

## 电主轴使用及安装说明

电主轴是一种高速高刚度精密的电动机，其由精密滚动轴承支承，油脂润滑，外循环水冷却，雕刻(铣)主轴一般为立式使用，使用的方法正确与否将直接影响雕刻和雕铣质量，以及主轴的工作寿命。

1. 避免撞击 强烈撞击，特别是主轴端部及前端盖部位绝不许撞击，否则会损坏精密轴承及主轴精度，造成主轴回转精度的丧失。

### 2. 正确安装和夹紧

安装前应确认主轴电机状态正常，主要指外观无损伤，主轴转动轻匀。用 500V 摇表查定子之对地绝缘电阻在 100 MΩ 以上。主轴电机套筒外径与夹持座孔间的配合公差必须保证主轴电机之套筒能顺利滑入座孔，在任何情况下都不能使用锤子或其他工具来使主轴定位，夹紧力不宜过大，否则会造成精密轴承的钢球滚道变形，使主轴精度及寿命受到影响。夹持后要检查主轴前端锥孔定心面的跳动应不大于 0.005MM，主轴回转轻匀。

### 3. 筒夹（ER 型）压帽和刀具的安装

刀具的安装必须保证回转精度，否则会产生剧烈振动，影响雕刻(铣)质量和效率及轴承寿命。必须十分小心的地擦净筒夹，压帽和刀具以及主轴前端之锥孔，装拆刀具应避免用力过猛。

组装后要查看刀具根部跳动 < 0.015MM 若超差要通过反复放松和拧紧并调整变换刀具柄接触面来纠正，若无改善要检查各接触面是否处于正常状态，切忌乱敲打。

### 4. 启动前必须

1) 确认主轴套筒所须的循环冷却水已开通，冷却水的温度一般不要超过 35° c，但也不宜过低，不宜直接接用自来水，因水温过低会造成主轴电机内部热空气遇冷而形成凝水影响绝缘和轴承生锈，冷却水流量一般可在 3-5L/MIN，冷却水应干净无杂质以防堵塞通道。冷却水箱中水量约 50L—100L，建议水泵用 AB-25 或 AB-50。进出水口不能相聚太近，必须使水在箱内有一冷却过程，力求使进出口水温差能达到 2—3° c，要避免造成热水循环而达不到冷却效果。

2) 确认电源电压，频率与主轴匹配关系正确，按主轴名牌数据或产品检测报告中提供的电压与频率对应关系设置变频器的 U/F 曲线，主轴插头座的 1 号芯接地，2.3.4 号芯接变频器的 U V W。启动时应先点动，查看主轴方向。（从轴伸端看主轴应逆时针旋转）若反转应即关车，切断电源，将三根进线中的任意两根对调即可。

对新启用的主轴电机宜先进行低速运行，建议先半速运行 0.5-1.0 小时，然后再进入高速。一般用调频调压方式启动主轴电机，应尽力避免突加满压启动。启动时间约 10 秒左右完成。

### 5、运行

按 U/F 曲线，调节变频器频率可以得到各种转速。此时变频器电压会自动跟踪调整至所需之值。在低速运行时，为适当提高转矩可将电压略为提高，一般可控制在标定值上浮 20%左右以工作电流值接近额定值（安培）为宜。雕刻铣电主轴不许超速运行。在一定的输出频率范围内，可能会遇到负载装置（雕铣主轴）的机械共振点，引起噪音和振动加大，此时应避免此频率工作，噪音和振动即可改善。

正常运行时应做到一听，二摸，三查，并尽量避免突然刹车，刀具卡死时要及时关车。

一听----听主轴电机运转声有无干磨擦和怪叫，发现异常要及时关车检查。

二摸----摸前盖或套筒发热及振动情况是否稳定，若发热和振动加剧应及时关车检查。（轴承能承受的温度 $< 90^{\circ} \text{C}$ ，定子绕组 $< 130^{\circ} \text{C}$ ）

