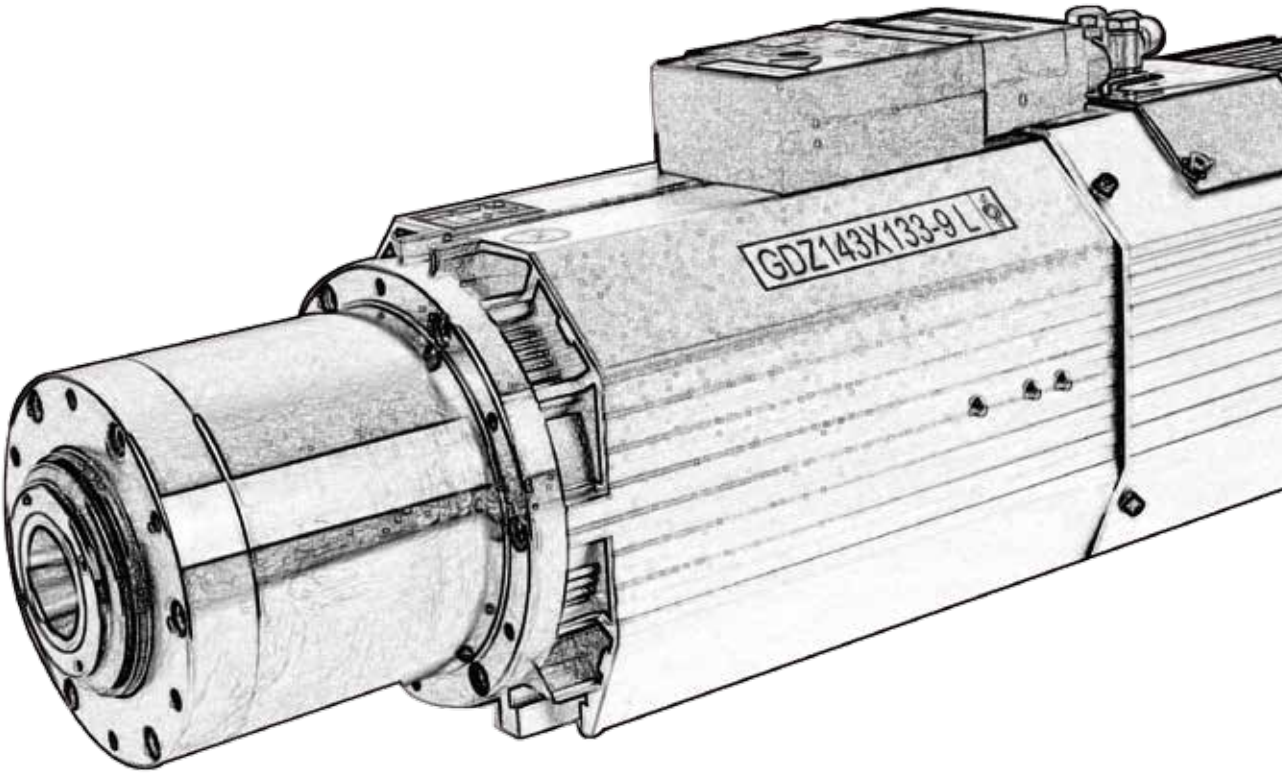
LNCS 林南昌盛®
LINNANCHANGSHENG

20 YEARS ELECTRIC SPINDLES
PRODUCTION EXPERIENCE



9KW ATC Spindle Installation, Operation and Maintenance Manual

Changzhou Tiansu Spindle Motor Co., Ltd.

1. ABOUT THE DOCUMENT

Thank you for purchasing our spindles.
This 9kw ATC spindle has the advantages of high precision, high rigidity, high efficiency and high output power etc.
Every sold automatic tool change electrical spindle is enclosed with electronic document of application and maintenance manual. This manual containing the safety warnings and instructions for installation, operation and maintenance; please read the document carefully.
All the personnel who perform operations to our spindle shall be considered that they have already clearly understood the document and shall operate strictly according to the document and the electronic documents of application and maintenance manual; otherwise, all the consequences and loss shall be borne by users. If the document or the electronic documents are not available, please ask the supplier to provide them.
Make sure that all the above documents are delivered with the spindle. If any are missing, ask us for a replacement copy.

2. TERMS OF WARRANTY

Tiansu Spindle Motor Co.,Ltd guarantees that this spindle has been QC passed in testing in the factory tiansu.
We decline all responsibility for non-compliance of the spindle caused by failure to follow the precautions and instructions given in this manual or by improper use or handling of the spindle. The customer has the right to replacement of all parts shown to be defective, unless the said defects are caused by unauthorized tampering, including the fitting of non-original our spare parts and/or the replacement of parts not described or authorized in this manual unless authorized beforehand and in writing by us.
We accept responsibility only for defects in electrical and mechanical parts. The warranty does not cover defects caused by the normal use of parts subject to continuous or rapid wear (e.g. seals, belts, bearings, etc.). In particular tiansu offers no guarantee as to the duration of bearings, since bearing wear depends on various factors including: tool balancing precision, type of machining operation, impacts and/or mechanical stress in excess of the manufacturer's declared limits.
In no case shall tiansu or its suppliers accept any responsibility for damage (including damage to the unit, damage incurred for lost production and income, down-time in manufacturing, loss of information or other economic losses) deriving from the use of tiansu products, even if tiansu has been advised of such risks in advance.
Dimensioned drawings and photographs are provided only for information purposes and to facilitate understanding of text.
We have a policy of constant development and improvement, and reserves the right to make functional and stylistic modifications to its products, to change the design of any functional or accessory part, and to suspend manufacturing and supply without notice and without obligation to third parties. Furthermore, we reserve the right to make any structural or functional change to the units, and to change the supply of spare parts and accessories without any prior notice.

3. WARNINGS AND SAFETY PRECAUTIONS

3.1 DISTRIBUTION OF THIS MANUAL

This manual contains important instructions and precautions, and must accompany the spindle at all times since it is essential for the safe operation of the spindle.
Keep this manual safe, and ensure that all persons involved with the spindle know of it and have access to it.
The safety precautions contained herein are designed to ensure the safety of all persons exposed to the residual risks associated with the spindle.
The instructions contained herein provide information necessary for the correct operation of the spindle, as required by the manufacturer.
If any information given in this manual is found to be in conflict with applicable safety regulations, contact us to request the necessary corrections and/or adaptations.
Make sure that you read and fully understand all the documentation supplied with the spindle to avoid incorrect operation of the unit and unnecessary risks of personal injury.

Keep this manual in a suitable place near the machine, where it will always be readily available to operators for consultation.

IMPORTANT: The information given in this manual is essential to ensure that the spindle is installed and used safely and correctly.

3.2 GENERAL SAFETY SYMBOLS

In this manual, important instructions or precautions are marked with the following symbols:

WARNING: Identifies situations that could lead to personal injury.

WARNING: Live electrical parts.

IMPORTANT: Identifies particularly important information.

3.3 RISKS ASSOCIATED WITH THE SPINDLE

Tiansu does not and cannot know how end users will install their spindles. The installer or customer must therefore perform risk assessment specific to each installation and application.
It is also the responsibility of the installer to ensure that adequate guards are provided to prevent accidental contact with moving parts.
The installer and the operator must also bear in mind other types of risk, particularly those associated with foreign bodies, explosive, inflammable, toxic or high temperature gasses.
Risks associated with maintenance operations must also be guarded against. Maintenance must be performed in conditions of maximum safety, and only with the spindle fully stationary and switched off.

3.4 RISKS ASSOCIATED WITH IMPROPER USE AND HANDLING

· Never impede the functioning of, remove, modify or in any way interfere with any safety device, guard, or control of individual parts or of the spindle as a whole.
· Never place your hands, arms, or any other part of your body near moving machinery.
· Do not use the spindle in atmospheres or environments where there is a risk of explosion.
· Unless you are duly authorized, never attempt to repair faults or spindle malfunctions and never interfere in any way with the spindle's operation or installation.
· On completion of servicing work for which guards, covers, or any other protections have been removed, always make sure that they have been correctly and securely replaced and are fully functional before re-starting the spindle.
· Keep all protection and safety devices in perfect working order. Also make sure that all warning labels and symbols are correctly positioned and perfectly legible.
· When troubleshooting the spindle always adopt all the safety precautions listed in this manual for the purpose of preventing injury or damage to persons and things.
· After adjusting any mechanical part, make sure that you fully tighten all screws, bolts or ring nuts you may have slackened or removed.
· Before you start the spindle, make sure that all the safety devices are installed and perfectly functional. Do not start the spindle if this is not the case, but immediately inform the person responsible for machine safety or your direct superior.
· Make sure that you have and use all the personal protective equipment (PPE) required by law. Do not wear loose or hanging clothing (ties, wide sleeves, etc.).
· Never use tool holders of different types to those specified in this manual. To do so could damage the

tool holder cone or lead to unsafe tool holder locking.

3.5 RISKS SPECIFIC TO MAINTENANCE

· Take great care not to cut yourself on the tools while servicing or cleaning the spindle. Ideally, tools should be removed prior to these operations.
· Rotating parts may continue to spin under the effect of inertia even when the spindle has been switched off. Make absolutely sure that the spindle is not spinning before accessing it.
· Perform all scheduled maintenance as described in this manual. Failure to do so may lead to mechanical failures and breakage through wear or inadequate maintenance.

WARNING: NEVER:
·Start any maintenance before making absolutely sure that the tool in the spindle is completely stationary.
·Start any maintenance on the spindle before disconnecting it from the main power supply.
·Attempt to clean the spindle while it is operating.

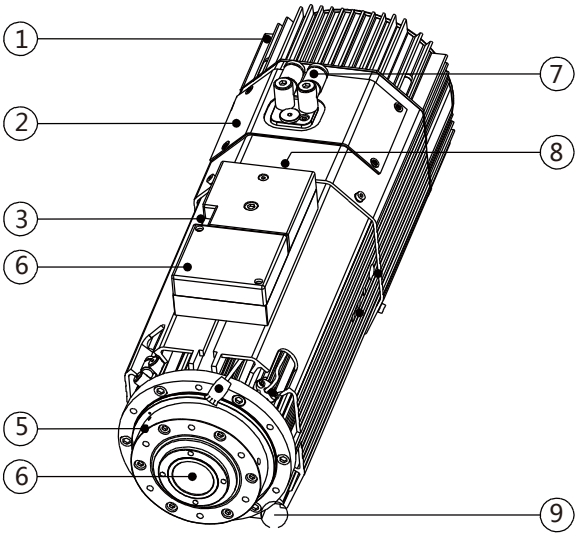
4. GENERAL INFORMATION

4.1 PROPER USE OF THE PRODUCT

Spindles are used as parts of machines. The machine structure to which the spindle is secured must be rigid and strong enough to support the weight of the spindle and withstand the machining operations to be performed.
The spindles described in this manual are designed for milling and drilling wood, plastic, aluminum and fiber-board.
They are all designed for operation in an S1 duty type. Technical specifications vary as detailed in section 5.
To prevent damage to the precision bearings, all spindles are fitted with a mechanical reaction system that counteracts the axial force that the piston applies to the spindle shaft during tool change operations.

