

Angle Spindle RAM-3014 OPERATION MANUAL

Thank you for purchasing the angle spindle "RAM-3014". This spindle is designed for chamfering and deburring on side faces, and for machining corners that are difficult to work with a straight-type spindle. The E3000i Controller, Brushless Motor, and Air Line Kit are required to drive this Spindle. Read this and all the associated component Operation Manuals carefully before use. Always keep this Operation Manual in a place where a user can refer to for reference at any time.

1. CAUTIONS FOR HANDLING AND OPERATION

- Read these warnings and cautions carefully and only use in the manner intended.
- These warnings and cautions are intended to avoid potential hazards that could result in personal injury to the operator or damage to the device. These are classified as follows in accordance with the seriousness of the risk.

Class	Degree of Risk
WARNING	A safety hazard could result in bodily injury or damage to the device if the safety instructions are not properly followed.
CAUTION	A hazard that could result in light or moderate bodily injury or damage to the device if the safety instructions are not followed.

WARNING

- This Spindle is not a hand tool. It is designed to be used on CNC machines or special purpose machines.
- Do not touch the cutting tool while it is running. It is very dangerous.
- Wear safety glasses, dust mask and use a protective cover around the Spindle whenever the Spindle is rotating.
- Never connect, disconnect or touch the Power Cord Plug or Motor Cord Plug with wet hands. This may cause an electric shock.
- Never operate or handle the Spindle and brushless motor until you have thoroughly read the Operation Manuals and safe operation has been confirmed.
 - To prevent injuries / damages, check the Spindle, brushless motor and cutting tool for proper installation, before operating the Spindle and brushless motor.
 - Before disconnecting the Spindle and motor, always turn the control power off and turn the compressed air supply to the CONTROLLER off. Then it is safe to remove the Spindle and motor.
- When installing a Spindle to a fixed base, make sure the fixed base is grounded in order to avoid the risk of an electric shock.
- When installing a tool, tighten the collet correctly and check again the collet before use. Do not over-tighten the collet. This may cause damage to the Spindle.
- Do not use bent, broken, chipped, out of round or sub-standard tools, as this may cause them to shatter or explode. Tools with fractures or a bent shank will cause injury to the operator. When using a new tool, rotate it in a low speed and increase speed gradually for safety.
- Do not exceed the maximum recommended allowable tool speed. For your safety, use speeds below the maximum allowable speed.
- Do not apply excessive force. This may cause tool slippage, tool damage, injury to the operator or loss of concentricity and precision.

CAUTION

- Do not exceed the maximum allowable motor speed of 15,000 min⁻¹ (rpm).
- Do not drop or hit this Spindle, as shock can damage to the internal components.
- Be sure to clean the collet, the inside of the Spindle before replacing the tool. If ground particles or metal chips stick to the inside of spindle or the collet, damage to the collet or Spindle can occur due to the loss of precision.
- When cleaning a Spindle, stop the motor and remove debris with a soft brush or a cloth. Do not blow air into the Spindle with compressed air as foreign particles or cutting debris may get into the ball bearing.
- Always clean the tool shank before installing the tool in the Spindle.
- When sizing the correct collet size to the tool shank diameter, a tolerance of +0 ~ -0.01 mm is strongly recommended. A tool shank within the +0 ~ -0.1 mm range is mountable, however, this may cause poor concentricity and or insufficient tool shank gripping force.
- Select suitable products or tools for all applications. Do not exceed the capabilities of the Spindle or tools.
- Do not stop the supply cooling air for motor during operation of the machine. Removing the air pressure from the Spindle causes a loss of purging, allowing the Spindle to ingest coolant. This will cause damage to the Spindle.
- Carefully direct coolant spray to the tool. Do not spray directly on the Spindle body. If large amount spray directly on the Spindle, it may cause excess load of the motor rotation with loss of durability to the Spindle.
- Stop working immediately when abnormal rotation or unusual vibration are observed. Immediately, please check the content of section " 13. TROUBLESHOOTING ".
- Always check if the tool, collet are damaged before and after operating.
- If the collet show signs of wear or damage, replace it before a malfunction or additional damage occurs.
- After installation, repair, initial operation, or long periods of non operation, please refer to section " 11. BREAK-IN PROCEDURE " detailed in Table 2. When checking the Spindle, no vibration or unusual sound should be observed during rotation.
- Do not disassemble, modify or attempt to repair this Spindle. Additional damage will occur to the internal components. Service must be performed by NAKANISHI or an authorized service center.
- When using this Spindle for mass production, please consider the purchase of an additional Spindle to be used as a back-up in case of emergency.