三查----查被加工的零件的质量是否稳定，如变化大应及时关车检查。

每天工作结束后应先关断电源待主轴停转以后，再关水泵停止供水，并将主轴电机擦干净。

## 6、维修保养

在正常使用情况下，一般运转一年左右，应将主轴电机拆洗重新装配使用，这样可保证轴承精度和延长使用寿命。为了保证主轴电机能正常良好地工作，其拆卸装配必须由有经验的专业操作人员，在清洁干净的环境中，以及使用合适的工具进行，切忌乱敲打。对暂时不用的电主轴要用压缩空气将水腔内的余水吹尽，套筒及轴头轴孔要上油防锈并放在阴凉干燥的地方。

感谢一、安装前准备工作

1、GDJ 系列水冷电主轴的工作环境温度通常为 $-10^{\circ}\text{C} \sim 40^{\circ}\text{C}$ 。

2、安装前首先用手转动电主轴轴头，应手感灵活，无阻滞现象。

3、用 500V 的摇表检查定子绝缘电阻不低于  $100\text{M}\Omega$ 。

4、将以上检验符合要求的电主轴装入机座内，电主轴外壳以机座安装孔的配合为滑动配合。电主轴严禁装夹在前、后轴承部位，以防轴承室变形，卡住轴承造成轴承提早损坏。夹紧力不宜过大，电主轴装入机座内不得松动。

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二、正确使用

1、按要求连接电主轴进出水管接头，检查连接处是否漏水和通畅。水冷电主轴的冷却系统系统应于机床的总开关连接；开机后至停机的中间，冷却系统系统应连续工作；冷却液水量按 2.5 升/千瓦·分钟计算，冷却液流量按 3~6 升/分钟，小的电主轴取小值，大的电主轴取大值；冷却液要求使用单独水箱，冷却液要求每月定期更换；冷却液的温度应低于环境温度 3~5 $^{\circ}\text{C}$ 为宜，最好控制在 25 $^{\circ}\text{C}$ 左右。

2、选择变频器应与电主轴的电压、功率、频率相匹配来配套使用。设置变频器首先设置变频器的基准频率，变频器的基准频率按电主轴的最高频率设置。变频器的最高频率、转折频率和对应的电压按电主轴的频压曲线对应设置；变频器的电流按电主轴的额定电流设置；载波频率按电主轴的功率大小设置，小于 10kw 电主轴按 8kHz 设置，大于 10kw 电主轴按 5kHz 设置；增、减速时间按 10s 左右设置，如遇到起动电流超过额定电流而保护时应延长增、减速时间。增、减速时间过短易造成前螺母松动。

3、将变频器与电主轴三相电源连接，其中变频器的三相电源线应焊接在插头

1(U1)、2(V1)、3(W1)脚上，4脚为地线。然后变频器与外接电源连接。接通电源后变频器点动，观察电主轴的旋转方向是否与电主轴指示方向一致，如旋转方向不一致应立即关机改正，电主轴严禁在错误的旋转方向上运转。电主轴与变频器连线不宜超过 25m。

4、电主轴在安装刀具时，应清除干净轴头锥孔及弹簧夹头表面的污垢，以免降低精度。装夹、拆卸刀具时应使用专用工具。注意装夹、拆卸时禁止用力过猛。

5、由于精密角接触球轴承油脂润滑的极限转速的限制，电主轴不允许超速运行。超速运行会造成精密角接触球轴承烧坏。

6、电主轴正常工作时做好一听，二摸，三看三个环节。一听电主轴有无异常声出现，发现异常声应及时关机检查。二摸电主轴发热、振动是否稳定，若发热、振动加剧及时关机检查。三看被加工的表面质量是否稳定，如不稳定及时关机检查。

### 三、电主轴运行常出现的问题

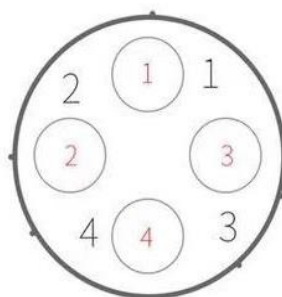
正常工作时电主轴常遇到发热现象，水冷电主轴表面温度与环境温度超过 15℃ 时可以认为发热。需关机检查，首先用温度计检查冷却水箱里的冷却液温度是否超过了环境温度，如超过应及时更换低于环境温度的冷却液。如果冷却水箱没有问题，应检查电主轴的冷却水道是否堵塞，冷却液是否清洁，冷却液一般一个月应定期更换，同时对冷却水箱上面应加防尘保护装置。

