Radial force controlled floating deburring tools User Manual

Model: LT-6000

Zhengzhou Linghang Robot Co.,Ltd

V1.0

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Warranty

The warranty period starts from the product received date. The guarantee time is one year under normal use. The warranty does not cover following cases, improper use or installation, normal wear, abuse, accidents, negligence, fire, water, lightning or other nature disaster, product external causes or other factors that beyond the control of Zhengzhou Linghang Robot Co., LTD.

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Catalogue

1.Foreword

1.1 Usage

This product is installed the matching spindle on the floating mechanism, radial floating 360°, Floating angle 4°, axial floating distance 10mm, it can absorb the shape of the product variable in deburring process, make adaptive processing, protect cutters effectively, reduce the difficulty of debugging. Robot system and all kinds of special equipment which install the floating deburring tools are suitable for the removing below materials, aluminum alloy below C5, black metal casting flash below C5, general burrs, sewing lines and injection nozzle below 5mm, etc.

☑ If the amount of remove burrs exceeds the output characteristics of the motor spindle (see motor torque output characteristics), then burrs cannot be removed.

☑If the chamfer to be removed is too large,the chamfer cannot be removed even after repeated use of the floating deburring tool.

1.2 Prerequisite

The person performing the instructions in this manual must have the knowledge and skills related to the use of spindles and understanding the risks associated with the use of spindles and industrial equipment. Please read manuals of DGZX-10036/6.0 D2-IFPWS High Speed Milling motorized spindle and Water chiller firstly.

1.3 Safety matters and instructions

Before using this product, please read the "Safety Matters and instructions" carefully and use this product correctly. These warnings and precautions guide you to use this product safely to prevent injury to yourself and others. Risks are classified according to the severity are as follows.

Sorts	Explanation
 Warning	Precautions that may cause personal injury or property damage
 Attention	Precautions that may result in moderate injury and property damage

Warning

1. The air pipes and air pipe conectors shall be securely connected with the pneumatic equipment including this product, otherwise, the air hose connectors may be disconnected and then cause injury to people by flying around of air hose.
2. The cooling water pipes and the water pipe connectors should be firmly connected with the water cooling equipment, the electric spindle cooling water inlet and outlet, otherwise, the cooling water pipes may be disconnected and then cause damage to the nearby electrical equipment and electric spindle by overflowing of the cooling water. The robot power supply must be turned off before installing the floating deburringtool on the robot.
3. The spindle power must be turned off when install the spindle into floating system or the spindle is out of use; To prevent the generation of the heat and other problems, please strictly follow the interface and pressure matching which shows in manual of DGZX-10036/6.0 D2-IFPWS High-speed Milling Motorized spindle.

The chillers should be selected according to the cooling flow and cooling temperature of the spindle, the maximum cooling flow of the chillers should be greater than the cooling flow required by the spindle, the working temperature should meet the cooling temperature required by the spindle, and the cooling capacity should be 20% greater than the spindle power. The coolant is required to use a separate tank and the addition anti-rust agent is needed. The coolant should be changed per month; Coolant flow 3-4 L/min; when the machine stops working and the spindle cools to room temperature, please turn off the chiller to avoid condensate water from damaging the main spindle due to excessive temperature difference.

4. This product only has the function of dust-proof and prevention of large burr chips, does not have waterproof performance.
5. Do not apply chip fluid or similar things to the floating product directly.

2. Product Introduction

☑Before using this product, it is necessary to install deburring tools on the product, such as motor spindle, deburring cutters, etc.; The motor spindle can be prepared by the user or ordered from us.

☑ The floating force of the floating deburring tool can be adjusted by precision pressure regulator and proportional valve. Prepare pneumatic equipment (such as precision regulators, proportional valves) as the driving source of the air floating components.

☑When using this product, an adaptor plate is required to install the product on the robot or other similar system.

Attention

1. The floating part of the product is floating through the air, a regularly check the connection between the air pipe and the quick-insert connector, the cooling water pipe and the water pipe connector is needed;
2. Do not drop or collide with hard objects, which may cause damage of the product.
3. If the product installation excessive tightening bolts or use the wrong tools to tighten the bolts, the bolts may be deformed, damaged or unable to use.
4. Provide clean air for the product, if the air mixed with dust or moisture into the product can cause product failure.
5. If the product produces smoke, abnormal sound, abnormal smell, etc., the power supply and air source should be turned off immediately and the cause should be investigated.
6. If the water cooler alarm, the electric spindle temperature is too high, etc. Then the the power supply and air source should immediately be turned off, and check the reason;
7. Before installing the spindle in the floating system, please read and understand the manual of the spindle and water cooler.
8. The person who use this manual must have basic knowledge and skills related to the use of spindles and understand the risks associated with the use of spindles, water chillers and industrial equipment.

2.1 Fixture system

In order to enable customers can use different diameter deburring heads during the operation of deburring products, all of our floating deburring tools are equipped with removable ISO25 tool handles so that customers can install or replace deburring tool's devices quickly (such as deburring heads, milling cutters, drills, etc.).

Tools replacement methods: The tool change process can be completed once the solenoid valve is reversed, install the suitable tool for the chuck diameter to a certain depth in the chuck,and tighten the chuck nut.

For floating deburring tools, it is not allowed to install the tool extension rod and then add the deburring head (the tool stiffness decreases after using the tool extension rod, and the tool or extension rod flies out during use will cause damage to people or

Attention

1. Before installing the tool handle and chuck, make sure that the interface (outside surface of chuck, inside hole of chuck, outside cone of tool handle, taper hole of tool handle, inner hole of spindle shaft core, external thread and end face) is absolutely clean.
2. When installing the chuck, find the right position and gently screw it in by hand (no tools are allowed), and then lock it evenly with a wrench after it is rotated to the end; If you feel stuck in the process of screwing, do not continue to screw in, please check the reason for the stuck, remove the abnormal before operation;

2.2 Positional installation

Installation the floating deburring tools

1. Connect with the adaptor plate, install on the robot or special equipment;

2. Install on the workbench with the workbench adapter, grip the workpiece by robots.

2.3 Operating environment

☑Working temperature: 0℃-40℃; ☑Storage temperature: 0℃-60℃;

☑Working environment humidity: 20%Rh-85%Rh(No condensation);
☑ Storage humidity: 0%Rh-90%Rh(No condensation);
Storage conditions: Store the packaging of the product in a dry place. If possible, store the product in the delivery package.

☑Execution facility: The product requires clean, dry, filtered, oil-free compressed air; A precision pressure regulator filter with a nominal value of 5 microns or less is required; Electric spindle cylinder discharger (TO), cylinder reset (TI) 0.6-0.7MPa, spindle dust removal pressure 0.2-0.3Mpa, spindle air seal pressure 0.25Mpa; Radial floating regulating air pressure 0.1-0.4MPa.

3.Characteristics and Precautions for use

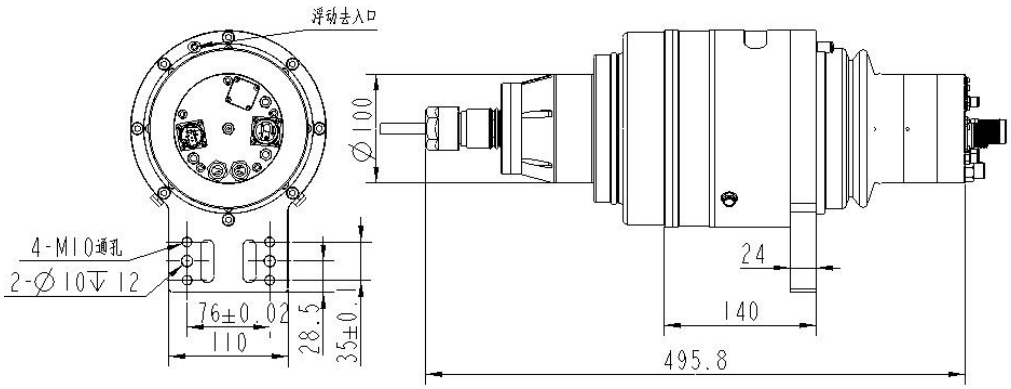


Figure 3-1 Floating deburring tools outline

3.1 Floating deburring tools characteristics

☑ The feature of this product is that the floating deburring tool can move freely in radial 360°, while tilting at the center of the shaft by 4°. In addition, the product has a 10mm axial compression function.

☑ The motor spindle with floating system can be used to remove burrs while overall absorbing small deviations from the X, Y, and Z axes of the workpiece.

☑Liquid usage: Clean air；

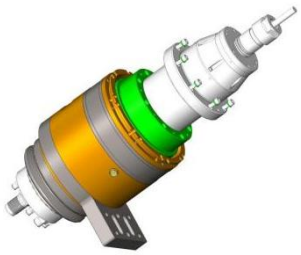
☑Range of working pressures:0.1-0.4MPa；

⚠Attention
1、Chiller，Distilled water is recommended and corrosion inhibitors are added.Such as，Fernox protective material F1（Use ratio 1：200）.if the ambient temperature is below freezing, antifreeze must be added. Users need to configure cooling water to ensure that extreme situations such as precipitation,corrosion and water freezing are prevented. 2、It is recommended to use room temperature coherent (temperature difference control) chiller, the coolant set temperature is consistent with the ambient temperature (lower than the ambient temperature 0-3℃). For example, if the environment is 30 ° C, set the chiller temperature to 27 ° C to 30 ° C. 3、123 Coolant temperature monitoring setting: the coolant temperature alarm value should be set to ±5℃ of the set temperature. For example: the coolant temperature is set to 27 ° C,then the upper limit of the coolant temperature alarm value should be set to 32 ° C, and the lower limit alarm value is 22 ° C.

3.2 Floating deburring tools Weight

Floating deburring tools total weight:30.7Kg(Including electric spindle, tool handleweight)；

4.Installation of the supporting spindle



4.1 Installation procedures：

The electric spindle is installed in the following steps:

☑Select a motor spindle with flange that can be installed in the mounting hole φ100H6 of the floating part of the product. (The spindle flange hole should be confirmed before use)

☑Place the spindle in the middle of the floating mechanism until the spindle reaches themounting plane of the limit ring.

☑Screw the main spindle holes and tighten all screws with a uniform,symmetrical torque of 16N.m. Mark all screws with a release mark.

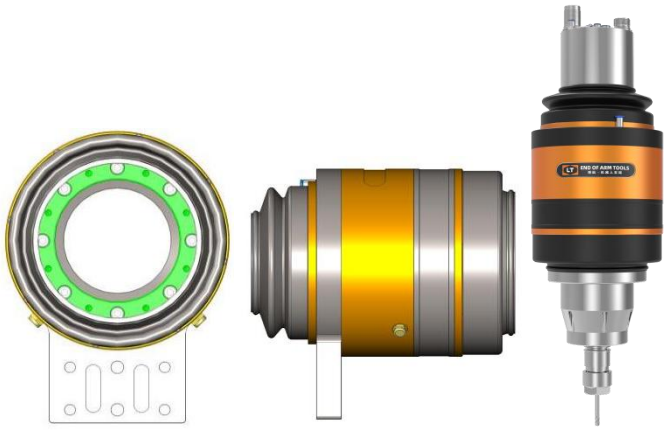


Figure 4-1 Floating spindle installation reference drawing

☑Any problems during installation,please contact us （www.zzlhjqr.com）；

4.2 Installation Notes

Warning
The user must ensure that the robot power supply is disconnected and that moving parts must be secured during this step;accidental movement may cause injury to equipment and workers.

Attention
1.When installing the electric spindle, do not fix it in the position of the motor. Otherwise, the motor housing will be deformed, causing heat and damage.To fix the motorized spindle, the 6 screws must be applied evenly and the torque required for screw fastening must be reached； 2.The electric spindle needs to be protected in the deburring environment for a long time; (In the process of using, it is necessary to open the gas seal first, and finally break the gas seal according to the specific situation of the dust after deburring)

☑

After the motor spindle is installed on the product,be sure to install a dustproo f cover. Install the dustproof cover on the abrasive mounting side of the spindl e,and install the V-shaped ring first for setting the dust ring. The installed dust proof cover can prevent debris from entering;

⚠ Attention
Note:After installing the motorized spindle to the floating mechanism, be sure to install the dustproof cover and V-ring. Breakdown may occur if debris enters.

5. How to install the floating deburring

5.1 Check upon delivery

Upon received ,the below things should be checked:

☑Delivery in accordance with shipping documents; packed in good condition.

☑If any packaging is damaged, or any goods are handled abnormally,open potentially damaged parts for closer inspection.If necessary, please contact the terminal of the LT to assist in evaluating the condition of the product.

5.2 Open and Carry

During transportation,storage and handling, the floating deburring tool device shouldalways be placed in the matching box.

The pneumatic tube and cable wires areconnected,bundled, and must be reduced in such a way as to allow free movementduring operation.

5.3 Installation

☑A transition plate is required to install the floating deburring tool on the robot or special equipment.

☑Zhengzhou linghang robot CO.,LTD can also make transition plates for you,if necessary, please feel free to contact us (www.zzlhjqr.com).

Varning
Note:The user must ensure that the robot power switch is disconnected and that moving parts must be secured during this step. Accidental movement may cause injury to equipment and workers.

6. Connecting Air

6.1 Pneumatic port connection

In the product pipeline must be installed a precision pressure regulator filter (0 -1Mpa) and precision pressure regulator (0.1Map-0.4Mpa), electrical proportional valve (0-1Mpa);

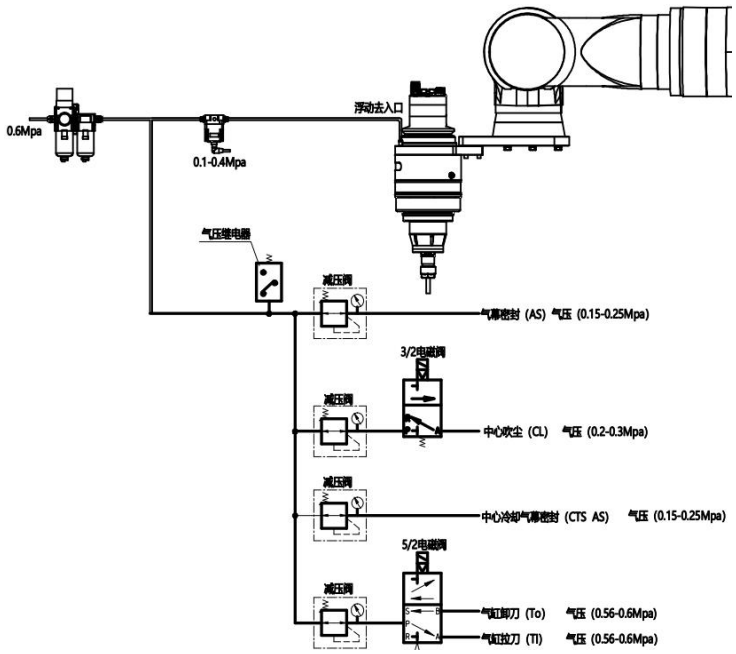


Figure 6-1 Floating deburring tool system connection diagram

☑As shown in the figure, there are two ways: 1. floating structure adjustment gas path: electrical proportional valve → floating deburring tools; 2. Main spindle gas path: See the main spindle control diagram for details;

Attention
1. TO Unload/loosen the air pressure:The compressed air enters the cylinder through the intake nozzle T0 to realize the tool unloading action; The required air pressure is 0.56~0.6Mpa; Too low air pressure will lead to slow unloading, poor unloading, clamping and other anomalies; High air pressure will lead to lower spring life and faster cylinder wear. 2. TI tension/tightening tool pressure: cylinder reset pressure, the air pressure and the lossen pressure (TO) interlock, provided by the same 5-position 3-way solenoid valve, reset pressure size requirements with the knife pressure (0.56~0.6Mpa); 3. AS air seal/curtain pressure: main shaft gas seal) joint, when the joint into 0.15~0.25Mpa compressed air, the gas will fill the inner cavity of the main shaft and the labyrinth seal leading to the shaft end, prevent external pollutants and coolant from entering the inner spindle, the air pressure is required to be normally open, it is recommended to open the pressure regulator on the power. Excessive air pressure will cause the bearing oil to blow out; Too low air pressure will result in the loss of gas seal effect . 4. CL blower/dust removal pressure: (spindle end cone blowing dust) joint, when the joint is fed into 0.2~0.3Mpa compressed air, and the cylinder is in the down state (spindle unloading tool), the air path is connected (aluminum water jacket - piston - rod - lower end cone of shaft core), to prevent pollutants from entering the shaft core and the tool handle with the cone when the main shaft tool is changed. It is recommended that the gas path be controlled with the same signal as TO and an interceptor valve be added..

6.2 Atmospheric pressure standard and Air circuit equipment

☑The standard gas supply pressure of constant force floating deburring products is 0.1-0.4Mpa.The maximum pressure of the product is 0.4Mpa,do not use more than this value of air pressure on the product.

☑For pipe diameters and pneumatic equipment (such as air filters, precision pressure regulating valves, electrical proportional valves, etc.),the connection should select the pipe diameter corresponding to the gas volume.

