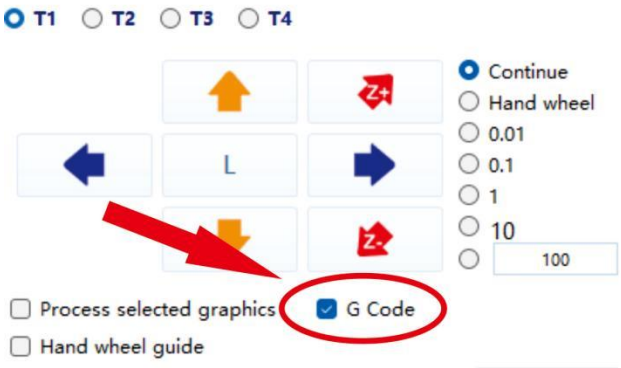
" to process:



5.6 Loading G-code file processing (generating G-code document by CAM software)



- Tick G Code



- **Preview the file path in the control software, confirm that it is correct, and load** CreateFile **the program**

5.7Set the origin position of the material (X0, Y0, Z0) to ensure accurate machining

In order to ensure the machining accuracy of the CNC Router, the origin position of the material must be set accurately. Here are the detailed steps:

(1) Set the coordinates of the work origin

Move the spindle to the origin position of the material processing:

- Depending on the settings in the machining file, the spindle is moved to the predetermined machining origin of the material by the hand crank controller or using the "manual movement" function of the control software. This point is usually the bottom left, right, or center of the material, depending on the machining design.
- Use the keyboard or the arrow keys on the control panel to adjust the position of the spindle respectively to ensure accurate positioning of the X, Y, and Z axes.

Set the working origin of the X-axis:

- When the X axis of the spindle has been moved to the desired position, press the "**Set X Axis Origin** X->0 " button (usually labeled "X0"). In this case, the X-axis coordinate will be reset to "0", indicating that the machining origin of the X-axis has been determined.

Set the working origin of the Y axis:

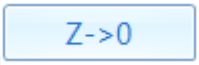
- Repeat the operation to move the Y axis of the spindle to the correct position.
- Press the "**Set Y-Axis Origin** Y->0 " button (marked "Y0"), the Y-axis coordinates are reset to "0", and the Y-axis machining origin is determined.

Set the working origin of the X and Y axes at the same time:

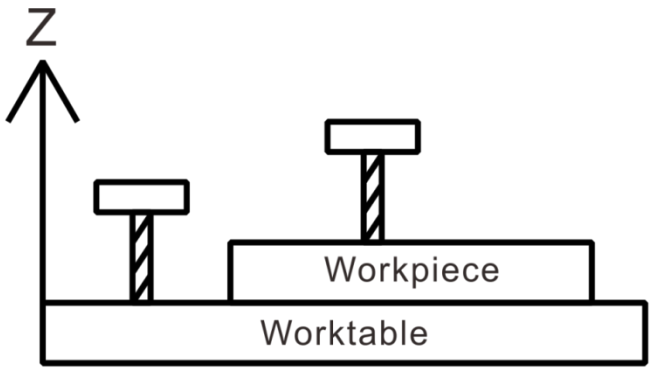
- If you need to set the X and Y axis origins at the same time, move the spindle to the intersection of X and Y, and then press the "**Set X/Y Axis Origin** New Origin " button. In this

case, the coordinates of X and Y are set to "0", which means that the point is the common origin of X and Y.

Set the working origin of the Z axis:

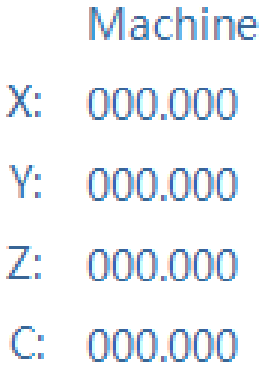
- Manually move the Z-axis downward, and make the cutter touch the surface of the material or the surface of the workbench according to the machining origin position of the processing file (when the Z-axis machining origin of the file is set on the surface of the material, the cutter touches the surface of the material; When the Z-axis machining origin of the file is set at the bottom of the material, the tool touches the surface of the work surface).
- After confirming that the tool touches the surface, press the "**Set Z-Axis Origin** 

" button (marked "Z0") and the Z-axis coordinate will be reset to "0". At this point, the Z-axis origin is set, indicating that the starting point of the tool's machining depth has been determined.



(2) Confirm the work origin setting

- **Check origin coordinates**:
  - Check the coordinate values of the X, Y, and Z axes on the display or control panel of the control software. At this point, the coordinates of all axes should appear as "0", indicating that the origin position has been set correctly.
- **Zeroing relative to the origin coordinates**:
  - When the origin coordinates of X0, Y0, and Z0 are set, the control software will display the real-time coordinates relative to the origin. If the spindle is at the origin, the X, Y, and Z axes should be "0".



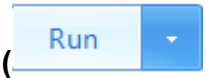
- **Save Origin Settings**:

- It is recommended that you save the current origin setting as the default origin of the machining operation to ensure that the origin setting is not lost even if it is paused or interrupted during machining.

(3) Precautions

- **Ensuring Accuracy**:
  - It is important to confirm the origin setting repeatedly before each machining, especially after changing materials or restarting the machine, to avoid machining deviations or scrap due to incorrect origin settings.

5.8 Start, suspend and stop the processing process

(1) Start the processing program (

).

Check the settings:

- Verify that the working origin of the X, Y, and Z axes is set correctly and displayed as zero.
- Confirm that the tool is correctly installed and matches the material to be machined and the G-code settings.
- Check that the material is securely fastened to ensure that the vacuum adsorption system or fixture is working properly.
- Load the correct G-code file and check if the machining path is as expected with the preview function.

Ready to start:

- Before starting processing, make sure that all personnel are away from the work area and that there is no obstacle around the equipment.
- Confirm that the spindle is started and that the tool is at the correct height.

Start the machining program:

- Press the key on the control screen 

to start the machining program. The device will start executing the loaded G-code file and make a cutting or engraving operation according to the set path.

Monitoring the machining process

- After start-up, the machining process is monitored in real time, observing the operation of the tool, the status of the material being processed, and the operating parameters of the machine (such as spindle speed and feed rate).
- Make sure the cutting or engraving process is as expected, and if you notice anything out of the ordinary, prepare to operate with **the F10** or **F11**.

(2) Suspend the processing procedure (

).

Use the pause function (

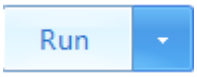
):

- If you need to pause the operation during machining, press the

key. This will temporarily stop the tool movement and spindle rotation, but will not lose the current machining position.
- The use

function is often used for temporary interruptions, such as checking the condition of the tool, adjusting the material, or removing debris from the machining area.

Resumption of processing:

- After the necessary checks or adjustments, the 

machining program can be continued at the press of the key. The machine will resume machining from the paused station without having to reset or reload files.
- Confirm that the tool and material are still correctly aligned and set to ensure the accuracy of the restored machining.

(3) Stop the processing procedure (

).

Use the stop function (

):

- If you need to completely terminate the current machining task, press the key 

. This immediately stops all tool movement and spindle operations and returns to the idle state.
- The use 

function is usually used in an emergency or when the machining process needs to be reset.

Precautions:

- **Stop and restart**: After pressing the key 

, if you need to restart the machining task, you need to set the zero point again and reload the G-code file. When you continue machining from a completed section, you may need to manually adjust the machining path.
- **Emergency Stop**: In the event of an emergency malfunction or dangerous situation of the device, it is recommended to use the emergency stop button instead of 

the key. The E-STOP button instantly cuts off all power for safety.

(4) Inspection after processing is completed

Automatic homing:

- When the machining program is completed naturally, the machine automatically returns to the set safe position (usually the origin or set safe height) and the spindle stops.

Check the processing quality:

- Carefully check the machining quality of the work piece, including the precision of the cut, the flatness of the edges, and the machining details to ensure that it is consistent with the design drawings.
- If machining errors or quality problems are found, you can check the machining parameters or readjust the origin settings.

Clean up the work area:

- Clean up debris and dust in the processing area to ensure the cleanliness of the workbench and the normal operation of the equipment. Routine inspections of tools and equipment are carried out to prepare them for the next machining.

Brief summary

- **Start**: Used to start or resume the machining program, suitable for starting or continuing the current task.
- **Pause**: Used to temporarily interrupt the machining, suitable for checking or adjusting the operation without losing the current position.
- **Stop**: Used to terminate the current task, suitable for restarting machining or when a reset is required.

