

エア軸受タービンスピンドル

Xpeed1200

取扱説明書

OM-K0548 002



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Air Bearing Turbine Spindle

Xpeed1200



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Thank you for purchasing our Xpeed1200. The Xpeed1200 is a ultra precision spindle which rotate by drive of a turbine adopting an air bearing. In order to use this spindle properly and effectively and enjoy long use, please fully understand this Operation Manual before use for sufficient care in handling. It is necessary for you to separately prepare related devices (such as an air line kit, piping connection hose and compressor) to supply highly clean compressed air .

1 CAUTIONS FOR HANDLING AND OPERATION

- Read these cautions carefully and correctly before using the device.
- Safety cautions are intended to avoid potential hazards that could result in personal injuries or damage to the device. They are classified as follows in accordance with the seriousness of the risk.

Class	Degree of Risk
 WARNING	Existence of a hazard that could result in bodily injury or damage to the device, if the safety instructions are not followed.
 CAUTION	Possibility of a hazard that could result in light or middle degree of bodily injury or damage to the device, if the safety instructions are not followed.

Warning

- ① This air bearing spindle (Xpeed1200) is not designed as a hand tool. Install it on your machine tool or special purpose machine.
- ② Do not touch the spindle during rotation, as the motor speed is very high.
- ③ Wear safety glasses and dust mask. Always use a protective surround on the machine to avoid flying debris.
- ④ Check that the cutting tool is securely tightened before each use.
- ⑤ Never operate or handle the product until you have thoroughly read the Operation Manual and safe operation is confirmed.
 - Handle or operate the product only after sufficient precautions have been met and ensure safety has been confirmed.
 - Prior to operating the product confirm that all of the above safety precautions have been taken. Do not connect the product to an energy source or supply compressed air until all safety checks have been confirmed.

Caution

- ① Use the spindle after running at its free speed for 5-10 minutes. Frictional heat caused by air can cause the spindle temperature to rise +20° above room temperature. Warm-up idling stabilizes spindle accuracy.
- ② Always drain the moisture condensation from the air filter to prevent it from rusting the spindle interior and causing premature failure.

2 FEATURES

- ① Adoption of the air bearing and turbine drive is suited for high speed mold cutting, and small diameter drilling and grinding of finely-shaped parts which require high precision machining.
- ② Optimal set-up of cutting conditions and selection with a machine used are achieved by making use of high speed rotation performance which exceeds 100,000 min⁻¹. This will result in increased production performance.
- ③ Run-out accuracy during rotation is minimized and high speed rotation accuracy is obtained by adoption of a high precision collet and balance characteristics held to a minimum. As a result, a prolonged tool life can be expected.
- ④ For the air bearing, a rotating shaft is floated without contact by supplying dry compressed air from which oil is removed to the bearing gap. This prevents the bearing from being worn and reduces energy consumption to a low level.
- ⑤ Electric wiring is unnecessary, and operation can be easily performed only through the air piping.

3 SPECIFICATIONS AND DIMENSIONS

No.	Item	Standard value
1	Model	Xpeed 1200
2	Maximum rotation speed	120,000min ⁻¹
3	Drive method	Compressed air turbine
4	Bearing type	Air Static Pressure Bearing
5	Rotating direction	Right Hand Rotation (FWD). Viewed from the rear of the Air Bearing Turbine Spindle toward the cutting tool.
6	Air Bearing Required Air Pressure	0.6MPa
7	Air Turbine Operating Air Pressure*	0.5MPa or less
8	Brake air supply pressure	0.5MPa or less
9	Spindle Accuracy	1 μm or less
10	Weight	2,300 g

* For details on how to set the turbine air supply pressure, refer to the separately attached inspection table.

	Temperature	Humidity	Atmospheric Pressure
Operation Environment	0 - 40°C	MAX.75% (No condensation)	800 - 1,060hPa
Transportation and Storage Environment	-10 - 50°C	10 - 85%	500 - 1,060hPa

<Option>

Collet (CHK - □□ AA)	Ø3.0mm, Ø3.175mm, Ø4.0mm, Ø6.0mm, Ø6.35mm
Collet Nut	CHN - 3A

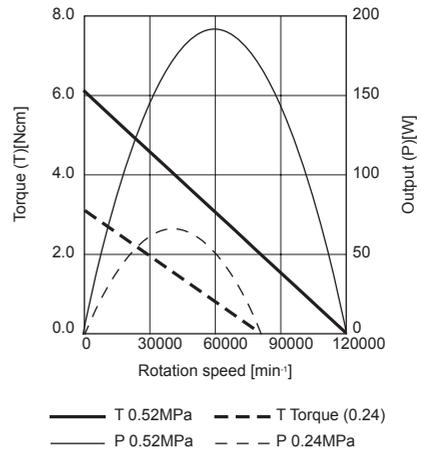
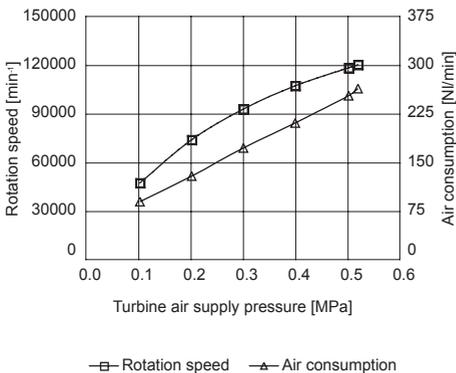