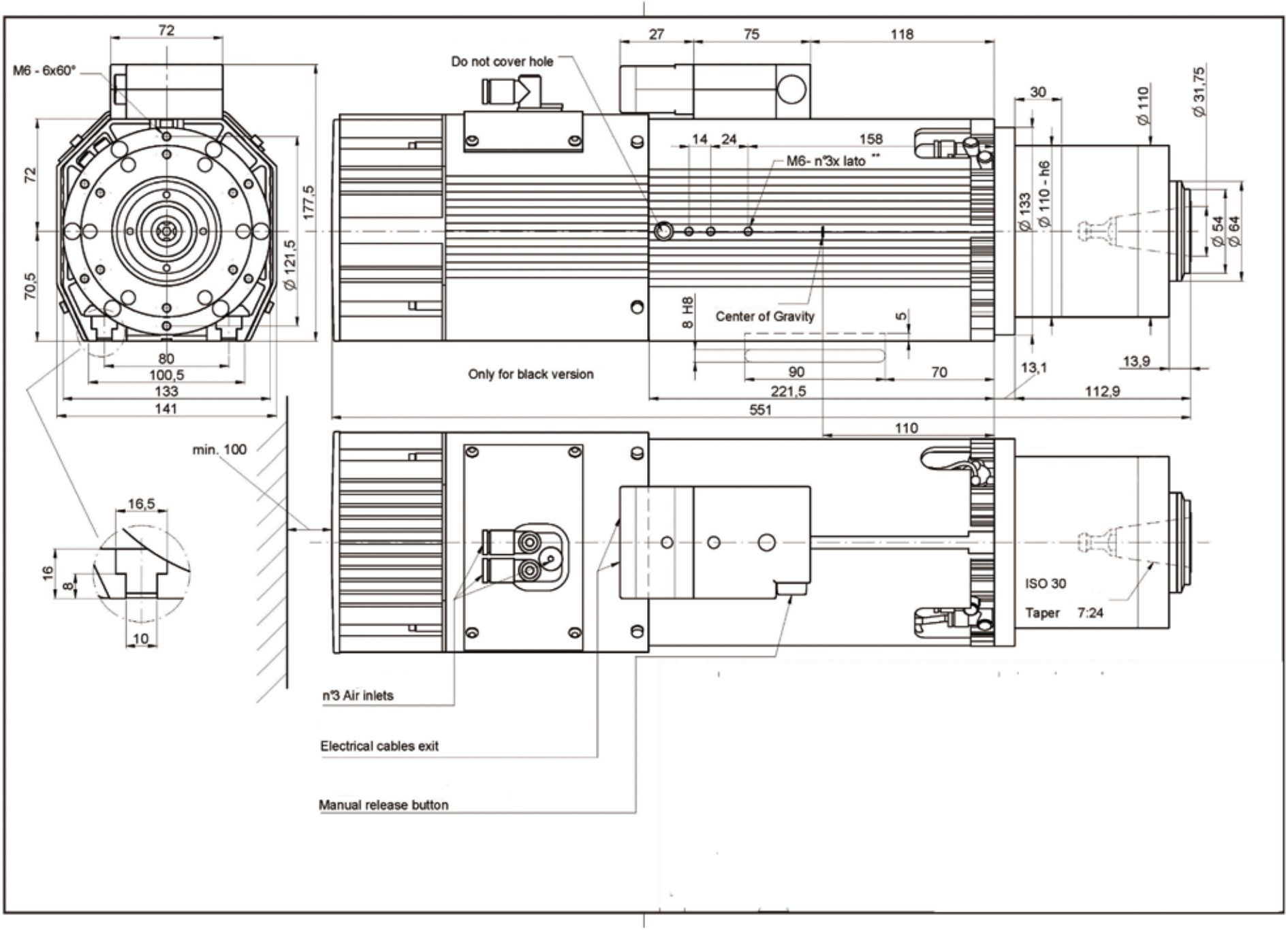
4.2 DESCRIPTION OF THE MAIN PARTS OF THE SPINDLE

1 Cooling fan
2 Sensor compartment
3 Terminal block
4 Manual tool holder release button
5 Spindle nose
6 Spindle shaft
7 Compressed air connectors
8 Electrical terminals
9 "T" slots for anchoring to support



5. TECHNICAL SPECIFICATIONS

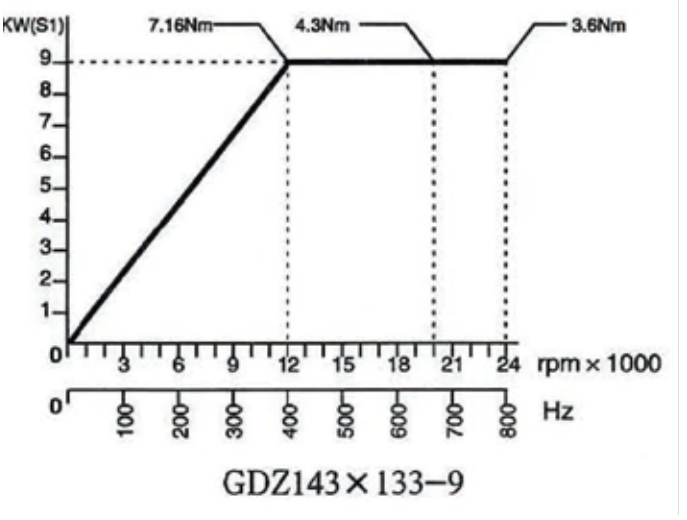
5.1 OVERALL DIMENSIONS


72
M6 - 6x60°
72
70,5
177,5
Ø 121,5
80
100,5
133
141
27
75
118
Do not cover hole
14
24
158
M6- n°3x lato **
30
Ø 110
Ø 31,75
Ø 133
Ø 110 - h6
Ø 54
Ø 64
8 H8
Center of Gravity
5
Only for black version
90
70
221,5
551
13,1
13,9
112,9
110
min. 100
16,5
16
8
10
ISO 30
Taper 7:24
n°3 Air inlets
Electrical cables exit
Manual release button

5.2 SPECIFICATIONS AND PERFORMANCE

Terminal connection type	Star	Delta
Rated voltage(*)	380V±10%	220V±10%
Rated current	22A	38A
Rated speed	12000rpm-24000rpm(400Hz-800Hz)	
Rated power	9KW	
Duty type	S1	
Rated torque	7.16NM	
Rated efficiency η	0.8	
Power factor cos θ	0.8	
Number of poles	4	
Insulation class	H	
Type of cooling	Cooling fan	
Weight	31KG	

[(*) from inverter]



Make sure power terminals are connected correctly before installing the spindle.

5.3 TECHNICAL SPECIFICATIONS OF COMPONENTS

5.3.1 Bearings

The front of the shaft is supported by a pair of precision angular contact ball bearings, 40 mm diameter for versions with ISO 30 tool fittings

The bearings are lubricated for life and do not require greasing.

5.3.2 Tool holder locking and release device

The tool holder is mechanically locked by springs that develop an axial force of 3500 N ± 10%
Tool release is achieved by the movement of a single acting, double stage, compressed air cylinder operating at a pressure of 7 bar (100 PSI).

The axial force applied to the tool holder by the locking springs is guaranteed to remain constant for a minimum of 2,000,000 tool change cycles.
1 tool change cycle = tool locked / tool released / tool locked

5.3.3 Automatic cleaning of the tool holder and internal pressurization

The tool holder cone and its conical housing in the spindle shaft are automatically cleaned by the air purge during the tool change phase.
This prevents dirt from building up on the mating surface. The condition of the surface should nevertheless be regularly checked as described in section 12.1 on scheduled maintenance.

The pneumatic circuit for internal pressurization prevents dirt from entering the spindle. This system is fed at 4 bar (58 PSI). Waste air is exhausted through the forward facing labyrinth ports in the spindle nose.

Compressed air at 4 bar (58 PSI) must always be delivered to the spindle even when it is not operating.

5.3.4 Proximity sensors

Sensor type: PNP proximity; NO (Normally Open)
Voltage: 10 - 30 V (DC)
Maximum load: 200 mA
No-load consumption: < 10 mA
Rated read distance: 0.8 MM

5.3.5 Tool release button

Push-button specifications
Rated voltage (DC): 24A
Maximum current: 100mA
Lamp specifications
Rated voltage (DC): 24A
Rated power: 0.7W
Maximum current: 29mA

5.3.6 Thermal switch

The spindle motor windings are protected by a normally closed bi-metallic switch encased in the stator. A second bi-metallic switch protects the cooling fan motor.
The two switches are connected in series .
The switches open if temperature reaches a potentially damaging level and close again when temperature drops to normal operating levels.
This thermal switch system must be connected in series to the machine's safety stop system.
The series of bi-metallic switches has the following specifications:

DC power : 48 VDC MAX
AC power : 230 VAC MAX
Current : 1.6 A MAX

5.3.7 Cooling Fan

The spindle is cooled by a rear mounted fan.The fan must be powered up even when the spindle is not operating. The fan is independent of the spindle shaft. This solution gives improved efficiency compared to shaft mounted fans.
If the fan motor overheats, the fan's own thermal switch, wired in series with the main spindle switch, shuts the unit down. Operation is re-enabled when the fan's motor drops to a safe operating temperature again.

Power	230 ± 10% VAC	
Cycles/second	50 Hz	60 Hz
Consumption	45 W	39 W
Thermal switch	Bi-metallic switch	

The fan's thermal switch only detects fan motor overheating. It cannot detect that the fan is prevented from turning, unless this causes overheating. For this reason, check the condition of the fan regularly.

The fan must remain on at all times when the machine is active even if the spindle is not operating.

6. TRANSPORT AND MOVING

Lifting and moving spindles can create situations of risk to persons nearby. Always follow the instructions provided by Tiansu and always use suitable lifting equipment.

Installation and assembly work must be performed only by specialist technicians.

Always use great care in lifting and moving spindles and their components. Avoid impacts that can damage the body which could cause malfunctions.

IT IS THE RESPONSIBILITY OF THE CUSTOMER TO ENSURE THAT THE LIFTING EQUIPMENT, CABLES, SLINGS AND CHAINS USED IS SUITABLE FOR THE PURPOSE IN TERMS OF FUNCTIONING AND LOAD CAPACITY.

6.1 STORAGE

If the spindle is to be stored for any length of time, make sure that it is protected against the elements and in particular against damp, dust, and other forms of damage by the atmosphere or storage environment.
Check on the general condition of the spindle periodically to prevent deterioration. Turn the spindle shaft by hand about once a month to keep the bearings free.

STORAGE TEMPERATURE: from –5°C (+23°F) to +55°C (+131°F)
NON-CONDENSING RELATIVE HUMIDITY: from 5% to 90%

6.2 LIFTING THE SPINDLE IN ITS CRATE

The spindle is shipped in a wooden crate packed with expanded polystyrene foam. The spindle itself is packed in a VCI plastic bag and is coated in protective grease to prevent corrosion. Use a clean cloth to wipe the protective grease off the new spindle.
(Note: The expanded polystyrene and the protective bag are plastics and must be disposed of as such).

Do not lift the spindle by the cooling fan cover. The cover could break and the spindle could fall, causing serious damage to the unit and injury to the operator.

7 INSTALLATION

7.1 FIRST CHECK

Before starting installation, check:
That no part of the spindle has been damaged during transport and/or handling.
That the connectors are not damaged in any way.

7.2 PREPARATION OF THE EQUIPMENT REQUIRED FOR INSTALLATION ON SITE

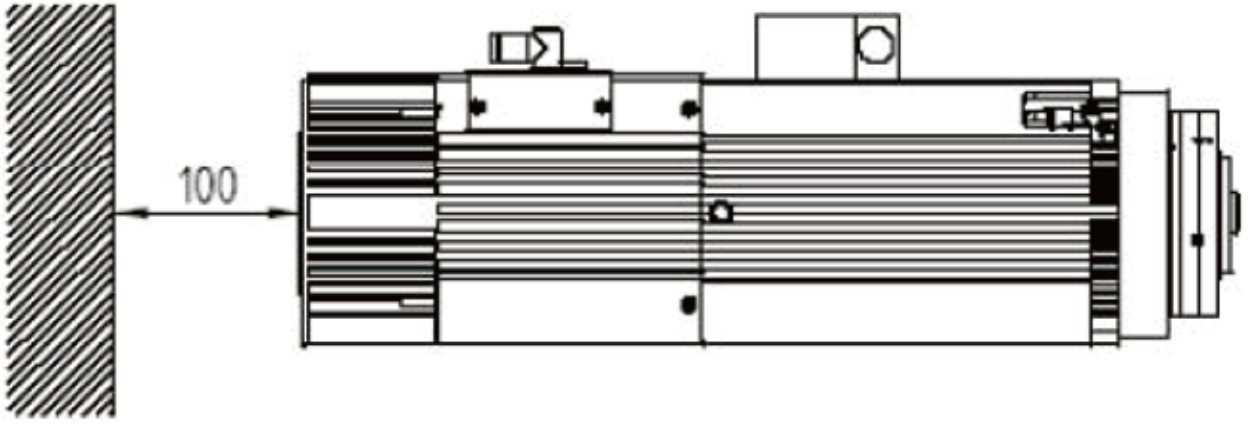
All work in preparation for installation of the spindle is the responsibility of the customer (e.g. preparation of electrical power supplies, compressed air etc.).
Make sure that the electrical power line to the spindle is of adequate gauge and power. Connection of the unit to the power supply must only be done by qualified electricians. The customer is responsible for all parts of the electrical power supply to the spindle.
The customer is expressly reminded that the spindle must be correctly connected to earth. Furthermore, the earth connection must comply with applicable regulations in the country in which the unit is installed and must be duly checked and tested by a qualified electrician.
See below for the installation layout and connection diagrams.