6. Maintenance & Maintenance

6.1 Maintenance of the transmission system

(1) Cleaning

- **Daily or after each use**:
  - Use a soft cloth or compressed air to clean the surface of the transmission to ensure that no chips, dust, or other foreign objects accumulate to prevent impurities from entering critical components and causing wear.
  - Special attention is paid to the surface cleaning of the screw, guide rail and rack to prevent impurities from affecting the sliding or meshing accuracy.
  - Clean the protective cover of the guide rail to ensure that it is intact and prevent foreign objects from entering the drive train.
  - When cleaning racks and gears, use a soft brush to remove impurities between the teeth.

(2) Lubrication

- **Weekly or monthly lubrication**:
  - Lubricate the screws, rails and racks regularly, using appropriate oil or grease. ISO VG 32-68 viscosity grade lubricants are recommended.
  - During lubrication, ensure that the surface of the transmission parts is evenly covered with oil film to ensure smoothness and minimize friction during operation.
  - If the equipment has an automatic lubrication system, check the storage amount of lubricating oil regularly and ensure that the lubricating oil is above the minimum storage line for the system to work properly.

(3) Check the wear and tear

- **Monthly checks**:
  - Check the wear of the screws, rails and racks to ensure that there is no visible wear, loosening or seizure.
  - Check the smoothness of the rail slider to make sure it moves without obstacles or unusual noise.
  - Check the meshing of the gears and racks to ensure that there is no excessive wear or misalignment. If the gear clearance is too large, it needs to be adjusted.
  - Check whether the fit between the screw and the ball nut is smooth to ensure that there is no excessive clearance or abnormal vibration.

(4) Calibration and adjustment

- **Quarterly**:
  - A full calibration of the drive system is carried out to check the accuracy of all shafts. Especially after long-term or frequent use, the accuracy of the transmission parts may be affected and recalibration is required.
  - For rack and pinion systems, adjust the gear engagement position if necessary to ensure no loosening or skipping.

(5) Belt inspection (if applicable).

- **Monthly checks**:
  - If the equipment has a belt drive, check the tension and wear of the belt. Maintain proper tension to avoid belt slippage or over tightness that can lead to increased wear.

(6) Fastener inspection

- **Monthly**:
  - Inspect fasteners (e.g. bolts, nuts) connected to screws, rails, and racks to make sure there are no loosening. Loosening of fasteners can cause the device to wobble or misalign during operation.

(7) Record and maintain logs

- **After each maintenance**:
  - Documentation of each service and maintenance activity, including cleaning, lubrication and inspection results. By recording the details of each maintenance, it is possible to track the status of the equipment and predict future maintenance needs.

6.2 Maintenance of the spindle

(1) Cleaning and inspection

The spindle surface is clean

- **Daily**: Use a clean cloth or compressed air to clean the spindle surface, especially after use, to ensure that no chips, dust or other impurities accumulate to avoid affecting heat dissipation and operation.
- **Do not use high-pressure air**: When cleaning the spindle, avoid blowing high-pressure air directly into the bearing or seal, so as to avoid foreign objects entering the interior and damaging the bearing.

Check the spindle taper (automatic tool change spindle)

- **Weekly**: Regularly inspect the taper bore of the spindle for wear or contamination. Clean the taper with a soft cloth to ensure that its inner surface is smooth and undamaged to ensure that the tool or chuck is securely mounted.

(2) Cooling system

- **Regularly check the oil cooling system**: If the spindle is oil-cooled, check the oil level, oil quality and whether there is any oil leakage in the oil cooler. Make sure the oil meets the manufacturer's recommended specifications, such as ISO VG 32 or VG 46 ratings.
- **Check the water cooling system regularly**: If the spindle is water-cooled, check the water level, water quality, and whether there are any water leaks in the oil cooler. The specification of the water is pure water.
- **Coolant (oil/water) replacement**: Replace the coolant regularly, usually every 6 months to 1 year, to prevent the deterioration of the coolant from affecting the cooling performance.
- **Check the status of the cooling fan**: If the spindle is air-cooled, check whether the fan is running normally and whether the cooling air channel is obstructed

(3) Spindle operation inspection

Check the spindle running status

- **Daily**: Listen to the sound of the spindle running when the machine is turned on to ensure that there is no abnormal noise or vibration. Any additional noise or excessive vibration may indicate bearing damage.
- **Check the spindle temperature**: Make sure the spindle is within the normal operating temperature range by touching or monitoring the temperature sensor on the device. If the spindle is overheating, it may be a malfunction of the cooling system or insufficient lubrication.

Tool clamping force check

- **Weekly**: Check the gripping force of the tool chuck to ensure that the clamping force is sufficient to prevent the tool from loosening when rotating at high speeds. Insufficient clamping force can lead to a decrease in spindle accuracy or a loose tool.

(4) Spindle calibration and balance

Check the run out of the spindle

- **Quarterly**: Use a dial gauge or other measuring tool to check the radial runout of the spindle to ensure that the concentricity of the spindle is within the allowable error range. Excessive run out may result in a decrease in machining accuracy.

Spindle dynamic balance adjustment

- **As required**: If there is significant vibration during high-speed machining, it may be necessary to adjust the dynamic balance of the spindle to ensure stable operation of the spindle at high speeds.

(5) Electrical system inspection

Spindle cable inspection

- **Monthly**: Check the cable connection of the spindle motor to ensure that there is no wear or looseness. Damaged cables can lead to unstable power supply to the spindle, which can affect the stability of machining.

Spindle control system check

- **Regular maintenance**: Check the working status of the spindle inverter or controller to ensure that the electrical system is working properly. Abnormal frequency converters can lead to unstable spindle speed.

6.3 Maintenance of the main electrical box of the equipment

(1) **Cleaning**

- Clean the exterior of the cabinet weekly to ensure that no dust accumulates.
- Clean the interior after a power outage every month, and remove dust with an anti-static brush or vacuum cleaner.

(2) **Check the heat dissipation and temperature**

- Check whether the cooling fan and vents are unblocked every day to ensure that the internal temperature of the electrical cabinet is normal.
- Make sure the electrical cabinet temperature is in the range of 10°C - 40°C.

(3) **Electrical connection inspection**

- Check the terminals monthly to ensure that there are no loose or poor contacts.
- Make sure the grounding wire is well connected.

(4) **Check the power module and inverter**

- Check the operation of the power module and inverter every month to ensure that there is no overheating or abnormal noise.
- Measure the input and output voltages regularly to ensure that the voltage is stable.

(5) **Protection and safety**

- Make sure the electrical cabinet door is well sealed daily to prevent dust and moisture from entering.
- Check protective equipment such as circuit breakers and fuses to ensure proper function.

(6) **Environmental inspection**

- Check the surroundings of the cabinet weekly to keep it ventilated, dry and clean.
- Control humidity between 40%-60% to avoid the effects of moisture.

(7) **Electrical component status check**

- Electrical components such as relays and contactors are inspected monthly to prevent aging or wear.
- Check the display and indicator lights of the inverter and deal with the abnormality in time.

(8) **Maintenance records**

- Record the inspection and cleaning content after each maintenance, and maintain a detailed maintenance log.

6.4 Maintenance of vacuum pumps

(1) Maintenance of high-pressure air pump

clean

- **Daily or Weekly**:
  - Clean the housing and air intake of the high-pressure air pump to ensure that there is no dust, debris or debris blockage. Pay special attention to whether the inlet filter or filter element is blocked to ensure smooth air circulation.
  - Regularly clean the radiator and cooling fan from dust to prevent overheating.

Filter maintenance

- **Monthly**:
  - Check the filter element of the air intake filter to make sure the filter is clean and working properly. If the filter is clogged or has too much dirt, it can lead to a drop in airflow or a decrease in the efficiency of the pump. Depending on the usage environment, replace the filter cartridge if necessary.

Wind pump blade inspection

- **Quarterly**:

- Inspect the blades inside the air pump for wear, breakage, or deformation. Damage to the blades may result in insufficient air volume or unstable operation of the pump. Replace the blades in time when problems are found.

Run a status check

- **Daily**:
  - When starting and running, check whether the air pump has abnormal noise or vibration to ensure smooth operation. If abnormal noise is found, it may be damage to the bearing or blade, and it should be dealt with in time.