Fig. 1 Xpeed1200 performance diagram

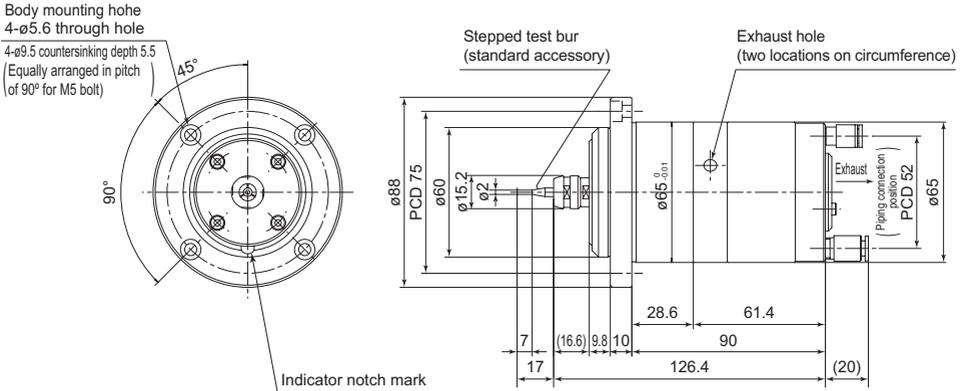


Fig. 2 Appearance dimensions detailed drawing

4 STANDARD ACCESSORIES

Standard accessories and attachments				
• Fitting for piping	KQ2S06-M5-X29	4 pcs.	• Stepped test bur $\varnothing 2 \times \varnothing 4 \times 34L$ (Ultra carbide)	1 pc.
	Air bearing air supply, brake air supply (for $\varnothing 6$ hose)		For measuring run-out accuracy	
• Fitting for piping	KQ2S06-01S-X29	2 pcs.	• Spanner 12 x 14	1 pc.
	Turbine air supply (for $\varnothing 6$ hose)		• Torque wrench (For tightening a collet nut) 14mm	1 pc.
• Fitting for piping	KQ2P-06-GR	6 pcs.	• Operation Manual	1 set
	Plug (for $\varnothing 6$ hose)		• Inspection record table	1 set
• Collet (CHK-4.0 AA)*		1 pc.	• $\varnothing 6$ blue hose (1.5m)	1 pc.
• Collet nut	K-265A	1 pc.	recommended by SMC is TU0604BU	
• Protect cap (for stepped test bur)		1 pc.	• $\varnothing 6$ transparency hose (1.5m)	1 pc.
• Protect cover		1 pc.	recommended by SMC is TU0604C	

* The value of run-out is within $3\mu m$

5 INSTALLATION OF Xpeed1200

In the case of installation of Xpeed1200 to the holder, Adoption a flange fixing method make damage to the mounting method minimized. The advanced characteristics incorporated in the spindle are fully utilized and observing the precautions shown below and proper installation can realize high precision machining.

- ① Remove the protect cover of the Xpeed1200.
- ② Insert the spindle housing diameter $\varnothing 65$ section into a holder (prepared by customer).
- ③ Secure the spindle to the countersunk holes (4 locations) on the flange using M5 bolts as shown in Fig.2 and Fig.3.

⚠ Caution

- ① Secure the main body so as not to block the exhaust holes (2 locations on the circumference) on the back of the spindle. Install the main body laterally so that the exhaust hole faces downward.
- ② If the spindle housing diameter $\varnothing 65$ section is tightened and fixed using bolts and a split sleeve, split holder arrangement, the main body will be geometrically deformed and assembly accuracy will be affected. Troubles such as rotation failure and heat generation may result. Absolutely never fix it with bolt and split type holders. (Refer to Fig.3).
- ③ Since the spindle housing section has been assembled by stacking some components with high precision, spindle damage can occur if the spindle receives shock by bumping while inserting it in the holder. Therefore, very carefully perform installation work.

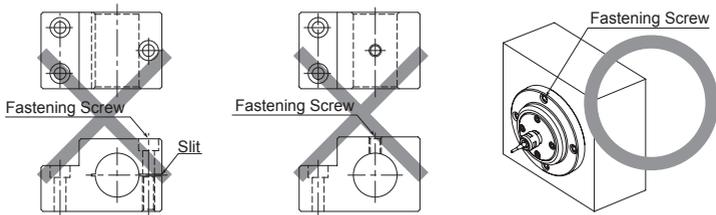


Fig. 3

6 PIPING CONNECTION

For connection of the piping to Xpeed1200, there are a large number of air supply pipes. For this reason, connect pipes to the predetermined positions without error with reference to the markings on the piping connecting section on the rear of the spindle as shown in Fig.4. This will allow you to prepare operation safely and without failure. In most failures of spindles equipped with air bearings, contaminants, water and oil are mixed into the piping and cleanliness is impaired, creating a problem that bearing performance is deteriorated. Therefore, build a piping system shown in Fig.5 and Fig.6 for air supply to the spindle to supply sufficiently clean and dry air.