7.3 MECHANICAL INSTALLATION

7.3.1 The supporting surface

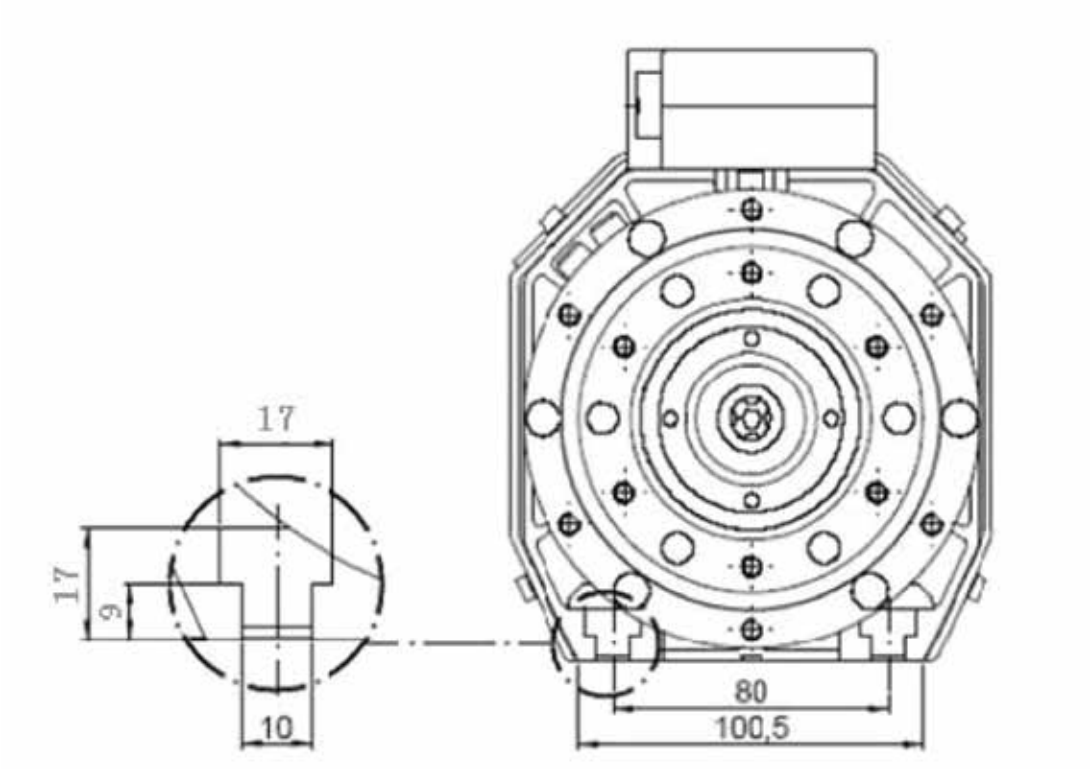
i spindle is fixed must have a flatness better than 0.02 mm.

7.3.2 Positioning the spindle

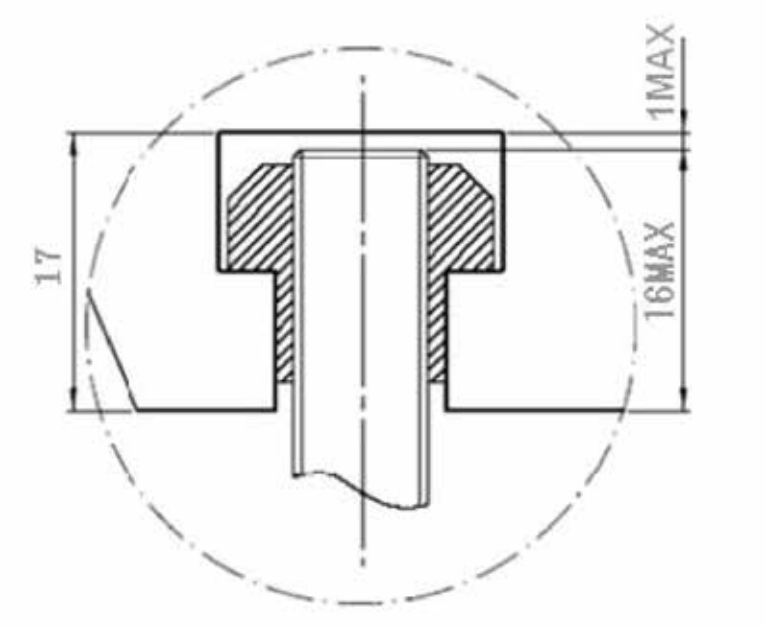


The spindle must be installed with at least 100 mm of free space behind the cooling fan cover to ensure an adequate flow of cooling air.

7.3.3 Mechanical fixing of the spindle



Fix the spindle to the carriage or spindle mounting using M8 bolts and nuts fitted in the T slots and tightened to a torque of 20 Nm. Maximum permitted protrusion of the fixing bolts is 15 mm, as shown in Figure. Greater protrusion can deform the spindle body and lead to incorrect fixing, reduced machining precision and reduced machining safety.

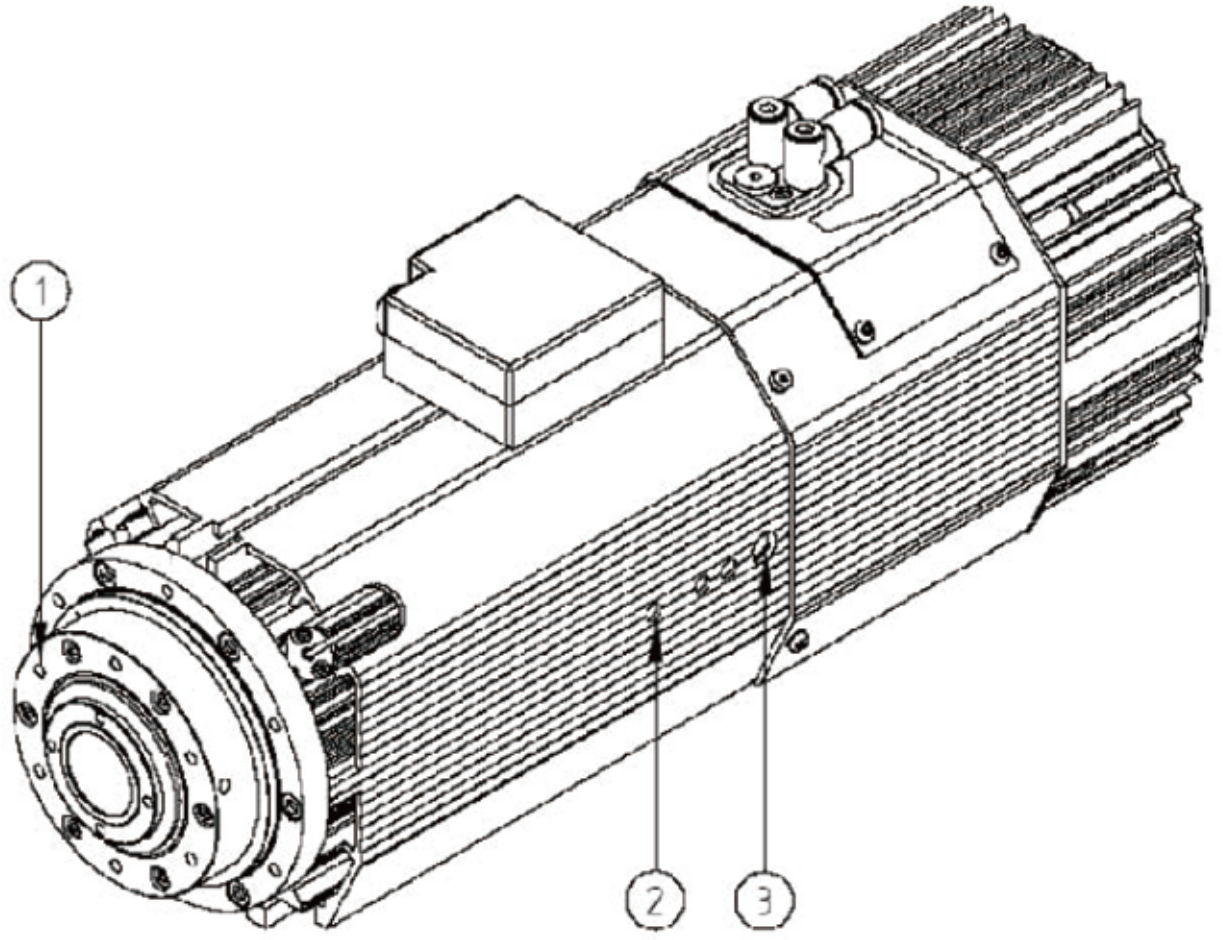


Maximum protrusion of bolt: 16 mm.
Leave a clearance of at least 1 mm.
Excessive protrusion can deform the spindle body and reduce machining precision and safety.

7.3.4 Threaded service holes

There are a number of M6 threaded holes in the spindle body, located as shown in Figure .

⚠	Attention: never to block the silenced exhaust air holes (Position 3 in Figure).

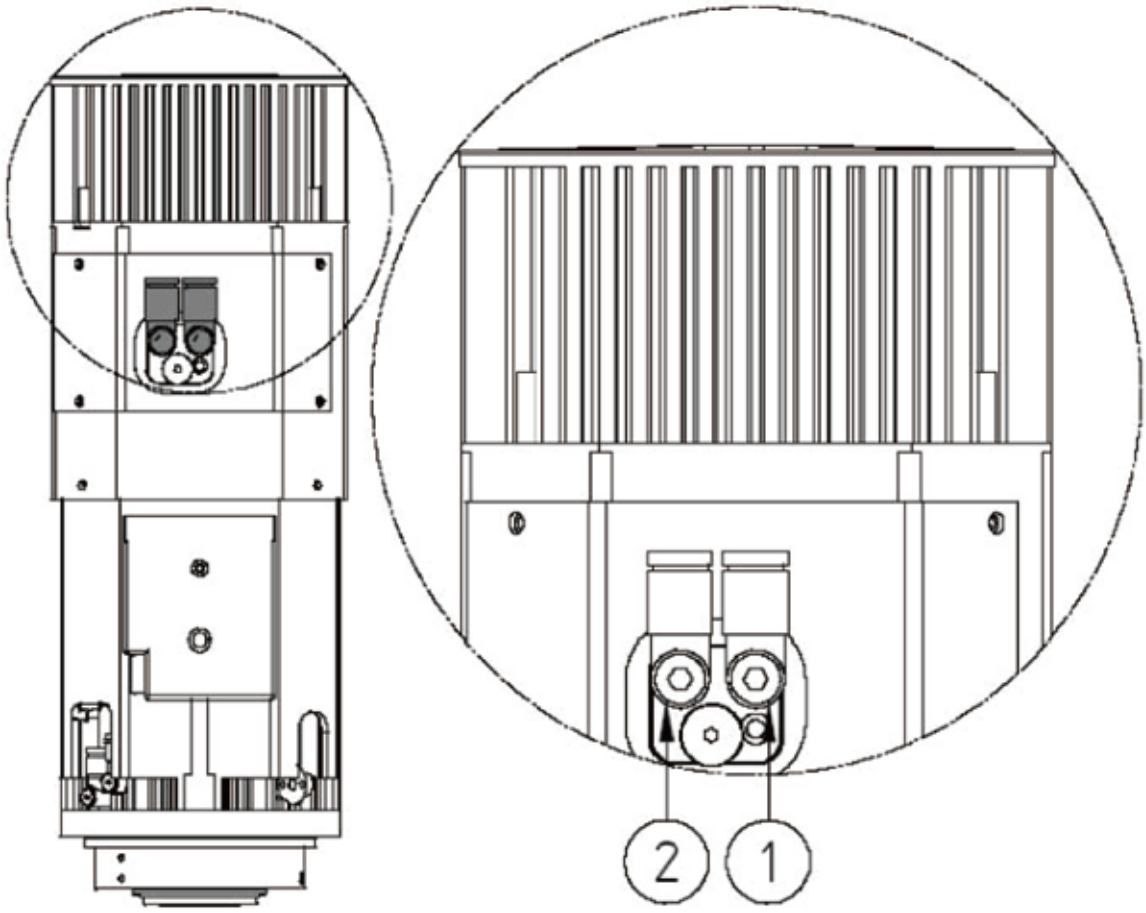


1	Frontal service holes	6
2	Side service holes	3 per side
3	Silenced exhaust air hole	1 per side

7.4 COMPRESSED AIR CONNECTIONS

7.4.1 Compressed air unions

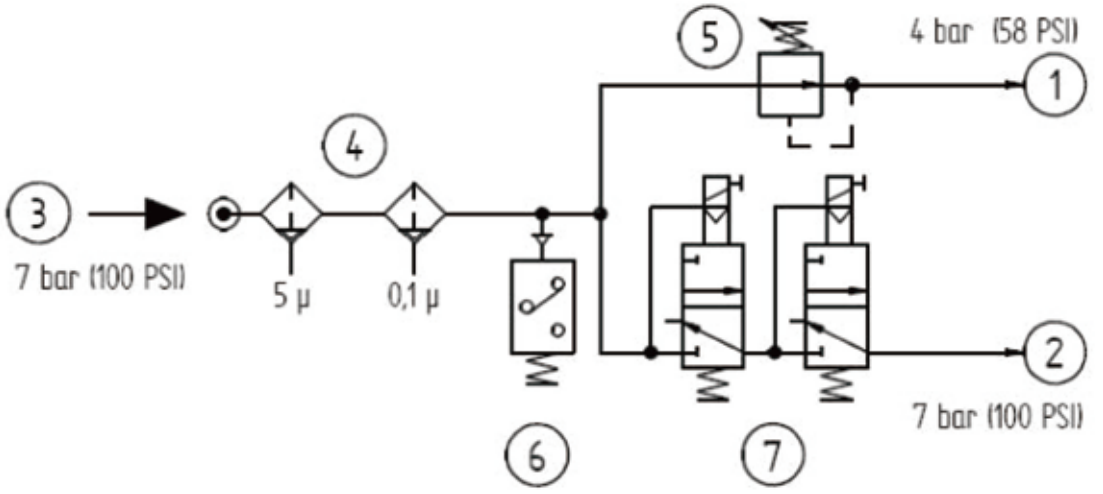
The compressed air unions are quick-fit unions. They are located as shown in Figure and are described in the table below.