### 四、维护和保养

1、电主轴运行时发现声音或振动异常时，应立即停机检查轴承，必要时须更换新轴承。当运行中发出异常气味或突然停转，应立即切断电源，用摇表测量定子对地电阻及三相电阻，绝缘电阻丧失为定子烧坏，应回厂更换定子。

2、电主轴停用时间较长时，应用压缩空气将冷却管道中的残余冷却液吹干净，并对电主轴进行防锈处理。电主轴存放或停用 6 个月后，须重新更换新油脂后方可使用，否则将影响电主轴寿命。

3、为延长电主轴的使用寿命，新的电主轴或更换新轴承的电主轴应在转速范围内均分 4~8 档，每段运行 30min 后再升速，避免直接高速运转而缩短轴承的使用寿命。在休假日后，开机使电主轴空载运转半小时后，再开始工作。



先调正数字方向，按上图示意，区分号码，其中：

银色插头：1、2、3接变频器U、V、W，4接地线或者不接

绿色插头：2、3、4接变频器U、V、W，1接地线或者不接

如果电机反转，U、V、W三根线任意调换两根即可

## **Electric spindle use and installation instructions**

The electric spindle is a high-speed, high-rigidity, precision motor. It is supported by precision rolling bearings, lubricated with grease, and cooled by external circulating water. The engraving (milling) spindle is generally used vertically. The correct method is directly used.

Affects the quality of engraving and engraving and milling, as well as the working life of the spindle.

1. Avoid impact and strong impact, especially the end of the spindle and the front cover must not be impacted, otherwise the precision bearings and the accuracy of the spindle will be damaged, resulting in the loss of spindle rotation accuracy.

### **2. Correct installation and clamping**

Before installation, make sure that the spindle motor is in a normal state, which mainly means that there is no damage to the appearance, and the spindle rotates evenly. Use a 500V shake meter to check that the stator's insulation resistance to ground is above 100 MΩ. The tolerance between the outer diameter of the sleeve of the spindle motor and the clamping seat hole must ensure that the sleeve of the spindle motor can smoothly slide into the seat hole. Under no circumstances should a hammer or other tools be used to position the spindle, and the clamping force should not be too large. Otherwise, it will cause the deformation of the ball raceway of the precision bearing, which will affect the accuracy and life of the spindle. After clamping, check that the runout of the centering surface of the taper hole at the front end of the spindle should not be greater than 0.005MM.

### **3. Collet (ER type) pressure cap and cutter installation**

The installation of the tool must ensure the accuracy of rotation, otherwise it will produce severe vibration, which will affect the quality and efficiency of engraving (milling) and bearing life. The collet, pressing cap and cutter and the taper hole at the front end of the spindle must be cleaned very carefully. Avoid using too much force when assembling and disassembling the cutter.

After assembly, check the tool's root runout. If 0.015MM is out of tolerance, correct it by repeatedly relaxing and tightening and adjusting the contact surface of the tool shank. If there is no improvement, check whether the contact surfaces are in a normal state. Avoid knocking randomly.

### **4. Must start before starting**

1) Make sure that the circulating cooling water required for the spindle sleeve is turned on. The temperature of the cooling water should generally not exceed 35 ° C, but it should not be too low. It should not be directly connected to tap water. The condensation caused by cold affects the insulation and rust of the bearing. The cooling water flow can generally be 3-5L / MIN. The cooling water should be clean and free of debris to prevent clogging the channel. The amount of water in the cooling water tank is about 50L-100L. AB-25 or AB-50 is recommended for the water pump. The water inlet and outlet cannot be too close together, and the water must be cooled in the tank, and the temperature difference between the inlet and outlet water can reach 2-3 ° C, and the cooling effect cannot be avoided due to the circulation of hot water.

2) Make sure that the matching relationship between the power supply voltage, frequency and the spindle is correct. Set the U / F curve of the inverter according to the voltage-frequency correspondence provided in the spindle brand data or the product test report. The core is connected to the UVW of the inverter. When starting, you should jog first to check the direction of the main axis. (The main shaft should be rotated counterclockwise when viewed from the shaft extension end.) If it is reversed, the car should be turned off immediately, the power should be cut off, and any two of the three incoming lines should be reversed.