⚠ Cautions

- ① Various fittings for piping connection are available for spindles. Sufficiently clean the fittings and install them after air blowing so as to prevent mixture of contaminants, oil and water when connecting. Also clean tools and hoses used for piping connection in the same manner.
- ② Securely connect the hoses. If a hose is removed during operation, a large amount of air will suddenly jet out and the hose will swing wildly, which is very dangerous. Check the operating pressure for the air piping hose, and use products having specifications sufficiently permissible to pressure supplied from the compressor and pressure required for the spindle. Unless the allowable pressure for the hose satisfies the operating pressure, the hose may be ruptured, which is very dangerous.
- ③ If the air piping is connected to an improper connecting position, unintentional operation may occur, and this may result not only in incorrect operation, but also in failure, which is very dangerous. Pay sufficient attention so as not to connect improperly.

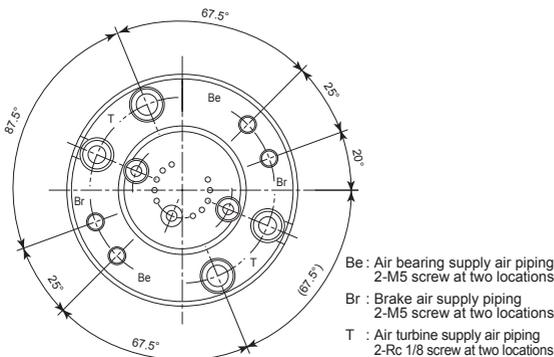


Fig. 4 Piping connection portion detailed drawing

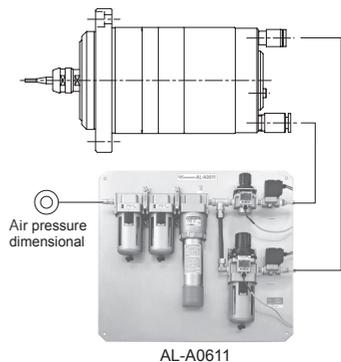
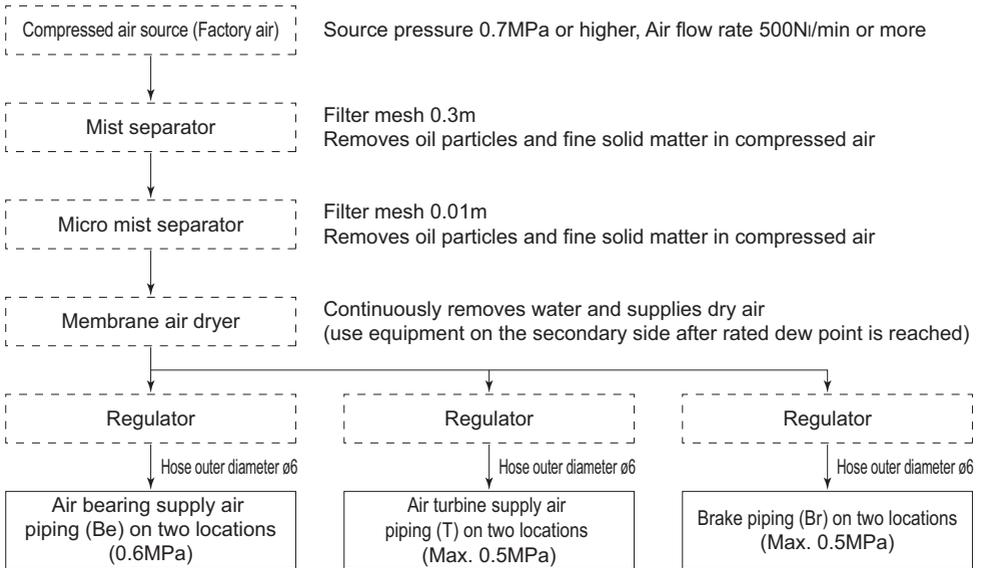


Fig. 5 Recommended piping system structure



* Note 1: Devices in the broken lined frame are not included with Xspeed1200, therefore, these should be prepared by the customer.

* Note 2: For details and precautions of each air device, refer to the Operation Manual of the manufacturer from which you purchased the each product.

* Note 3: Make sure the set air pressure at the Air Bearing Turbine Spindle piping connection port.