	DESCRIPTION	PRESSURE (bar / PSI)	EXTERNAL HOSE Ø (mm)
1	Inlet for pressurization and cone cleaning air	4 / 58	8
2	Tool release air inlet - outlet	7 / 100	8

7.4.2 Functional diagram of spindle compressed air connections

Figure shows typical compressed air system connections, to be prepared by the customer. The use of two solenoid valves connected in series reduces the risk of system malfunctions. Though it is very rare for this type of fault to occur, it can have very serious consequences if it does. Redundancy is therefore recommended.



1	Cone cleaning and internal pressurization air inlet
2	Tool holder release air inlet
3	Factory air supply inlet
4	Compressed air filtration/drying group with automatic condensate drain: first stage 5µ and second stage 0.1µ
5	4 bar (58 PSI) pressure regulator
6	Pressure switch
7	Pair of 3 way, mono-stable solenoid valves

⚠ Use 2 separate circuits to connect the solenoid valves (pos. 7 in Figure) to the numeric control unit or manual control system.

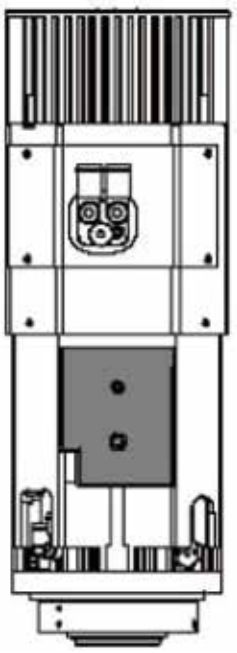
⚠ The air supply to the compressed air circuit must be **dry and filtered.**

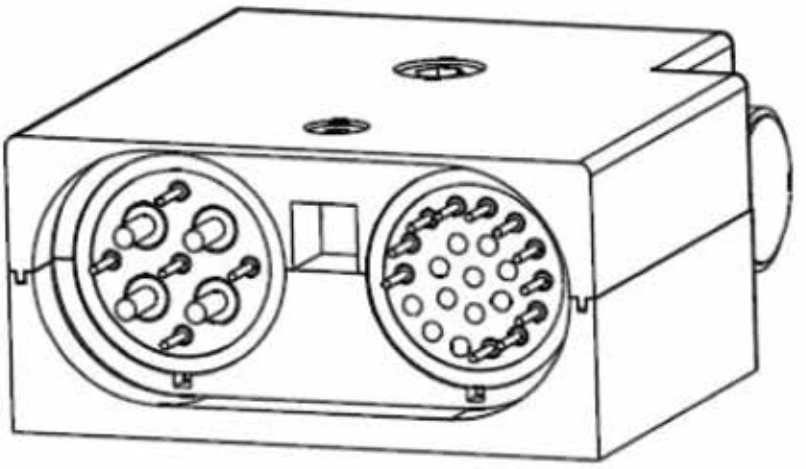
⚠ When the machine is powered on, pressurized air must be delivered even when the spindle is stopped, to prevent dust and dirt from the machining area from entering the spindle .
When the spindle stopped, make sure that there is uniform flow of air around the spindle shaft (pressurization air). If there is not, check the compressed air circuit and connections.

7.5 ELECTRICAL CONNECTIONS

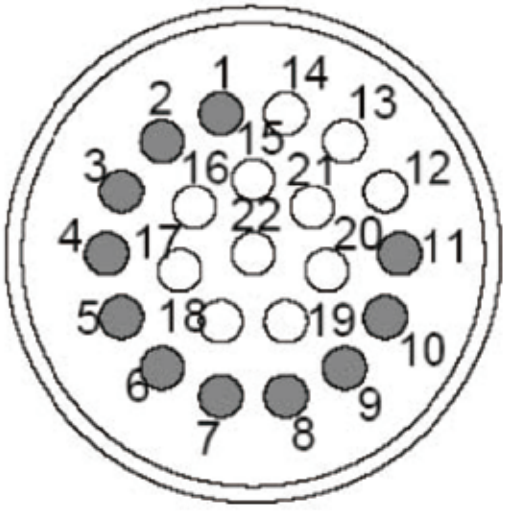
7.5.1 Connectors

The spindle is fitted with two connectors, one for power and the other for signals.





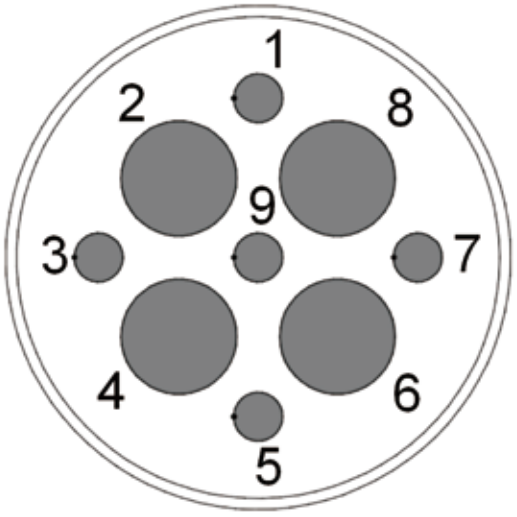
7.5.2 Pin layout of fixed signals connector



PIN	DESCRIPTION
1	Sensor S2 (tool ejected) output
2	Sensor S1 (tool locked) output
3	+24V DC power to S1, S2
4	+24V DC power to push-button lamp
5	0V power to S1, S2
6	+24V DC power to push-button
7	Push-button output
8	Temperature sensor for front bearings
9	Temperature sensor for front bearings
10	0V power to push-button, lamp, and SC

i **Use AWG22 wires.**

7.5.3 Pin layout of fixed power connector

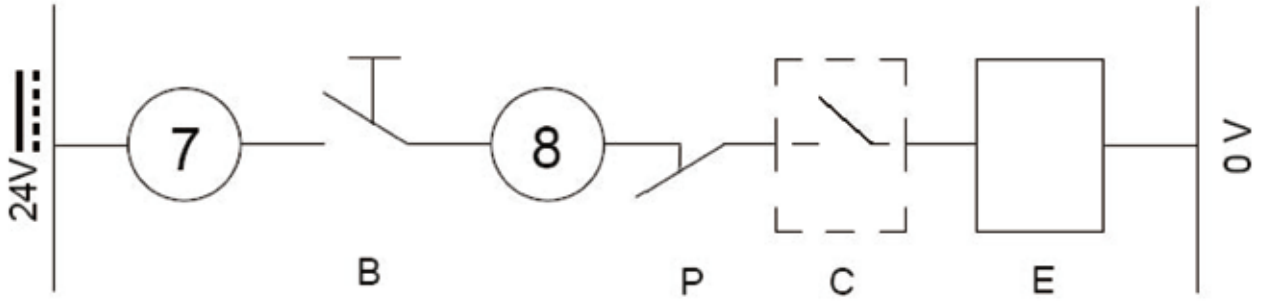


PIN	DESCRIPTION
1	Thermal switch: normally closed bi-metallic switch to be connected in series to machine safety stop system. **230V AC MAX; 48V DC MAX; 1.6A MAX**
2	* PE common to pin 7
3	220V AC 50/60 Hz cooling fan
4	U Motor phase
5	Thermal switch (see pin 1)
6	V Motor phase
7	* PE common to pin 2
8	W Motor phase
9	220V AC 50/60 Hz cooling fan

Use AWG10 wires for the even pins and AWG18 for odd pins.

7.5.4 Tool holder release system electrical wiring diagram for spindles not controlled by CNC

The control system must disable the tool release push-button signal while the spindle is rotating.
The push-button must only be enabled when the spindle is completely stationary.
Only use the push-button to lock/release tools on manually controlled machines.



7-8	Pins 7 and 8 of the signals connector
B	Tool release button
P	Pressure switch to prevent tool release in case of insufficient air pressure
C	Safety check (spindle stopped check device)
E	Tool release solenoid valves

- When button "B" on the spindle is pressed, the coils of solenoids "E" (not supplied) are energized and the tool holder is released.
- Press button "B" to release the tool holder.

8. GENERAL CHECKS AFTER INSTALLATION AND DURING START-UP

8.1 CHECKING THE SPINDLE BEFORE START-UP

Positioning

- There must be at least 100 mm of free space behind the cooling fan cover.

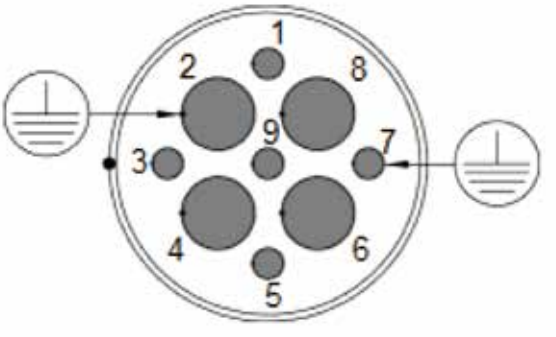
Compressed air connections

- The internal pressurization and cone cleaning air hose must have an external diameter of 8 mm, and must deliver dry, filtered air at a pressure of 4 bar (58 psi).
- The tool change air hose must have an external diameter of 8 mm, and must deliver dry, filtered air at a pressure of 7 bar (100 psi).

THE TOOL RELEASE CYLINDER IS SINGLE ACTING.

Electrical connections

- The ground wire of the spindle and cooling fan must be connected to the ground (pins 2 and 7 of the power connector in the figure on the right).
- The motor's thermal switch (NC switch) must be connected in series with the machine's safety stop system (pins 1 and 5 of the power connector in the figure on the right.



Inverter programming

- The maximum power voltage setting must match the value on the spindle's data label.
- The minimum frequency value at which maximum voltage is delivered (rated frequency, also referred to as knee or bend frequency) must match the value on the spindle's data label.
- The maximum frequency value must match the value on the spindle's data label.
- The maximum continuous current value must match the value on the spindle's data label.
- Contact us if you wish to check other inverter parameters.

8.2 CHECKING THE SPINDLE ON FIRST START-UP

- Warm up the spindle briefly at no load.
- Make sure that pressurization air comes out from the labyrinth ports in the spindle nose. (Check with the spindle stationary.)
  PRESSURIZED AIR MUST ALWAYS BE PRESENT, EVEN WHEN THE SPINDLE IS NOT OPERATING.
- Check that the air from the fan flows towards the spindle nose.
  THE FAN MUST ALWAYS BE ON, EVEN WHEN THE SPINDLE IS NOT OPERATING.
- Check that the air purge is on during tool changes.
- Check that the compressed air hoses and unions do not interfere with cables or machine parts during tool change movements (approx. 1 mm).
- Check that the spindle control sensors operate according to requirement.
- The tool holder must be ejected about 0.5 – 0.9 mm in ISO 30 versions.
  TOOL CHANGES MUST ONLY TAKE PLACE WHEN THE SPINDLE AND THE MACHINE ARE STATIONARY (SENSOR 2 ON AND SENSOR 1 OFF).
- The push-button on the terminal block must execute a manual tool change.
  THIS BUTTON MUST ONLY BE ENABLED WHEN THE SPINDLE AND MACHINE ARE STATIONARY.
- The direction of spindle rotation must match the settings in the numeric controller.

9. OPERATING THE SPINDLE

9.1 CLIMATIC CONDITIONS

Tiansu has designed and tested its spindles to operate under the following standard climatic conditions:

- Altitude not above 1000 m above sea level
- Maximum ambient air temperature not above +40°C (+104°F)
- Minimum ambient air temperature not below -15°C (+5°F)
- Coolant temperature (if relevant) at inlet to spindle not above +27°C (+81°F) and not below +23°C (+73°F).

Outside these tolerances some of the values declared in the tables and figures in section § 7 may vary.
Contact us for information on installations other than the standard ones illustrated or described in this manual.

9.2 RUNNING IN

The spindle is run in in the factory prior to shipment. This ensures correct distribution of the long-life grease in the bearing races. The run in cycle also includes comprehensive testing of all spindle controls and signal devices, and simulates various types of working cycles.

9.3 WARMING UP

Every day, when the spindle is started up for the first time, let it warm up slowly without load, this ensures that the bearings reach their running temperature gradually, and that the bearing races expand evenly.
The following warming up cycle is recommended, to be performed with the tool holder in place
but without actually machining (no load):
50% maximum rated speed for 2 minutes.
75% maximum rated speed for 2 minutes.
100% maximum rated speed for 1 minute.
Warm the spindle up before machining whenever the machine has been left idle long enough for it to cool down to ambient temperature.