2. PACKAGE CONTENTS

When opening the package, check if it includes all items listed in " Table 1 Package Contents List ". In the event of any shortage, please contact either NAKANISHI (see the " 4. CONTACT US " section) or your local dealer.

Table 1 Package Contents List

Spindle • 1 pc.	Collet* (K - 252) • 1 pc.	Wrench (22 × 27) • 1 pc.
Chuck Wrench (K - 232) • 1 pc.	Inspection Card • 1 pc.	Operation Manual • 1 pc.

* The collet is attached to the Spindle.

3. WARRANTY

We provide a limited warranty for our products. We will repair or replace the products if the cause of failure is due to the following manufactures defects. Please contact us or your local distributor for details.

- Defect in manufacturing.
- Any shortage of components in the package.
- Where damaged components are found when initially opening the package. (This shall not apply if the damage was caused by the negligence of a customer.)

4. CONTACT US

For your safety and convenience when purchasing our products, we welcome your questions. If you have any questions about operation, maintenance and repair of the product, please contact us.

Contact Us

- For U.S. Market
 - Company Name : **NSK America Corp.**
 - Industrial Div.
 - Business Hours : 8:00 to 17:00 (CST) (closed Saturday, Sunday and Public Holidays)
 - U.S. Toll Free No. : +1 800 595 4675
 - Telephone No. : +1 847 843 7664
 - Fax No. : +1 847 843 7622
 - Website : www.nskamericacorp.com
- For Other Markets
 - Company Name : **NAKANISHI INC.**
 - Business Hours : 8:00 to 17:00 (JST) (closed Saturday, Sunday and Public Holidays)
 - Telephone No. : +81 289 64 3520
 - e-mail : webmaster-ie@nsk-nakanishi.co.jp

5. FEATURES

- This is the smallest angle head for machine mounting.
- This can be used for drilling, chamfering, and deburring inside small-diameter holes.
- This is a spindle for hole machining dedicated to tools with a shank diameter of ϕ 1.6 mm.

6. SPECIFICATIONS AND DIMENSIONS

6 - 1 Specifications

Model	RAM-3014
Maximum Motor Rotation Speed	15,000 min ⁻¹
Maximum rotating speed at the tool	13,630 min ⁻¹
Reduction Ratio	10 / 11
Appropriate Motor	EM-3060/EM-3060J/EM-3030T/EM-3030T-J
Weight	116 g
Noise Level at 1m distance	65 dB (A) or less
Vibration	2.0 mm/s or less

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

CAUTION

Use less than the maximum allowable motor speed 15,000 min⁻¹ (rpm). DO NOT exceed the Maximum allowable motor speed 15,000 min⁻¹ (rpm) for the spindle.

RECOMMENDATION

For normal (forward) rotation, the collet may loosen. Therefore, operate the spindle in reverse rotation and use reverse rotation cutting tools.

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Collet	K - 252
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6 - 2 Outside View

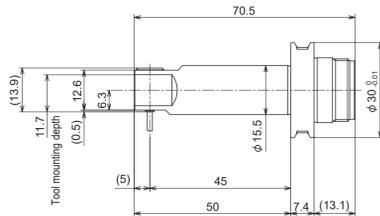


Fig. 1

7. CONNECTION OF THE SPINDLE TO THE MOTOR

CAUTION

Make sure your hands and all interlocking parts of the Spindle and motor are clean before connecting the motor to the Spindle. This is critical in preventing contaminants from entering the motor or Spindle.

Align the thread on the front end of the brushless motor / reducer and the rear of the Spindle, and turn the Spindle clockwise. If the drive shaft of the brushless motor / reducer does not engage properly to the transmission clutch on the spindle, it may only turn approximately two threads before stopping. DO NOT FORCE THEM TOGETHER. Loosen the Spindle from the brushless motor / reducer, rotate the Spindle shaft by hand then re-try. The drive shaft and the transmission clutch must be fully engaged. When fully engaged, secure the brushless motor / reducer and Spindle using the provided 27 mm wrench (Fig. 2).