Temperature and heat dissipation checks

- **Weekly**:
  - Check the working temperature of the high-pressure air pump to ensure that the cooling system is working properly. If the pump is kept at high temperatures for a long time, it may affect the service life.

Fastener inspection

- **Monthly or quarterly**:
  - Check the fasteners on the air pump, including bolts and nuts, to make sure they are not loose. Loose fasteners can cause increased vibration of the device and can cause damage.

(2) Maintenance of dry vacuum pump

Clean

- **Daily or Weekly**:
  - Clean the air intake, casing and cooling system to ensure that no dust or debris clogs the air intake and exhaust ports, and that good air circulation is maintained.
  - Use anti-static brushes or compressed air to clean the radiator and fan to keep the pump well dissipated and avoid overheating.

Carbon flakes inspection and maintenance

- **Quarterly or semi-annual**:
  - **Check the flakes for wear**: Regularly check the thickness of the flakes to ensure that they are not worn to the minimum allowable value. Excessive wear of the carbon flakes can lead to a decrease in vacuum efficiency, affecting the performance of the pump.
  - **Check the carbon flakes for damage or cracks**: If the carbon flakes are cracked or broken, it may cause the pump to lose its tightness and should be replaced immediately.
  - **Clean the pump chamber and rotor groove**: Every time you inspect or replace the carbon flakes, clean the pump cavity and rotor grooves to ensure that no dust or debris accumulates to avoid affecting the normal operation of the carbon flakes.

Replace the carbon sheet

- **Every 6-12 months**:

    - **Replace the carbon sheet**: When the carbon sheet wears down to the minimum thickness recommended by the manufacturer, it should be replaced in a timely manner. Use genuine or high-quality replacement parts that match the pump model.
    - **Check the degree of installation freedom**: When replacing the carbon sheet, make sure that the carbon sheet can slide freely in the rotor groove to avoid jamming.

Filter and exhaust system inspection

- **Monthly**:
    - Check the filter elements of the intake and exhaust filters to make sure they are not clogged. Clogged filters can reduce the efficiency of the vacuum pump and increase the load on the pump. Clean or replace the filter as necessary, and it is generally recommended to replace the filter every 6-12 months.

Vacuum level check

- **Weekly**:
    - Use a vacuum gauge to measure the vacuum level of the pump to ensure that the vacuum capacity of the pump is normal. If the vacuum level drops, it may be that the carbon flakes are over worn, the seal is poor, or the filter is clogged.

Run a status check

- **Daily**:
    - Check the noise, temperature and vibration of the pump when starting and running. Ensure that the pump runs smoothly and without abnormal noise or overheating.
    - If there is abnormal noise or vibration, it may be that the carbon sheet is worn, damaged or there are debris in the pump, and the machine should be stopped for inspection in time.

Seal inspection

- **Quarterly**:
    - Check the seals of the pump to ensure there are no air or oil leaks. If the seal is found to be damaged or aged, it should be replaced in time to prevent the vacuum level from dropping.

Temperature monitoring

- **Monthly**:
    - Regularly check the operating temperature of the pump to ensure that the cooling system is working properly. High temperatures can exacerbate wear and tear on carbon sheets and other internal parts.

Fastener inspection

- **Monthly or quarterly**:
    - Check whether all bolts and nuts on the pump body are tightened to prevent the equipment from vibrating or loosening, and ensure the stability of the pump structure.

Maintain records

- **After each maintenance**:
    - Record the inspection and replacement of carbon flakes, as well as other maintenance contents, establish a maintenance log, and track the working status of the pump and future maintenance needs.

6.5 Maintenance of cooling system

Water cooling system maintenance

(1) Coolant inspection and replacement

- **Monthly checks**:
    - Check the coolant level in the tank to make sure it is within the normal range. If the liquid level is too low, replenish it in time.
    - Check the cleanliness of the coolant for impurities, sedimentation or discoloration. If the coolant deteriorates, replace it promptly.
- **Replace every 6 months or according to usage**:
    - **Replace the** coolant: The coolant should be replaced regularly according to the frequency of use to avoid lime scale, corrosion, or bacterial growth. It is recommended to use treated deionized water or anticorrosive coolant, and antifreeze is recommended in cold regions.
    - Inspect the water pump and related pipes to ensure smooth water flow.

(2) Clean water cooling system

- **Every 6 months**:
    - Clean tanks, pipes, and radiators to prevent scale and sediment from clogging pipes or radiators.
    - Clean the water pump filter to ensure that the filter is not clogged and the water flow is smooth.

(3) Check the pump and flow rate

- **Monthly checks**:
    - Check that the pump is working properly to ensure that there is no water leakage, abnormal noise, or overheating.
    - Test the flow rate of the coolant to ensure that the flow meets the requirements of the equipment. If the water flow is insufficient, it may be a pump failure or a blocked pipe, and it should be checked and repaired in time.

(4) Inspection of pipes and connectors

- **Quarterly**:
    - Inspect water pipes and connections for age, cracking, or leakage, and replace pipes or seals if necessary.
    - Make sure all water pipe fittings are tightened and leak-free.

(5) Radiator and fan inspection

- **Monthly**:

- Check whether there is dust, impurities or blockages on the surface of the radiator, and clean the radiator and filter in time to ensure good heat dissipation.
- Check whether the fan is running normally, make sure that the fan has no abnormal noise, vibration, and is running smoothly.

(6) Temperature monitoring

- **Monthly**:
  - Check that the temperature of the coolant is normal. Use a temperature sensor or monitoring instrument to confirm that the temperature of the system is within the recommended range of the equipment and avoid overcooling or overheating.

Oil cooling system maintenance

(1) Cooling oil inspection and replacement

- **Monthly checks**:
  - Check the cooling oil level in the oil tank to ensure that the oil level is within the normal range, and replenish the oil volume in time.
  - Check the condition of the cooling oil for discoloration, thickening, or impurities. If the oil deteriorates, replace the cooling oil in time.
- **Replace every 6-12 months**:
  - **Replace the cooling oil**: Replace the cooling oil regularly according to the use of the oil to prevent the aging and oxidation of the oil from reducing the cooling effect. It is recommended to use an ISO VG 32 or **ISO VG 46** rated cooling oil that meets the requirements of the equipment.

(2) Clean the oil cooling system

- **Every 6 months**:
  - Clean the oil tank, oil pipe and oil pump to ensure that there is no impurity deposit and avoid oil circuit blockage.
  - Inspect and clean the filters in the oil cooling system to ensure they are not clogged to maintain the cleanliness and fluidity of the oil.

(3) Oil pump and flow check

- **Monthly checks**:
  - Check the working condition of the oil pump to ensure that there is no abnormal noise or overheating. The operation of the oil pump should be stable, and the flow rate should meet the requirements of the equipment.
  - Regularly test the flow rate of the oil cooling system to ensure smooth oil circulation and prevent cooling efficiency from decreasing.

(4) Inspection of pipes and joints

- **Quarterly**:
  - Inspect the pipes and joints of the oil cooling system for leakage, aging or cracking, and replace them if necessary.
  - Make sure all tubing fittings are tightened to prevent oil leakage.

(5) Radiator and fan inspection

- **Monthly**:
  - Clean the radiator and filter of the oil cooling system to ensure that the surface is free of dust and impurities, so as to avoid the reduction of heat dissipation efficiency.
  - Check the working condition of the fan to ensure that the cooling fan is operating properly and that there is no noise or abnormal vibration.

(6) Temperature monitoring

- **Monthly**:
  - Use a temperature sensor to monitor the temperature of the oil cooling system to ensure that the temperature of the system is within the recommended range of the equipment when the system is running, and prevent the oil from overheating or under heating the spindle performance.

6.6 Maintenance of dust collection system

(1) Dust bag and filter maintenance

- **Daily or after each use**:
  - Clean or shake the dust bag to make sure the dust does not clog the bag. Long-term accumulation of too much dust can lead to a decrease in suction.
  - Check the filter for dust accumulation, which affects the filtration effect. Clogged filters can increase the load on the system.
- **Monthly**:
  - **Replace or clean the filter**: If the filter is washable, it can be cleaned with water or compressed air. For non-washable filters, replace them regularly (or depending on the frequency of use).