☑Using a smaller diameter air pipe,or pneumatic equipment with a smaller flow rate,will cause pressure loss and may not achieve the desired output.

☑Install air filter and air dryer in air main pipeline.Or similar equipment to re move dust and moisture from the air and provide clean air for the equipment.
☑Air filters remove moisture and dust from air sources.Discharge accumulated emissions when necessary.

Attention

1.The maximum pressure of the product is 0.4Mpa, do not use air pressure ex ceeding this value.Long-term excessive pressure will reduce the service life of the spindle.

2.The floating inlet pipeline needs clean and dry air.

3.In order to prevent pressure loss and insufficient flow, the main air pipeline should be as large as possible.

4.When installing the pipeline, keep the length of the pipeline from the precisi on controlvalve to the floating deburring tool as small as possible.
s too long, it will cause pressure loss and may not get good results.

7.Adjust the floating force by adjusting the air supply pressure value

☑In order to adjust the size of the floating force, the user needs to adjust the pressure value accordingly.

☑Connect the air source to the precision regulator valve through the precision regulator filter and to the floating deburring tool floating power inlet through th e air pipe.

☑Use a precision pressure regulator to adjust the pressure and obtain the required floating force. Please refer to the below figure to adjust the air pressure.

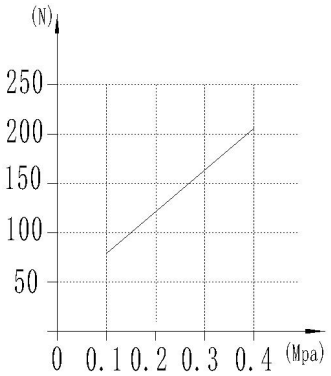


Figure 7-1 Floating force change diagram

☑If it is necessary to automatically adjust the floating force,it can be achieved by installing an electrical proportional valve.

ntion
1.Figure 7-1 illustrates the vertical direction, with the chuck pointing toward the ground as floating force changes with applied air pressure. Measured value may range from 0Mpa to 0.4Mpa and convert applied pressure into floating force. The actual force characteristics depend on the installation direction and conditions of the device. In applications where the deburring tool is mounted horizontally, applying air pressure requires overcoming the weight of the motor. The amount of floating force also depends on the material of the workpiece, the type of tool, and the amount of material being removed. 2.The upward dynamic change diagram is the vertical downward direction of the tool handle, based on the data obtained when the test rod is 50mm from the nut; The force on the tip of the knife varies according to the usage of the floating, the length of the deburring head is different, the shape is different, and the installation length is different,the floating force is also different.

8. Operation

These operating instructions are designed to help system integrators program,start,and complete a robotic floating deburring tool device,
it consisting of a floating mechanism
and an electric spindle mounted on the floating mechanism.The system integrator should have some knowledge of deburring programming and automation.

8.1.Safety precautions

All personnel involved in the operation of the floating deburring tool must have athorough understanding of the operating procedures. Failure to follow theseprocedures or neglect safety precautions can cause danger . It may even injure peopleor damage deburring devices and tools.

Warning
1.This device is a robot floating deburring tool, do not hold the floating deburring tool towork by hand. 2.Do not use a floating deburring tool device in a manner that creates an axial load.

3.Do not use floating deburring tools to sink or drill holes.

The metal forming process should not be performed by a floating deburring device. If the breakdown is caused by external forces,it is dangerous to personnel and equipment.

The floating deburring device cannot be used for the burr removal of fragile materials, the normal removal of materials is in the form of debris, the broken workpieces may cause material debris to harm the surrounding working environment and personnel.When the floating deburring tool is working, the feed speed should be reduced at first contact. In some cases, it may cause the contact movement between the deburring tool and the workpiece to collide too quickly. Collisions can cause a danger to people and equipment on both sides.When performing maintenance,must remember to tighten the nuts and bolts.

⚠Attention

1.Select floating deburring tools according to the size of burrs. Small burrs but use big tools , it will cause the product to be damaged;Large burrs but use small tools will lead to reduced service life of electric spindle overload; if so,it will can not achieve the desired deburring effect.
2.Do not use spare parts other than those recommended by the LT company. Use of parts other than those provided and recommended by LT company may damage the equipment and void the warranty.
3.Do not be near the deburring tool when it is started or running. Flying debris and rotating parts can cause injury.If it is necessary to approach the use of a deburring tool in motion, stand behind a suitable visible object.
4.Do not use or start the deburring tool without reading and understanding the relevant manual. If you do not understand the installation and operation procedures before using the tool, personal injury or device damage may occur.
5.If you have any questions during installation,please contact our company in time, our company has professional personnel to answer your questions.

8.2 Normal Operation

☑Air quality: The air source should be dry, filtered and free of oil. The main air source needs to install a precision pressure regulator filter before entering the floating tool (the former filtration accuracy is 5um and the later filtration accuracy is 0.3um,and the water removal rate is 99%).

☑No lubrication: Any form of lubrication is strictly prohibited.

☑ Tool selection,design and maintenance: Use carbide tools. The tool has a high operating speed, and the tool speed must reach the specified speed range.Check tool quality regularly to ensure no wear. The use of worn tools can lead to product disqualification;Do not extend the tool rod, because the combination of large torque load and high speed can be dangerous.

8.3 Floating deburring tools working environment

As mentioned earlier, the floating deburring tool device should be placed in an automated unit.

The working unit must be protected by a fence and no personnel are allowed to enter.The working unit can be equipped with an access lock, and operation and maintenance personnel can only enter with authorization. The working unit may be partially or entirely composed of plexiglass so that it can observation of deburring.

Ensure that the floating deburring tools and robot stop working during system or floating deburring tools maintenance.

during the installation and testing and floating deburring tool operation, on-site personnel should be equipped with safety helmet,

protective glasses and other protection.

8.4 Center point position and programming

When the radial range of floating deburring is small,the deburring effect is the best. The floating deburring tool is not allowed to run when the robot is programmed. In the robot programming process,the floating pressure inlet must be ventilated,and the minimum value of the precision pressure regulator is 0.08Mpa.

The following two programming methods are recommended.

The first method is to simulate the tool shank diameter method.When simulating the path of the robot,a cylindrical pin of the appropriate length of φ10 is installed at the position of the deburring head of the floating deburring tool to replace the deburring head(simulating the tool shank).

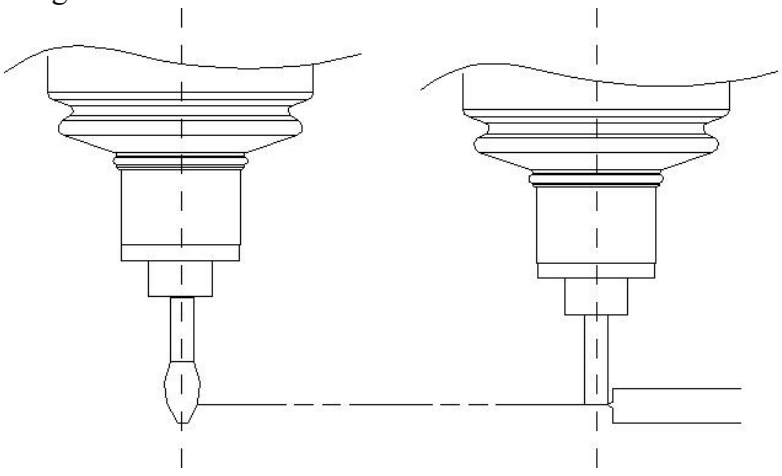
The handle extends sufficiently to the surface of the burr

to be cut (Figure 8-1).The diameter of the tool shall not exceed the diameter of the dowel pin and shall not exceed the floating range of the floating deburring tool.

浮动打磨工具打磨头 浮动打磨工具加工示意图

Floating deburring tools- deburring head diagram

Floating deburring tools machining



刀具和毛刺的理论接触点 Theoretical contact point between cutter and burr
毛刺:burr 圆柱销 cylindrical pin

Another programming approach is to write the path along the part edge as a burr centerline guide, and then manually or automatically add offsets to the robot path to achieve the final correct burr path (see Figure 8-2).The programming method used will depend on the capabilities of the machining center or robot and the programming style of the programmer.

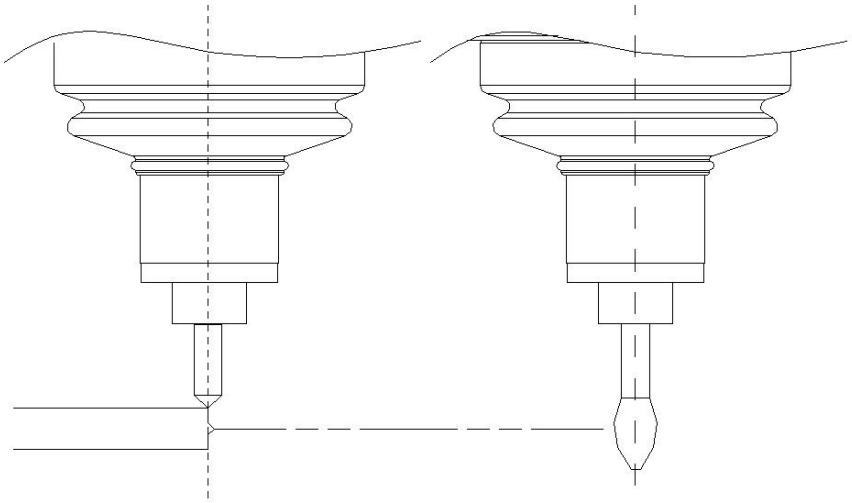


Figure 8-2 Burr's centerline guide teaches

Rounded corner is a complex case of flexible deburring spindles. In general, the tool should not touch the two vertical surfaces of the rounded corners at the same time. The resulting force imbalance between the two planes will cause severe tool chatter. Customers are advised to create a tool path, which will prevent the tool from touching two vertical surfaces at the same time. If the tool is tilted and near the tool tip, the taper tool can be extended into such a rounded corner. (Note: When working near the

taper tool tip, the surface cutting speed is reduced.) A similar situation may occur when deburring within a radius.

Customers are advised not to attempt deburring with an internal diameter less than 1.5 times the desired tool diameter (Rmin = 1.5 x tool diameter). Depending on the depth of the cut, if not follow these guidelines ,it will result in excessive tool contact, resulting in excessive tool chatter. When the program was run for the first time, the radial compliance gas supply of the observed path dropped below 1Mpa; As the robot path speed increases, be aware that the robot may deviate from the programmed path. Once the robot path is determined, the burr compliance should be adjusted (Figure 8-1) to achieve the correct burr removal depth.

☑The approach path of the deburring tool should be slow and angled: The entry path of the deburring tool should be slow to approach the workpiece at an Angle. When starting to deburr, try to slowly reduce the Angle while maintaining a slightly parallel path to the surface. If the tool quickly approaches the workpiece vertically, it can lead to pitting of the workpiece, tool damage and premature wear of the electric spindle bearing.

☑A collision is a dangerous situation for both people and equipment.

☑Program the robot to include 50% of the tool's floating stroke: Program the robot so that its tools on the marked path conform to 50% of the stroke. When the edge of the part deviates from the normal path, the cutting bit can use the float to move along the high and low points without losing contact or hitting the workpiece. Do not put the floating mechanism "at 0° position", make sure that it reaches a floating position.

8.5 Selection of cutters and Milling methods

Floating deburring devices perform best in "down milling". This means that the cross cutting direction of the cutter and the direction of rotation of the cutter are the same.In the case of floating, the tool rotation is clockwise direction. Thus, down milling involves a clockwise motion on the outside of the deburring part. In down milling, the heaviest cutting is when the tool enters the workpiece.In traditional milling, the cutting moves in the opposite direction of the tool rotation,which may contribute to the stability of the tool in some operations,however,the cutting edge of the tool is subject to higher friction and cutting forces. In this mode, tool wear is accelerated and the surface finish quality usually decreases.When using conventional milling methods,

where extra care must be taken around corners,cutting forces can deflect burrs, causing the tool to break as the robot continues along its path,which poses a potential hazard.

Plastic is one of the most difficult challenges to deburring because debris builds up on the deburring head.During this process, if the tool is dull or the feed and speed of the material being removed is incorrect,the chip will melt and weld it to the tool or workpiece.For plastics,the feed speed will be higher to reduce the temperature generated by cutting, but at the same time,it will also produce a greater amount of cutting.

8.6 Selection of cutters

LT can provide guidance on the choice of cutters, cutters characteristics corresponding to the appropriate material,through communication with professional cutters manufacturers,as well as a lot of practice to get the following data.

Cutters selection summary table		
Blade shape (φ3)	◎ Name/application	Features
	◎Tungsten steel cylindrical deburring head, single groove flat head, medium tooth type A •For hardened and tough materials, super alloys, stainless steel, alloy steel and fiber reinforced plastics.	•The surface is smooth after cutting.
	◎Tungsten steel cylindrical deburring head, double groove flat head, medium tooth type A •For hardened and tough materials, super alloys, stainless steel, alloy steel and fiber reinforced plastics.	•Higher cutting capability than standard cutting. •The surface is smooth after cutting.
	◎Diamond deburring head, type A •Suitable for deburring, beveling, chamfering; •For hardened and tough materials, super alloys and stainless steel; •Steel, alloy steel and fiber reinforced steel plastics.	•Higher cutting capability than standard cutting. •The surface is smooth after cutting.
	◎Aluminum alloy tool, cylindrical wide tooth type A •Suitable for hard aluminum alloy,soft non-ferrous metals and thermoplastics; •Used for deburring cast aluminum.	•The chips pass easily. •The chute does not clog, even when cutting sticky metal. •Smooth operation due to the peeling effect of the teeth.

	◎Oval coarse teeth E type •Suitable for cast aluminum and thermoplastics. Circular blade. •Used for deburring cast aluminum.	•The chips pass easily. •The chute does not clog, even when cutting sticky metal. •Smooth operation due to the peeling effect of the teeth.
	◎Single cross grooved L shape. •Suitable for hardened and ductile materials, super alloys, stainless steel, alloy cast steel and fiber reinforced plastics.	•The surface is smooth after cutting.
	◎Double cross grooves L-shaped; •Suitable for hardened and ductile materials, super alloys, stainless steel, alloy cast steel and fiber reinforced plastics.	•Higher cutting capability than standard cutting. •The surface is smooth after cutting.
	◎Round and spherical type D •Suitable for hardened and tough materials, super alloy, stainless steel, alloy steel and fiber reinforced plastics.	•Inner hole burr.
	◎Fiberglass deburring tool. •Suitable for deburring and profile milling of all glass and carbon fiber reinforced plastics.	•Due to the low cutting force, the special cutting geometry allows for high feed rates.

9.Trouble removal

Cutting tool wear	Hard to cut working material	Use a better grade of tool material to add coating.
	Excessive floating force	Reduced cutting width/continuous multiple deburring .
	Feed speed too low	Increase feed speed.
Cutting tool break	Excessive floating force	Reduced cutting width/continuous multiple deburring .
	Deflection at the corner	Straight milling, do not start from the sharp forward
	Collide	Reduce the contact entry speed at an Angle
Workpiece finish is poor	The feed rate is too high	reduce feed speed.
	Cutting tool wear	Check the cutting tool regularly
	Low speed	Increase speed
Secondary burrs appear after polishing	Cutting Tool selection error	Change the appropriate cutting tool
	Cutting tool wear	Change cutting tool
	Tool contact Angle is incorrect	Adjust the tool contact Angle
Shaking in the	The feed rate is too high	Reduce feed speed.

polishing process	Lack of rigidity	Increase radial compliance pressure
	Overcut	Reduced cutting width/continuous multiple deburring

10.Maintenance

In order to make the products run for a long time we provide reliable service;

The floating deburring tool has very few parts that can be repaired by the user. It is recommended that the user send the floating deburring tool back to our co mpany for repair.

☑This section describes how to maintain the product.

☑This product uses high-grade lubricating oil,the lubricating oil viscosity is hig h and not easy to lose,and the floating deburring tool structure is designed with an oil storage chamber during the use of self-lubrication.

☑For the air pipeline,please strictly comply with the following regulations;

☑It is recommended to check whether the fixing screw of the spindle is loose every month (remove the rubber sleeve, use 42N.m symmetrical screw to che ck whether the nut is loose),and use a depth gauge to check whether the spind le position is 80.6 for axial movement;

☑The water chiller is recommended to be replaced once a month with pure water;

Warning

1.The bending radius of the air pipeline should not be less than 50mm.Do not bend or distort the air pipeline.

2.Do not near the fire source,high temperature objects,collision object,sharp objects surface.

3.The air source pressure is not less than 0.4Mpa.

4.Water cooler use precautions: ① pure water; ② Add anti-corrosion water agent: Fenox protective agent F1; ③ It is recommended to change the water time for 1 month; ④ The water cooler needs to add glycol antifreeze in winter,and Clariant is recommended; ⑤ Timely supplement the water in the chiller according to the ambient temperature and evaporation of the workshop.

Note: This product is screw-locked and cannot be disassembled by itself. Regular maintenance is recommended for long-term use of this product. Once every 1-2 years,but it depends on the customer);If you need regular maintenance and repair, please contact us.