Fig. 6 Recommended piping system structure

Procedures to supply air to air bearing and precautions

- ① Perform flushing of hose to be connected for piping for a few minutes and completely remove contaminants, water and oil in the piping.
- ② It normally takes some time from starting to flow air into air dryer until reaching the rated dew point. It is necessary to supply air to the spindle in a state that the dehumidifying state of an air dryer which the customer uses has reached the rated dew point.
- ③ Adjust the set pressure in each piping to 0MPa in advance before supplying air for the first time after connecting the piping, and ensure that piping is performed to the predetermined position. Sufficiently keep in mind that, if piping is improperly connected to the air bearing, and air is supplied to the turbine and brake piping, and not supplied to the air bearing, the rotating shaft rotates without floating, and this damages the bearing and the rotating shaft.
- ④ Supply air to the air bearing piping.
- ⑤ Adjust the set pressure for the air bearing so as to become 0.6MPa at the piping connection port. Sufficiently keep in mind that correct pressure may not be obtained due to pressure loss if the piping connection port is apart from the pressure detecting section.
- ⑥ Slightly rotate the rotating shaft by hand to check that the shaft smoothly rotates without an abnormal feeling and sticking feeling. In this case, in order to avoid danger, never supply air to the turbine air supply and brake air supply piping.
- ⑦ Leave Xspeed1200 as it is without operating for approximately 30 minutes after supplying air to the air bearing piping, and check the until the inside of the spindle is sufficiently cleaned and dehumidified. Carry out this operation for approximately one hour especially if Xspeed1200 has not been used for an extended period of time.
- ⑧ It is necessary to properly install the end tool to the collet section before operating Xspeed1200.

7 CHANGING CUTTING TOOLS

Replace cutting tools refer to Fig.5 by the following procedures.

- ① Supply air at a proper pressure to the air bearing.
- ② Set the provided spanner 12mm on the spindle shaft to fix.
- ③ Set the provided Torque wrench (14mm) on the collet nut, turn it counterclockwise to loosen the collet nut and pull out the end tool. When the collet nut is turned by approximately one turn, it is tightened, and when further turned, the collet is opened.
- ④ Insert another cutting tool into the collet, and turn the collet nut clockwise to fix .
(To tighten collet nut with provided Torque wrench.
The Torque wrench should be set up 4N·m)

⚠ Cautions

- ① Never replace the cutting tool and collet without supplying air to the air bearing. If replacement operation is performed with no air supplied, since the spindle shaft contacts the bearing, the contact parts of both are damaged, which may cause improper functioning.
- ② When tightening the collet nut, make sure to insert the cutting tool into the collet nut. If the collet nut is tightened without inserting the collet nut, the collet has been tightened more than necessary and the collet may be internally disengaged from the latch of the collet nut. When the latch is disengaged, the collet remains in the spindle even if the collet nut is loosened and the collet may not be removed.
- ③ When tightening the collet nut, runout accuracy of cutting tool will deteriorate by tightening more than necessary and the collet may be damaged.
- ④ After installing the cutting tool, measure the runout accuracy at the outside diameter section and check that there is no abnormality.

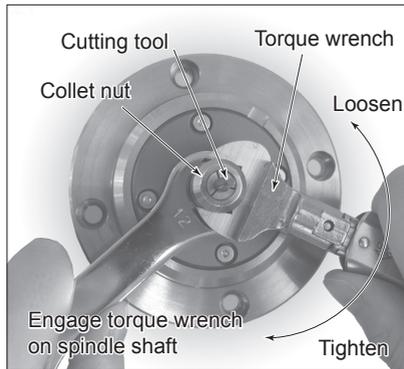
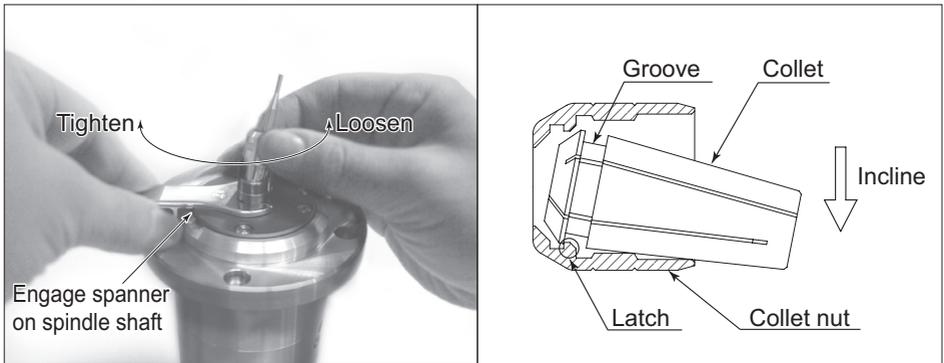


Fig. 7 Replacement of cutting tool

8 REPLACING THE COLLET

Replace the collet refer to Fig.8 by the following procedures.

- ① Supply air at proper pressure to the air bearing.
- ② Loosen the collet nut with the cutting tool installed according to the "7 Changing Cutting Tools" described above, and turn until the collet nut is removed from the spindle shaft, then pull it together with the end tool from the spindle shaft. After that, pull out the cutting tool from the collet .
- ③ Hold the collet nut by hand and incline the collet in either one of the spanner engaging directions, then the collet can be removed. If the collet cannot be removed, incline it in the other spanner engaging direction.
- ④ When installing the collet , incline it in either one of the spanner engaging directions.



* When install the collet, make sure to correctly engage the inside diameter latch of the collet nut to the groove on the collet outer circumferential section.