9.4 SELECTING THE TOOL HOLDER AND TOOL

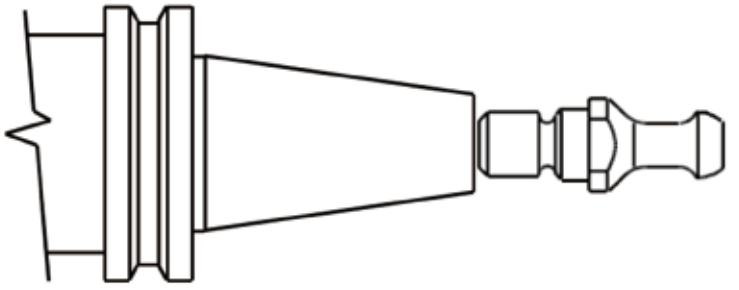
9.4.1 ISO 30 tool holders

Always respect the following conditions when selecting a tool holder:

- Cone geometry must comply with DIN 69871 standard.
- Use only ISO 30 tool holders of AT3 precision rating.
- Do not use tool holders that have lumps, hollows, or other shapes that could affect dynamic balancing.
- Dynamic balancing must be better than G=2.5 (ISO 1940 standard) at the spindle's maximum rated speed.
- Balancing must always be done with the tool assembled (pull stud, cone, elastic collet, ring nut, tool).
- Only use pull studs (also referred to as retention knobs) provided by qualified supplier.

Proceed as follows to install the pull stud in the ISO 30 cone:

- Thoroughly clean the mating surfaces of the pull stud and its seat.
- Smear the threads of the pull stud with LOCTITE 270 (or similar thread locking compound).
- Tighten the pull stud in place to a torque of 62 Nm.
- Leave the cone rest for at least 12 hours, so that the thread locking compound grips (or follow the instructions of the locking compound manufacturer).



ISO 30 CONE
DIN69871

Pull Stud

⚠ WARNING: Incorrect installation or the use of non-original pull studs can lead to the tool holder cone being thrown from the spindle.

9.4.2 General safety precautions for tool holders

⚠ THE RIGHT CHOICE OF TOOL HOLDER IS ESSENTIAL FOR SAFE MACHINING. CAREFULLY FOLLOW THE INSTRUCTIONS GIVEN IN SECTIONS 9.4.1 (ISO 30).

KEEP THE CONICAL SURFACES OF THE TOOL HOLDER AND ITS HOUSING IN THE SPINDLE SHAFT PERFECTLY CLEAN TO ENSURE A SAFE GRIP .

DURING MACHINING, TAKE GREAT CARE TO AVOID CONTACT BETWEEN NON-CUTTING ROTATING PARTS AND THE WORK.

DIRT MUST NOT BE ALLOWED TO ENTER THE CONICAL HOUSING. CLOSE IT WITH A SUITABLE PLUG OR A SPARE TOOL HOLDER.

AT THE END OF THE WORKING DAY, ALWAYS REMOVE THE TOOL HOLDER FROM THE SPINDLE, TO PREVENT IT FROM STICKING.
PROTECT OR COVER THE SPINDLE NOSE AGAINST CONTAMINATION.

9.4.3 Choosing tools

Dynamic balancing must be better than G=2.5 (ISO 1940 standard) at the spindle's maximum rated speed.
Always respect the following conditions when selecting a tool:

- Only use fully sharpened tools, and make sure that they are securely locked in the tool holder.
- Never use bent or damaged tools, chipped tools, or tools that are not perfectly balanced.
- Always make sure that the mating surfaces of a tool are perfectly clean and dent free before fitting the tool in the collet and tool holder.
- Never use tools at speeds in excess of the rated speed by the manufacturer.
- Always ensure that the following essential requirements are met before using any tool at high speed:
  -The tool must be of compact, short, and lightweight design.
  -The tool must be a precision instrument, and any inserts must be secured tightly.
  -The tool must be balanced and must mate symmetrically with the tool holder.
- The cutting surfaces of the tool must be located near its centre of rotation.

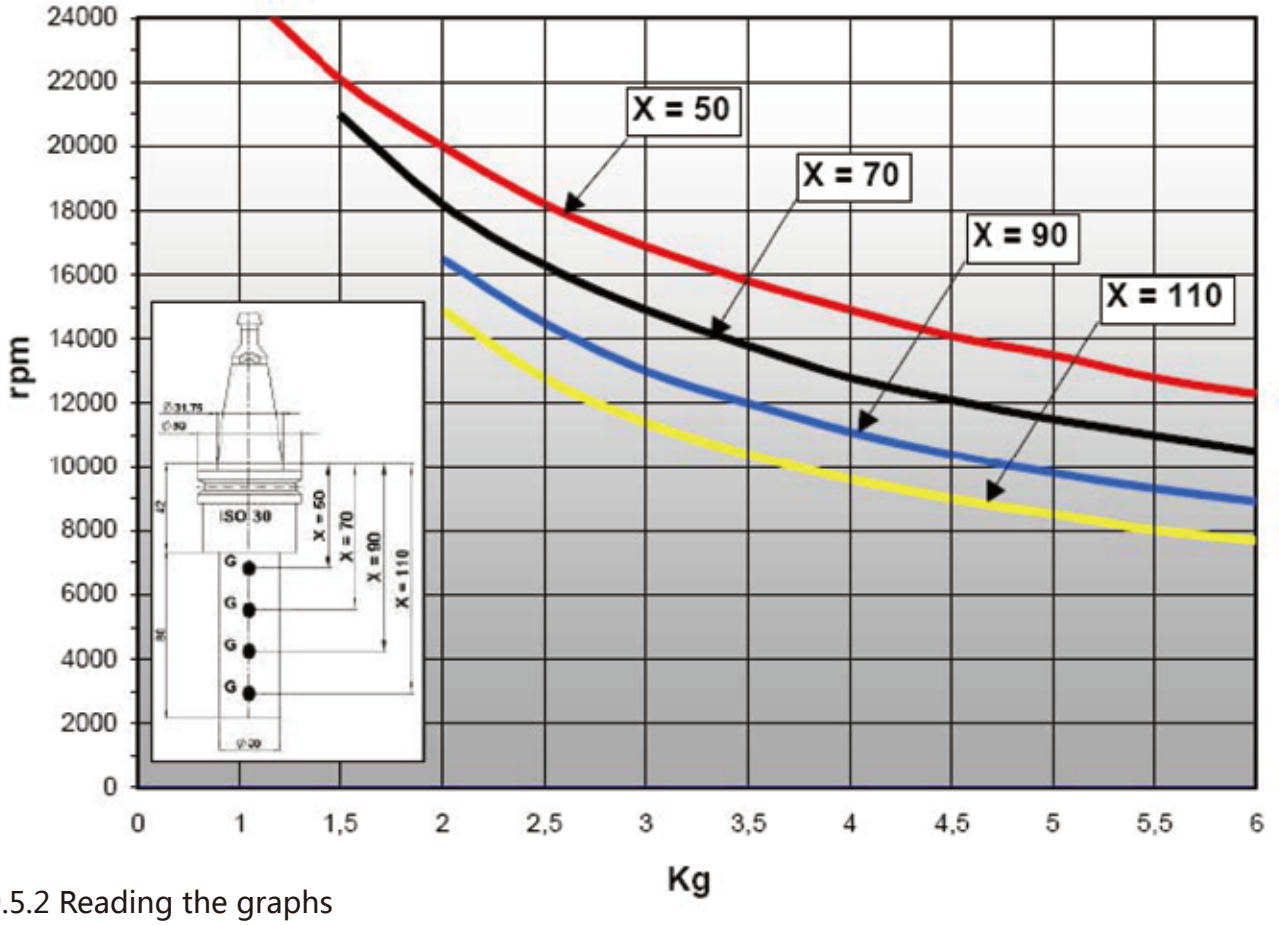
9.5 SPEED LIMITATIONS

ALWAYS RESPECT THE MAXIMUM TOOL SPEED (RPM) SPECIFIED BY THE TOOL MANUFACTURER.

Never exceed the maximum speed specified by the tool manufacturer.
It is the operator's responsibility to decide whether to perform certain machining operations at slower speeds (NEVER HIGHER) than those specified by the tool manufacturer or those listed as guidelines in the following pages.

9.5.1 Content of graphs

The graphs on the following pages show sample maximum no-load spindle rotation speeds. These have been calculated for different total weights of the TOOL + TOOL HOLDER assembly (including ring nut and elastic collet), and for different distances between the nose of the spindle and the centre of gravity "G" of the tool + tool holder assembly.
The tool + tool holder assembly has been considered as a single mass applied at the centre of gravity "G" (without considering size or shape).
The degree of balancing is that recommended in the previous sections.
The graphs on the following pages are purely indicative. Tiansu does not know and the graphs therefore cannot take into account details of individual machining operations, tool specifications, or characteristics of the material being machined. It is therefore the operator's responsibility to determine maximum safe speed on a case by case basis.



9.5.2 Reading the graphs

1. Select the curve for distance "X" between the nose of the spindle and the centre of gravity "G" of the tool + tool holder assembly. If the value of "X" measured on your spindle does not appear in the graph, use the curve for the next higher value of "X" (see example).
2. Read off the maximum speed value for the weight of the tool + tool holder assembly.
EXAMPLE
You have an 9kw spindle, and want to use a tool + tool holder assembly weighing a total of 3.5 kg (including ring nut and elastic collet). The distance between the spindle nose and the centre of gravity "G" of the tool + tool holder assembly "X" is 120 mm.
1. Since there is no curve for "X"=120 mm, use the curve for the next higher value, i.e. the yellow curve for "X"=130 mm.
2. Against the weight 3.5 kg read off the maximum no-load speed, which is 10000 rpm.

9.6 SENSOR FUNCTIONING

Note:
The optional sensors (the "spindle shaft stopped" sensor S3) are optionally installed in ISO 30.
ISO 30 versions are fitted with two -spindle sensors. Sensors S1 and S2 perform the functions described below.

S1	Detects correct locking of the tool holder. It is used to provide the NC with a safety signal permitting spindle rotation.

CONDITION	OUTPUT S1
Tool holder locked	+24V
No tool holder	0V
Tool holder ejected (collet open)	0V

Always monitor S1 during spindle rotation and stop rotation if S1 drops to 0 Volt.

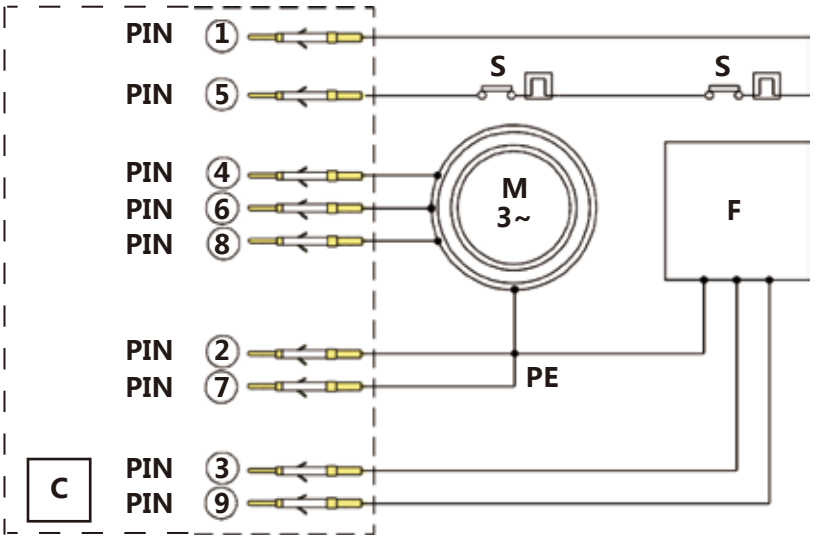
Ignore S1 from the moment the tool eject command is given until the next tool locking command is given.

S2	Important during tool changes. Detects ejection of the tool holder, permitting the next phase in the tool change cycle to take place.

CONDITION	OUTPUT S2
Tool holder locked	0V
No tool holder	0V
Tool holder ejected (collet open)	+24V

9.7 THERMAL SWITCH

The spindle is protected by two normally closed bi-metallic switches wired in series. These protect the spindle motor and cooling fan motor respectively.
They must be connected in series with the machine's safety stop system or inverter safety stop system .
The switches open if temperature reaches a potentially damaging level, tripping the machine's safety stop system and stopping machining. They close again when temperature drops to normal operating levels.



C	Power connector
S	Bi-metallic switches
M	Spindle motor
F	Cooling fan
PE	Electrical protection

The fan's thermal switch only detects fan motor overheating. It cannot detect that the fan is prevented from turning, unless this causes overheating. For this reason, check the condition of the fan regularly.