(2) Fan and pipe inspection

- **Weekly**:
  - Check whether the fan has abnormal noise or abnormal vibration to ensure the normal operation of the fan.
  - Check whether the speed and power of the fan are normal. The fan should be kept stable when working, without abnormal noise and excessive heating.
- **Monthly**:
  - **Clean the fan blades**: Check whether there is any dust or debris accumulation on the fan blades, clean the blades to ensure that the air volume is normal, and avoid overload operation of the fan.
  - **Check the pipe seal:** ensure that the connection between the pipe and the dust collection port and the main engine is not loose or leaking. Poor sealing will lead to a decrease in the vacuuming effect.

(3) Clean the dust bin

- **Weekly**:
  - Empty the dust bin to ensure that there is no excessive dust accumulation. Too much dust in the dust bin will reduce the dust collection efficiency and increase the load on the system.

- **Monthly**:
  - Clean the inside of the dust bin to ensure that there is no dust accumulation on the inner wall to avoid clogging and damaging the equipment.

(4) Pipeline inspection of dust collection system

- **Monthly**:
  - Check whether there is any debris and dust accumulation inside the pipe, and clean the pipe regularly to prevent blockage. Dust clogging can lead to increased system pressure and decreased suction.
  - Inspect pipes for cracks, looseness, or damage, and replace pipe components if necessary.

(5) Electrical system inspection

- **Monthly**:
  - Check the electrical connections of the dust collection system, including the motor and controller. Make sure the wiring is secure, not loose or damaged.
  - Ensure that the control switch and actuator are working properly to prevent electrical failures that cause the dust collection system to be inoperable.

(6) Inspection of the suction port and accessories

- **Weekly**:
  - Check whether the suction ports of the CNC Router are unblocked, blocked or damaged.
  - Clean the dust around the suction port and make sure that its connection to the pipe is tightly sealed to prevent air leakage.

(7) Overall inspection and testing of the system

- **Quarterly**:
  - The performance of the entire dust collection system is tested to ensure that the suction power and air volume meet the working requirements. Regular testing can prevent potential problems.
  - Check the wear and aging of each component of the system, and repair or replace key components in a timely manner.

7. Problems and Troubleshooting

7.1 The machine does not start

7.1.1. Power Supply Issues

Cause: The power connection is not working properly, the plug is loose, or the cable is damaged.

Solution: Check the electrical outlets and cables to make sure the connection is secure and not damaged. If there is a power indicator, check whether it is on; If not, you may need to replace the cable or repair the electrical outlet.

7.1.2. The E-STOP button (E-STOP switch) is pressed

Cause: The emergency stop button was accidentally pressed, causing the device to fail to boot.

Solution: Check the E-STOP button on your device to make sure it has been released. If the E-STOP button is still pressed, the device will enter a protected state, preventing it from starting.

7.1.3. Insufficient voltage or current

Cause: Insufficient voltage or current, resulting in the machine not functioning properly.

Solution: Check whether the power supply voltage is within the normal range. If the voltage is too low or unstable, you can try using a voltage regulator to regulate the voltage.

7.1.4. Fuse Blowout

Cause: The fuse in the circuit may burn out due to excessive current, causing the circuit to fail to close.

Solution: Check whether the fuse is in good condition, if it has been burned, replace it with a fuse of the same specification.

7.1.5. Control System Failure

Cause: The control system of the CNC router may have a software or hardware failure.

Solution: Check whether the control system starts normally and restart the software or device. If the problem persists, you may need to update the control system software or contact technical support to check for hardware issues.

7.1.6. The limit switch is triggered

Reason: The limit switch of the machine is triggered, and the machine automatically enters the protection state.

Solution: Check if all limit switches have been accidentally triggered to make sure the machine table is in the normal position. If the limit switch is triggered, try to start the machine again after resetting.

7.1.7. Drive or Motor Problems

Cause: Damaged drive or motor or loose connection.

Solution: Check whether the connection between the motor and the driver is tight, and confirm that the driver is working normally. If necessary, replace the damaged drive or motor.

7.1.8. Software Setup Issues

Cause: The startup parameters in the CNC software are not set correctly.

Solution: Check the parameter settings of the CNC control software to make sure the startup settings are correct. If in doubt, you can revert to the default settings or refer to the operator's manual to reconfigure.

7.2 Machinery cannot be moved

7.2.1. Control System Setup Issues

Cause: The parameter settings in the CNC control system may be restricting the movement of the machine or may not function properly due to incorrect settings.

Solution: Check the movement settings in the CNC control software to make sure the parameters are correct. You can try to revert to the default settings or reconfigure the parameters according to the operator's manual.

7.2.2. The limit switch is triggered

Reason: After the limit switch is triggered, the CNC will enter a protective state and cannot be moved to avoid collision.

Solution: Check whether all limit switches are triggered, and confirm that the machine is not out of the working range. If triggered, reset the limit switch and make sure the table is in the proper position.

7.2.3. Drive Failure or Motor Problems

Cause: The drive or stepper motor (or servo motor) may malfunction, preventing the drive shaft from moving.

Solution: Check the drive and motor connections to make sure there is no loosening or damage. Check the status lights of the motor and drive to make sure they are working properly. If damaged, the motor or drive needs to be replaced.

7.2.4. Control Card or Line Connection Problems

Cause: The control card or internal wiring connection is loose or damaged, resulting in the control signal cannot be transmitted.

Solution: Check the connection between the control card and the line to ensure that it is firm and reliable. If a loose or damaged cable is found, reconnect or replace the cable.

7.2.5. Power Supply Issues

Cause: The power supply voltage is insufficient or unstable, resulting in the motor not being able to obtain sufficient power.

Solution: Check whether the power supply voltage is within the specified range, if the voltage is too low or unstable, use a voltage regulator or power conditioner to ensure a stable power supply.

7.2.6. Software or Program Problems

Cause: There may be a malfunction in the CNC control software, or there is a problem in the program, which causes the instructions to not be transmitted properly.

Workaround: Restart the CNC control software, or reload the machining program. If the problem persists, consider reinstalling or updating the software.

7.2.7. Mechanical Seizure

Cause: The guide rail or lead screw may be unable to move due to lack of lubrication or foreign object seizure.

Solution: Check the guide rails and lead screws, clean any foreign objects, and fill the lubricating oil regularly. Make sure the moving parts are clean and free of rust.

7.2.8. The E-STOP button is not discharged

Cause: The emergency stop button is pressed, and the device enters protection mode, resulting in inability to move.

Solution: Check whether the emergency stop button is pressed and make sure that the emergency stop state has been lifted before operating.

7.3 Machinery cannot be returned to machinery

7.3.1. Limit switch failure

Cause: The limit switch will be triggered when returning to the origin, and if the limit switch is damaged or malfunctioning, it may not be able to return to the origin accurately.

Solution: Check whether the limit switch is working normally, if it is damaged or in poor contact, you need to replace the limit switch or adjust its position.

7.3.2. Origin sensor failure

Cause: The origin sensor is damaged or obscured and cannot be detected correctly.

Solution: Check whether the origin sensor is normal, clean up the foreign objects around the sensor, and make sure that it is not occluded. If the sensor is damaged, it needs to be replaced with a new one.

7.3.3. Mechanical Jamming or Blocking

Cause: The guide rail or lead screw may have foreign objects, rust, or lack of lubrication, causing the moving parts to get stuck and not move smoothly to the origin.

Solution: Check and clean the guide rails and lead screws, and fill them with lubricating oil if necessary to ensure that they are unobstructed.

7.3.4. Control system parameter setting error

Cause: The original point setting parameters in the control system are incorrect, which may cause the machine to fail to recognize the correct origin position.

Solution: Check the origin settings in the control system to confirm whether the parameters are correct. If you are unsure about the parameter settings, you can refer to the operation manual or restore the default settings.

7.3.5. Drive or Motor Failure

Cause: The drive or motor of the control shaft is faulty, and the drive back to the origin cannot be driven back properly.

Solution: Check the status of the drive and motor to ensure that there is no abnormal situation. If damaged, the drive or motor needs to be repaired or replaced.

7.3.6. Software or Program Errors

Cause: An error occurred in the back-to-origin program or instruction in the CNC software, which may result in the back-to-origin action not being executed.

Workaround: Restart the CNC control software, or reload the machining program. If the problem persists, you can try reinstalling or updating the software.

7.3.7. The E-STOP button is not discharged

Reason: The emergency stop button is pressed, the device enters the protection state, and it cannot return to the original point.

Solution: Check whether the E-STOP button is disarmed, make sure that the device is in a normal state, and then try to return to the original point.

7.3.8. Unstable power supply or voltage

Cause: The power supply voltage is insufficient or unstable, which may affect the normal operation of the drive system and cause it impossible to return to the original point.