Fig. 8 Replacement of collet

⚠ Caution

To install the collet, make sure to fully engage the inside diameter latch of the collet nut to the groove on the collet outer circumferential section. Keep in mind that if the collet has been incompletely installed, the cutting tool cannot be properly gripped, and this may result in a dangerous situation.

In addition, keep in mind that if the collet is attached without being engaged with the latch of the collet nut, the collet cannot be removed and this may cause impairment of both parts.

9 OPERATION OF Xpeed1200

Never rotate Xpeed1200 at high speed to speed to avoid a dangerous situation. It is necessary to observe the following precautions and warnings to ensure safe operating conditions and operate in a state that the operation can be stopped whenever necessary.

When operating for the first time after purchase, or if Xpeed1200 has not been used for one week or longer, operate Xpeed1200 according to the operating procedures shown in Fig.9, and perform a subsequent break-in operation according to the operation stop procedures shown in Fig.10.

Caution

- ① Remove the protect cap of the stepped test bur. Do not operate with a protection cap on the stepped test bur.
- ② When not air bearing to air supply, please observe the following.
 - Never rotate the rotating shaft unnecessarily.
 - Never apply air pressure to the turbine air supply piping.
 - Never splash or flood coolant on Xpeed1200.
 - Never directly blow air on Xpeed1200.

*Keep in mind that the sealing effect will not be obtained when air is not supplied to the air bearing and turbine. Contaminants, water and oil may enter into the spindle and cause air bearing and rotating shaft seizing or galling.
- ③ Re-check whether piping has been properly connected, and air has been air supply to the air bearing. Also check that the cutting tool has been properly installed.
- ④ In the case where air supply pressure of the air bearing is low or air supply to the air bearing is incorrectly shut off during operation due to a mistake in operation method, not only does the air bearing abnormally operate, but also the rotating shaft and the bearing come into contact with each other to cause it to seize. Please observe the correct pressure.
- ⑤ When using in an adverse environment which allows cutting oil or chips to be mixed, keep supplying air to the air bearing even if the spindle is not used.

Warning wiht regard to operating

- ① Check that the spanner or wrench used for tightening of the collet nut and used as a detent for the rotating shaft has been completely removed from the spanner engagement area. Always keep in mind that the tool will fly off, and this may cause injury and damage to property or operator if the shaft is rotated with the tools engaged.
- ② Acceleration at start up of running is very fast and dangerous. Make sure to install a protective cover, which ensures safety around Xpeed1200 as well as complete safety for the operator and those around the Xpeed1200.
- ③ Adjust the rotating speed by adjusting the regulator with reference to the turbine air supply pressure and measured values of the rotating speed described in the inspection table. Never perform operations exceeding the maximum rotation speed, as it is very dangerous and may result in damage to the spindle. In addition, when setting the turbine pressure, confirm the pressure at the spindle piping connection port is similar to the pressure setting of the air bearing and make any necessary adjustments.
- ④ Check that there is no excessive vibration, generation of abnormal sounds or abnormal heat generation during running.
- ⑤ If you sense anything abnormal, immediately shut off the turbine air supply pressure to stop rotation.
- ⑥ Keep in mind that rotation is not completely stopped when air flow to the air bearing is removed, even if rotation is stopped by shutting off air supply to the turbine.
- ⑦ Since the cutting tool and collet during rotation are very dangerous, absolutely never touch them by hand and never bring your face close to them.