The fan must remain on at all times when the machine is active even if the spindle is not operating.

10. MAINTENANCE

Read this section carefully before attempting any maintenance on the spindle. This section contains information that is important for the safety of maintenance personnel and for the reliability of maintenance work itself.

All applicable safety precautions must be taken whenever maintenance work is done on the spindle. In particular:

- Maintenance and/or lubrication must be performed only by qualified, expert personnel, with the authorization of factory management, in compliance with applicable safety directives and standards, and with the use of suitable tools and instruments.
- When performing maintenance, always wear suitable clothing such as tight fitting work overalls and safety shoes. Never wear long or slack clothing or clothes with parts that hang loose.
- When performing maintenance on a machine, mark it clearly with panels stating “MACHINE UNDERGOING MAINTENANCE”, and guard from unauthorized access.

During all maintenance work make sure that the spindle is:

- disconnected and insulated from the electrical power supply;
- fully stopped (not still spinning).

Maintenance managers must ensure that their team is trained to ensure optimum co-ordination and safety. All persons performing maintenance must remain fully visible to colleagues at all times so that they can signal for assistance if necessary.

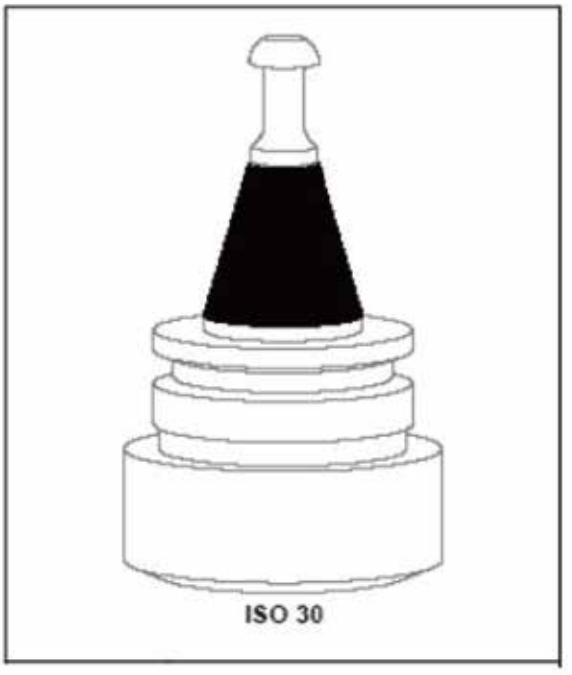
SPECIAL TOOLS ARE NOT NORMALLY REQUIRED FOR SPINDLE MAINTENANCE.

10.1 SCHEDULED MAINTENANCE

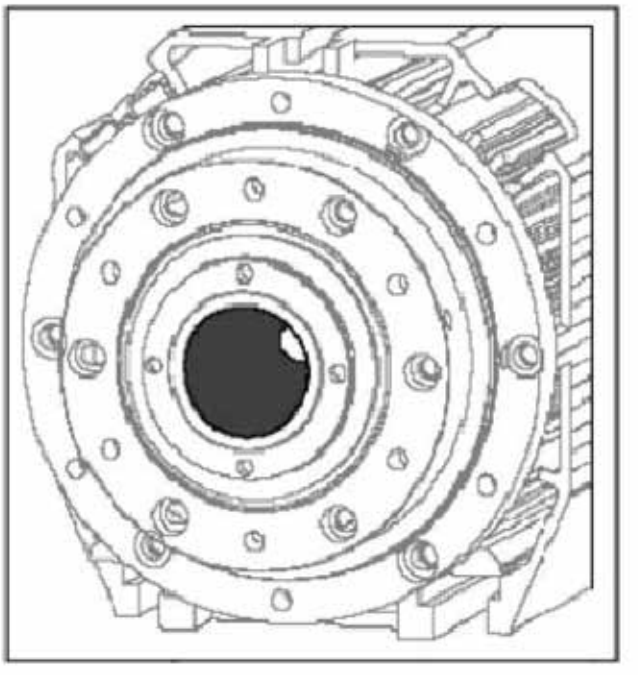
The following maintenance schedule must be followed scrupulously to keep the spindle in peak condition.

The frequency has been calculated taking into account an 8-hour a day, 5-day working week, in a normal working environment.

10.1.1 Checking the cleanliness of the tool holder cone and of the spindle shaft tool housing



Conical surface of an ISO 30 tool holder (in black)



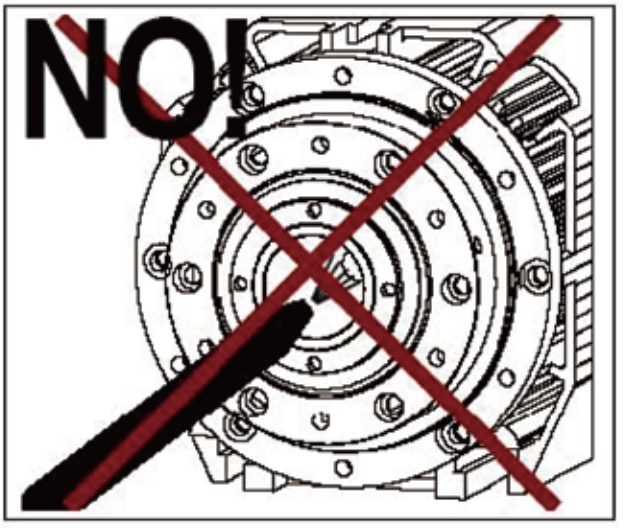
Conical surface of ISO 30 spindle shaft (in grey)

DAILY

Always keep the conical surface of the tool holder (shown in black in Figure) and that of the housing in the spindle shaft (shown in grey in Figure) perfectly clean and free from dust, grease, coolant, oil, metal shavings, and corrosion or lime scale. Check these before you start to use the spindle.

Clean these parts carefully at the end of every working day with a clean and soft cloth.

BLOWING COMPRESSED AIR INTO THE SPINDLE NOSE WHEN THERE IS NO TOOL HOLDER IN PLACE CAN CAUSE DAMAGE.



BLOWING COMPRESSED AIR INTO THE SPINDLE NOSE WHEN THERE IS NO TOOL HOLDER IN PLACE CAN CAUSE DAMAGE .

DIRTY MATING SURFACES CAUSE AN UNCORRECT TOOL HOLDER SEATING, WITH SERIOUS CONSEQUENCES FOR OPERATOR SAFETY, SPINDLE AND TOOL HOLDER WEAR, AND MACHINING PRECISION.

USE A CLEAN AND SOFT CLOTH TO CLEAN THE CONICAL SURFACES AND THE FACES SHOWN IN FIGURES. ABSOLUTELY NEVER USE ABRASIVE TOOLS OR MATERIALS LIKE METAL BRUSHES, EMERY CLOTH, ACIDS AND OTHER AGGRESSIVE CHEMICALS.

10.1.2 Cleaning the tool holder cone

Clean carefully the conical surface of the tool holder (shown in black in Figure 10.1.1) using a clean, soft cloth dipped in ethyl alcohol.

10.1.3 Protecting the spindle shaft's conical housing

DIRT MUST NOT BE ALLOWED TO ENTER THE CONE SEAT. CLOSE IT WITH A SUITABLE PLUG OR A SPARE TOOL HOLDER.

AT THE END OF THE WORKING DAY, ALWAYS REMOVE THE TOOL HOLDER FROM THE SPINDLE, TO PREVENT IT FROM STICKING.
PROTECT OR COVER THE SPINDLE NOSE AGAINST CONTAMINATION.

10.1.4 Bearings

THE BEARINGS ARE LUBRICATED FOR LIFE AND DO NOT REQUIRE GREASING.

10.2 REPLACING PARTS

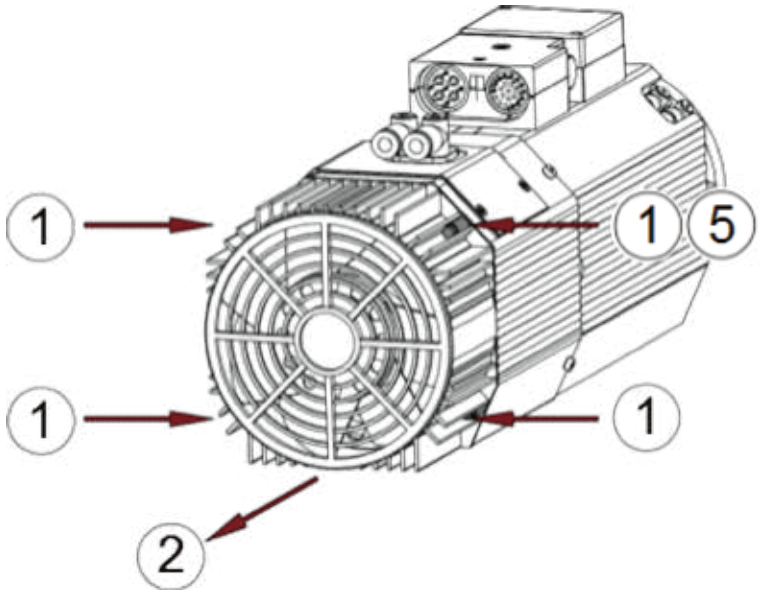
Parts must only be removed and replaced by qualified and authorized personnel.

RESIDUAL RISKS:	THE DRAW BAR SPRING IS PRE-LOADED WITH A FORCE OF HUNDREDS OF KILOGRAMS. THE DRAW BAR CAN BE VIOLENTLY EXPELLED FROM THE UNIT, WITH SERIOUS RISK OF INJURY, IF THE SPINDLE IS DISASSEMBLED BY UNTRAINED PERSONNEL. PERFORM ONLY THE TASKS DESCRIBED IN THIS MANUAL. FOLLOW THE INSTRUCTIONS SCRUPULOUSLY. IN CASE OF DOUBT, CONTACT THE TECHNICAL ASSISTANCE SERVICE.

ALL DISASSEMBLY AND RE-ASSEMBLY OPERATIONS MUST BE PERFORMED WITH:
ABSOLUTE CERTAINTY THAT THE MACHINE IS STOPPED, THE CONTROL PANEL IS DISCONNECTED AT THE POWER SWITCH, AND THE SWITCH LOCKED, WITH THE KEYS HELD BY THE MAINTENANCE MANAGER
ABSOLUTE CERTAINTY THAT THE TOOL IN THE SPINDLE IS STATIONARY
A WORKING ENVIRONMENT THAT IS EQUIPPED WITH ALL NECESSARY TOOLS AND EQUIPMENT AND FREE FROM SOURCES OF POTENTIAL DANGER THOROUGH CLEANLINESS OF THE PARTS BEING FITTED, WHICH MUST ALSO BE EITHER DEGREASED OR LUBRICATED ACCORDING TO THEIR USE.

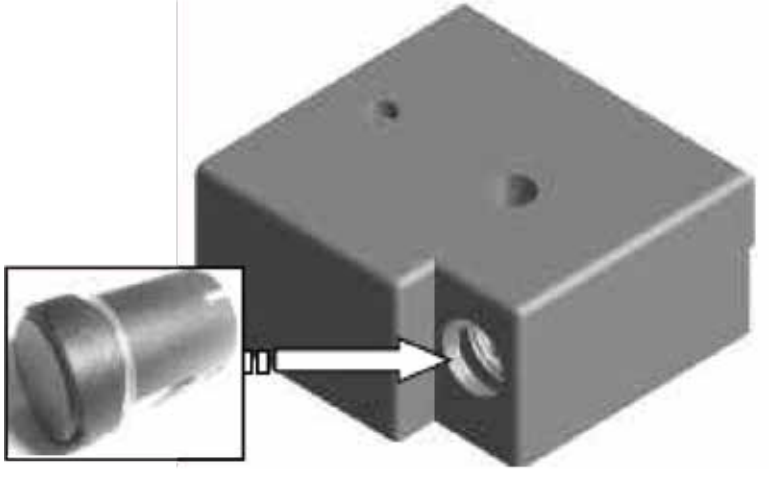
USE ONLY ORIGINAL SPARE PARTS AND PERFORM ONLY THE INSTRUCTIONS DESCRIBED IN THIS MANUAL. NO OTHER WORK ON THE SPINDLE IS PERMITTED AND WOULD INVALIDATE THE WARRANTY.

10.2.1 Replacing the cooling fan



1	Remove the four fixing screws from the cooling fan unit.
2	Pull the fan unit off in the direction shown by the arrow.
3	Disconnect the cooling fan's electrical connector.
4	Connect up the connector of the new cooling fan unit.
5	Push the earth cable of the new cooling fan unit into the hole (5), to ensure that it will be locked in position by the screw fitted in the next step (6).
6	Fit the new cooling fan unit and secure it with the four fixing screws, taking care to achieve an efficient earth connection.