11. Listing of standard parts

☑ **The following accessories are standard for the floating** deburring **tool LT-6000.**

No.	Name	Model	qty	remarks
1	LT-6000 Force controlled floating material removal tool	LT-6000	1set	Includes spindle and interchangeable tool handle
2	High speed milling motorized spindle manual	DGZX-10036 / 6.0D2-IFPWS	1pc	Electronic Edition

12. Products parameter and drawing model.

https://www.zzlhjqr.com/mrt.html

13.Contact us

ZHENGZHOU LINGHANG ROBOT CO., LTD
Add： No. 11 Building , Zhengtou science and technology Innovation Park, Duqin Road, Mazhai industrial zone, Erqi District, Zhengzhou,China,450000
Tel：+86-371-86256680
Phone：+86 15333867590
Email：info@ltautotools.com
Website：https://www.ltautotools.com/

☑Product specifications and appearance are subject to change without prior notice.

☑The contents of this manual are subject to change without prior notice.

(DGZX-10036 / 6.0D2-IFPWS)

High-speed Milling Electric Spindle (DGZX-10036 / 6.0D2-IFPWS)

USER MANUAL

1 .Basis information

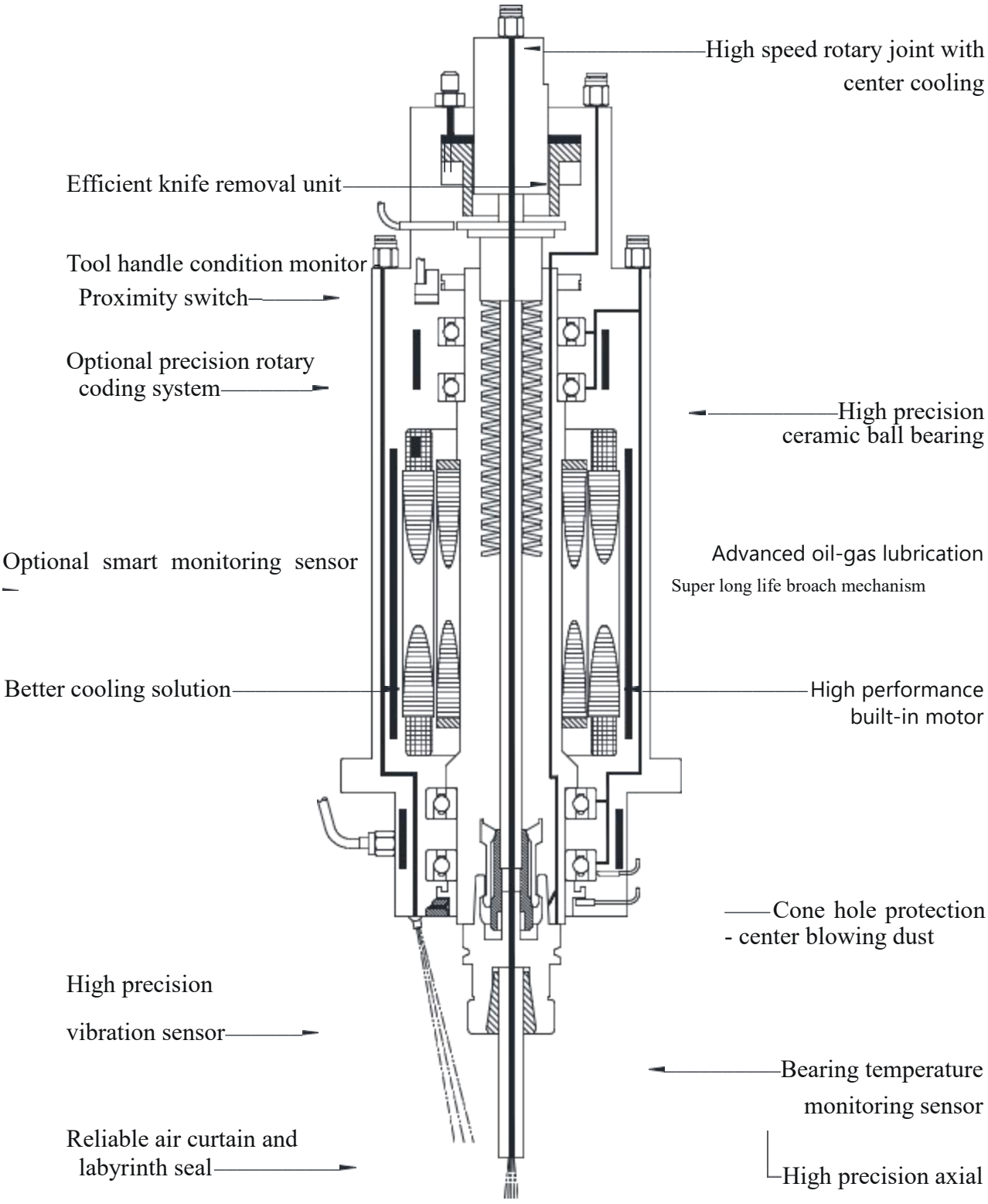


Figure 1.1 Motorized spindle diagram

1.1 Product purpose

High speed milling electric spindle is specially designed for high precision milling of various metals and non-metals. According to the machining characteristics of the workpiece of different materials,the processing parameters of the appropriate tool can be selected to play the best performance of the electric spindle.

1.2 Product characteristics

This series of products is the motor built-in spindle. Built-in three-phase AC motor,stepless variable speed control by the driver, the product has the characteristics of compact structure,low inertia, low vibration and low noise.

This series of products uses high-precision bearings, and adopts the optimal shafting arrangement, so that the products have high running accuracy, high stability and large rigidity,large bearing capacity.

This series of products are provided with circulation cooling channels.The cooling medium flows through the reasonably arranged circulation channel inside the spindle to quickly take away the heat generated by the rotation of the spindle,so that the spindle quickly enters a lower thermal balance state, so that to ensure the dimensional stability of the processed products,high precision, and maintain the long life of the spindle.

This series of products can install intelligent monitoring sensors according to customer needs, which can adjust motor temperature,bearing temperature and shaft core heat elongation,spindle vibration and other real-time monitoring to meet a variety of intelligent control and processing needs.

1.3 Statement of responsibility

The reliable operation and service life of the spindle depend on the correct operation of the user. Users must carefully read, understand and comply with the operating instructions of this spindle before use.In addition,accident prevention codes, safety guidelines and environmental protection codes must be observed.

This instruction manual must be kept safe for reference when necessary.

If we do not comply with this instruction manual or modify the spindle structure without permission,we will not assume any responsibility for any personal and property losses and loss of quality of the spindle.

Please note that please do not disassemble the spindle during the warranty period. After the spindle is disassembled without authorization,our company is not responsible for warranty.

1.4 Services and Consulting

As a leading supplier of spindle R&D and production,we are happy to help you solve your spindle problems and provide you with corresponding consulting services. Welcome to call our service hotline: 4006189083

2 Spindle safety information

2.1 Attention matters

1) It is forbidden to set,disassemble or repair this motorized spindle by technicians who are not designated by our company.

2) By monitoring the temperature,vibration,abnormal sound,noise of the spindle,we can judge whether the spindle is running normally. If an exception occurs, shut down the system immediately and notify maintenance personnel.

3) Do not run the electric spindle before the spindle is equipped with a tool handle.

4)When the spindle is running,the rotating parts will produce huge centrifugal force,and the necessary safety protection devices must be set up.

5)The tool handle and tool used by the spindle must be corrected by dynamic balance (in line with

the dynamic balance level within ISO1940 specification G2.5),otherwise it will lead to excessive vibration of the spindle,reduce the accuracy of the spindle,and cause equipment damage in serious cases.

6) It is strictly prohibited to operate beyond the technical parameters specified in the motorized spindle,otherwise it will cause unexpected and serious consequences.

7) It is strictly prohibited to spray compressed air and liquid to the nose end of the spindle to avoid foreign matter entering the spindle and damaging the spindle .

8) Do not use sandpaper or deburringwheel to polish the installation position of the spindle core cone hole,end face,body outer circle and flange end face.

2.2 Symbolic identification

Xx Indicates a prohibited matter,violation of which may have unexpected and serious consequences.

Xx Improper operations may result in personal injury and equipment damage.

Xx Enforcement matter.

Xx Danger！High Voltage.

3 Storage

Follow these instructions for spindle storage:

1)The outer surface of the spindle should be coated with anti-rust oil,wrapped with anti-rust paper, and placed in the packing box.

2)When the spindle is placed, avoid squeezing the spindle core, joints,sensors,cables, etc.

3)The spindle storage environment must be dry and free of dust and dirt.

4)The storage temperature of the spindle ranges from 10℃ to 40℃.

5)In order to prevent condensation inside of the spindle,the storage environment temperature should be relatively stable, so that moisture in the air cannot be reached the condensing point. For example: 65% relative humidity, the maximum allowable temperature drop of 8 ° C.Please check the enthalpy and humidity meter for details.

6)The spindle should avoid contact with acid,alkali,salt and other corrosive substances.

7)The maximum storage time of the spindle is 18 months.If the storage time exceeds 18 months, it needs to be re-tested before it can be used.

8) 

The spindle shall be re-run every three months after storage,and the running-in operation mode shall be performed according to Table 3.1

Table 3.1 Run in operation

Step	Rotational speed	Duration
1	25% of the maximum RPM	5 mins
2	Motionless	5 mins
3	50% of the maximum RPM	5 mins
4	Motionless	5 mins
5	80% of the maximum RPM	20 mins

4 Installation operation

4.1 Pre-installation confirmation

1)Whether the package of the goods received is in good condition and shows no signs of damage.

2)Check that the packing list is exactly the same as the goods received.

3)Check whether the spindle technical parameters (see the spindle technical parameters table and outline drawing) match the peripheral equipment completely.

4.2 Driver selection principle

1)According to the motor type and related configuration of the spindle, combined with the actual processing needs, select the appropriate drive type.

2） The rated output voltage of the driver matches the rated voltage of the spindle.

3）Under normal circumstances, under the same voltage level,the rated output power of the driver is not less than 1.5 times the rated output power of the spindle motor,and the drive power level specified in the national standard is selected according to the nearest and greater principle. If the motor rated power is 2.3kW, then drive selection of 3.7kW.

4）The brake resistance value can be selected according to the recommended value of the driver

manufacturer and customer requirements.

4.3 Preparatory work

1)When unpacking the spindle,take appropriate protective measures to check whether the appearance of the electric spindle is damaged.If there is damage, please call the service hotline 4006189083.

2) 禁止 The handling process is strictly forbidden to force the rotating shaft and cylinder .

3)Before installation,all supply pipes and lines must be cleaned to prevent foreign matter from entering the spindle.

4) After installation,the exposed part must be treated with rust prevention.

4.4 Mechanical installation

4.4.1 Mechanical connection

1) 禁止 During spindle installation,do not install rotating parts under force, otherwise the spindle will be damaged. As shown in Figure 4.1.

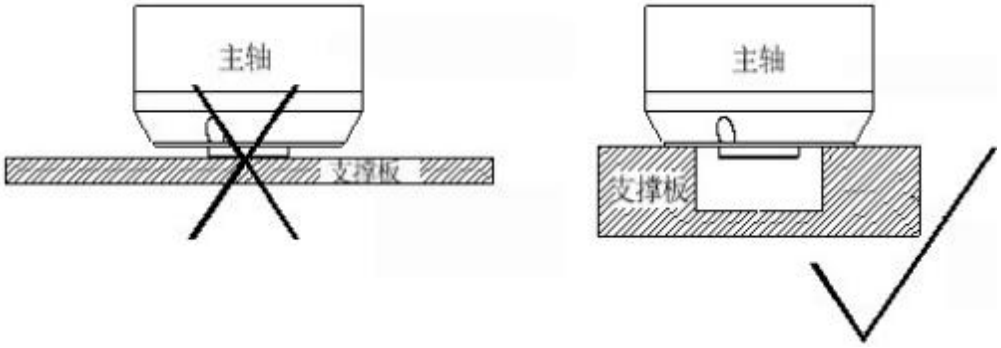
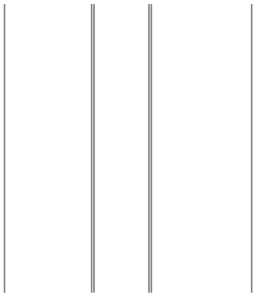


Figure 4.1 Spindle installation force diagram

2) 注意 When the spindle is center outlet or horizontal installation,the leakage hole and the center overflow hole should be straight down,as shown in Figure 4.2 below.



、前端迷宫密封 前端泄漏孔

Center overflow connector DWS
前端迷宫密封:Front labyrinth seal
前端泄漏孔:Front-end leak hole

Figure 4.2 Horizontal installation center overflow hole diagram

4.4.2 Clamp installation method

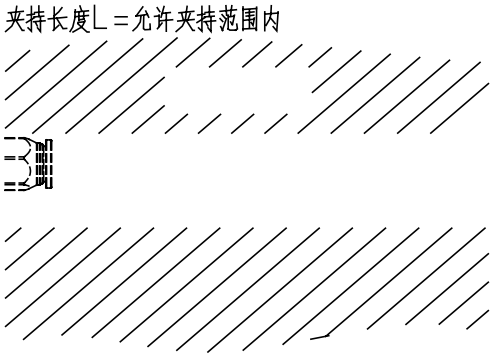
1) Before installation,please ensure that the aperture of the clamp is ΦDH6,the cylindricity of the inner hole is less than or equal to 0.01mm,and the clamping range is shown in the scale line of the body, as shown in Figure 4.3.

2) 禁止 Do not clamp the spindle beyond the scale line.

3) A slotted clamp with a protective gasket is recommended,as shown in Figure 4.4.

4) 注意 During installation,wipe the assembly surface of the clamp and spindle with industrial alcohol and other cleaning agents.

5) When clamping screws are tightened, a torque wrench is recommended to tighten them evenly.



夹持长度：Clamping length =允许夹持范围内 Clamp allowed within range

Figure4.3 Spindle clamping diagram

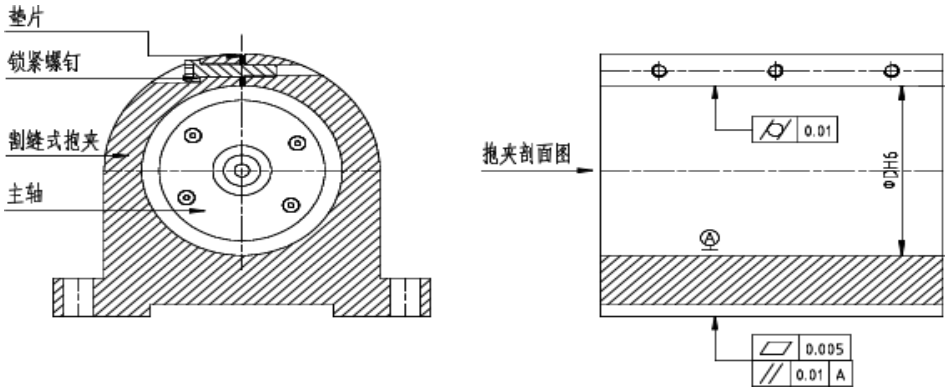


Figure 4 .4 Slit clamp installation diagram

4.4.3 Flange installation methods

1)When locking screws,it is recommended to use a torque wrench and use a symmetrical locking, so that each screw is evenly stressed and securely fastened.

2) In order to prevent vibration caused by loosening,should use the lock washer,clamping diagram see 4.5.

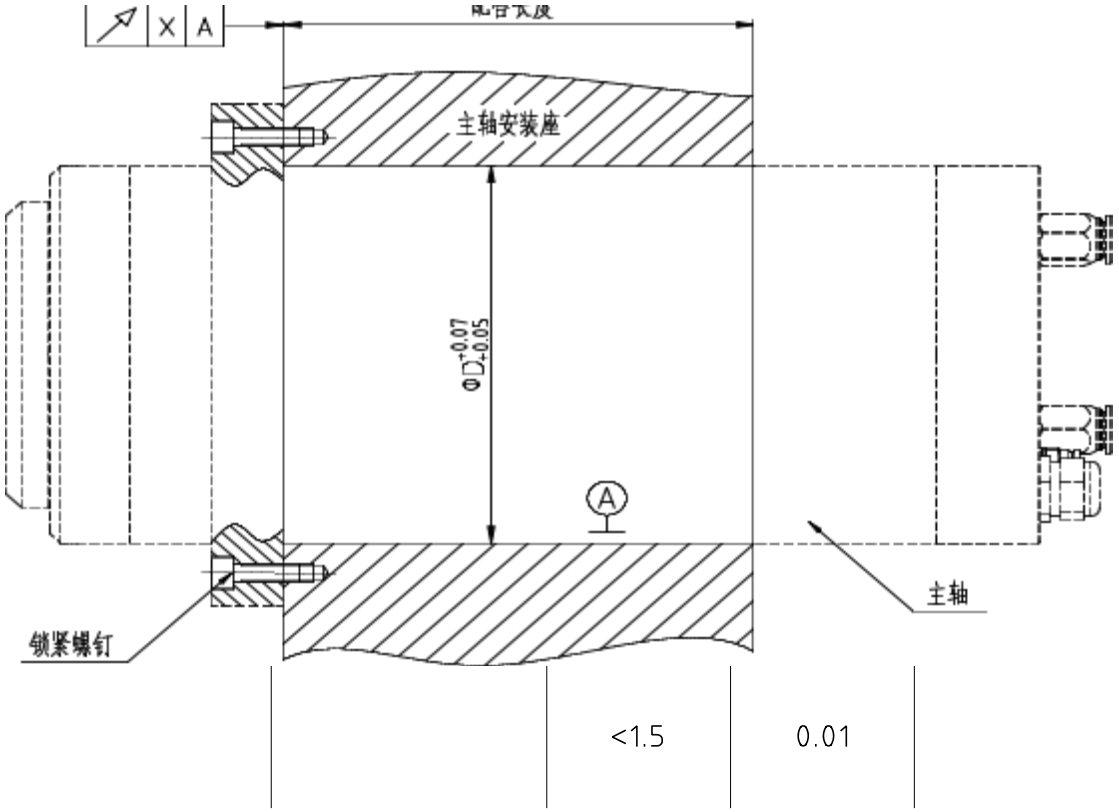


Figure4.5 Spindle clamping diagram (Spindle matched with the hole in the body)

4.5 Pipe identification description

1)Remove the gas plug,screw plug and protection plug of the spindle connecting end joint and keep it in good place for use when needed.