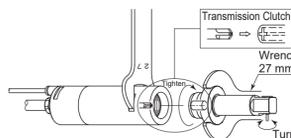


Fig. 2

8. CHANGING THE TOOL

CAUTION

- The tip tool shank diameter is 1.6 mm.
- Never tighten the collet when there is no tip tool in the collet. The collet may be excessively tightened, causing damage to the collet.

Align the tabs of the included chuck wrench with the head split part and insert them, turn the chuck wrench handle counterclockwise, then remove the tip tool. At that time, turning the chuck wrench handle about a quarter turn is sufficient.

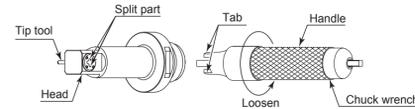


Fig. 3

- Insert a new tip tool into the collet and, in the condition described in ①, turn the chuck wrench handle clockwise to secure the tip tool.

9. REPLACING THE COLLET

- Remove the tip tool according to "8. CHANGING THE TOOL."
- With the chuck wrench tip tabs aligned with the head split part and inserted, turn the handle of the chuck wrench counterclockwise until the collet is released.



Fig. 4

- Attach a new collet to the end of the chuck wrench and turn the handle clockwise about 4 to 5 turns with the tabs of the chuck wrench attached to the head split part.
- Insert the tip tool into the collet and turn the chuck wrench handle clockwise more to secure the tip tool.

10. INSTALLATION OF THE SPINDLE

WARNING

When installing a Spindle to a fixed base, make sure the fixed base is grounded in order to avoid the risk of an electric shock.

CAUTION

- To use this product, please select and prepare a dedicated holder that meets the specifications required for your application.
- When installing a spindle, do not hit, drop or cause shock to the spindle. This may cause damage to internal components and result in malfunctions.
- Cautions when tightening the Fastening Bolt of the Holder. Do not over tighten the bolt. This may cause damage to motor spindle's precision. Tighten the bolt until the spindle body can not be turned by hand within the fixture. Extreme tightening is not necessary or recommended. Apply working force and check that the motor spindle is tight before using.

- When installing a spindle to the holder, recommended installation method is shown Fig. 5.

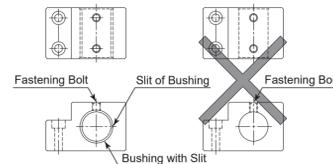


Fig. 5

Fig. 6

CAUTION

Do not allow set screws to come directly in contact with the spindle body as shown in Fig. 6, as this will result in damage to the spindle housing and internal components. When installing, never clamp directly over the bearings, as this will result in bearing damage (Refer to Fig. 6).

- Mounting (Example: When using split bushing RB-30x32)
 - Prepare a holder as shown in Fig. 5. The inner diameter of the holder should be ϕ 32 mm with a tolerance of +0.05 mm to 0 mm.
 - Attach the split bushing to the outer diameter of the motor and insert it into the holder.
 - Tighten the split bushing's outer diameter with the Fastening Bolt (e.g., screw plug) until the motor can no longer be rotated by hand.
 - It is recommended to confirm the tightening using the current display function of the E3000i Controller.

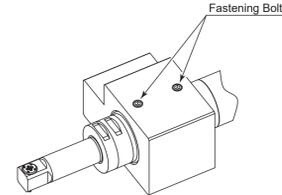


Fig. 7

CAUTION

The final responsibility for ensuring holder's safety for use in a given application is left to the designer of the equipment in which NAKANISHI's spindle is installed. NAKANISHI offers spindle with a wide variety of capabilities and specifications. Please carefully check the spindle's specifications against the requirements of your equipment and verify suitability and safety of the Holder prior to initial use.

- Motor current value display function and tightening when clamping
 - Motor current value display function
 - The Control Unit has a function that displays load on the motor spindle in current (× 10mA). (Refer to "PARTS NAMES" of the E3000i CONTROLLER Operation Manual). This function allows you to confirm the working load / clamping level when clamping the Motor Spindle in fixtures.
 - Clamping the Motor Spindle
 - Adjust the clamping pressure level using the motor current value display. Run the motor spindle at any speed and note the current level while the motor spindle is not secured in any manner. Insert the motor spindle into the fixture and carefully and slowly tighten. The clamped current value should never be more than +1 (+10mA) of the current load reading before clamping.

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- Split Bushings
 - By attaching the bushing to the outer diameter of the motor, the outer diameter can be adapted to ϕ 32 mm or ϕ 36 mm.