Running-in method

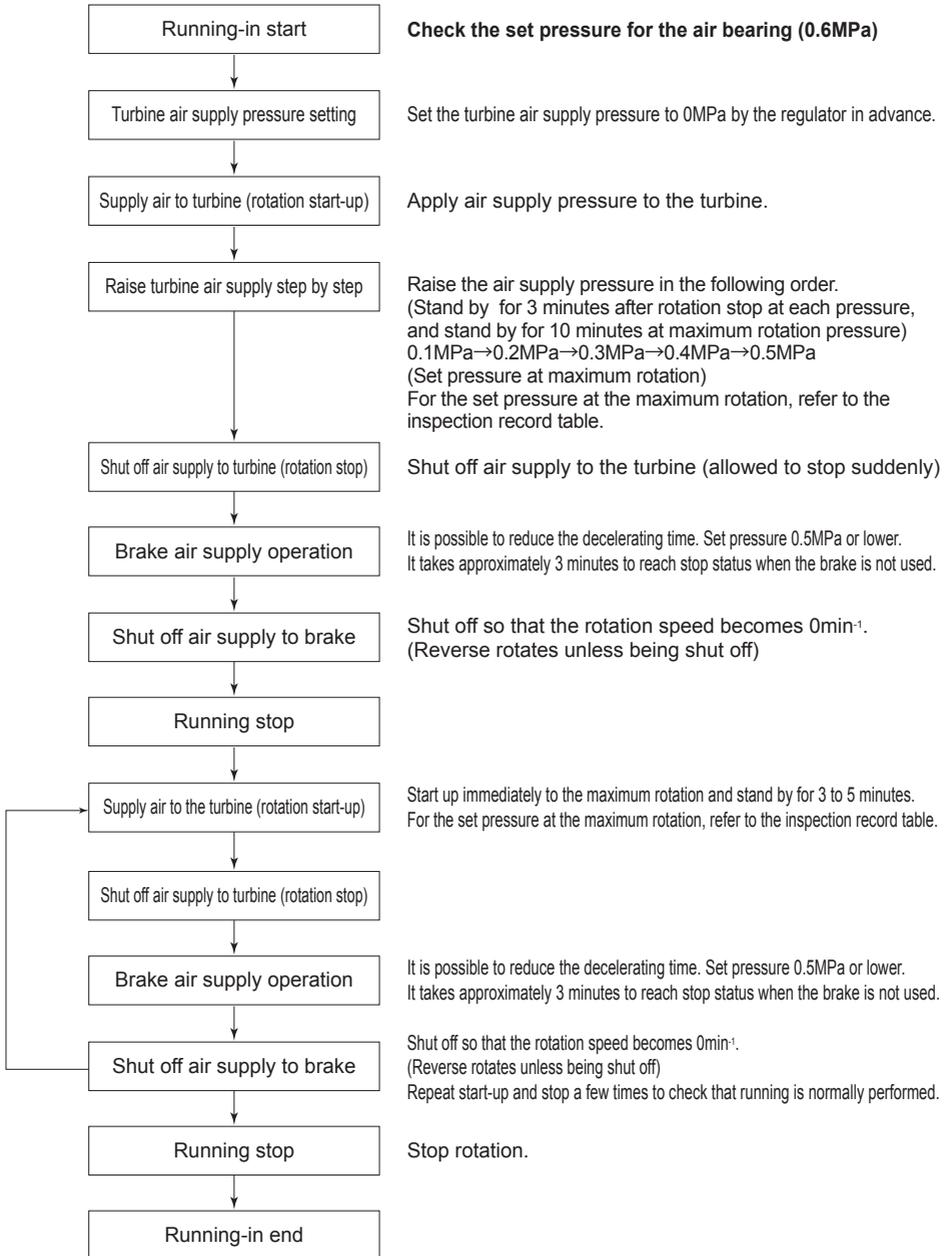


Fig. 9 Running-in procedures

Operation of Start/Stop

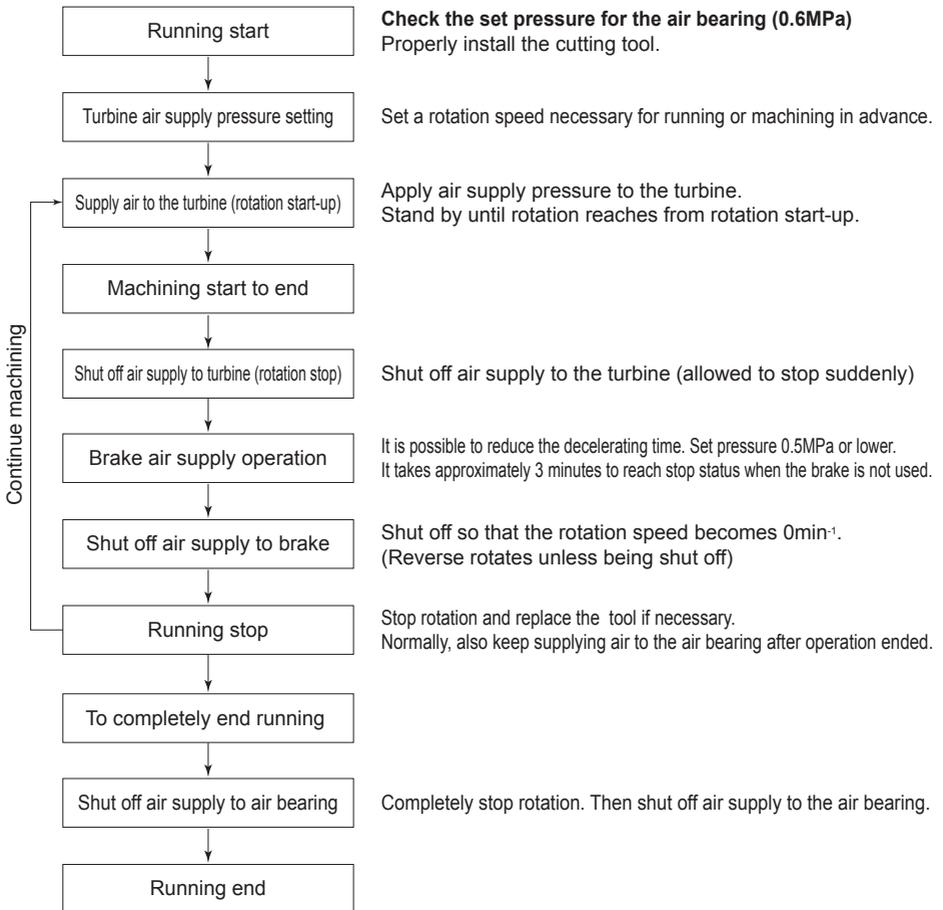


Fig. 10 Running stop procedures

10 DETECTION OF ROTATION SPEED

The Xpeed1200 rotation speed can be controlled by adjusting the air pressure supplied to the turbine with reference to the separately attached inspection table. However, since rotation speed during running cannot be, in fact, accurately measured, its structure allows a sensor to be installed at the rear of the spindle as shown in Fig.9 for detection. This product is not equipped with a sensor, however, this product can employ a method to apply reflected light to an identification indicating mark (range of 180° set on the end of the rotating shaft on the rear of the spindle for detection. For this reason, in order to select a sensor to be used, a sensor having sufficient responsiveness to rotation frequency 2000Hz (output of one pulse/rev) which is reached at 120,000 min⁻¹ is required.

Installation

- ① Remove the M3 bolt fixed on the rear cover by loosening the M3 set screw on the side of the piping flange.
- ② When the M3 bolt is removed, you can find a hole of $\phi 3.1$ and depth 17mm. Install a rotation detecting sensor which can be inserted into the hole.
- ③ If the rotation detecting sensor is inserted approximately until a depth of 17mm, the end of the sensor will contact the rotating shaft. Therefore, return the installing position within a detectable range of the used sensor to avoid contact.
- ④ Slightly tighten the M3 set screw on the side of the piping flange to fix. (For recommended tightening torque, refer to the operation manual from the manufacturer of the sensor used.)
- ⑤ When rotation is not detected by rotating Xpeed1200, make a re-adjustment. If the installing position is correct, its installation is completed. Pay attention so as not to forget tightening the M3 set screw on the side of the piping flange. Contact of the sensor with the rotating shaft may cause some trouble.

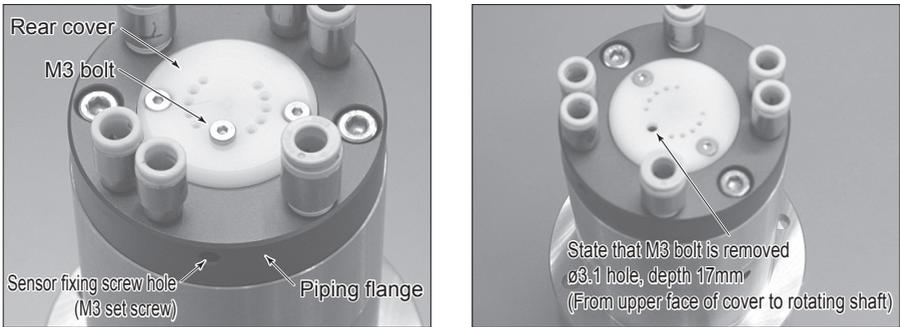


Fig. 11 Sensor installing section details

⚠ Cautions

- ① Make sure to install the rotation detecting sensor with the rotation of the turbine being stopped.