2)The meaning of the letters marked on the spindle housing according to the structural characteristics of the spindle is shown in Table 4.1 below.

Table 4.1 Spindle marking letter meaning

Joint category	Joint name	Typing mark
Power line function connector	Power line connector	EC
	U-phase winding outlet	U
	V-phase winding outlet	V
	W-phase winding outlet	W
	U-phase winding beginning end	U1
	U-phase winding end	U2
	Beginning end of phase V winding	V1
	V-phase winding end	V2
	W-phase winding beginning end	W1
	W phase winding end	W2
	Grounding protection	PE
Signal cable Function connector	Signal connector	SE
	Cutter clamping signal outlet	TI SE
	Cutter release signal outlet	TO SE
	Knifeless signal outlet	NT SE
	Vibration sensor signal connector	V SE
	Displacement sensor signal connector	D SE
	Encoder signal adapter	EN
	Bearing temperature sensor signal connector	T SE
	PTC stator temperature sensor signal connector	PTC
	KTY stator temperature sensor signal connector	KTY
	NTC stator temperature sensor signal connector	NTC
	Cooling water inlet	WA IN
	Cooling water outlet	WA OUT

Water function joint	Shaft core cooling water inlet joint	SWA IN
	Shaft core cooling water outlet connector	SWA OUT
	Hydraulic water inlet connector	WI
	Hydraulic water outlet connector	WO
	Central cooling inlet (water, oil, gas) connection	CTS IN
	Center overflow joint	DWS
	Ring spray water connector	TCW
Oil function joint	Cooling oil into the connector	OIL IN
	Cooling oil outlet connector	OIL OUT
	Cylinder discharge tool oil connector	TO
	Cylinder reset oil connector	TI
	Hydraulic oil into the connector	OI
	Hydraulic oil outlet connector	OO
	Brake inlet connector	OC
gas function joint	Compressed gas into the joint	AIR
	Air curtain sealing joint	AS
	Center cooling air curtain sealing joint	CTS AS
	Center blow dust connector	CL

	Gas cooling into the joint	AIR IN
	Gas cooling out of joint	AIR OUT
	Cylinder knife discharge gas connector	TO
	Cylinder reset gas connector	TI
	Brake intake connector	AC
	Fixture intake joint	FI
	Fixture outlet joint	FO
Oil and gas function joint	Front bearing oil and gas entry joint	LF
	Rear bearing oil and gas inlet joint	LR
	Bearing oil and gas outlet joint	LRET

4.6 Cooling system

4.6.1 Cooling system connection

Cooling system connection please comply with the following requirements:：

1)The coolant flow direction enters the spindle through the WAIN interface and exits from WA

OUT.

2)The coolant pipe should be a flexible pipe with a maximum operating pressure greater than 1.0MPa. Do not use non-bendable tubes such as hard plastic or metal.

3)The coolant pipe must not be twisted, and the position near the joint must be fixed to prevent pulling or twisting.

4)The flow meter is connected in the coolant circulation loop to monitor the coolant flow in real time to ensure the normal supply of the main shaft coolant.

5)After the cooling system is connected,it should be run on a test basis to check whether the coolant loop is leaking.

4.6.2 Coolant liquid requirements

1) 注意 If there is no special indication in the technical parameter table, the default cooling medium is water. If customers need to use oil cooling,please contact us for the best solution.

2) Distilled water is recommended and corrosion inhibitors are added. For example,Fernox protective agent F1 (use a ratio of 1:200). If the ambient temperature is below freezing, antifreeze must be added.Users need to configure cooling water to ensure that extreme situations such as precipitation, corrosion and water freezing are prevented.

4.6.3 Chiller setting

It is recommended to use room temperature coherent (temperature difference control) chiller, the coolant set temperature is consistent with the ambient temperature (lower than the ambient temperature 0-3℃). For example,if the environment is 30 ° C,set the chiller temperature to 27 ° C to 30 ° C.

Coolant temperature monitoring setting:the coolant temperature alarm value should be set to ±5℃ of the set temperature.For example: the coolant temperature is set to 27 ° C,then the upper limit of the coolant temperature alarm value should be set to 32 ° C,and the lower limit alarm value is 22 ° C.

The machine stops working.After the main spindle cools to room temperature,please turn off the chiller to avoid condensate water from damaging the main spindle due to excessive temperature difference.

4.7 Air circuit system

4.7.1 Air circuit system consist

The air system of this series of motorized spindles includes the following functional branches:

a)Oil and air distributor for bearing oil and gas lubrication system；

b)Main spindle nose air curtain seal AS；

c)The spindle tool change process blows the dust CL in the center of the cone hole.

d)Spindle center cooling function non-contact rotary joint air curtain seal CTS AS.

e)The tool discharging power of the spindle cylinder is TO and the broach power is TI.

4.7.2 Air circuit system connection requirements

Please comply with the following requirements for connecting the air system：

1)All air pipes directly connected to the spindle joint should be flexible pipes with a maximum working pressure greater than 1.0MPa, and non-bendable pipes such as hard plastics or metals should not be used;

2)The air pipe can not be twisted, avoid force,prevent pulling or twisting；

3)The pneumatic relay should be connected to the air circuit system according to Figure 4.6 for real-time monitoring to ensure the normal supply of compressed air;

4)Before connecting the AS, CL and CTS AS air pipes, adjust the compressed air pressure and confirm that the air pressure conforms to the pressure value specified in the spindle technical parameter table before connecting the air pipes to the corresponding joint;

5)Figure 4.6 shows all possible configurations of the gas branches of this series.When connecting the air system,connect the air branches according to the actual configuration of your spindle.

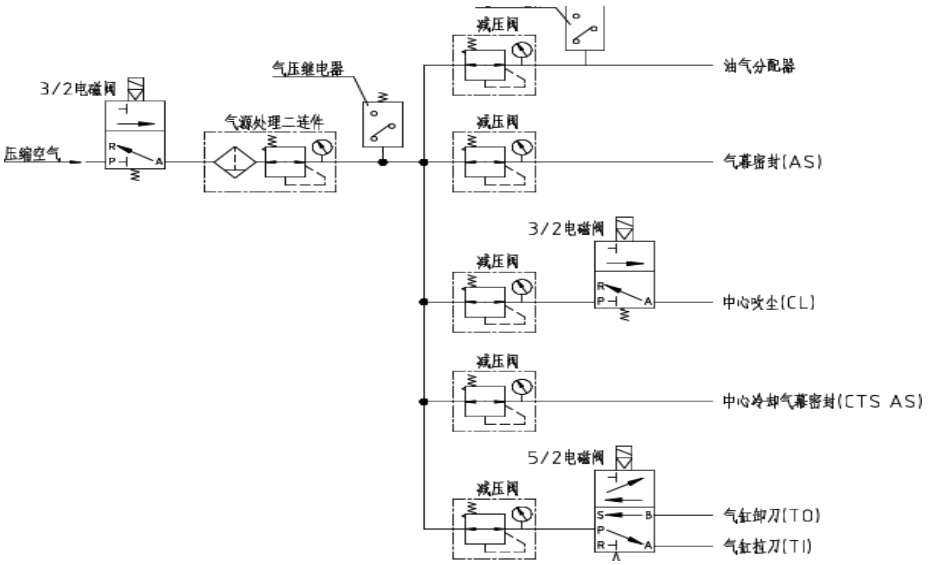


Figure 4-6 Schematic diagram of air system connection

4.7.3 Compressed air quality requirements

强制 Compressed air must be filtered,oil-water separation treatment, must meet the requirements of ISO 08573,gas quality requirements are as follows:

a) Maximum oil content, grade 3: oil concentration < 1mg/m³;

b) Solid particles,Grade 3:particle size < 5μm,particle concentration < 5mg /m³.

c) Pressure dew point,level 4: < 3℃.

强制 If the spindle is lubricated by oil and gas,the quality of the compressed air shall be based on the quality requirements of the compressed air lubricated by oil and gas.

4.7.4 Air circuit system control requirements

The air circuit system should be controlled according to the following requirements.

1)The pressure of the main circuit of the gas system must meet the pressure requirements of each branch.

2) Oil and gas distributor control according to 4.6 oil and gas lubrication system requirements;

3) Air curtain sealing AS compressed air must be started at the same time as the machine tool.If it cannot be met, the cutting fluid must be ventilated first. After the main spindle stops running,the cutting fluid should be closed firstly and then the ventilation should be stopped.

4) The center blowing dust CL must be interlocked with the broach signal TI SE of the tool handle condition monitoring proximity switch. As long as the broach signal TI SE has no output signal, the center blowing dust CL will keep starting with compressed air and stop ventilation when the

broach signal TI SE is received.

5)Central cooling air curtain sealing AS compressed air must be started at the same time as the machine tool, if it cannot be met,it must first ventilate the central cooling medium,close the central cooling medium firstly and then stop the ventilation;

6) 强制 The cylinder discharger TO and broach TI must be interlocked by a 2-position 5-way solenoid valve. When the discharger TO starts, the broach TI must be in the exhaust state; when the broach TI starts,the discharger TO must be in the exhaust state;

7) 强制 It is strictly forbidden TO start the unloading tool during the spindle rotation.

4.8 Oil-gas lubrication system（If configurated）

4.8.1 Oil-gas lubrication system connection requirements

Please comply with the following requirements when connecting the oil and gas lubrication system:

1)The oil-gas lubrication system is connected according to Figure 4.7；

2)Oil and gas pipelines must use flexible transparent plastic pipes that are resistant to hydraulic oil, and the maximum working pressure is not less than 1.0MPa.

3)The best inner diameter of oil and gas pipe is 2-2.5mm.

4) In order to form a stable circular flow,the shortest length of oil and gas pipe is 1m, the longest is not more than 10m, and the best length is 4m.

5)Each oil and gas pipe should have a spiral structure of 5 turns,with a diameter of about 50mm, about 0.5-1m from the spindle joint,and the axis of the spiral structure shall be horizontal or inclined not more than 30° from the horizontal to ensure that the lubricant can continue to supply soon after the spindle restarts, as shown in figure. 4.8.

6)The air circuit system should be connected to the pneumatic relay according to Figure 4.7 for real-time monitoring to ensure the normal supply of compressed air;

7) Special oil and gas pipe for oil and gas lubrication is recommended.

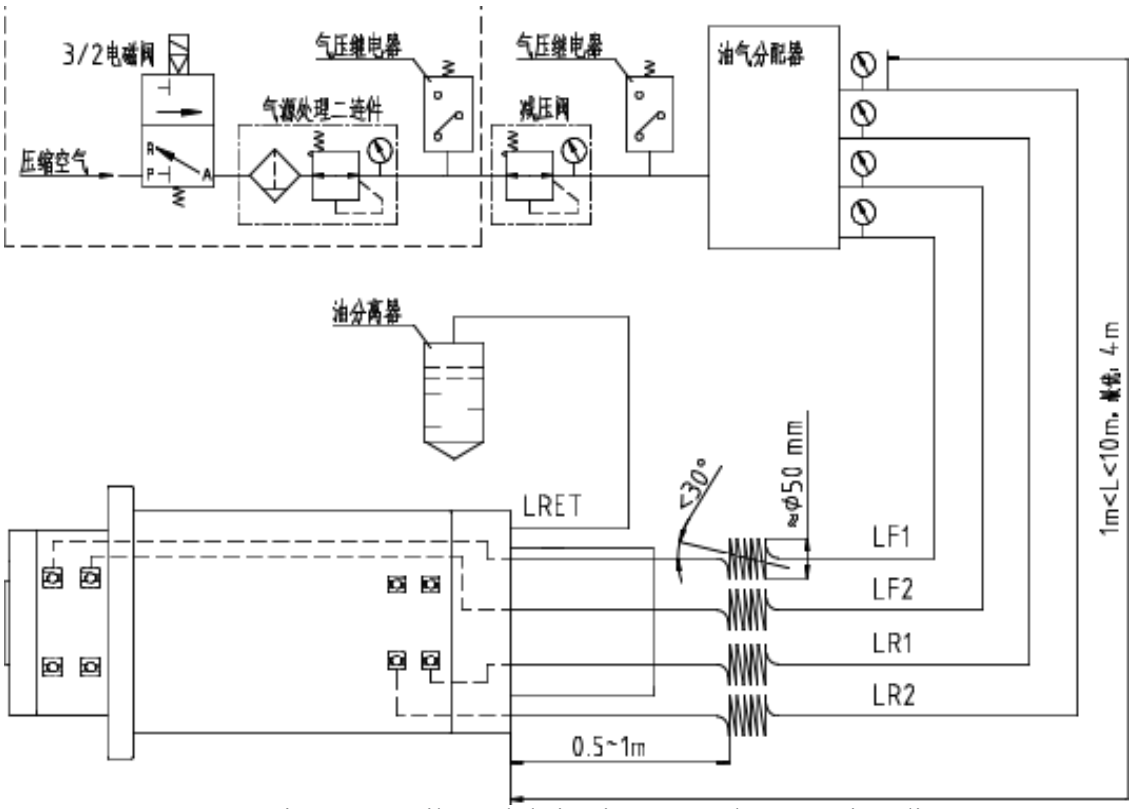


Figure 4.7 Oil-gas lubrication control connection diagram

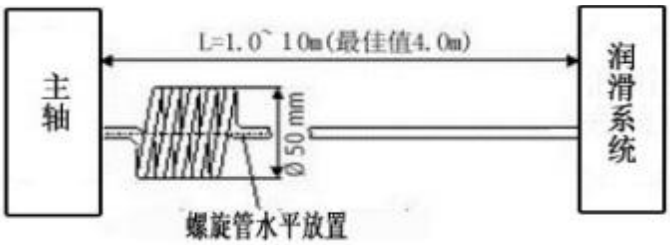


Figure 4.8 Schematic diagram of oil and gas lubrication hose

4.8.2 Lubricating oil quality requirements

Lubricants for oil and gas lubrication systems are recommended to be selected from Table 4.2 and ensure that they meet the following requirements:

a)ISO VG 68+EP standard lubricants with extreme pressure synthesis are recommended.

b)Lubricants containing molybdenum disulfide are prohibited,there is a risk of nozzle blockage.

c) It is prohibited to use railway lubricating oil mixtures.

d)Only filtered oil can be used,and the cleanliness of the lubricating oil must meet ISO4406, pollution level 13/10.

Table 4.2 Recommended lubricant brand

Company	Lubricant brand
Esso	SpartanEP68

Shell	Omala-Öl 68
Mobil	Drucköl KLP 68-C
Aral	Degol BG 68
BP	Energol HLP-D68

4.8.3 Compressed air quality requirements

Compressed air must be filtered, oil-water separation treatment, must meet the requirements of ISO 08573,gas quality requirements are as follows:：

1)Air dryness: Dew point is +2℃;

2)Air dryness: Dew point is +2℃.

4.8.4 Oil-gas lubrication system control requirements

The oil and gas lubrication system should be controlled according to the following requirements：

1)The oil and gas lubrication system must be started and stopped simultaneously with the machine.

2)The supply of compressed air and the pressure of each oil-gas branch in the oil-gas lubrication system must meet the requirements in the technical parameter table.

4.9 Tool changing unit

The tool changing unit of this series of products has two forms of pneumatic and hydraulic, the specific configuration is selected according to the characteristics of the tool handle. If the main shaft is in the form of pneumatic tool change, the connection and control of the cylinder can be completed by referring to the 4.6 gas path system in this manual. The following describes the connection and debugging of the hydraulic tool change system.

4.9.1 Connection requirements for hydraulic tool change systems

Please comply with the following requirements when connecting the hydraulic tool change system:

1)Hydraulic tool change system can be connected according to Figure 4.9;

2)All the pipes directly connected with the spindle joint should choose flexible pipes with the maximum working pressure greater than the maximum working pressure of the hydraulic tool change system. Rigid plastic or metal pipes cannot be used.