The newly activated spindle motor should be run at low speed first. It is recommended to run at half speed for 0.5-1.0 hours before entering high speed. Generally, the spindle motor is started by frequency and pressure regulation, and every effort should be made to avoid sudden full voltage start. The startup time is about 10 seconds.

### 5.Run

According to U / F curve, adjust the frequency of the inverter to get various speeds. At this time, the inverter voltage will be automatically adjusted to the required value. In low-speed operation, the voltage can be slightly increased in order to properly increase the torque. Generally, it can be controlled to float about 20% of the nominal value, and it is appropriate that the working current value approaches the rated value (ampere). The engraving and milling electric spindle is not allowed to run at excessive speed. In a certain output frequency range, the mechanical resonance point of the load device (engraving and milling spindle) may be encountered, causing noise and vibration to increase. At this time, you should avoid this frequency to work, and noise and vibration can be improved.

During normal operation, you should do one listening, two touching, three checking, and try to avoid sudden braking, and shut down the car in time when the tool is stuck.

I heard ---- listen to the main shaft motor running sound for dry friction and strange screams. If you find any abnormality, please close the car and check in time.

Second touch: Touch the front cover or sleeve to check whether the heat and vibration are stable. If the heat and vibration are intensified, close the car and check in time. (Bearing temperature <math>90^{\circ}</math> c, stator winding <math>130^{\circ}</math> c)

Three inspections-check whether the quality of the processed parts is stable, if there is a big change, close the car and check in time.

At the end of each day, the power should be turned off and the spindle stopped, and then the water pump should be turned off to stop the water supply, and the spindle motor should be wiped clean.

### 6, maintenance

Under normal use, the spindle motor should be disassembled, washed and reassembled for about one year. This can ensure bearing accuracy and prolong service life. In order to ensure that the spindle motor can work normally and

properly, its disassembly and assembly must be performed by an experienced professional operator in a clean environment and using suitable tools. Avoid knocking randomly. For the unused electric spindle, use compressed air to blow away the remaining water in the water cavity. The sleeve and the shaft hole of the shaft head should be oiled to prevent rust and placed in a cool and dry place.

Thanks I. Preparation before installation

1. The working environment temperature of GDJ series water-cooled electric spindle is usually  $-10\text{ }^{\circ}\text{C} \sim 40\text{ }^{\circ}\text{C}$ .
2. Before installation, first turn the spindle of the electric spindle by hand. It should be flexible and without blocking.
3. Use a 500V shaker to check that the stator insulation resistance is not less than  $100\text{M}\ \Omega$ .
4. Put the electric spindle that meets the above requirements into the machine base. The housing of the electric spindle takes the fit of the mounting hole of the machine base as a sliding fit. It is strictly forbidden to clamp the electric spindle on the front and rear bearing parts to prevent the bearing chamber from deforming and jamming the bearing to cause early damage to the bearing. The clamping force should not be too large, and the electric spindle should not be loosened when it is installed in the machine base.

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Second, use correctly

1. Connect the water inlet and outlet pipe joints of the electric spindle according to the requirements, and check whether the connection is leaking and smooth. The cooling system of the water-cooled electric spindle should be connected to the main switch of the machine tool; the cooling system should work continuously after the machine is turned on until the machine is stopped; Min., The small electro-spindle takes the small value, and the large electro-spindle takes the large value. Separate water tank is required for the coolant, and the coolant needs to be replaced regularly every month. The temperature of the coolant should be lower than the ambient temperature by  $3\text{ to }5\text{ }^{\circ}\text{C}$ . Well controlled at about  $25\text{ }^{\circ}\text{C}$ .
2. The inverter should be matched with the voltage, power and frequency of the

electric spindle for matching use. To set the inverter, first set the reference frequency of the inverter. The reference frequency of the inverter is set according to the highest frequency of the electric spindle. The maximum frequency, turning frequency and corresponding voltage of the inverter are set according to the frequency and voltage curve of the electric spindle; the current of the inverter is set according to the rated current of the electric spindle; the carrier frequency is set according to the power of the electric spindle, and the electric spindle smaller than 10kw is set at 8kHz. The setting is greater than 10kw, the electric spindle is set at 5kHz; the increase and decrease times are set at about 10s. If the starting current exceeds the rated current for protection, the increase and decrease time should be extended. Too short acceleration and deceleration time may cause the front nut to loosen.