Solution: Check the power supply voltage to make sure it is within the normal range. If needed, use a voltage regulator to keep the voltage stable.

7.4 Automatic tool change failed

7.4.1. Mechanical jamming of the Tool library

Reason: The mechanical structure of the Tool library is stuck, the guide rail is worn, or there are foreign objects stuck in the Tool library, which will cause the tool to be unable to rotate or push the tool smoothly when changing the tool.

Solution: Check the Tool library and guide rail for foreign objects or wear, clean up the debris and lubricate the guide rail and mechanical structure regularly to ensure the smooth operation of the Tool library. If the wear is severe, the damaged parts need to be replaced.

7.4.2. The tool is not clamped correctly

Cause: The tool is not fully clamped in the spindle or Tool library, which makes it impossible to remove or put the tool in smoothly during tool change.

Solution: Check the clamping of the tool to ensure that the tool is installed firmly and in place. Replace the poorly clamped tool or re-calibrate the tool.

7.4.3. Insufficient air pressure

Reason: The automatic tool change system usually relies on the pneumatic system to complete the tool change action, and the insufficient air pressure will cause the tool change action to be unable to be completed normally.

Solution: Check the air source and barometer to ensure that the air pressure meets the requirements of the equipment. If the air pressure is insufficient, check whether the air pump and air pipe are normal, and if necessary, increase the air pressure or replace the pneumatic parts.

7.4.4. Tool change position sensor is faulty

Cause: The tool change position sensor is malfunctioning or the position is offset, causing the control system to detect the tool position correctly.

Solution: Check whether the sensor is damaged or whether the position is correct, adjust or replace the sensor if necessary, and ensure that it can accurately feedback the tool position.

7.4.5. The hood does not return to the specified position,

The hood does not return to its designated position, and the tool cannot be replaced normally

Check whether the suction hood is raised, check that the position sensor is in the correct position, and make sure that the suction hood is in the raised state and the position sensor receives the signal when changing tools

7.4.6. The spindle does not return to the tool change position

Cause: The spindle does not return to the specified tool change position, resulting in the tool cannot be changed normally.

Solution: Check the program code to make sure the spindle returns to the correct tool change position as required. The tool change position can be re-set in the system to ensure that the spindle is in place before each tool change.

7.4.7. Servo motor or drive failure

Cause: The servo motor or drive that controls the movement of the magazine and spindle has failed, causing the tool change process to be blocked.

Solution: Check the status of the servo motor and drive to make sure they are working properly. If an abnormality or malfunction is found, the motor and drive need to be repaired or replaced.

7.4.8. Tool coding error

Cause: The tool code is set incorrectly, causing the system to not recognize the current tool or make an incorrect tool change.

Solution: Check whether the tool code is consistent with the program setting to ensure that the code is correct. If necessary, re-code the tool and update the relevant information in the program.

7.4.9. Tool change procedure error

Cause: The tool change program code is incorrect or incorrectly configured, resulting in an exception during the tool change process.

Solution: Check the tool change program code to make sure that the tool change instructions and path are correct. Rewrite or adjust the tool change code, and contact technical support for debugging if necessary.

7.4.10. Electrical Control System Failure

Cause: The control system circuit board or wiring is loose and damaged, which will lead to unstable signal transmission and affect the tool change operation.

Solution: Check the electrical control system to make sure all wiring is free of loose and damaged. Reconnect circuits or replace faulty parts if necessary.

7.4.11. The magazine is not homed

Cause: The magazine is not fully returned to its position after the last tool change, resulting in stuck or unable to find the position during the next tool change.

Solution: Check the homing situation of the Tool library to ensure that the Tool library is completely returned after each tool change. If there is an offset, you need to manually adjust the Tool library or check whether the Tool library homing sensor is normal.

7.4.12. The tool is too heavy or not suitable for automatic tool change

Cause: Some tools are too heavy or out of specification and may cause the tool change to fail.

Solution: Make sure you use a tool size that is appropriate for the automatic tool change system, if you need to use heavier or special tools, you may need to change the tool manually.

7.5 The spindle cannot be started

7.5.1. The spindle power supply is not turned on

Cause: The spindle power supply is not turned on, resulting in the inability to provide power.

Solution: Check whether the power switch of the spindle is turned on to ensure that sufficient power has been provided to the spindle.

7.5.2. The spindle inverter is set incorrectly

Cause: The parameter setting of the inverter is incorrect, which may cause the spindle to fail to start or rotate.

Solution: Check whether the parameters of the inverter are set correctly, including frequency, acceleration time and operation mode. If the parameters are incorrect, please adjust them according to the operating manual or the settings provided by the manufacturer.

7.5.3. The E-STOP button is pressed

Reason: After the emergency stop button is pressed, the device enters the protection state, and the spindle cannot be rotated.

Solution: Check whether the E-stop button is pressed, confirm that the E-STOP state is lifted, and then try to start the spindle.

7.5.4. Power or Cable Problems

Cause: The power cable connection of the spindle motor is loose or the cable is damaged.

Solution: Check the power connection of the spindle motor to ensure that the cable connection is secure and not damaged. If damaged, replace the cable.

7.5.5. Frequency converter or spindle motor failure

Cause: The inverter or spindle motor may be damaged, resulting in the inability to drive the spindle normally.

Solution: Check the status of the inverter and spindle motor to confirm whether there is a fault alarm indication. If the equipment fails, the inverter or spindle motor needs to be replaced.

7.5.6. Control System Setup Issues

Cause: The spindle control parameters in the CNC control system are set incorrectly, resulting in the spindle not starting.

Solution: Check the spindle parameter settings in the CNC control system to make sure it is in the correct working mode. If in doubt, you can restore the default settings or refer to the operator's manual to reconfigure.

7.5.7. Program Code Errors

Cause: The spindle boot command (e.g. M03 or M04) in the G-code program is missing or incorrect, causing the spindle to not receive the rotation command.

Solution: Check the program code to confirm whether it contains the spindle start command. If it is missing or incorrect, please add the correct command (e.g. M03 S18000 to set the spindle speed to 18000 RPM).

7.5.8. Spindle overload or overload protection

Cause: The spindle is overloaded, causing the inverter or control system to activate overload protection.

Solution: Check whether the load of the spindle is too high, and restart the spindle after lowering the load appropriately. In case of frequent overloads, the machining parameters need to be adjusted or the spindle checked for mechanical faults.

7.5.9. Spindle start-up delay setting

Reason: Some control systems have a spindle start-up delay, and the spindle may not start until the delay time has elapsed.

Solution: Check the start-up delay setting of the CNC system, if there is a start-up delay, you can wait for the delay time or cancel the setting.

7.6 Abnormal spindle noise

7.6.1. Worn or damaged spindle bearings

Reason: The spindle bearing may be worn or damaged after long-term use, resulting in abnormal noise during rotation.

Solution: Check the status of the spindle bearing, if it is found to be worn or damaged, the bearing needs to be replaced in time. It is recommended to use high-quality bearings to improve durability.

7.6.2. Lack of lubrication

Cause: Lack of lubrication of spindle bearings or transmission parts can increase friction and lead to abnormal noise.

Solution: Check the state of lubricating oil or grease, and regularly fill the spindle bearing and transmission parts with an appropriate amount of lubricating oil to ensure smooth operation.

7.6.3. Loose spindle assembly

Reason: The spindle is loose due to vibration or other reasons during use, which may cause abnormal noise.

Solution: Check the fastening status of the spindle to ensure that all fasteners are firm and not loose. Reposition the spindle if necessary and secure.

7.6.4. Tool clamping is not firm or unbalanced

Cause: The tool is not clamped correctly, or the tool is unbalanced, which can cause vibration and abnormal noise during rotation.

Solution: Reinstall the tool to make sure the tool clamping is secure and centered. If the tool is unbalanced, it is recommended to replace the tool with high quality and good balance.

7.6.5. Improper cutting data

Cause: Excessive cutting speed or feed rate will cause the spindle to be overloaded and produce abnormal noise.

Solution: Check the cutting parameters, reduce the cutting speed and feed rate, especially when machining materials with high hardness, and avoid overloading the spindle.

7.6.6. Spindle cooling system failure

Cause: Problems with the spindle cooling system (e.g., cooling water pump, coolant circulation) cause the spindle temperature to be too high and produce abnormal noise.