3)In order to improve the response speed of the hydraulic tool change system, the connecting tubing should be as short as possible.

4)Tubing can not be twisted, avoid force,prevent pulling or twisting.

5)Before connecting the tubing, the output pressure should be adjusted firstly,and the hydraulic pressure should meet the pressure value specified in the spindle technical parameter table before the tubing can be connected to the corresponding joint.

6)When the hydraulic tool change system is connected, the requirements of the supplier of the hydraulic pump station should be strictly observed.

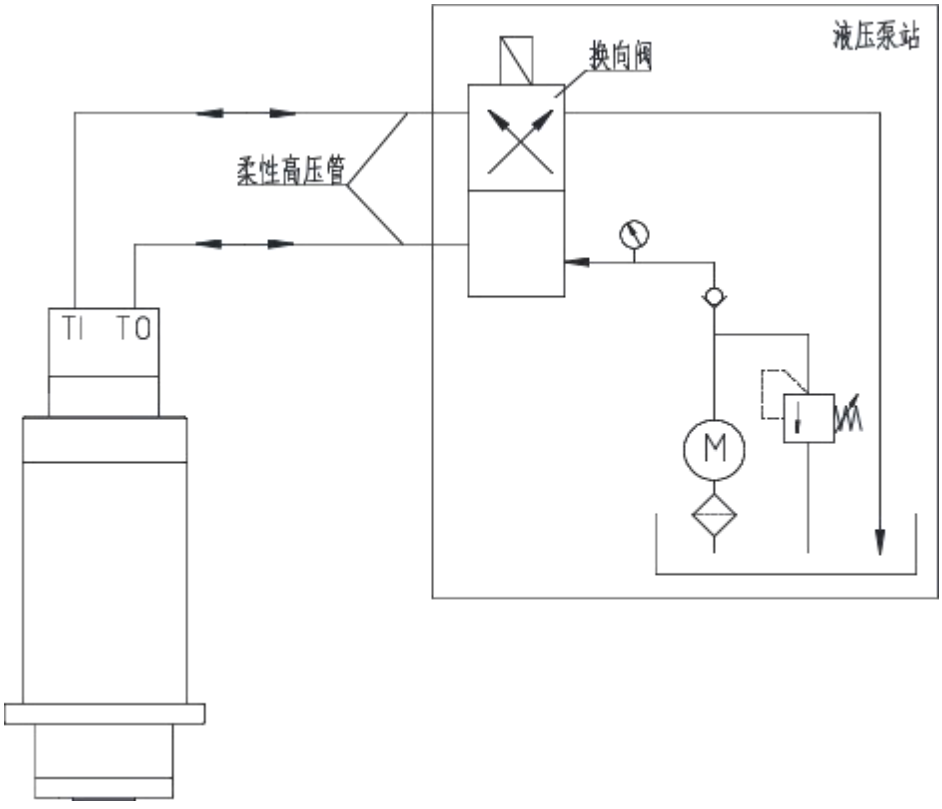


Figure 4.9 Hydraulic tool change system connection diagram

4.9.2 Hydraulic oil quality requirements

Hydraulic oil quality for hydraulic tool change system must meet the following requirements:

1)Must be HLP zinc-free anti-wear hydraulic fluid and comply with ISO VG32(32 mm2/s 40 ° C)

2)Hydraulic oil purity must meet the requirements of ISO 4406 standard 18/16/13 or higher.

4.9.3 Hydraulic tool change system control requirements

The oil and gas lubrication system shall be controlled according to the following requirements:

1) 

Tool TO and broach TI must be interlocked control,when the tool TO start, the broach TI must be in the pressure relief state, when the broach TI start,the tool TO must be in the pressure relief state.

2) 

It is strictly forbidden TO start the unloading tool during the spindle rotation.

4.10 Central cooling system

4.10.1 Central cooling system connection requirements

The connection of the rotary joint of the core cooling system shall comply with the following requirements:

1) Swivel joints can be connected as shown in Figure 4.10.

2) Part of the rotary joint has radial and axial cooling medium inlet CTS IN,the user selects one of the inlet according to the machine structure, and seals the other inlet with a screw plug;

3)The cooling medium input pipeline directly connected with the rotary joint should be flexible with the maximum working pressure greater than the maximum working pressure of the rotary joint tubes, can not use rigid plastic or metal and other non-bendable tubes;

4)Flexible pipes with a maximum operating pressure greater than 1.0MPa must be used for the pipes connecting to the overflow outlet of the rotary connector.Non-bable pipes such as rigid plastics or metals must not be used .

5) All pipes can not be twisted, avoid force,prevent pulling or twisting.

6)The cooling medium injection pipeline should be connected to the pressure relay for real-time monitoring to ensure the normal supply of cooling medium;

7) The swivel overflow line must be horizontal or downward,and the overflow outlet is the highest point of the entire overflow line to ensure the smooth removal of spilled coolant.

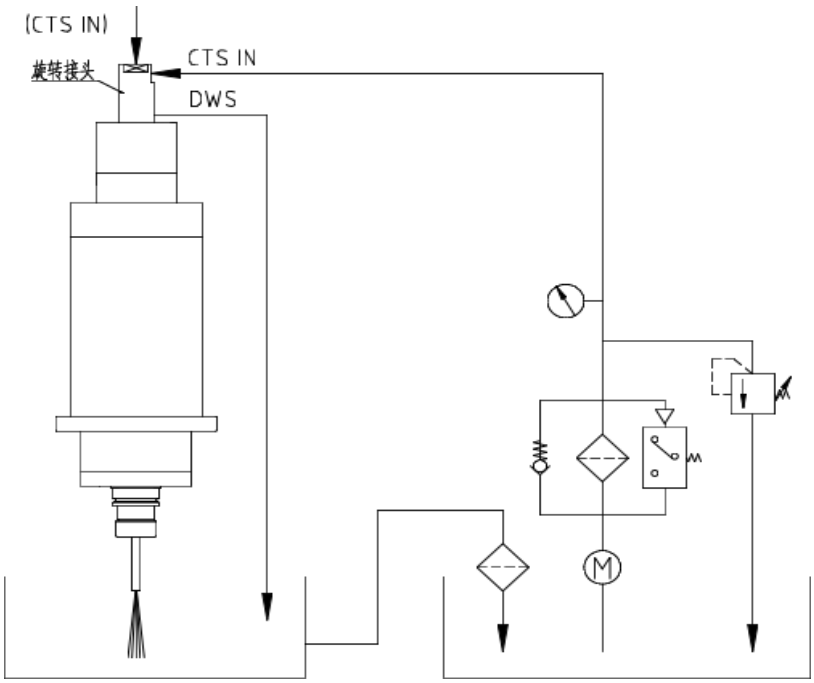


Figure 4.10 Connection diagram of rotary joint

4.10.2 Cooling medium quality requirements

The cooling medium for the central cooling system shall meet the following requirements:

1)The cooling medium should be selected according to the technical parameter table and the actual processing requirements;

2) If the cooling medium is liquid, solid particles < 25μm;

3)If the cooling medium is gas,solid particles < 5μm;

4)The injection pressure range of the cooling medium should meet the requirements in the technical parameter table;

5)The maximum injection temperature of the cooling medium is 60℃.

4.11 Electrical system connection

4.11.1Electrical connection classification

As shown in Figure 4.11, the spindle washer connection is mainly divided into:

1) Aviation plug connection ① ;

2)Extension cable aviation plug connection ② ;

3) Extension cable for direct connection ③ 。

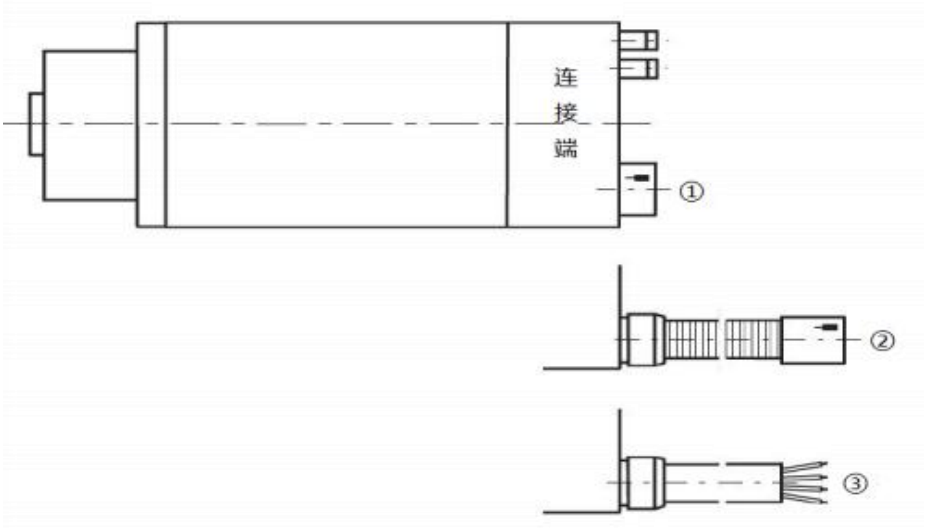


Figure 4.11 Electrical connection classification

连接端：Connecting end point

4.11.2 Power line connection

1)△ High pressure is dangerous! Perform this operation with caution and wear insulation gloves.

2) The electric spindle must be reliably grounded.

3)Aviation plug to ensure that the connection is safe and reliable,to ensure the correct insertion and withdrawal.

4) For direct connection using an extension cable,following the below steps.

a)When installing the electric spindle, first ground,and then connect the phase line;Remove the phase wire and then the ground wire when removing the motorized spindle.

b) Make sure the phase sequence is properly connected;

c) During the connection of permanent magnet synchronous electric spindle,do not rotate the spindle core.

4.11.3 Signal line connection

1)Aviation plug to ensure that the connection is safe and reliable,to ensure the correct insertion and withdrawal;

2) Signal cable The shielded cables in the cables must be grounded reliably;

3)Wear ESD gloves when connecting cables.;

4)If necessary, add a magnetic ring on the signal line to increase anti-interference ability.

4.11.4 Motor temperature detection signal

The temperature sensor is embedded inside the winding coil to monitor the motor temperature in any time,Temperature sensor standard configuration type PTC/KTY/NTC,The specific model can refer to the spindle technical parameter table.

1)PTC Stator temperature sensor (see appendix)

2)KTY Stator temperature sensor (see appendix)

3)NTC Stator temperature sensor (see appendix)

4.12 The handle and chuck

4.12.1 The handle use requirements

The tool handle should be selected according to the tool handle interface in the technical parameters,and the following requirements should be strictly implemented.

1) The handle must meet the relevant shank technical standards;

2)The tool handle and tool used by the spindle should be as short and light as possible,and should be strictly symmetrical;

3)The tool handles and tools used by the spindle shall comply with the G2.5 dynamic balance class specified in ISO1940;

4)The circular runout of the tool end shall not exceed 0.01mm;

5)Before clamping the tool handle,ensure that the tool is correctly clamped, ensure that the nut and other accessories are installed reliably,and check whether the contact surface of the tool handle is clean;

6)After clamping the knife check that the handle is in place.

7)The spindle speed shall not exceed the limit speed of the tool holder and tool.

4.12.2 Tool handle with center cooling installation instructions

Spindle with HSK taper hole and center cooling function must be clamped to handle and tool with center water function in order to operate.Otherwise it will damage the spindle. The HSK handle may be internally required to install the aqueduct,as shown in Figure 4.12. The following requirements should be met when installing aqueducts:

1)To ensure that the aqueduct is well sealed, it is recommended to apply thread sealant to the

thread assembly.

2)After the aqueduct is installed,the Angle between it and the turning center of the tool handle shall not exceed 1°.

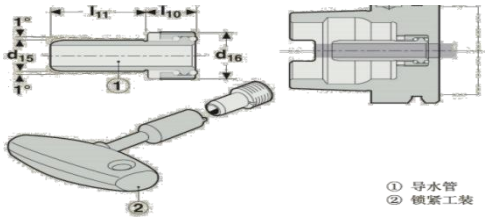


Figure 4.12 HSK The handle installation aqueduct diagram

4.12.3 The handle installation instructions without center cooling

注意 For a spindle with HSK taper hole and no central cooling function,the aqueduct inside the HSK handle should be removed,and the through hole of the upper handle should be sealed with the small screw to prevent impurities such as cutting fluid from entering the taper hole of the spindle and contaminating the handle clamping system,as shown in Figure 4.13.

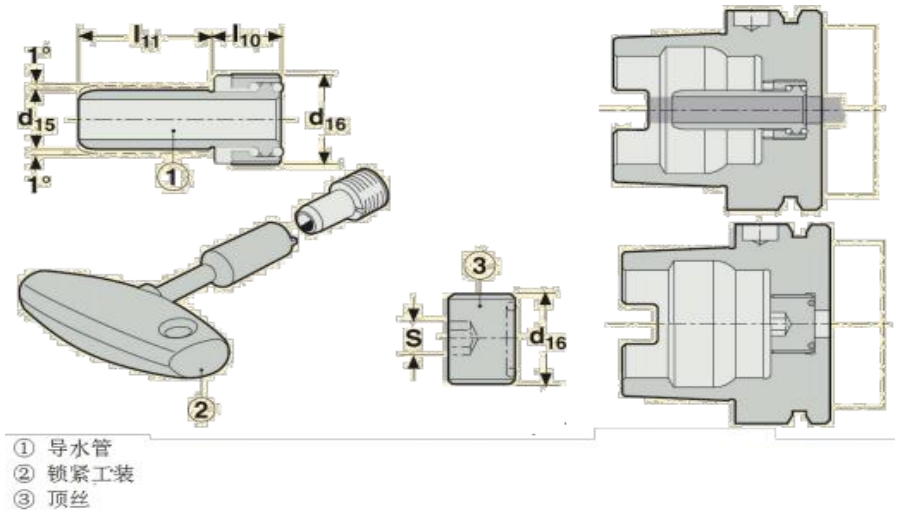


Figure 4.13 HSK tool handle does not install aqueduct

4.12.4 The handle and chuck installation requirements

a)Before installing the tool handle and chuck, make sure that the interfaces (the outer surface of the chuck, the inner hole of the chuck,the outer cone of the tool handle, the taper hole of the tool handle, the inner hole of the spindle,the external thread and the end face) are absolutely clean before installation.

b)When installing the tool handle and the chuck, apply a small amount of grease to the joints (the outer surface of the chuck,the outer cone of the tool handle, the taper hole of the tool handle,and the inner hole of the spindle shaft),and the grease must not contain impurities.

c) When installing the chuck, find the right position and gently screw it in by hand (no tools are allowed), and then lock it evenly with a wrench after it is rotated to the end;If you feel stuck in the process of screwing,do not continue to screw in,please check the reason for the stuck,remove the exception before performing operations.

5 Operation

5.1 Checking items before operation

1) Please ensure that the spindle is in a condition that can be stopped in an emergency at any time.
2) Real-time detection of broach signal,broach signal and operating signal must be interlocked, only the broach signal normal transmission.
3) Please check other items according to the following table.

Table 5.1 Checking items before operation

Cooling	If cooling loop leakage
	If Spindle motor leakage
	Whether the chiller is running
	Whether the cooling flow rate is satisfied
air-oil lubrication	The oil and gas plant is in normal operation
	The spindle must be pre-lubricated before starting
compressed air	The air circuit system is operational
hydraulic pressure	Hydraulic system in operation
system parameter	The system parameters are set correctly

5.2 Operation instructions

1)The tool is not allowed to run before the spindle is fixed,otherwise it will endanger the safety of personnel.
2)Do not touch the rotating part of the spindle when it is running.

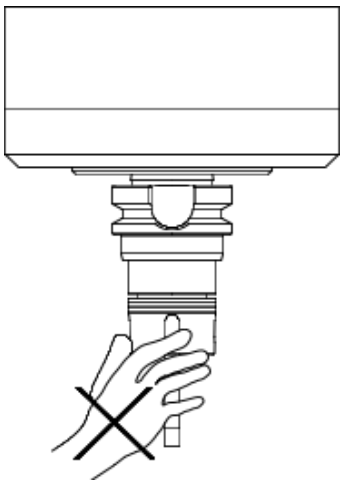


Figure 5.1 Do not touch the spindle while it is rotating

3)The machine must be heated before starting up or finishing directly in the cold state every day. The heat machine can make the machine and the spindle reach a thermal stable state.The operation of heat engine is shown in Table 5.2.

4)If the spindle has cooled to room temperature or has been stagnant for a long time,it is prohibited to restart at the highest speed,and the speed should be gradually increased.

5) 注意 If the spindle has not been used for a long time,please follow the run-in operation regulations in Chapter 3.

Table 5.2 The operation of heat engine

Steps	Rotational speed	Duration
1	25% of the maximum working speed	5 mins
2	50% of the maximum working speed	5 mins
3	application frequency	30 mins

5.3 Oil and gas prelubrication

1)In order to ensure reliable lubrication of the bearings, the spindle must be pre-lubricated before starting.

2) Pre-lubrication requirements:Lubricating oil is observed to flow into the spindle at the interface between the lubrication pipe and the spindle,and then continue for 5 minutes.