10.2.2 Replacing the tool change push-button

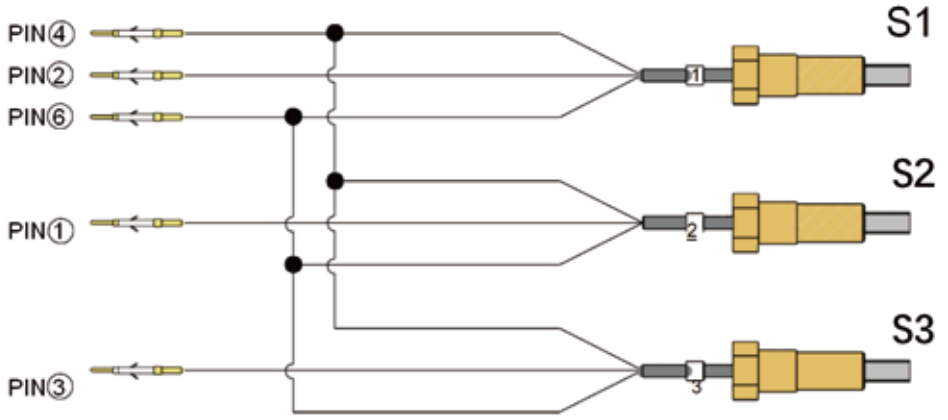


1	Remove the two screws from the terminal block cover.
2	Remove the terminal block cover.
3	Disconnect the push-button cable.
4	Gently push the old button out from inside the terminal block while also pulling it from the outside.
5	Fit the new push-button.
6	Connect up the push-button cable.
7	Replace the cover on the terminal block.
8	Fit and tighten the two cover screws.
9	Check the functioning of the new push-button.

⚠ IT IS STRICTLY FORBIDDEN TO CHANGE CABLES INSIDE THE TERMINAL BLOCK.

10.2.3 Replacing sensors S1, S2, S3 and S4

10.2.3.1 Wiring of sensors in ISO 30 versions



10.2.3.2 Accessing the sensors

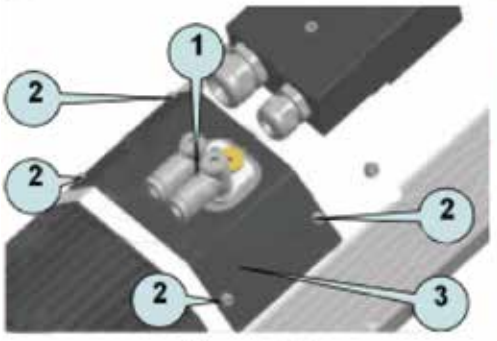


Figure 10.14

Figure 10.15

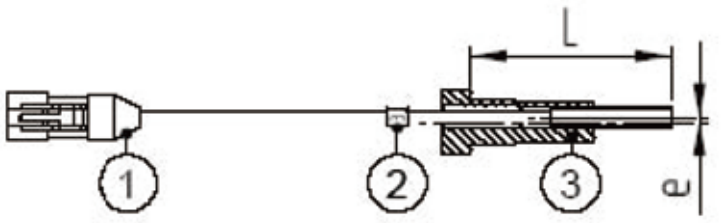
Figure 10.14	Figure 10.15
1 PAIR OF QUICK-FIT UNIONS	**3** COVER OF SENSOR COMPARTMENT
2 SCREWS	**4** SENSOR COMPARTMENT

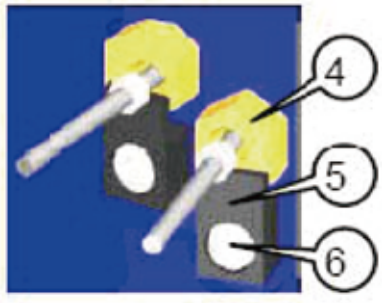
10.2.3.3 Location of sensors

10.2.3.4 The sensor assembly

> The sensors are identified by a numbered cable tag. Take care not to mix up the sensors. This could damage moving parts of the spindle.

The sensors are pre-fitted in calibrated seats to enable them to be quickly fitted to the spindle at the correct depth.
For this reason always make absolutely sure what sensor you need to replace. The cables of the sensors installed in the spindle and of those provided as spares are all tagged with a number ring to facilitate identification.





1	Electrical connector	**e**	Adjustment eccentric
2	Cable number ring	**4**	Sensor
3	Calibrated seat and sensor	**5**	Sensor fixing bracket
L	Calibrated depth	**6**	Allen screw

10.2.3.5 Replacing a sensor assembly

1. Remove screw (6) securing the bracket (5) of the sensor to be replaced (4).
2. Pull the faulty sensor out from its housing and disconnect its electrical connector (1).
3. Fit the replacement sensor in the housing and connect the electrical connector.
4. Replace bracket (5) and replace and tighten screw (6). Do not fully tighten yet. Leave it loose enough to turn the sensor for calibration.
5. After you have calibrated the sensor, tighten the fixing screw to maintain the calibration setting.

> Perform as many tests as possible using all available tool holders to verify the effectiveness of the new sensor calibration.

Warning: Incorrect sensor calibration can lead to spindle malfunctions.

10.2.3.6 Calibrating sensors S1, S2, and S3 on ISO 30 spindles

When you have replaced the sensor as instructed in section 10.2.3.5 , proceed as follows to calibrate it.
1. Check whether the signal output from the sensor corresponds to that specified in section 9.6 in the table for the sensor you are calibrating.
2. If it does not, turn the sensor seat (4) until you obtain the output specified in the table for the sensor you are calibrating. Hold the sensor in this position and tighten the fixing screw (6).

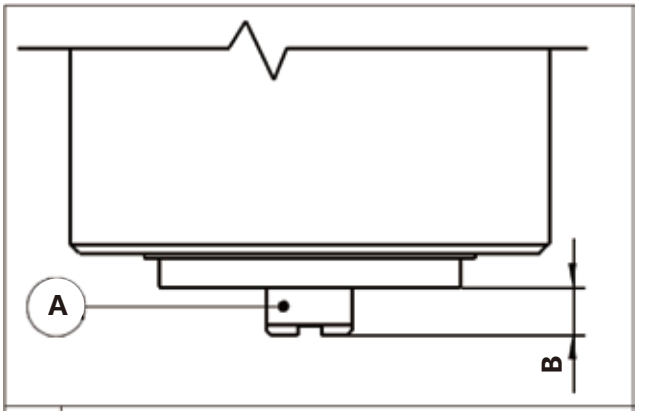
10.2.3.6.1 Procedure for S1

When you have replaced the sensor as instructed in section 10.2.3.5 , proceed as follows to calibrate it.
1. Check whether the signal output from sensor S1 corresponds to that specified in the table below.

CONDITION	OUTPUT S1
Tool holder locked	+24V
No tool holder	0V
Tool holder ejected (collet open)	0V

2. Turn the spindle shaft by hand and check whether the conditions in the table are fulfilled throughout the 360° of a complete revolution.
3. If they are not, turn the sensor seat (4) until you obtain the output specified in the table. Hold the sensor in this position and tighten the fixing screw (6).

10.2.3.6.2 Procedure for S2



A	Ejector
B	Reference measurement

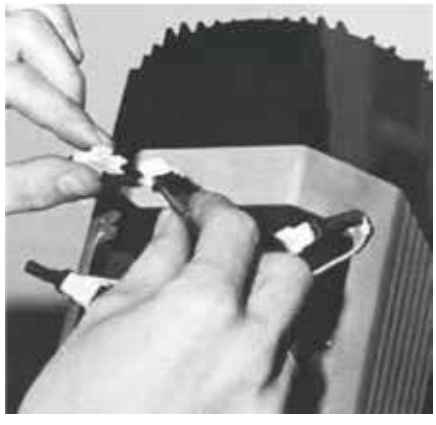
When you have replaced the sensor as instructed in section 10.2.3.5 , proceed as follows to calibrate it.

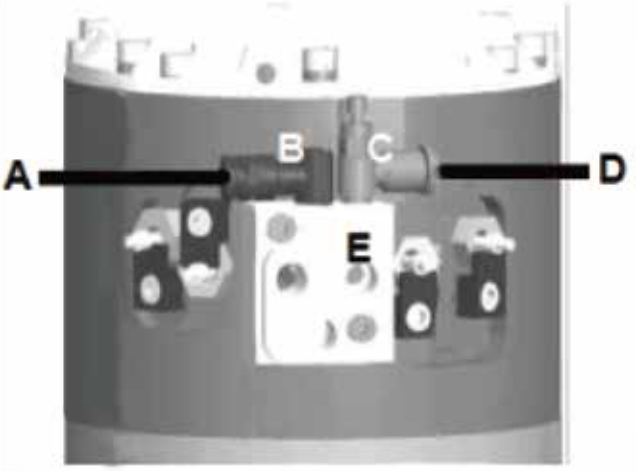
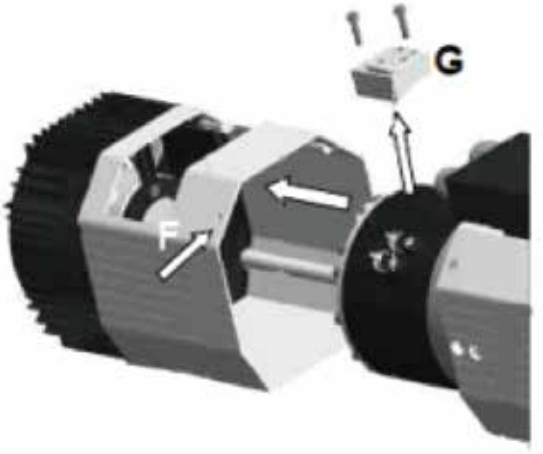
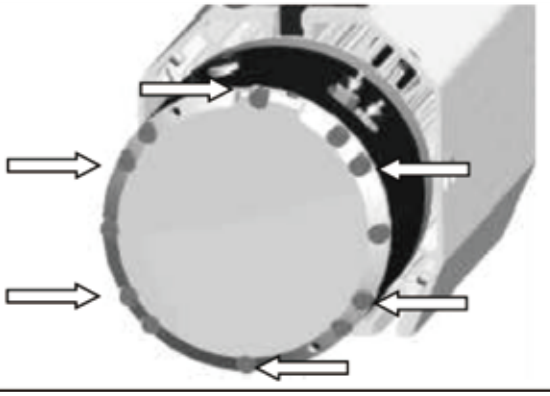
1. Connect compressed air at 6/7 bar (85/100 PSI) to the spindle's cylinder and set the spindle in a condition of "tool holder ejected (collet open)".
2. Use a depth callipers as shown in Figure to check whether distance (B) from the tip of the ejector to the nose of the spindle at its maximum is 10.5 ± 0.1 mm. If it is not, do NOT proceed but contact the Our Customer Assistance Service.
3. Release the air from the cylinder. The ejector retracts, and (B) returns to its minimum value.
4. Use a pressure regulator to gradually increase pressure in the cylinder and extend the ejector.
5. Stop when distance (B) reaches 10.3 ± 0.1 mm.
6. If necessary, slacken off the fixing screw (6) for sensor S2.
7. Turn the seat (4) of sensor S2 until the sensor gives a "high" signal (24V) with (B) = 10.3 ± 0.1 mm and a "low" signal (0V) with (B) < 10.3 ± 0.1 mm. Hold the sensor seat firmly in this position.
8. Turn the spindle shaft by hand and check that when (B) = 10.3 ± 0.1 mm the output from S2 is "high" (24V) and "low" (0V) when (B) < 10.3 ± 0.1 mm through 360° of a complete revolution.
9. Tighten the screw (6) to secure the sensor fixing bracket (5).
10. Perform as many tests as possible using all available tool holders to verify the effectiveness of the new sensor calibration.

10.2.3.6.3 Procedure for S3

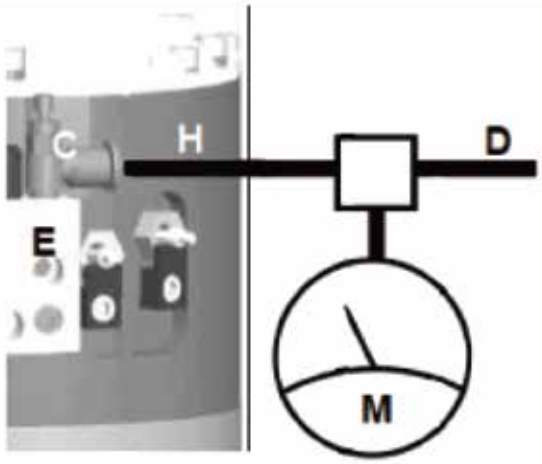
When you have replaced the sensor as instructed in section 10.2.3.5 , proceed as follows to calibrate it.
1.Check whether the signal output from the sensor corresponds to that illustrated in figure.
2.If it does not, turn the sensor seat (4) until you obtain the output specified in the table. Hold the sensor in this position and tighten the fixing screw (6)

10.2.4 Replacing the cylinder assembly

1		Open the sensor compartment as instructed in section 10.2.3.2.
2		Disconnect all the electrical connectors.
3	IMPORTANT:	Before you disconnect hoses A and D (see step 4 below) tag them or mark them with adhesive tape, so that you can recognize which is which in the rest of the procedure.