Solution: Check the working status of the cooling system to ensure that the cooling water or coolant is circulating normally. If the cooling pump is damaged, it needs to be replaced in time.

7.6.7. Spindle motor problems

Cause: Failure of the spindle motor itself, such as damage to the motor coil and unbalanced windings, may cause the spindle to produce abnormal noise during operation.

Solution: Check whether the spindle motor has abnormal vibration or temperature rise, and replace or repair the motor if there is a fault.

7.6.8. Worn or loose spindle belts

Cause: The spindle belt is worn or slack, which may cause abnormal noise when the belt rubs against the pulley.

Solution: Check the status of the spindle belt, if there is wear or slack, replace the belt or adjust the tension of the belt to ensure that the belt runs smoothly.

7.6.9. Dust or foreign matter inside the spindle

Cause: Dust, metal shavings and other foreign substances accumulate inside the spindle, resulting in friction and abnormal noise.

Solution: Clean the spindle regularly to avoid dust from entering the interior. If there is a foreign object inside the spindle, it needs to be cleaned thoroughly.

7.6.10. Spindle Balancing Problems

Reason: The spindle itself has poor balance due to manufacturing errors or long-term use, and abnormal noise will occur.

Solution: If the spindle balance is poor, you can try to find a professional for balance calibration. If calibration is not possible, it is recommended to replace the spindle.

7.6.11. The supply voltage is unstable

Cause: Unstable power supply voltage or poor power supply quality will cause the spindle motor to run unsteadily, resulting in abnormal noise.

Solution: Check whether the power supply voltage is stable, use a voltage regulator or power supply filter device, and make sure that the power supply voltage is within the normal range.

7.6.12. Inverter parameter settings are incorrect

Reason: Improper setting of the acceleration and deceleration time or frequency of the inverter may lead to the unsmooth operation of the spindle and abnormal noise.

Solution: Check the parameter settings of the inverter, adjust the acceleration and deceleration time, and ensure that the settings are suitable for the working needs of the spindle.

7.7 The processing accuracy error is large

7.7.1. Improper calibration of the machine

Cause: The calibration of the CNC machine is not accurate, resulting in positioning errors and dimensional deviations.

Solution: Calibrate the machine regularly to ensure that the position of each axis is accurate. Use standard gages to check and adjust to ensure that the movement accuracy of each axis meets the requirements.

7.7.2. Worn or improper selection of tools

Cause: The tool is worn or not suitable for the material being machined, which may affect the machining accuracy.

Solution: Check the condition of the tool and replace it if it is worn. Make sure that the tool type and size are appropriate for the machining task at hand to reduce errors.

7.7.3. Spindle is loose or oscillating

Cause: There may be a loosening of the bearings or mounting of the spindle, causing the tool to deflect during machining.

Solution: Check whether the spindle is tight, if it is loose, adjust the spindle and fix it firmly. If the bearing is damaged or loose, the spindle bearing needs to be replaced or the spindle needs to be overhauled.

7.7.4. Unstable work piece clamping or vacuum suction

Reason: The work piece clamping or vacuum suction is not firm, which will cause displacement during processing, resulting in dimensional errors.

Solution: Make sure that the work piece clamping or vacuum suction is firm, you can add a fixture or use a more suitable clamping method, so that the work piece will not move during processing. Before placing materials each time, clean the countertop, enhance the vacuum suction area, clean the vacuum pipe and filter, and keep the suction pipe unblocked.

7.7.5. Improper feed rate and cutting data

Reason: The feed speed is too fast or the depth of cut is too large, which may lead to excessive force on the tool and affect the machining accuracy.

Solution: Adjust the feed rate and depth of cut to suit the material to be machined and the capacity of the tool. Usually slower feed rates and smaller depth of cut contribute to improved accuracy.

7.7.6. Temperature Effects

Reason: Temperature changes can cause thermal expansion of materials or heating of equipment parts, affecting machining accuracy.

Solution: Control the temperature of the processing environment, try to avoid drastic temperature changes, or carry out proper preheating before the operation of the equipment to reduce the impact of thermal deformation.

7.7.7. Drive train clearance or loosening

Cause: Wear or loosening of transmission components such as lead screws, guide rails or gears may lead to movement clearance, which may affect machining accuracy.

Solution: Inspect and tighten the transmission parts, and replace the worn parts if necessary. Maintain the drive train regularly to reduce clearance.

7.7.8. Improper setting of control system accuracy

Cause: Incorrect setting of step or positioning accuracy parameters in the CNC control system.

Solution: Check the accuracy parameters in the control system to ensure that the step distance and accuracy are set correctly. Refer to the operating manual or consult technical support to ensure that the parameter settings meet the requirements.

7.7.9. Vibration or External Interference

Reason: The vibration of the machine or the surrounding environment during machining may affect the machining accuracy.

Solution: Make sure that the machine is installed on a stable ground to avoid vibration interference from other equipment in the processing environment. Shock-absorbing pads can be added under the machine to reduce the impact of vibration on accuracy.

7.7.10. Insufficient accuracy of servo motors or drives

Cause: Faulty or insufficient accuracy of the servo motor or drive, which may lead to positioning errors.

Solution: Check the working status of the servo motor and drive to ensure that its accuracy meets the processing requirements. In case of failure or lack of accuracy, consider replacing or upgrading the motor and drive.

7.8 Vacuum adsorption is unstable

7.8.1. Insufficient suction power of the vacuum pump

Cause: Vacuum pump failure or insufficient suction power of the pump will lead to poor vacuum adsorption effect.

Solution: Check the status of the vacuum pump to ensure that it is operating properly. If the suction power of the vacuum pump is insufficient, it may be necessary to clean the debris inside the pump, or replace worn parts, and consider replacing the vacuum pump if necessary.

7.8.2. Pipeline Leaks

Causes: Loose vacuum pipe connections, broken pipes or aging seals will cause air leakage and affect the adsorption effect.

Solution: Check whether the vacuum pipe connection is tight and ensure that the pipe is not damaged or cracked. In case of leaks, repair or replace broken pipes and check the condition of the seals.

7.8.3. Dirt or damage to the adsorption table

Reason: There are dust, chips, oil and other debris on the table, which will affect the fit between the workpiece and the adsorption table.

Solution: Clean the adsorption countertop to ensure that there are no foreign objects on the surface, or check whether the countertop is damaged. If there is any damage, repair or replace the countertop in time to maintain a good adsorption effect.

7.8.4. The bottom of the work piece is uneven

Reason: If the bottom of the work piece is uneven and cannot be fully attached to the adsorption table, the vacuum adsorption effect will deteriorate.

Solution: Ensure that the bottom of the work piece is flat, and if necessary, the bottom of the workpiece is treated to better fit the adsorption table.

7.8.5. Adsorption hole blockage

Cause: The adsorption hole is blocked by foreign objects such as dust and chips, which will lead to weakened suction.

Solution: Clean the adsorption holes regularly to ensure that the pores are unobstructed. If the orifice is severely blocked, it can be purged with compressed air, or cleaned manually.

7.8.6. Clogged filter screen of vacuum pump

Cause: A clogged vacuum pump filter restricts air circulation, resulting in insufficient suction.

Solution: Check and clean the filter to make sure there is no clogging. Replace the filter if necessary to keep the air circulating smoothly.

7.8.7. Improper setting of the control valve in the vacuum system

Cause: The control valve is not set properly, resulting in insufficient vacuum.

Solution: Check the control valve settings to ensure that the vacuum level meets the requirements. Adjust the control valve appropriately to provide sufficient adsorption force.

7.8.8. The snapping area is not set properly

Reason: When machining smaller work pieces, if the adsorption area is set too large, the adsorption force will be dispersed.

Solution: Adjust the adsorption area according to the size of the work piece, and use baffles or sealing strips to concentrate the adsorption force to improve the adsorption effect.

7.8.9. Ambient Temperature or Humidity Influences

Reason: High temperature or high humidity environment may affect the performance of the vacuum pump, resulting in unstable adsorption.

Solution: Try to use the equipment in a suitable temperature and humidity environment, install dehumidification or cooling equipment if necessary, and maintain the normal working conditions of the vacuum pump.

7.9 Inverter alarm

7.9.1. Overvoltage alarm

Reason: It is usually because the grid voltage is too high, or there is too much regenerative voltage feedback during the deceleration process, resulting in the internal voltage of the inverter is too high.