3) 

The life of the spindle is inversely proportional to the speed of use.If the spindle runs at the limit speed for a long time,the life of the spindle will be reduced.

6 Services and maintenance matters

6.1 Cooling system services and maintenance

1)Real-time monitoring of water cooler water level is normal,if it is lower than the specified water level, please supplement in time according to the correct method.

2)Check the cooling water level every week whether there is scale,floating matter,if there is, please replace the cooling water in a timely manner.

6.2 Oil-gas lubrication system services and maintenance

1)Check the compressed air water separator regularly to prevent water and dirty things from entering the system.

2)Before filling oil,clean the tank and filter the lubricating oil with filter paper and filter to prevent debris from entering.

3)Regularly check whether the air pressure of each channel of the oil and gas lubrication system, the amount of oil injection of the oil pump,and the interval of oil injection cycle meet the requirements to prevent the bearing from being damaged by insufficient oil supply or the bearing from large heat output due to excessive oil supply.

6.3 Swivel joint unit services and maintenance

1)When the spindle starts operating,it is necessary to visually measure the daily leakage amount of the rotary joint overflow outlet.In the case of abnormally constant high leakage,the spindle should stop working in time and investigate the reason.If the swivel is damaged, replace it in time.

2)We recommend to use our rotary joint,it also can use our recommended brand model rotary joint.

6.4 Tool interface services and maintenance

1)If the end customer stops for a long time,please do the necessary rust prevention treatment for the spindle cone hole before stopping,so as to avoid rust and affect the spindle yaw accuracy.
2) When replacing the spindle tool,be sure to clean the spindle tool interface to avoid the tool sticking or affecting the accuracy of the spindle.
3)Check the E.M value of the unloading tool adjustment distance of HSK taper hole every month,and compare it with Table 6.1.If it exceeds the allowable range,please contact the company's sales or call the service hotline: 4006189083.
4)Check whether the broach force is normal every month,if the tension is lower than 70% of normal value,please contact the company's sales service or call the service hotline: 4006189083.

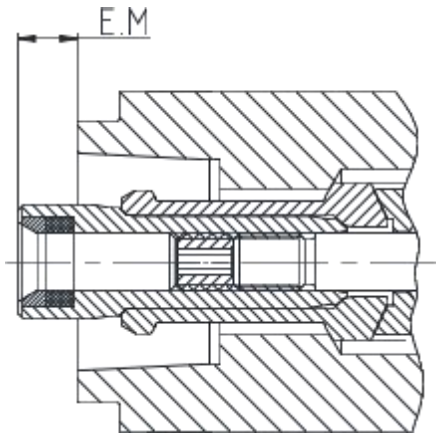


Figure 6.1 HSK taper hole discutter adjustment distance E.M value

Table 6.1HSK handle measuring EM value schematic diagram

Types	A/C	B/D	E	F	Tolerance
HSK 25	/	/	6.5	/	±0.1
HSK 32	8.5	/	8.5	/	±0.1
HSK 40	8.5	8.5	8.5	/	±0.1
HSK 50	10.5	8.5	10.5	8.5	±0.1
HSK 63	10.5	10.5	10.5	10.5	±0.1
HSK 80	13.0	10.5	/	10.5	±0.1
HSK 100	13.0	13.0	/	/	±0.1
HSK 125	16.5	13.0	/	/	±0.1

7 Error Diagnosis

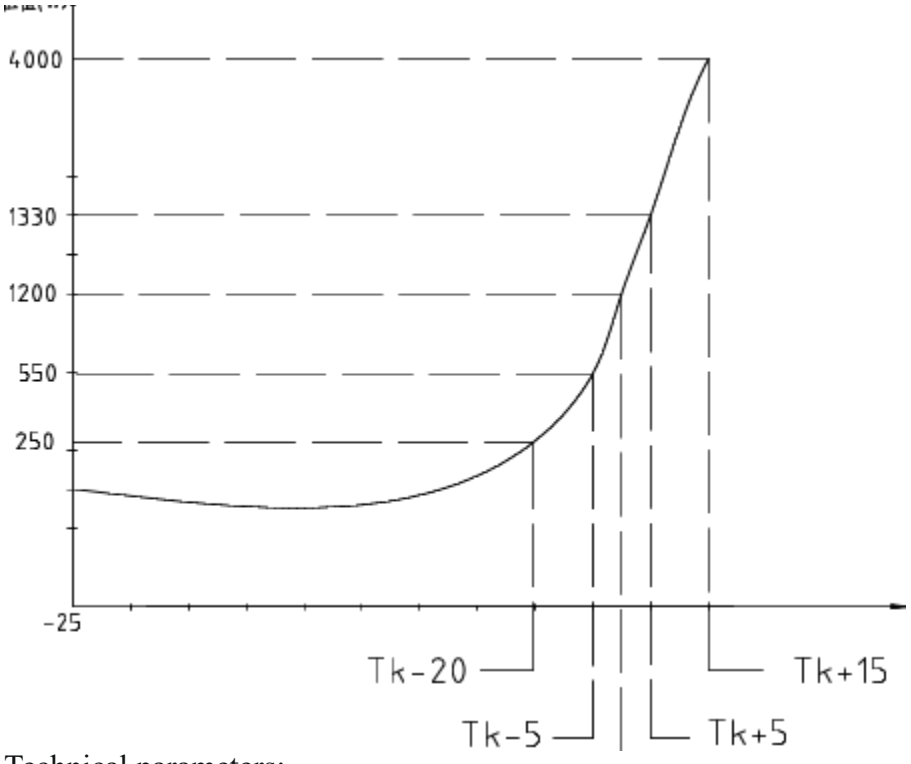
Table 7.1 Error diagnosis table

Problems	Possible reason	measures of remediation
Spindle cannot start	The spindle power cable is incorrectly connected	Check the power connection
	Drive error	Check driver Settings
	Encoder signal error	Check sensor signals and signal cable connection
	The spindle is clamped	Loose tongs
Spindle too hot	Coolant supply is low	Pump rotation direction is wrong,two phases are exchanged.
		If the cooling pipe is blocked,clean the cooling system or check whether the cooling pipe is bent.
	The coolant temperature is too high	Cooling system not working,Check safety system
	Overload operation	Check whether the normal output has been exceeded.
	Bearing wear	Change bearing
	Bearing lubrication units supply non-specified lubricants	Check whether the lubricating oil meets the requirements
	Bearing lubrication unit oil supply is too little or too much.	Check whether the oil supply Settings meet the requirements
Spindle weakness	Driver parameter setting	Set the driver parameters according to the instructions
The spindle runs	Bearing damaged	Contact us for maintenance

unsmoothly and has irregular vibration.	Spindle missing phase	Check whether the spindle power supply is securely connected
Leakage of rotary joint unit	Rotary joint unit seal worn	Replace the swivel unit
Unreleasable tool	The discharge pressure is too small	Adjust the output pressure of the hydraulic pump station or the compressed air pressure of the discharge knife according to the technical parameter table
	The tool change unit is abnormal	Contact us for maintenance
Excessive spindle vibration	The handle or tool does not meet the dynamic balance requirements	Calibrate handles and tools according to the G2.5 dynamic balance class specified in SO1940
	Bearing damaged	Contact us for maintenance

Appendix 1 PTC Stator temperature sensor (Optional)

Temperature-resistance curve of a single PTC temperature sensor



Technical parameters:

1)Sensor type:PTC(Positive Temperature Coefficient)3 in series, normal temperature resistance R25≤255Ω(3×85Ω).

2)Switching characteristic:Temperature control point Tk=145°C, Tk-5≤1650Ω(3×550Ω)

Tk+5≥3990Ω(3×1330Ω).

3)Tk deviation ΔT=±5℃,Tk repeatability ΔT=±0.5℃。

4)Thermal operation time:≤2S。

5)Maximum operating voltage 30V（DC），Insulation strength2.5KV.

6)Maximum allowable operating temperature 180℃,Minimum allowable operating temperature-25℃

Appendix 2 KTY Stator temperature sensor (Optional)

KTY temperature resistance table

Ambient temperature		temperature coefficient （%/K）	KTY84/130			
(℃)	(°F）		Resistance(Ω)			Temperature error（K）
			Minimum	Representative	Max	
-40	-40	0.84	340	359	379	±6.48
-30	-22	0.83	370	391	411	±6.36
-20	-4	0.82	403	424	446	±6.26
-10	14	0.80	437	460	483	±6.16
0	32	0.79	474	498	522	±6.07
10	50	0.77	514	538	563	±5.98
20	68	0.75	555	581	607	±5.89
25	77	0.74	577	603	629	±5.84
30	86	0.73	599	626	652	±5.79
40	104	0.71	645	672	700	±5.69
50	122	0.70	694	722	750	±5.59
60	140	0.68	744	773	801	±5.47
70	158	0.66	797	826	855	±5.34
80	176	0.64	852	882	912	±5.21
90	194	0.63	910	940	970	±5.06
100	212	0.61	970	1000	1030	±4.9
110	230	0.60	1029	1062	1096	±5.31
120	248	0.58	1089	1127	1164	±5.73
130	266	0.57	1152	1194	1235	±6.17
140	284	0.55	1216	1262	1309	±6.63
150	302	0.54	1282	1334	1385	±7.1
160	320	0.53	1350	1407	1463	±7.59
170	338	0.52	1420	1482	1544	±8.1
180	356	0.51	1492	1560	1628	±8.62
190	374	0.49	1566	1640	1714	±9.15
200	392	0.48	1641	1722	1803	±9.71
210	410	0.47	1719	1807	1894	±10.28
220	428	0.46	1798	1893	1988	±10.87
230	446	0.45	1879	1982	2085	±11.47
240	464	0.44	1962	2073	2184	±12.09
250	482	0.44	2046	2166	2286	±12.73
260	500	0.42	2132	2261	2390	±13.44
270	518	0.41	2219	2357	2496	±14.44
280	536	0.38	2304	2452	2600	±15.94
290	554	0.34	2384	2542	2700	±18.26
300	572	0.29	2456	2624	2791	±22.12

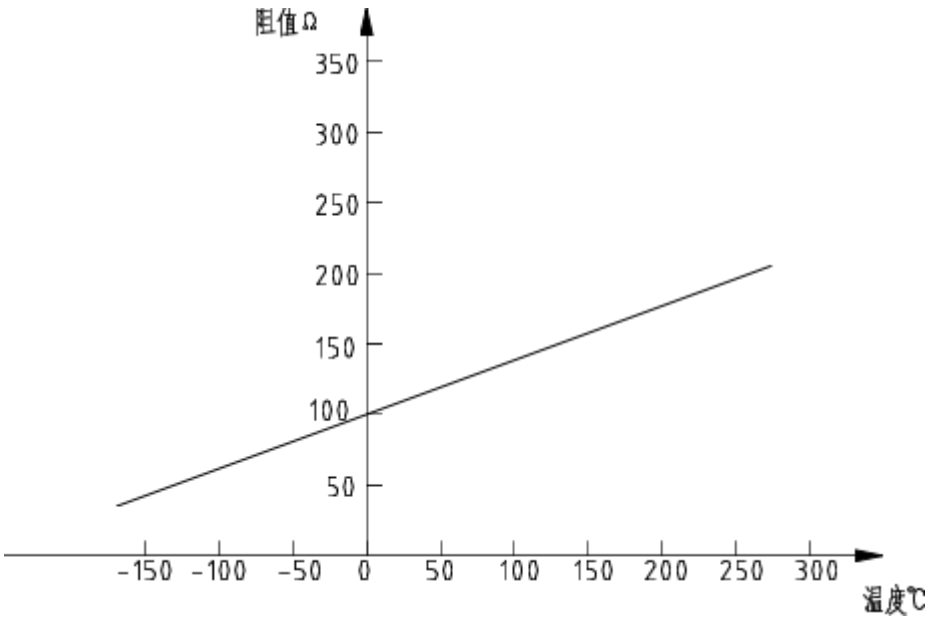
Technical parameters:Sensor type：KTY84-130,Cold resistance R20 about 581Ω,Hot resistance R100,about 1000Ω.

Appendix 3 NTC Stator temperature sensor (Optional)

NTC Temperature resistance characteristics table

$R_{25℃}$=10.0KΩ					$B_{25/50}$=3950K				
T(℃)	R(KΩ)	T(℃)	R(KΩ)	T(℃)	R(KΩ)	T(℃)	R(KΩ)	T(℃)	R(KΩ)
-50	450.974	-9	50.534	32	7.369	73	1.552	114	0.439
-49	427.897	-8	48.013	33	7.090	74	1.500	115	0.427
-48	405.892	-7	45.627	34	6.798	75	1.450	116	0.415
-47	384.927	-6	43.368	35	6.520	76	1.402	117	0.404
-46	364.967	-5	41.229	36	6.255	77	1.356	118	0.393
-45	345.975	-4	39.204	37	6.002	78	1.312	119	0.383
-44	327.915	-3	37.285	38	5.760	79	1.269	120	0.373
-43	310.751	-2	35.468	39	5.529	80	1.228	121	0.363
-42	294.448	-1	33.747	40	5.309	81	1.188	122	0.353
-41	278.969	0	32.116	41	5.098	82	1.150	123	0.344
-40	264.279	1	30.570	42	4.897	83	1.113	124	0.335
-39	250.344	2	29.105	43	4.704	84	1.078	125	0.326
-38	237.130	3	27.716	44	4.521	85	1.044		
-37	224.603	4	26.399	45	4.345	86	1.011		
-36	212.733	5	25.150	46	4.177	87	0.979		
-35	201.487	6	23.965	47	4.016	88	0.948		
-34	190.836	7	22.842	48	3.863	89	0.919		
-33	180.750	8	21.776	49	3.716	90	0.891		
-32	171.201	9	20.764	50	3.588	91	0.863		
-31	162.163	10	19.783	51	3.440	92	0.873		
-30	153.610	11	18.892	52	3.311	93	0.811		
-29	145.516	12	18.026	53	3.188	94	0.787		
-28	137.858	13	17.204	54	3.069	95	0.763		
-27	130.614	14	16.423	55	2.956	96	0.740		
-26	123.761	15	15.681	56	2.848	97	0.718		
-25	117.280	16	14.976	57	2.744	98	0.697		
-24	111.149	17	14.306	58	2.644	99	0.676		
-23	105.351	18	13.669	59	2.548	100	0.657		
-22	99.867	19	13.063	60	2.457	101	0.637		
-21	94.681	20	12.487	61	2.369	102	0.619		
-20	89.776	21	11.939	62	2.284	103	0.601		
-19	85.137	22	11.418	63	2.204	104	0.584		
-18	80.750	23	10.921	64	2.126	105	0.567		
-17	76.600	24	10.449	65	2.051	106	0.551		
-16	72.676	25	10.000	66	1.980	107	0.535		
-15	68.963	26	9.571	67	1.911	108	0.520		
-14	65.451	27	9.164	68	1.845	109	0.505		
-13	62.129	28	8.775	69	1.782	110	0.491		
-12	58.986	29	8.405	70	1.721	111	0.477		
-11	56.012	30	8.025	71	1.663	112	0.464		
-10	53.198	31	7.716	72	1.606	113	0.451		

Appendix4 PT100 Bearings temperature sensor (Optional)



PT100 Temperature resistance characteristic curve

Technical parameters:

1)Sensor type:PT(Positive Temperature Coefficient:PTC)Resistance resistance at zero R0=100Ω Temperature rate number TCR-0.003851.

2)Temperature measuring range: -50℃~200℃.