- ② Keep in mind that, if the rotation detecting sensor is installed extremely close to the rotating shaft or contacts the rotating shaft, the sensor will not only be damaged, but also the air bearing and the rotating shaft for the spindle will be damaged, and this may cause improper operation.
- ③ Make sure to tighten the M3 set screw on the side of the piping flange fixing the rotation detecting sensor.
- ④ When not using the rotation sensor, install an provided M3 screw into the $\phi 3.1$ hole.

⚠ Warning

- ① Never use a cutting tool which is flawed, broken, cracked or bent.
- ② Use a drill, end mill and grindstone in the allowable speed range as determined and recommended by the tooling manufacturer.
- ③ It is necessary to lower the rotation speed in consideration of shape and material. Always observe precautions when carrying out operations.
- ④ Use cutting tools with sufficient balance characteristics. For the balance state during operation of the spindle, operation exceeding JIS G2.5 grade (2.5 mm/sec vibration speed) cannot be performed.
- ⑤ Do not use cutting tool large in runout of the grind stone, or with flaws or cracks.
- ⑥ Operation exceeding 2,000 m/min of a peripheral speed of the grind stone with shaft is very dangerous. Never perform such operation.

⚠ Caution

- ① When installing the cutting tool, wipe off contaminants and fit the cutting tool in the collet in a extremely clean condition.
- ② Use a cutting tool whose shank diameter is within a tolerance of $\varnothing 4^{+0}_{-.001}$. Keep in mind that use of the tool outside the recommended tolerance results in nonconformities including runout and a reduction in the gripping force.
- ③ If a machining load drastically increases and the rotation speed decreases, the rotation will suddenly stop due to the load exceeding the drive torque of the turbine, and this may cause damage or break the cutting tool and impair the spindle. Since this is very dangerous, pay attention to the state of the machining load.

12 CAUTIONS WHEN HANDLING AND STORING

Cautions in handling

Handling as shown below may cause failure due to poor rotation, heat generation, deformation of sheath or deterioration in assembly accuracy. Pay sufficient attention to handling.