Solution: Check the grid voltage to ensure that the power supply voltage is within the rated range of the inverter. If the deceleration process causes an overvoltage, the deceleration time can be extended, or the regenerative voltage can be dissipated by using a braking unit and a braking resistor.

7.9.2. Under voltage Alarm

Cause: The grid voltage is too low or unstable, or there is a problem with the power module inside the inverter.

Solution: Check the power supply voltage to make sure it is stable and within the rated range. If the power supply is normal but the alarm still appears, it may be that the internal power supply module is faulty, and it is recommended to contact technical support or replace the module.

7.9.3. Overload Alarm

Reason: The motor load is too large, or the output current of the inverter exceeds the rated current, resulting in an overload alarm.

Solution: Check the motor and load to ensure that the motor load does not exceed the rated range. Check the acceleration and deceleration time settings and extend the acceleration and deceleration times appropriately to avoid overload caused by load fluctuations.

7.9.4. Over current Alarm

Cause: Usually excessive load current during acceleration, deceleration, or operation, or overcurrent due to faults such as short circuits, grounding, etc.

Solution: Check the insulation of the motor and cable to ensure that there is no short circuit and ground fault. Adjust the acceleration and deceleration time to avoid current shocks caused by

acceleration and deceleration too fast. Make sure the motor and drive capacity match, and if necessary, reduce the load or replace the drive with the appropriate capacity.

7.9.5. Over temperature alarm

Cause: The temperature of the inverter or motor is out of the safe range, which may be caused by too high ambient temperature, poor heat dissipation, or internal fan failure.

Solution: Check the ambient temperature around the inverter and motor, keep good ventilation, and avoid excessive ambient temperature. Clean the dust on the radiator and fan of the inverter to ensure heat dissipation. Check that the fan is working properly, and if it is damaged, replace the fan.

7.9.6. Short Circuit or Ground Fault Alarm

Cause: A short circuit or ground fault occurred between the output of the inverter and the motor.

Solution: Check the insulation of the cable and motor to ensure that there are no short circuits or grounding problems. Troubleshoot motor wiring issues and make sure the connection is secure and free of exposed wires. If the fault persists, the damaged cable or motor may need to be replaced.

7.9.7. Control Circuit Failure

Cause: The inverter's internal control board is faulty, the signal is lost, or the wiring is loose.

Solution: Check the control circuit board to ensure that the wiring is firm and not loose. If the control board is damaged, you need to contact the manufacturer or technical support for repair or replacement.

7.9.8. Abnormal frequency setting

Reason: The frequency setting exceeds the rated frequency of the inverter, or does not meet the working requirements of the equipment.

Solution: Check the frequency setting parameters to ensure that the set frequency is within the rated range of the inverter. Adjust the frequency setting according to the load of the device and avoid frequencies that are too high or not suitable.

7.9.9. Input Phase Loss or Output Phase Loss

Cause: Lack of phase in the wiring of the power supply or motor will cause the current to be unbalanced, which will trigger an alarm.

Solution: Check whether the power input is normally supplied to ensure that the three-phase voltage is balanced. Check the wiring between the output and the motor to ensure that there is no phase loss.

7.9.10. Motor stalled

Cause: The motor is overloaded or stuck, resulting in a sharp increase in current during operation, which triggers an inverter alarm.

Solution: Check if the motor is stuck or there are foreign objects blocking the rotation. Check the load condition to make sure the motor is not overloaded

7.10 Servo alarm

7.10.1. Overload Alarm

Reason: The servo motor is overloaded, exceeding the rated load of the motor, causing the current to exceed the set value.

Solution: Check the motor load to make sure the load is within the rated range of the motor. If the load is normal, you can try to adjust the acceleration and deceleration parameters of the motor to avoid overload caused by excessive acceleration and deceleration. Check the mechanical transmission system for any problems such as jamming and friction.

7.10.2. Overheating alarm

Cause: The servo motor temperature is too high, which may be due to long-term overload or poor heat dissipation.

Solution: Check the heat dissipation conditions around the motor to ensure good ventilation. Clean the dust on the motor radiator to ensure the heat dissipation effect. If the motor overheats frequently, it may be necessary to reduce the load or increase cooling measures.

7.10.3. Position Deviation Alarm

Reason: The servo system cannot reach the predetermined position correctly, resulting in a position error that exceeds the set value.

Solution: Check the connection between the servo motor and the mechanical system to ensure that there is no loosening or damage. Confirm that the signal of the encoder is working properly and recalibrate the encoder if necessary. Check the parameter settings of the control system to ensure that the position control parameters are appropriate.

7.10.4. Power Failure

Reason: The power supply of the servo system is unstable, which may lead to an alarm.

Solution: Check the power supply voltage to make sure it is within the rated range of the servo system. Check the power connections to make sure the wiring is secure and not loose.

7.10.5. Encoder Failure

Cause: The encoder signal is lost or malfunctioning, which will cause the servo system to fail to feedback the current position.

Solution: Check the encoder's cable to ensure that there is no damage and poor contact. Test whether the output signal of the encoder is normal, and replace the encoder if there is a fault.

7.10.6. Short Circuit or Ground Fault

Cause: Short circuit inside the servo system or motor, which may lead to a fault alarm.

Solution: Check the insulation of the motor and connecting wires to ensure that there is no short circuit or grounding problem. Carry out the necessary electrical tests to troubleshoot short circuits.

7.10.7. Signal Interference

Reason: Electromagnetic interference or noise affects the normal operation of the servo system.

Solution: Make sure that the cable routing of the servo system is kept at a certain distance from other electrical equipment to avoid interference. Check the grounding of the servo drive to ensure a good grounding system.

7.10.8. Improper setting of control parameters

Reason: Improper setting of servo control parameters may lead to unstable or inability to operate the system.

Solution: Check the control parameter settings of the servo drive to ensure that the parameters meet the system requirements. If you are unsure of the parameter settings, please refer to the device manual or contact technical support for adjustment.

7.10.9. Drive Failure

Cause: The servo drive is internally faulty or damaged, resulting in failure to work properly.

Solution: Check the status of the drive, if it is damaged, it needs to be repaired or replaced. If the alarm persists, you may need to contact professional technical support for a detailed inspection.

7.10.10. Servo Connection Problems

Cause: Poor connection between the servo motor and the drive, resulting in blocked signal transmission.

Solution: Check the connection line between the servo motor and the drive to ensure that the connection is firm. Make sure all connecting terminals are not loose or corroded.

7.10.11. Improper setting of operating mode

Cause: The operating mode of the servo system is not set correctly, which may lead to unnecessary alarms.

Solution: Confirm whether the operation mode of the servo system (such as position control, speed control, etc.) matches the application requirements. Adjust the operating mode settings according to the requirements of the equipment.

8. Safety Guidelines

To ensure the safety of the operator and the proper operation of the equipment, the following safety guidelines must be strictly followed when using CNC Router:

8.1 Wear protective gear

- **Safety goggles**: When operating, especially during the cutting and engraving process, flying debris or dust will be generated, and wearing safety goggles can effectively protect the eyes from injury.
- **Earmuffs**: CNC Router produces high noise when it is running, and prolonged exposure to high noise can lead to hearing damage. Always wear earmuffs or earplugs when operating to reduce the impact of noise.
- **Protective gloves**: Wear protective gloves to avoid scratches, cuts, or burns and keep your hands safe when carrying materials, cleaning equipment, or performing routine maintenance.

8.2 Emergency stop button

- **Familiarize yourself with the location of the emergency stop button**: The operator should confirm the position of the emergency stop button before using the equipment each time. The emergency stop button is usually located in a conspicuous position on the control panel, once there is an emergency or equipment failure (such as electrical abnormality, air supply interruption, material fixing failure, etc.), the emergency stop button should be pressed immediately to ensure that the equipment stops running immediately to prevent the accident from expanding.
- **Test the emergency stop function**: Regularly check the working status of the emergency stop button to ensure that it can work normally at all times and avoid being unusable in case of emergency.

8.3 Protection against overload

- **Respect for equipment load limits**: Each CNC Router has its specific maximum load capacity, including the thickness of the material being machined, the hardness, and the working load of the spindle and tool. When operating, do not exceed the load capacity of the device, as this may result in excessive wear or damage to the spindle, motor, or equipment frame.
- **Monitor the working status of the spindle**: pay attention to the noise, temperature and vibration conditions of the spindle when it is running, the overloaded spindle may produce abnormal noise or overheating. If an abnormality is found, the machine should be stopped immediately and the processing parameters should be checked to see if the processing parameters are beyond the allowable range of the machine.
- **Correct setting of machining parameters**: according to the requirements of the processing materials and tools, reasonably set the feed speed, cutting depth and spindle speed to avoid overload of the equipment due to improper parameter setting.