Model	Inside diameter	Outside diameter	Length
RB-30x32	ϕ 30 mm	ϕ 32 mm	45 mm
RB-30x36	ϕ 30 mm	ϕ 36 mm	45 mm



Fig. 8

11. BREAK-IN PROCEDURE

During transportation, storage or installation, the grease inside the bearings will settle. If the Spindle is suddenly run at high-speed, the grease will be ejected from the bearings, causing excessive heat that will cause bearing damage. After installation, repair, initial operation, or long periods of non operation, please follow the break-in procedure detailed in Table 2.

Table 2

< In case of connecting a brushless motor >

Steps	1	2	3
Rotation Speed (min ⁻¹) (rpm)	5,000	10,000	15,000
Rotation Time (min)	15	10	15
Items to Check	No Abnormal Noises.	The Spindle housing temperature during the break-in process should not exceed 20 degrees C (36 degrees F) above ambient temperature. Should the Spindle exceed this limit, rest the Spindle for at least 20 minutes and re-start the break in procedure from the beginning. If the housing temperature rises again and exceeds 20 degrees C (36 degrees F) above ambient temperature, check the Spindle and motor for proper installation.	The Spindle housing temperature during the break-in process should not exceed 20 degrees C (36 degrees F) above ambient temperature.

12. CAUTIONS WHEN USING CUTTING TOOLS

CAUTION

Refer to the following formula for the maximum spindle rotation speed when using a drill or an end mill.

$$\text{Rotation speed (min}^{-1}\text{)} = \frac{1,000 \times \text{Cutting speed (m/min)}}{3.14 \times \text{Cutting tool diameter (mm)}}$$

- Cutting speed varies depending on the tool diameter and the workpiece material.
- Please follow the manufacturer's recommended feeds and speeds. Applying tools outside of manufacturer's maximum recommended rotational speed may cause damage to the spindle or injury to the operator.
- In order to maintain tolerance and safety, set cutting tools inside the collet maximizing the contact with the cutting tool shank and reducing excess and unnecessary cutting tool overhang. This will increase rigidity and accuracy while decreasing deflection and minimizing tool breakage.
- When increasing the cutting tool overhang, reduce the motor speed.
- Keep the cutting tool shank and collet clean. Any contaminants in the collet or collet nut will cause excessive runout and will therefore cause damage to the cutting tool and or spindle.
- Do not strike, drop or disassemble the spindle.

Table 3 Relationship between drill overhang length and RPM

Overhang length (mm)	Max RPM
Drill diameter × 10 times	100% of the RPM
Drill diameter × 20 times	70% of the RPM
Drill diameter × 20 times or more	50% or less of the RPM

Overhang length (mm)

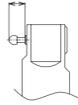


Fig. 9

Table 4 Relationship between end mill overhang length and RPM

Overhang length (mm)	Max RPM
Shank diameter × 5 times	100% of the RPM
Shank diameter × 10 times	50% of the RPM
Shank diameter × 10 times or more	30% or less of the RPM

13. TROUBLESHOOTING

If a problem or concern occurs, please check the following prior to consulting your dealer.

Trouble	Cause	Inspection / Corrective Action
Spindle does not rotate or rotate smoothly.	The Spindle ball bearings have been damaged. The motor has been damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.) Replace the motor. (Return to NAKANISHI dealer service.)
Overheating during rotation.	Cutting debris has contaminated the ball bearing, and the ball bearings are damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
Abnormal vibration or noise during rotation.	The tool shank is bent. Cutting debris has contaminated the ball bearings. The spindle ball bearings have been damaged.	Replace the tool. Replace the ball bearings. (Return to NAKANISHI dealer service.)
Tool slippage.	Collet chuck is not correctly installed. The collet is worn.	Check and clean the collet. Reinstall the collet. Replace the collet.
High run-out.	The tool is bent. Collet chuck is not correctly installed. The collet is worn. Inside of the Spindle is worn.	Change the tool. Secure the collet correctly. Replace the collet. Replace the Spindle shaft. (Return to NAKANISHI dealer service.)
	Contaminants inside the collet or the Spindle. The Spindle ball bearings have been damaged.	Clean the collet and the inside of the taper and Spindle. Replace the ball bearings. (Return to NAKANISHI dealer service.)

In case of using a brushless motor, refer to brushless motor and E3000i Controller Operation Manuals.

14. DISPOSAL OF THE SPINDLE

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