3)Temperature/resistance characteristics (temperature resistance pairs)

When -200℃<t<0℃ $R_t=R_0[1+At+Bt^2+C(t-100)t^3)]$

When 0℃<t<850℃ $R_t=R_0(1+At+Bt^2)$

R_t:Resistance value at t ℃

R_0:Resistance value at 0℃

4)Coefficient value when TCR=0.003851

Coefficient	A	B	C
Numerical value	3.9083×10^{-3} ℃$^{-1}$	-5.775×10^{-7} ℃$^{-2}$	-4.183×10^{-12} ℃$^{-4}$

5) Measurement error

Resistance error % at zero	Temperature error ℃	Temperature coefficient TCR error Ω/Ω/℃
±0.12	±(0.30+0.005|t|)	0.003851±0.000012

6) PT100 Platinum resistance index table (see table as below listed)

PT100 Platinum resistance index table

Temperature ℃	0	1	2	3	4	5	6	7	8	9
	Resistance value(Ω)									
-50	80.31	79.91	79.51	79.11	78.72	78.32	77.92	77.52	77.12	76.73
-40	84.27	83.87	83.48	83.08	82.69	82.29	81.89	81.5	81.1	80.7
-30	88.22	87.83	87.43	87.04	86.64	86.25	85.85	85.46	85.06	84.67
-20	92.16	91.77	91.37	90.98	90.59	90.19	89.8	89.4	89.01	88.62
-10	96.09	95.69	95.3	94.91	94.52	94.12	93.73	93.34	92.95	92.55
0	100	99.61	99.22	98.83	98.44	98.04	97.65	97.26	96.87	96.48
0	100	100.39	100.78	101.17	101.56	101.95	102.34	102.73	103.12	103.51
10	103.9	104.29	104.68	105.07	105.46	105.85	106.24	106.63	107.02	107.4
20	107.79	108.18	108.57	108.96	109.35	109.73	110.12	110.51	110.9	111.29
30	111.67	112.06	112.45	112.83	113.22	113.61	114	114.38	114.77	115.15
40	115.54	115.93	116.31	116.7	117.08	117.47	117.86	118.24	118.63	119.01
50	119.4	119.78	120.17	120.55	120.94	121.32	121.71	122.09	122.47	122.86
60	123.24	123.63	124.01	124.39	124.78	125.16	125.54	125.93	126.31	126.69
70	127.08	127.46	127.84	128.22	128.61	128.99	129.37	129.75	130.13	130.52
80	130.9	131.28	131.66	132.04	132.42	132.8	133.18	133.57	133.95	134.33
90	134.71	135.09	135.47	135.85	136.23	136.61	136.99	137.37	137.75	138.13
100	138.51	138.88	139.26	139.64	140.02	140.4	140.78	141.16	141.54	141.91
110	142.29	142.67	143.05	143.43	143.8	144.18	144.56	144.94	145.31	145.69
120	146.07	146.44	146.82	147.2	147.57	147.95	148.33	148.7	149.08	149.46
130	149.83	150.21	150.58	150.96	151.33	151.71	152.08	152.46	152.83	153.21
140	153.58	153.96	154.33	154.71	155.08	155.46	155.83	156.2	156.58	156.95
150	157.33	157.7	158.07	158.45	158.82	159.19	159.56	159.94	160.31	160.68
160	161.05	161.43	161.8	162.17	162.54	162.91	163.29	163.66	164.03	164.4
170	164.77	165.14	165.51	165.89	166.26	166.63	167	167.37	167.74	168.11
180	168.48	168.85	169.22	169.59	169.96	170.33	170.7	171.07	171.43	171.8
190	172.17	172.54	172.91	173.28	173.65	174.02	174.38	174.75	175.12	175.49
200	175.86	176.22	176.59	176.96	177.33	177.69	178.06	178.43	178.79	179.16

Appendix5 Encoder

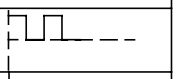
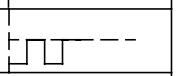
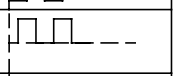
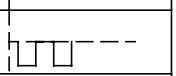
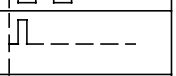
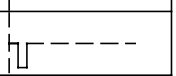
Technical parameters of chord encoder

Electrical data	
Supply voltage UB	5 V DC±5%，Anti-reverse polarity, anti-voltage surge
Output level	1 Vss differential signal
Output signal	Two 90° offset sinusoidal signals and their opposite signals, anti-short circuit; Option: Reference pulse.
Output frequency	0 to 200 KHz
Power consumption at no load	≤0.3 W
Electromagnetic compatibility(EMC)	EN61000-6-1 TO 4
Insulation strength	500V，on the basis of EN 60439-1
Mechanical data	
Allowable air gap	0.5mm±0.3,When the modulus is 1.0; 0.20mm±0.03,when the modulus is 0.5; 0.15mm±0.02，When the modulus is 0.3;
Measure the material of the gear	Ferromagnetic steel
Operating temperature range	-30℃ to +85℃
Operating temperature and storage temperature range	-40℃ to +120℃
Protection class	IP 68
Vibration resistance	200 m/s^2 ，on the basis of DIN EN 60068-2-6
Impact resistance	2000 m/s^2 ，on the basis ofDIN EN 60068-2-27
Quality	30g
Housing material	Zinc die-casting
Electrical connection	
Core number x core cross section	9×0.15mm^2
Maximum allowable cable length	100 m
Cable diameter	5 mm
Minimum bending radius	25 mm

芯的颜色	信号/功能		
白色	U_{1+}	轨迹1	
棕色	U_{1-}	/轨迹1	
灰色	U_{N+}	基准轨迹	
蓝色	0V	0V	
红色	U_B	+5V电源电压	
玫瑰色	U_{2+}	轨迹2	
黑色	U_{2-}	/轨迹2	
黄色	U_{N-}	/基准轨迹	
绿色	U_{sense}	5V Sense	

Square wave encoder technical parameters

Electrical data	
supply voltage UB	5 V DC±5%
Time consuming current	≤60mA
VOH（open-output）	≥2.5V
VOL（open-output）	≤0.5V
VOH（RL=120Ω)	≥2.5V
VOL（RL=120Ω)	≤0.5V
Output signal	TTL（Line Driver）
Maximum phase shift	+25。
Maximum corresponding frequency	≥500 KHz
Mechanical data	
Allowable air gap	0.15±0.03 mm
Operating temperature range	-20℃ to +80℃
Protection class	IP 68
Vibration resistance	10G
Impact resistance	100G
Electrical connection	
Core number x core cross section	9×0.15mm^2

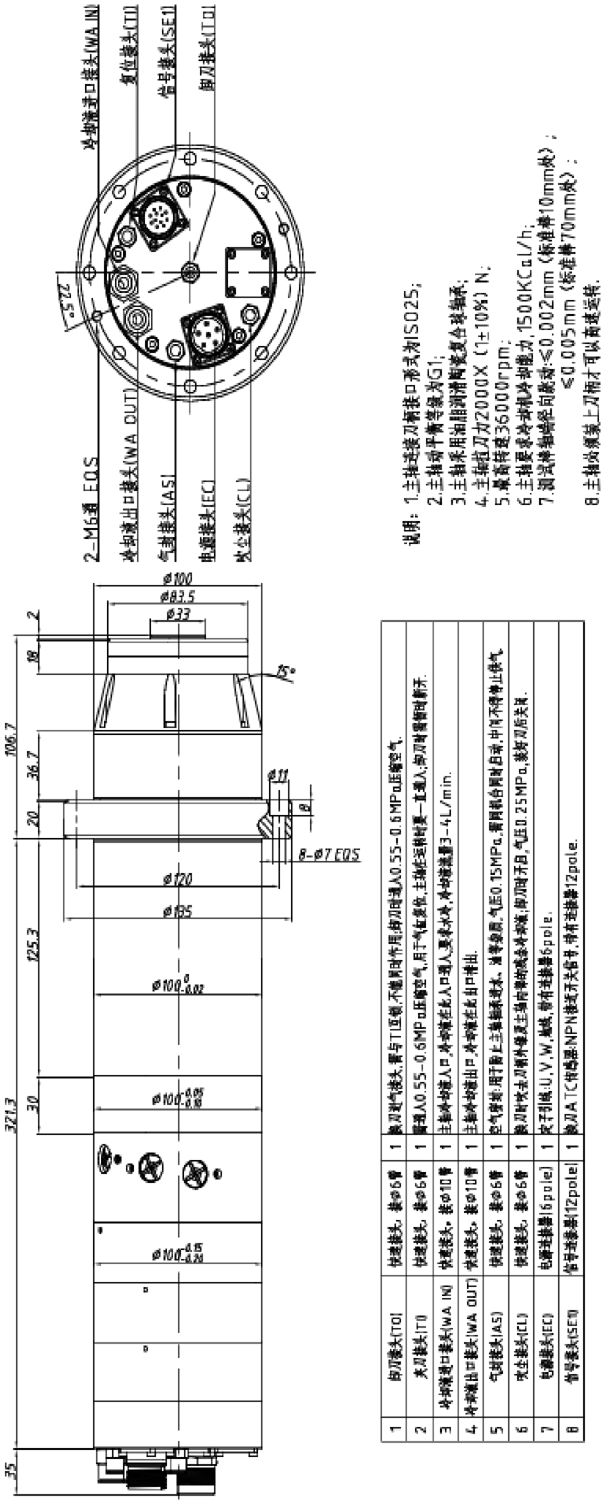
芯的颜色	信号/类型		
绿色	A+	标准TTL	
黄色	A-		
蓝色	B+		
红色	B-		
灰色	Z+		
粉红色	Z-		
棕色	5V		
白色	0V		

Appendix6 Proximity switch

Proximity switch technical parameters

Aftermath, Max (% Ue)，	10%
Reverse polarity protection	Yes
Ready delay tv, Max	21 ms
Operating voltageUb	10…30 VDC
Switching frequency	5000 Hz
Measuring operating voltage Ue DC	24 V
Measuring working currentIe	100 mA
Voltage drop, static, Max	2 V
Lag H, Max (% of Sr)H，（Sr ）	15.0%
Temperature drift, Max (% Sr)	10%
Ambient temperature	-25℃…+70℃
Protection class	IP 67
Housing material	Stainless steel
Connection mode	Cables and connectors，0.30m

Appendix 7. Spindle outline drawing



1.卸刀接头：Knife discharge joint: 快换接头 Tool change joint

2.夹刀接头：Knife joint 快换接头

3.冷却液进口接头 Coolant inlet connector	快换接头
4.冷却液出口接头 Coolant outlet connector	快换接头
5.气封接头 Gas seal joint	快换接头
6.吹尘接头 CL Dust-blown joint	快换接头
7.电源接头 Power connector	电源适配器 Power adapter
8.信号接头 Signal connector	信号连接器 Signal connector
说明：	Remarks
1.主轴连接刀柄接口形式为 IS025.	The interface between the spindle and the tool holder is IS025.
2.主轴动平衡等级为 G1	The spindle dynamic balance level is G1
3.主轴采用油脂润滑陶瓷复合球轴承	The spindle uses grease lubricated ceramic composite ball bearings
4.主轴拉刀力 2000X(1±10%)N	Spindle broach force 2000X(1±10%)N
5.最高转速为 36000rmp.	The maximum speed is 36000rmp.
6.主轴要求冷却机冷却能力 1500KCol/h.	The spindle requires cooling capacity of 1500KCol/h.
7.测试棒轴端径向跳动：≦0.002mm(标准棒 10mm 处，≦0.005mm(标准棒 70mm 处)	Radial runout of test rod shaft end: ≦ 0.002mm(standard rod 10mm, ≦ 0.005mm(standard rod 70mm)
8.主轴必须要装上刀柄才可以高速运转。	The spindle must be equipped with a tool handle to operate at high speed.

换刀进气接头，需与 TI 互锁，不能同时作用，卸刀时进入 0.55-0.6MPa 压缩空气	Tool change air inlet joint, need to be interlocked with TI,can not work at the same time,when unloading the knife into 0.55-0.6MPa compressed air
需接入 0.55-0.6MPa 压缩空气，用于气缸复位，主轴在运转时要一直接入，卸刀时要暂时断开。	It is necessary to connect 0.55-0.6MPa compressed air for cylinder reset, the spindle should be connected all the time when running,and the knife should be temporarily disconnected when unloading.
主轴冷却液入口，冷却液在此入口通入，要求水冷，冷却液流量是 3-4L/min.	The spindle coolant inlet,where the coolant enters, requires water cooling,coolant flow rate is 3-4L/min.
主轴冷却液出口，冷却液在此出口排出	The spindle coolant outlet, where the coolant is discharged
空气密封：用于防止主轴轴承进水，油雾分离，气压 015MPa,需同机台同时启动，中间不得停止供气。	Air seal: used to prevent the main shaft bearing water, oil mist separation, air pressure 015MPa, need to start at the same time, the middle shall not stop the gas supply.
换刀时吹去刀柄外部及主轴内部的残余冷却液，卸刀时开启，气压 0.25MPa,装好刀后关闭。	When changing the tool, blow off the residual coolant outside the tool handle and inside the spindle, open when unloading the tool, the air pressure is 0.25MPa, and close after the tool is installed.
定子引线，U,V,W,	Stator leads, U,V,W,
换刀 AT ,传感器：NPN,接近开关信号，带有连接器	Tool change AT, sensor: NPN, proximity switch signal, with connector

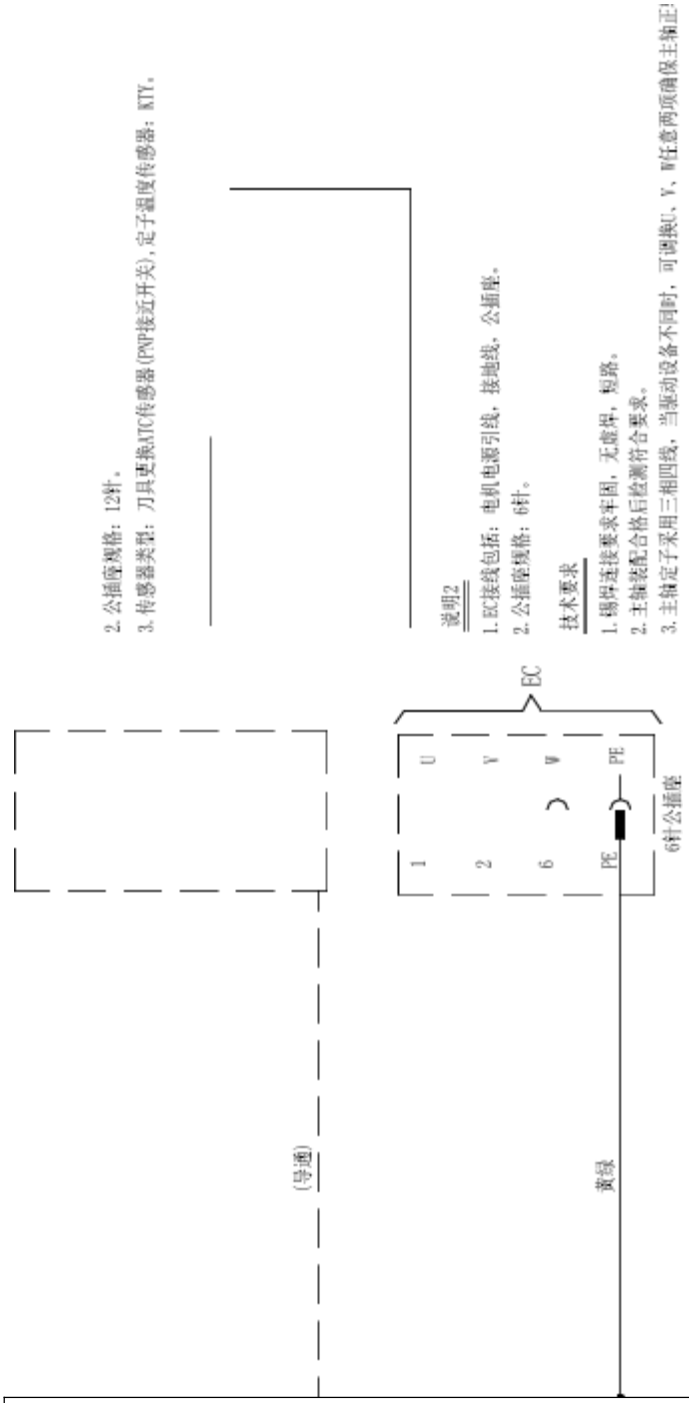
Appendix 8. Spindle technical parameters table

Spindle mode	DGZX-10036 / 6.0D2-IFPWS		
Motor type	Asynchronous induction	Bearing lubrication	Grease
Maximum frequency	1200Hz	Maximum speed	36000 rpm
Voltage	380V	Spindle weight	17.4kg
Rated frequency	667Hz	Rated speed	20000 rpm
Rated powe(S1-100%)	6kW	Rated power(S6-40%)	9kW
Rated current(S1-100%)	13A	Rated current(S6-40%)	19.5A
Rated torque(S1-100%)	2.8Nm	Rated torque(S6-40%)	4.3Nm
Motor winding insulation resistance	≥500(MΩ)	Voltage resistance test of motor winding(V/M)	1500V/1 minute voltage resistance test
Number of motor poles	4	Stator temperature sensor model	KTY
The tool handle joint	ISO 25	Tool change mode	Cylinder tool change
Loose and broach signal	The PNP is normally on（2 sensors）	Encoder	NO

Technical parameters

1	Cylinder discharger oil pressure (Mpa)	0.55-0.6
2	Cylinder reset pressure (Mpa)	0.55-0.6
3	Dust blowing gas flow (L/min)	80±20(Atmospheric pressure 0.25MPa)(When changing tool)
4	Sealed air flow rate (L/min)	60±20(Atmospheric pressure 0.15MPa)(Working)
5	Radial stiffness (N/μm)	≥120
6	Axial stiffness (N/μm)	≥60
7	Shaft end radial runout (mm)	≤0.002（At test rod 10mm ） ≤0.005（At test rod 70mm）
8	Cone bore runout (mm)	≤0.001
9	Vibration value(mm/s)	≤0.8 mm/s
10	Outside diameter (mm)	Φ100(0/-0.02)
11	Coolant flow (L/min)	3-4（Cooling pressure 0.25MPa）
12	Handle tension (N)	2000(1±10%)
13	Axial displacement of tool handle during tool unloading (mm)	0.4-0.6
14	Cooling medium	Water

Appendix 9 Spindle wiring diagram



说明 1	Remark1
1.SE1 接线包括：ATC 传感器引线，定子温度传感器引线	SE1 cables include: ATC sensor lead, stator temperature sensor lead
2.公插座规格：12 针	The socket size: 12 pins