8.4 Security Around the Device

- **Keep the work area clean**: Make sure there is no buildup of debris around the equipment and avoid anything that could trip, slip, or impede the operation of the equipment, especially cables, tubing, and scrap. Cleaning chips and dust from workbenches and floors helps maintain a safe work environment.
- **Prevent interference with operation**: Never enter the range of motion of the device while the CNC Router is running. Do not attempt to move the material or make any adjustments while the equipment is working to avoid hand or body injury.
- **Multi-person operation coordination**: If multiple people are operating equipment or performing maintenance at the same time, make sure everyone is aware of the progress and tasks to avoid accidents caused by improper operation or poor communication.

8.5 Routine Maintenance and Inspection

- **Inspect the equipment regularly**: Check the key components of the equipment (e.g., spindle, tool, air supply, vacuum system, etc.) before operation to ensure that they are in good condition. If abnormal wear or damage is found, it should be replaced or repaired in time.
- **Lubrication and cleaning**: According to the equipment maintenance manual, lubricate the transmission system regularly, clean the dust collection system and cooling system, and maintain the smooth and stable operation of the equipment.
- **Electrical and air pressure check**: Check the connection status of the power supply and air source before starting the machine every day to ensure that the voltage and air pressure are within a safe range, and prevent equipment damage or safety hazards caused by electrical failure or insufficient air pressure.

8.6 Prevent material rebound

- **Correct fixing of the work piece**: Before machining, make sure that the workpiece is firmly fixed to the table. Loose materials can cause rebound during processing, causing equipment damage or personal injury. Depending on the material properties, the appropriate fixing method is selected, such as vacuum adsorption or mechanical fixtures.
- **Check the tool and spindle**: Make sure the tool is properly installed and securely fastened, check the tool and spindle for wear. If the tool is loose or worn, it can lead to tool breakage or material rebound during machining.

8.7 Use a vacuum system

- **Maintain good ventilation**: Ensuring that the suction system is working properly prevents the accumulation of dust and waste generated during the cutting process on the bench or in the air, which not only helps to keep the work area clean, but also prevents dust inhalation from affecting the health of the operator.
- **Clean the dust collection system regularly**: After the equipment runs for a period of time, clean the filter and dust collection box of the dust collection system in time to avoid affecting the processing accuracy due to the decrease in suction power.

8.9 Safety Signs and Warnings

To ensure operator safety, the equipment is equipped with **ANSI (American National Standards Institute)** compliant safety markings that clearly indicate potentially hazardous areas during equipment operation. Please read and familiarize yourself with all warning signs carefully before operating the equipment.

8.10 Security Logo Categories

The safety signs on the equipment are divided into the following categories according to the hazard class and type, and all operators must be familiar with them:

- **DANGER Marking: Affixed to the location of the electrical box to warn of the danger of electric shock**

- **WARNING:**

  Collision protection warning signs are posted on fast-moving machine beams

  Do not touch the warning sign and post it on the spindle unit

- **Protection Requirements Labeling**: Reminds operators that they must wear personal protective equipment (PPE), such as safety goggles, earmuffs, and gloves.

8.11 Pre-Operation Safety Checks

Before operating the device, make sure of the following:

- **Check that all security signs are clearly visible** and that they are not covered, damaged, or blurred. If the markings are damaged or missing, contact the equipment supplier immediately for a replacement.
- **Familiarity with the meaning of each type of marking** ensures that operators are able to identify the different types of safety signs on the equipment and the potential risks they suggest.
- **Regularly inspect the safety signs of the equipment** to ensure that it is in good condition and that it is safe to operate.

9. Disclaimer

9.1 Statement of User Responsibility:

This appliance must be operated by a trained professional. The manufacturer shall not be liable for any damage or injury caused by improper use, incorrect operation, or operation, maintenance and care of the equipment not carried out in accordance with the provisions of this manual.

9.2 Warranty Limitation Statement

The warranty service described in this instruction manual applies only to equipment failure caused by a manufacturing defect under normal use conditions. The warranty will be void for failures caused by incorrect operation, unauthorized modifications, use of non-original parts, or failure to maintain on time.

9.3 Statement of Security Responsibility

The safety devices and warning signs equipped with this equipment are the basic measures to ensure the safety of the user, and the user must comply with all safety operating procedures. The manufacturer is not responsible for accidents or damages caused by failure to comply with safe operations.

9.4 Data Accuracy Statement

The technical specifications and performance data in this manual are subject to change without notice due to product upgrades or improvements. The manufacturer is not responsible for any consequences arising from the use of outdated information.

9.5 Third Party Claims of Damages

The manufacturer is not liable for any damage caused to third parties by using this appliance. The user should ensure that the device is operated in accordance with local laws and safety standards.

9.6 Environmental and Power Liability Statement

This equipment should be operated under the environmental conditions specified in the manual, and the user shall ensure that a stable power supply and a working environment that meets the requirements are provided. The manufacturer is not liable for damage caused by environmental factors (e.g. excessive humidity, unstable power supply) or natural disasters (e.g. fire, flood).

9.7 Statement of Equipment Modification and Use

Users are prohibited from making unauthorized modifications to the device or using non-original accessories. The manufacturer is not responsible for any problems or damages caused by the modification of the device or the use of non-original parts.

9.8 Equipment Handling and Installation Statement

The handling and installation of this equipment must be carried out by professionals. The manufacturer is not responsible for damage to the equipment caused by improper handling or installation.

9.9 Disclaimer:
This appliance must be operated and maintained in accordance with the instructions provided. The manufacturer shall not be liable for any damage or personal injury resulting from failure to comply with the operating regulations in the instructions or unauthorized modification of the equipment. The use of this device is at the user's own risk.

10. Warranty & Support

10.1 Warranty Information

This product comes with a **two-year limited warranty**, effective from the date of purchase. The warranty covers equipment problems caused by manufacturing defects and includes the following parts:

- **Electrical components**,
  such as control panels, circuit boards, sensors, and other electrical control components, are covered by the warranty in the event of manufacturing defects or failures under normal use conditions.
- **Spindle motor**:
  The spindle motor equipped with the equipment is faulty or damaged due to manufacturing reasons during the two-year warranty period, and warranty services are provided to ensure the processing performance of the equipment (Note: the spindle bearing is not covered by the warranty if it is a consumable product).
- **XYZ axis drive system**:
  including the X, Y, and Z axis transmission system of the equipment, such as servo motors, ball screws, guide rails, racks, etc., if the movement is abnormal or invalid due to manufacturing defects, it will be repaired or replaced within the scope of warranty.

10.2 Warranty Terms and Conditions

1. **Repair and replacement during the warranty period**:
   During the warranty period, the user has the right to receive free repair or replacement service for faults caused by manufacturing defects. It is up to the manufacturer to determine how to repair or replace parts to ensure that the device is back in working order.
2. **What is not covered by the warranty**:
   The following are not covered by the warranty:
   a. Damage or malfunction of the equipment caused by misuse, abuse, improper operation, or failure to operate and maintain as required in the operating instructions.
   b. Damage caused by external factors such as voltage instability, overload, accidents (e.g. fire, flood, earthquake).
   c. Equipment failure caused by unauthorized disassembly, modification or use of non-original parts.
   d. Normal consumables and wear parts are not covered by the warranty, such as: spindle bearings, tools, belts, seals, etc.
3. **Warranty requirements**:
   The user shall properly keep the proof of purchase or the warranty card of the equipment as a valid proof of warranty service. If you need repair service during the warranty period, please contact an authorized service center with proof of purchase and serial number of the device.
4. **In case of invalid warranty**:
   The user must use and maintain the equipment in strict accordance with the operation and maintenance requirements in the manual. Any failure to operate or maintain the device as specified and resulting in damage to the device will automatically void the warranty.
5. **After-sales support**:
   During the warranty period, if the equipment fails, please contact the authorized after-sales service center immediately. The after-sales team will provide users with repair or replacement services according to the specific situation to ensure the normal operation of the equipment.

11.3. After-sales support

For technical support or repair services, please contact us at:

- **Phone**: +1 (909) 755 1011
- **Email**：techsupport@mintechusa.com
- **Website**：www.mintechusa.com