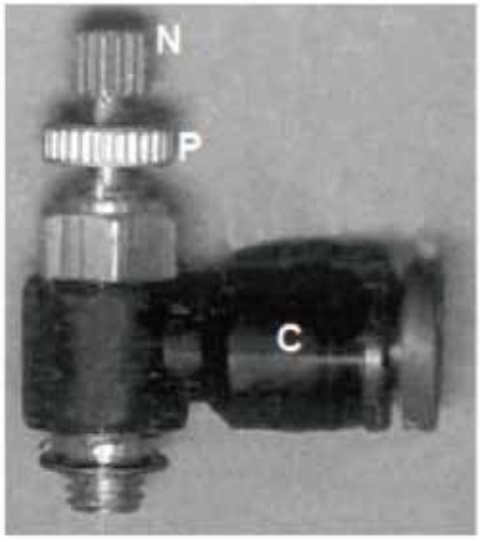
4		**A** Compressed air line for optional functions **B** Quick-fit union **C** Quick-fit union with pressure regulator **D** Compressed air line for internal pressurization **E** Compressed air inlet for cone cleaning and pressurization
5		• Clearly mark hoses **A** and **D** as instructed in step **3**. • Disconnect hoses **A** and **D** from unions **B** and **C**. • Remove the two fixing screws from block **G**. • Remove block **G** taking care not to lose or damage the seals. • Remove the four screws **F**. • Remove the cooling fan cover in the directions shown by the arrow.
6		**Remove only the six screws shown** to release the cylinder.
7		Fit the new cylinder using the six screws removed in step **6**.

8



C	Quick-fit union with pressure regulator
D	Compressed air line internal pressurization
E	Compressed air inlet for cone cleaning and pressurization
H	Connection hose
M	Pressure gauge

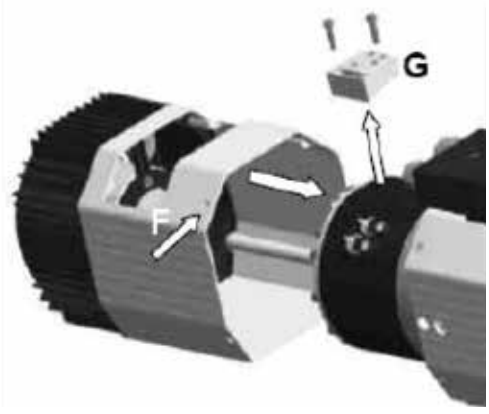
9



C	Quick-fit union with pressure regulator
N	Adjuster
P	Lock nut

- Fit a pressure gauge **M** as shown in step **8** to measure the outlet pressure from union **C**.
- Connect an air supply at **4 bar (58 PSI)** to **E**.
- Turn adjuster **N** until the pressure on the gauge reads **0.8 bar (11.6 PSI)**.
- Tighten lock nut **P** to lock the adjustment. Disconnect the pressure gauge **M** and hoses **D** and **H** from union **C**.

10



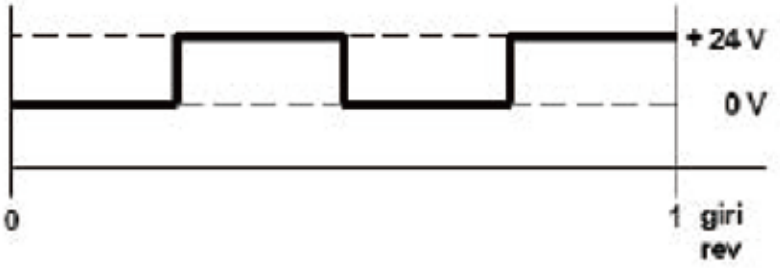
- Block **G** must be removed to re-fit the cooling fan cover.
- Remove the two fixing screws from block **G**.
- Remove block **G** taking care not to lose or damage the seals.
- Fit the cooling fan cover and secure with screws **F**.
- Fit block **G** again, taking care to seat the seals correctly, and tighten the two fixing screws.
- Reconnect hoses **A** and **D** to quick-fit unions **B** and **C** respectively (see the figure for step **4**).
- Connect the cooling fan' s electrical connector.

11		Follow the instructions in section 10.2.4 to: • remove the sensors from the old cylinder; • fit them on the new cylinder; • calibrate the sensors; • Close the sensor compartment.
12		• Use an M6 Allen key to remove the EXTERNAL compressed air unions from the old cylinder and fit them to the new cylinder.

CALIBRATE THE SENSORS AFTER THE CYLINDER ASSEMBLY HAS BEEN REPLACED.

11 ACCESSORIES AND OPTIONS

"SPINDLE SHAFT STOPPED" SENSOR S3
The "SPINDLE SHAFT STOPPED" sensor outputs two "ON" and two "OFF" pulses per shaft revolution. It remains permanently "ON" at high speeds.



See section 5.3.4 for the sensor's electrical specifications.
See section 10.2.3 to install and calibrate the sensor. Make sure that output meet the requirement.

Ignore the output of S3 during tool changes.

12.TROUBLE SHOOTING

BEFORE STARTING ANY WORK ON THE SPINDLE, READ AND FOLLOW ALL THE SAFETY PRECAUTIONS AND MAINTENANCE SAFETY WARNINGS.

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
The spindle does not turn	There is no power	Check the mains power supply. Check all power terminals. Check all electrical cables and connections for breaks.
	No tool holder is fitted	Fit a tool holder.
	The tool holder not correctly seated	See"The tool holder is not locked" below.
	The thermal switch has tripped	Wait for the spindle to cool down and the thermal switch will automatically reset. If the thermal switch trips frequently, see "The spindle overheats" below.
	The inverter switch has tripped	Consult the inverter's own manual or contact the inverter manufacturer.
	Sensor S1 (ISO 30) is disconnected or faulty	Check the sensor connectors. Check the sensor cables for breaks. Calibrate the sensors as instructed. Replace any faulty sensors as instructed.
	There is no spindle enabling signal	Consult the manuals or contact the manufacturers of the machine, numeric controller, and inverter.
The tool holder is not locked	There is dirt or foreign bodies between the tool holder and the spindle shaft housing	Remove any large foreign bodies and clean the tool holder cone and spindle housing.
	The tool holder cone is not of the right type	Choose a tool holder as instructed.
	There is insufficient air pressure to open the collet	Check the air pressure settings in accordance with section 7.4. Check the compressed air system for leaks and pressure losses.
	The spindle is not aligned with the tool holder magazine	Consult the machine's own manual or contact the machine manufacturer.
	Sensor S2 is disconnected or faulty	Check the sensor connectors. Check the sensor cables for breaks. Calibrate the sensors . Replace any faulty sensors.

	There is a control error	Consult the machine's own manual or contact the machine manufacturer.
The tool holder is not ejected	There is insufficient air pressure	Check the air pressure settings. Check the compressed air system for leaks and pressure losses.
	There is no ejection enabling signal	Consult the manuals or contact the manufacturers of the machine, numeric controller, and inverter.
There is no air pressure inside the spindle	There is insufficient air pressure or the compressed air system is faulty	Check the air pressure settings . Check the compressed air system for leaks and pressure losses. Contact the Our Technical Assistance Service.
One of the sensors does not give the required output	A sensor is disconnected or faulty	Check the sensor connectors. Check the sensor cables for breaks. Calibrate the sensors. Replace any faulty sensors.
The spindle overheats	The cooling fan is not working properly	Check that the cooling fan is working. Check the cooling fan for damage. Check that nothing is preventing the fan from turning. If the fan unit itself is faulty, replace it.
	The air channels through the spindle body are blocked	Remove the cooling fan. Inspect and clear the air channels through the spindle body. Re-fit the cooling fan.
	The machining is taking up too much power	Reduce the machining power requirements.
	The inverter setup is incorrect	Check the specifications for your model of spindle on its data label.
	The power supply voltage is incorrect	Check the voltage requirements on the spindle's data label.
	For models with configurable power terminals only: the connections at the configurable power terminals are incorrect	Check that the power terminals are configured correctly for the mains power rating.

Excessive current absorption	For models with configurable power terminals only: the connections at the configurable power terminals are incorrect	Check that the power terminals are configured correctly for the mains power rating.
Performance below specifications	For models with configurable power terminals only: the connections at the configurable power terminals are incorrect	Check that the power terminals are configured correctly for the mains power rating.
	The inverter setup is incorrect	Check the specifications for your model of spindle on its data label
	The power supply voltage is incorrect	Check the power supply voltage requirements on the spindle's data label.
The spindle vibrates	The tool holder is not balanced	Choose a tool holder.
	The tool is not balanced	Choose a tool
	There is dirt or foreign bodies between the tool holder and the spindle shaft housing	Remove any large foreign bodies and clean the tool holder cone and spindle housing
	The inverter setup is incorrect	Check the specifications for your model of spindle on its data label
	The machining is taking up too much power	Reduce the machining power requirements.
	The fixing bolts are loose	Tighten the fixing bolts.
	The bearings are worn or damaged	Replace the spindle shaft kit.
The bearings are noisy	The bearings are worn or damaged	Replace the spindle shaft kit.

13. DISPOSING OF THE SPINDLE

At the end of the spindle's working life it is the customer's responsibility to dispose of it correctly.
First of all, clean the unit and separate the various components into mechanical and electrical parts. Then separate the component parts according to type of material: electric motors (copper windings), metal parts (body, etc.), plastic parts, etc.. Dispose of the various materials in compliance with the laws and regulations applicable in the country where the spindle has been installed.

20 YEARS ELECTRIC SPINDLES
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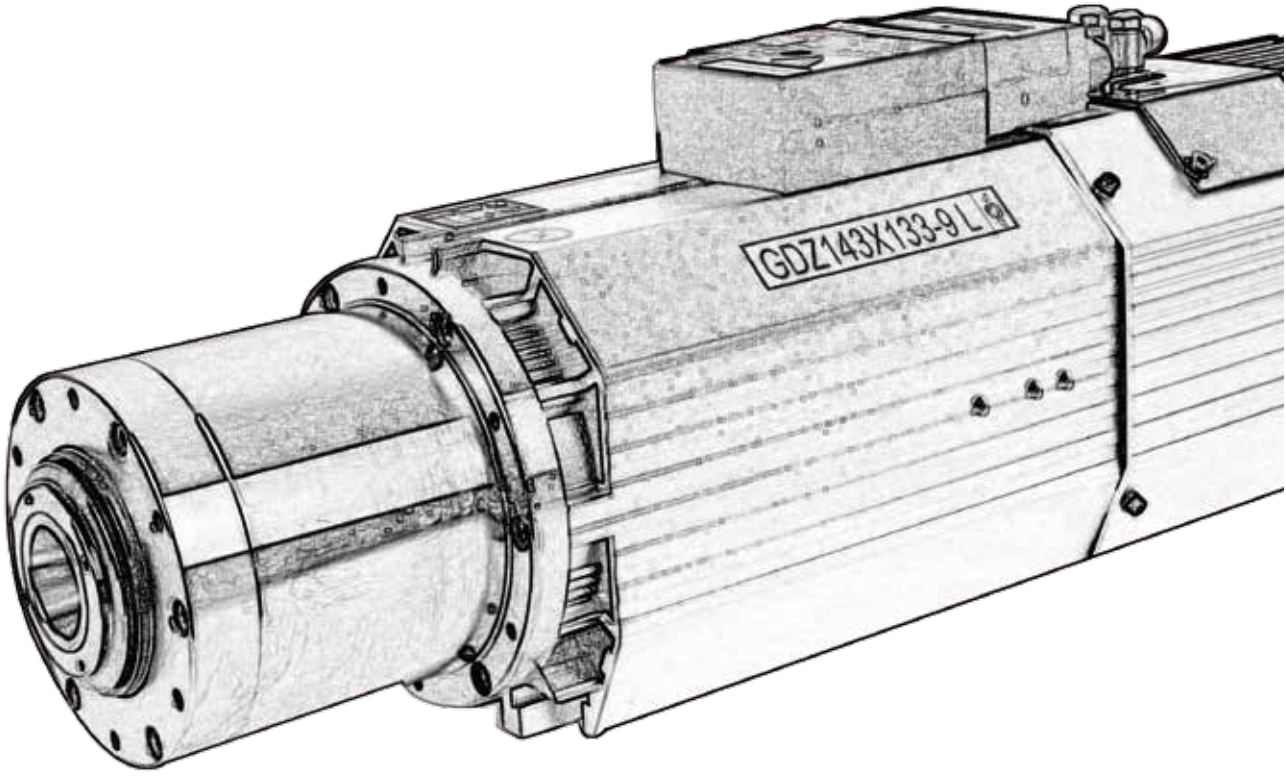

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