3.传感器类型：刀具更换 ATC 传感器（PNP 接近开关），定子温度传感：KTY	Sensor type: Tool change ATC sensor (PNP proximity switch), stator temperature sensor: KTY

ATC 传感器位置调整要求			
序号	TO	NT	动作要求
1	1	0	卸刀具状态
2	0	1	无刀具状态
3	0	0	刀具拉紧状态

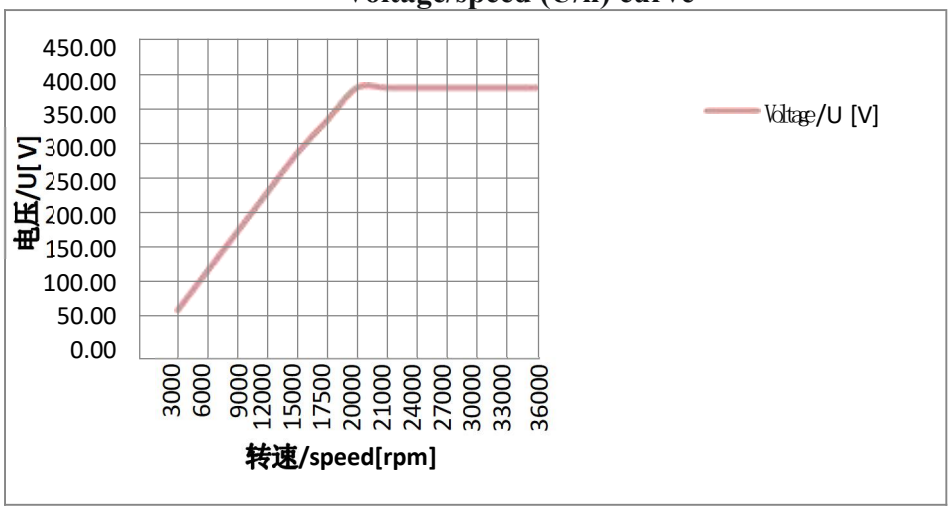
ATC sensor position adjustment requirements			
No.	TO	NT	Action requirement
1	1	0	Tool unloading condition
2	0	1	Toolless condition
3	0	0	Tool tension condition

说明 2	Remark2
1.EC 接线包括：电源电机引线，接地线，公插座	EC cables includes: power motor lead, ground wire, male socket
2.公插座规格：6 针	The socket size: 6 pins

技术要求	Technical requirements
1.锡焊连接要求牢固，无虚焊，短路	Solder connection must be firm, no welding, short circuit.
2.主轴装配合格后检测符合要求	After the spindle assembly is qualified, the test meets the requirements
3.主轴定子采用三相四线，当驱动设备不同时，可调换 U,V,W 任意两确保主轴正转	Spindle stator adopts three-phase four-wire, when the driving equipment is different,you can exchange U,V,W any two to ensure that the spindle is turning

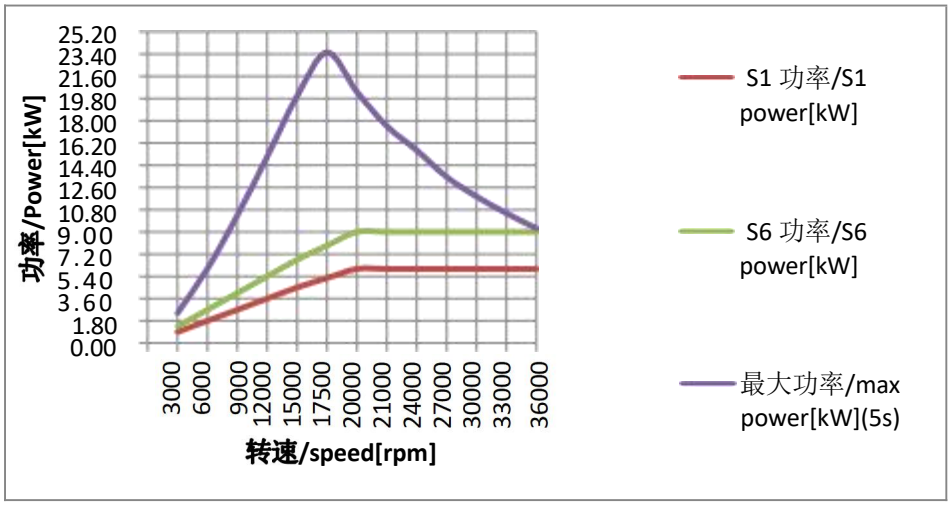
Appendix 10. Motor characteristic curve

Voltage/speed (U/n) curve

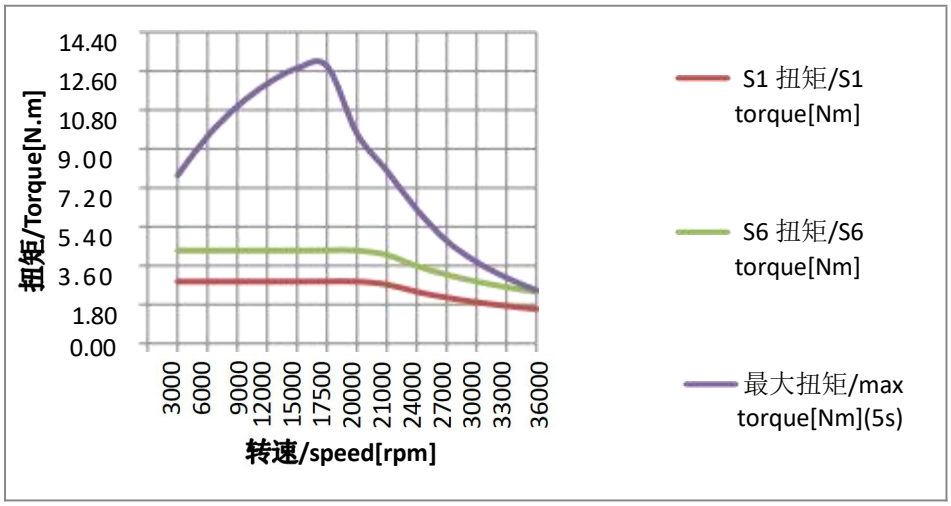


电压： **Voltage**

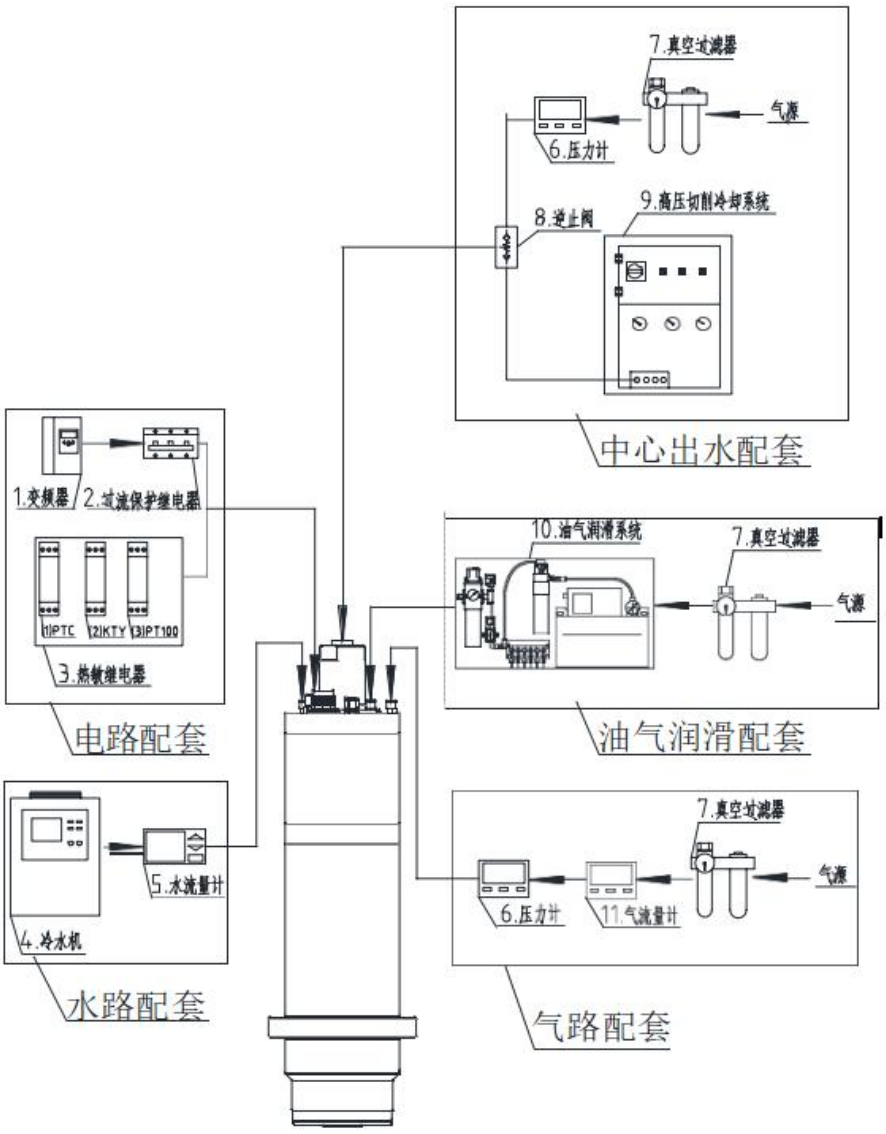
Power/speed (P/n) curve



Torque/speed (T/n) curve



Appendix 11. Water, gas and electricity supporting facilities



	
Name	Variable-frequency Drive
Function	Drive spindle operation, monitor motor condition, detect thermal sensitivity, etc.
Brand model：	Taida Variable-frequency Drive,sieb & meyer Variable-frequency Drive. CT Variable-frequency Drive.
Parameter	Power, voltage, current, frequency, etc.
Selection basis ：	The Variable-frequency Drive selection should be based on the maximum voltage and power of the spindle motor, the Variable-frequency Drive should be greater than the spindle voltage, the fVariable-frequency Drive power should be greater than the maximum power of the spindle. Taking DGZX-11330/8.5-KFPWVS as an example, the maximum voltage is 380V, the power is 8.5kW, and the maximum power is 10.2kW, then the inverter chooses the voltage 380V and the power is greater than 11kW.

Name:	Overcurrent protection relay
Function:	Automatically disconnect when the current is too large to prevent burning the motor.
Brand model :	Meilan Power D100A
Parameter:	Maximum carrying current;Number of terminals (3p/4p)
Selection basis:	The maximum turn-off current should be determined according to the maximum allowable current of the spindle and the maximum withstand current time,the maximum turn-off current of the relay should be higher than the maximum allowable current of the spindle, and the turn-off time should be equal to the maximum allowable current passing time of the spindle. Take DGZX-11330/8.5-KFPWVS as an example, the maximum allowable through current is 31A,the maximum allowable current duration is 2s,then the relay should select the maximum disconnecting current greater than 31A,the maximum allowable current through time is equal to 2s type relay.

Name	KTY Thermistor relay
Function	Automatically disconnect when the temperature is too high to prevent the motor from overheating.
Brand model：	Schneider TeSys LT3
Selection basis ：	The selection of a thermistor should be based on the specific thermistor type of the spindle and the maximum thermistor resistance required by the spindle.

Name:	PT100 Temperature monitoring relay
Function:	Automatically disconnect when the temperature is too high to prevent the motor from overheating.
Brand model:	ABB CM-TCS.23S
Selection basis:	The selection of a thermistor should be based on the specific thermistor type of the spindle and the maximum thermistor resistance required by the spindle.

	
Name	PTC Thermistor relay
Function	Automatically disconnect when the temperature is too high to prevent the motor from overheating.
Brand model:	ABB CM-MSE 24VAC
Selection basis ：	The selection of a thermistor should be based on the specific thermistor type of the spindle and the maximum thermistor resistance required by the spindle. Take DGZX-10036/3.5-IFPWVS as an example. If the thermistor type is PTC and the resistance value of the thermistor in normal operation is less than or equal to 550Ω, the thermistor relay should be PTC thermistor relay and the maximum opening resistance should be greater than 550Ω

Name:	Chiller
Function:	Ensure sufficient flow and stable temperature of the cooling medium.
Brand model:	RUCOL RCW-20P
Alarm pressure, temperature::	MPa（Head or pressure），XX℃, Must be connected to the machine PLC for monitoring.
Have the function of:	Insufficient water pressure, high temperature, all need to alarm, must be connected to the machine PLC for monitoring.
Selection basis:	Chiller selection should be based on the main shaft cooling flow and cooling temperature, chiller cooling maximum flow should be greater than the main shaft cooling flow,the working temperature should meet the spindle cooling temperature requirements,cooling capacity should be greater than 20% of the main shaft power.

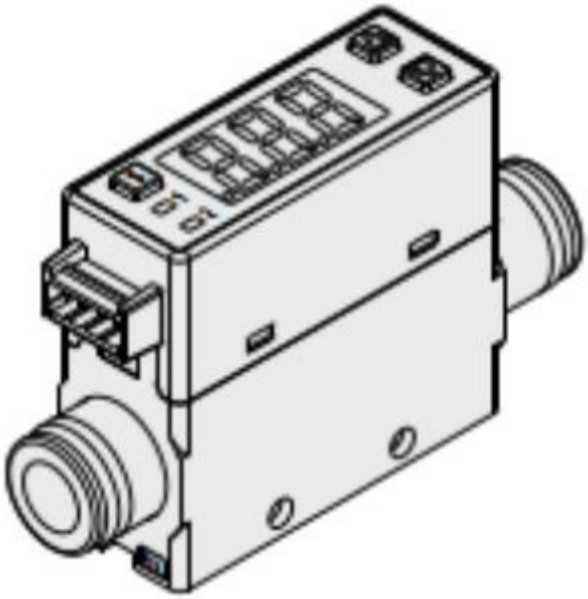
Name:	Water flowmeter
Function:	Monitor cooling media flow.
Brand model:	SMC PF2W720T-00-27N
Alarm flow	XX L/min,(The water flow is not lower than the recommended water flow of the spindle, the recommended water flow of the spindle can refer to the technical parameter table in the spindle manual), must be connected to the machine PLC for monitoring.
Selection basis:	The maximum flow rate that the water flowmeter can monitor should be greater than the flow rate of the chiller.

Name:	Pressure gauge
Function:	Monitoring safe pressure
Brand model:	SMC ISE40A-01-R
Warning pressure	XXX MPa,The air pressure shall not be lower than the minimum recommended pressure of the spindle, the recommended pressure of the spindle can be referred to the technical parameter table in the spindle manual), and must be connected to the machine PLC for monitoring
Selection basis:	The monitoring flow range should cover the normal working pressure of the spindle.

Name:	Vacuum filter
Function	Three-stage filtration of water, oil and other impurities in the air source
Brand	SMC triplet F.R.L.. SMC Air dryer IDG50A-03
Filter element type	af30p-060s（5um）Pre-filter fluid, water） afm30p-060as（0.3um）Condensate filter removes oil） afd30-f03d（0.01um）Activated carbon removes oil vapors）
Filter element change cycle	It is appropriate to replace it once every 4 months, and the drainage cycle is appropriate for 1 month.
Selection basis:	The air flow through the spindle requires filtration accuracy < 1μm, oil content < 0.01mg/m³, and solid particles < 1μm.

	
Name:	Check valve
Function:	Switch moisture to ensure the moisture required for processing.
Brand:	DETER ORS01/3
Selection basis:	One-way switching high pressure water gas, the maximum pressure is greater than the pressure used by the main shaft, such as the current central power supply main shaft water pressure 0.5-6MPa, so the pressure is more than 6MPa.
	
Name:	High pressure cutting cooling system
Function:	Provide high pressure water for central outlet with a maximum water pressure of more than 6MPa.
Brand model:	Yinkai Precision Machinery (Shanghai) Co., LTD PJ-30M-70F
Selection basis:	The pressure provided by the high-speed cutting liquid cooling system should be greater than the pressure required by the main spindle. Taking DGZX-11330/8.5-KFHWVS as an example, using the water pressure range of 0.5-6MPa, the high pressure cutting liquid cooling system can provide higher water pressure Hydraulic pressure.

Name:	Oil-gas lubrication system
Function:	Provide oil and gas lubrication spindle oil and gas
Brand name:	SKF OLA8- 1B6BB..
Capacity:	3L
Selection basis:	
	Spindle assembly bearing inner diameter, bearing thickness and combined with actual use to determine the oil required for oil and gas lubrication, usually take 120-180 cubic mm/hour. (Calculation formula Q=w× d×B (Q= dosage (cubic mm/hour) w= coefficient =0.01 mm/hour d= inner diameter of shaft bearing (mm) B= bearing width (mm)).



Name	Gas flowmeter
Function	Monitor for blockage
Brand model	SMC PF2A721-03-27
Alarm flow	XXL/min，Must be connected to the machine PLC for monitoring.
Selection basis	The monitoring flow range should cover the normal working flow of the spindle.

Name:	Air source
Function ：	Ensure the normal operation and conversion of the spindle.
Air pressure:	The central water supply is 0.25MPa, the oil and gas lubrication is 0.5-0.7MPa, and the gas route is 0.6MPa.
Selection basis:	Select the appropriate pressure air source according to the needs of the spindle.