3. Connect the inverter to the three-phase power supply of the electric spindle. The three-phase power cord of the inverter should be welded to the pins 1 (U1), 2 (V1), and 3 (W1), and the 4 pin is the ground wire. The inverter is then connected to an external power source. After turning on the power, the inverter jogs and observes whether the rotation direction of the electric spindle is consistent with the direction indicated by the electric spindle. If the rotation direction is inconsistent, it should be turned off and corrected immediately. The electric spindle is strictly prohibited to run in the wrong rotation direction. The connection between the electric spindle and the inverter should not exceed 25m.

4. When the electric spindle is installed with a tool, the dirt on the shaft head taper hole and the surface of the spring collet should be cleaned to avoid reducing accuracy. Special tools should be used when clamping and disassembling tools. Be careful not to use excessive force when clamping and disassembling.

5. Due to the limitation of the limit speed of grease lubrication of precision angular contact ball bearings, the electric spindle is not allowed to run at high speed. Over-speed operation will cause burnout of precision angular contact ball bearings.

6. When the electric spindle is working normally, do one listening, two touching, and three watching three links. When you hear the abnormal sound of the electric spindle, you should shut down and check in time if you find any abnormal sound. Second, check whether the electric spindle's heat and vibration are stable. If the heat and vibration increase, shut down and check in time. Thirdly, see if the quality of the surface being processed is stable, if it is unstable, shut down and check in time.

Third, the common problems of electric spindle operation

During normal operation, the electric spindle often encounters heating. When the surface temperature of the water-cooled electric spindle and the ambient temperature exceed 15 ° C, it can be considered as heating. Need to shut down and check, first use a thermometer to check whether the temperature of the coolant in the cooling water tank exceeds the ambient temperature. If it exceeds, replace the coolant below the ambient temperature in a timely manner. If there is no problem with the cooling water tank, you should check whether the cooling

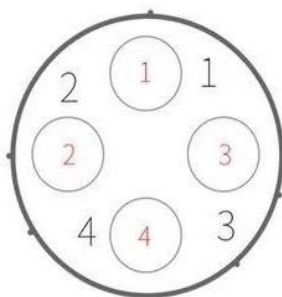
water channel of the electric spindle is blocked and whether the cooling liquid is clean. The cooling liquid should be replaced regularly one month at the same time. At the same time, the cooling water tank should be equipped with a dust protection device.

Fourth, maintenance and upkeep

1. When abnormal sound or vibration is found during the operation of the electric spindle, the bearings should be stopped immediately to check the bearings, and new bearings must be replaced if necessary. When an abnormal smell or sudden stop occurs during operation, the power should be cut off immediately, and the stator's resistance to ground and three-phase resistance should be measured with a shaker. The loss of insulation resistance means the stator is burned out. The stator should be returned to the factory for replacement.

2. When the electro-spindle is inactive for a long time, compressed air should be used to blow away the residual cooling liquid in the cooling pipe, and the electro-spindle should be anti-rusted. After the electric spindle is stored or deactivated for 6 months, it must be replaced with new grease before use, otherwise it will affect the life of the electric spindle.

3. In order to prolong the service life of the electro-spindle, the new electro-spindle or the new-spindle electro-spindle should be equally divided into 4 to 8 gears in the speed range, and the speed will be increased after each segment runs for 30 minutes, to avoid direct high-speed operation and shorten the bearing Service life. After the holidays, turn on the electric spindle to run without load for half an hour before starting work.



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银色插头：1、2、3接变频器U、V、W，4接地线或者不接

绿色插头：2、3、4接变频器U、V、W，1接地线或者不接

如果电机反转，U、V、W三根线任意调换两根即可

First adjust the number direction, as shown in the figure above, and distinguish the numbers. Among them, the silver plug: 1.2.3 is connected to the inverter U.V.W, 4 ground wire or not connected to the green plug: 2.3.4 is connected to the inverter U.V.W, 1 ground wire or not. If the motor is reversed, two U.V.W wires can be exchanged arbitrarily.