- ① Do not drop or hit the spindle.
- ② Do not tap the spindle with a hammer, and giving excessive shock.
- ③ Do not loose and tighten bolts on each part of the spindle.
- ④ Do not disassemble, overhaul modify or attempt to repair the spindle as it will damage the internal components. There are no user serviceable parts available, so do not attempt to repair it. (refer to **13) MAINTENANCE AND INSPECTION** (3) and (4).

Original Packaging / Shipping Material Form Delivery

As a packaging method, the Xspeed1200 body is wrapped with a vapor phase corrosion inhibitor wrapping film and packaged in a quilting structured corrugated box. Therefore, this packaging method minimizes influence of outside atmosphere and external shock, this for allows optimum secure packing. Various standard attachments are stored in the packaging box as well. Keep all original packing materials for future storage purposes.

For long-term storage

- ① Clean so as to prevent contaminants or foreign matter from entering into the piping, air lines and spindle bearing gap. Do not allow rust inhibitor from entering any portion of the spindle or operating accessories. Rust inhibitors will damage internal surfaces causing poor performance.

- ② Insert the standard attachment plugs (6 locations) into the joints of the piping connecting locations. These plugs prevent contaminants or foreign matter from intruding through the connectors.
- ③ When fitting the stepped test bur to store, attach the protective cap to eliminate the chance of damaging the test shaft.
- ④ Wrap the spindle with a vapor phase corrosion inhibitor wrapping film in which the spindle was packaged from the factory. Wrap the spindle quilting material and store in the factory corrugated box.
- ⑤ Store the packaged spindle in a secure place so as not to allow vibration, high temperature and high humidity. In particular, pay attention so as to prevent condensation due to a temperature difference and select a dehumidified location for storage.

13 MAINTENANCE AND INSPECTION

(1) Routine Pre-operation Checks

Please check the following daily as pre-operation checks:

- Cleanliness of supplied air
- Air supply pressure to the air bearing and brake
- Breakage of the cutting tool, collet, collet nut, piping fitting and air hose
- Excessive vibration, abnormal sound or heat generation during test or operation

(2) Cleaning

The spindle using the air bearing functions by supplying compressed air into a narrow gap between the rotating shaft and bearing section, floating them without contact between each other. For this reason, cleaning is performed with air supplied to the air bearing shut-off. However, if compressed air or coolant is blown onto the spindle, contaminants, oil or water will intrude into the bearing gap, causing interference. Therefore, do not use compressed air for general cleaning.

When cleaning is required, keep supplying air to the air bearing, and completely wipe away debris with a soft cloth. At this time, be careful so as not to supply air to the turbine. Never clean with the cutting tool rotating.

(3) Disassemble, rework

Never disassemble or rework this spindle for any reason. All warranties will be voided.

(4) Overhaul

The spindle uses an air bearing is rotated without contact between the spindle shaft and bearing section. Its precision and performance can be maintained for a long time by the using proper methods of cleanliness.

If any abnormalities occur, please contact Nakanishi.

(5) Spare

When using this spindle for mass production, please purchase a spare spindle to eliminate the risk of downtime.

(6) Troubleshooting

If a problem occurs, please use the following table to diagnose the symptom to the corrective action before sending to Nakanishi for repair.

Trouble	Cause	Inspect/Corrective Action
Tool Slippage	Contaminants inside the collet or the spindle	Clean the collet and spindle taper. Replace the collet nut or collet if there is any flaws on them.
	Collet is not properly positioned.	Set the collet properly.
	Air pressure for Air Bearing is too low.	Set air pressure for Air Bearing properly.
	Deformation due to excessive tightening of the collet nut	Replace the collet nut and collet and tighten with proper torque. Send to NAKANISHI for repair, if the spindle has incurred any damage.
	Bent tool.	Change the tool.
Noise or vibration during rotation	Air pressure for the air bearing is not proper.	Set air pressure properly.
	The cutting tool is bent, or run-out of the tool is excessively large.	Re-grab the cutting tool again to adjust run-out to a proper value, or replace.
	Protrusion amount of the cutting tool is too long.	Return protrusion amount of the cutting tool into the allowable range.
Poor rotation (Rotation speed cannot be increased)	Pressure in the air supply source lowered.	Set the air supply source to the proper pressure.
	Diameter of a hose used for air supply piping is too small.	Change the hose to one with the proper diameter.
	Contaminants, oil or water is mixed into the air supply piping (such as a bearing, turbine, brake piping)	Send to NAKANISHI for Repair.
	When the spindle shaft is rotated by hand, there is some abnormal feeling or sticking.	Send to NAKANISHI for Repair.
	Excess load or contact with the bearing resulted in a reduction in the rotation speed or stop of the spindle shaft.	Reduce a excessive load. If the spindle shaft is seizing, Send to NAKANISHI for Repair.
	There is continuity with air supplied.	Send to NAKANISHI for Repair. (Because the spindle shaft is damaged.)

14 DISPOSAL OF THE AIR BEARING TURBINE SPINDLE

When disposal of an Air Bearing Turbine Spindle is necessary, follow the instructions from your local government agency for proper disposal of industrial components.

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本書の内容は、改善のため予告無しに変更することがあります。

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