

Spindle

NRF - 3060S

OPERATION MANUAL

Thank you for purchasing spindle NRF-3060S. This spindle designed for grinding, small diameter drilling and milling, etc. The E3000 <CONTROLLER>, <Blushless Motor>, <Air Line Kit> or <Air Motor>, <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 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

- The 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 and Motor Cord Plug with wet hands. This may cause an electric shock.
- Never operate or handle the spindle until you have thoroughly read the owner's manual and safe operation has been confirmed.
 - To prevent injuries / damages, check the spindle and cutting tool for proper installation, before operating the spindle.
 - Before disconnecting the spindle, always turn the control power off and turn the compressed air supply to the control unit off. Then it is safe to remove the spindle.
- 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 and collet nut 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 they may cause shatter or explode. Tool 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 drop or hit the spindle, as shock can damage to the internal components.
- Be sure to clean the collet and collet nut, 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 dust proof cover area (refer to section "6 - 2 Outside View") 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 ~ - 0.01mm is strongly recommended. A tool shank within the +0 ~ - 0.1mm 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.
- Carefully direct coolant spray directly on the tool. Do not spray directly on the spindle and collet nut. Large amounts of coolant sprayed directly on the spindle may cause excess load of the spindle causing a loss of durability and longevity of the spindle.
- Stop working immediately when abnormal rotation or unusual vibration are observed. Immediately, please check the content of section "14. TROUBLESHOOTING".
- Always check if the tool, collet or collet nut are damaged before and after operating.
- If the collet or collet nut show signs of wear or damage, replace them 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. 1. When checking the spindle, no vibration or unusual sound should be observed during rotation.
- Do not disassemble, modify or attempt to repair the spindle. Additional damage will occur to the internal components. Service must be performed by NSK NAKANISHI or an authorized service center.
- When using the spindle for mass production, please purchase another spindle as a spare in case of emergency.

2. BASIC PACKAGE

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

Table. 1 Packing List Contents

Spindle • 1pc.	Collet Nut (K-265) • 1pc.*	Wrench (12 × 14) • 2pcs. Wrench (22 × 27) • 1pc.
Hexagon Socket Head Screw (M4 × 12) • 4pcs.	Operation Manual • 1set.	Inspection Card • 1pc.

* The Collet Nut 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 : 8:30am to 17:00pm (CST)
(closed Saturday, Sunday and Public Holidays)
800-585-4675
U.S. Toll Free No. : 847-843-7664
Telephone No. : 847-843-7622
Fax No. : www.nskamericacorp.com
Web Address

• For Other Markets
Company Name : **NAKANISHI INC.**
Business Hours : 8:00am to 17:00pm
(closed Saturday, Sunday and Public Holidays)
+81 (0) 289-64-3520
Telephone No. : +81 (0) 289-64-3520
e-mail Address : webmaster-ie@nsk-nakanishi.co.jp

5. FEATURES

- The spindle housing is made from precision ground, hardened, stainless steel (SUS) with an outside diameter of $\phi 30\text{mm}$ with flange.
- The spindle utilizes ceramic bearing for 60,000min⁻¹.
- Various sizes of collets are available CHK 0.5mm - 6.35mm. Standard collet is CHK 3.0mm or CHK 3.175mm. (For U.S. market CHK 3.175mm.)

6. SPECIFICATIONS AND DIMENSIONS

6 - 1 Specifications

Model	NRF-3060S		
Allowable Motor peed	60,000min ⁻¹ (Continuous use : Less than 50,000min ⁻¹)		
Spindle Accuracy	Within 1 μm		
Weight	285g		
Noise Level at 1m distance	Less than 65dB (A)		
	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 - □□)	$\phi 0.5\text{mm} \sim \phi 6.0\text{mm}$ in 0.1mm increments and $\phi 2.35\text{mm}$, $\phi 3.175\text{mm}$, $\phi 6.35\text{mm}$		
*Note 1			
Collet Nut	K-265		

*Note 1 : Collet is sold separately. Please select the suitable collet size for your application.

6 - 2 Outside View

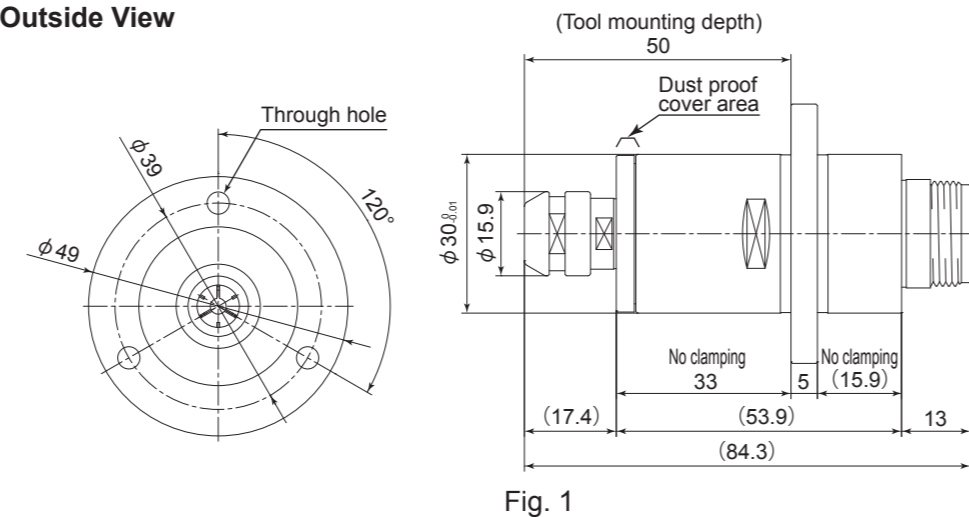


Fig. 1

7. CONNECTION 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 to prevent contaminants from entering the motor or spindle.

Align the threads on the front end of the motor and the rear end of the spindle, and turn the spindle clockwise. If the drive shaft of the motor does not engage the drive dog on the spindle, the spindle could not be turned. DO NOT FORCE. Turn the spindle back a few threads, rotate the cutting tool by hand to engage the drive shaft and the drive dog, and make the final turns with provided 27mm wrench. (Fig. 2)

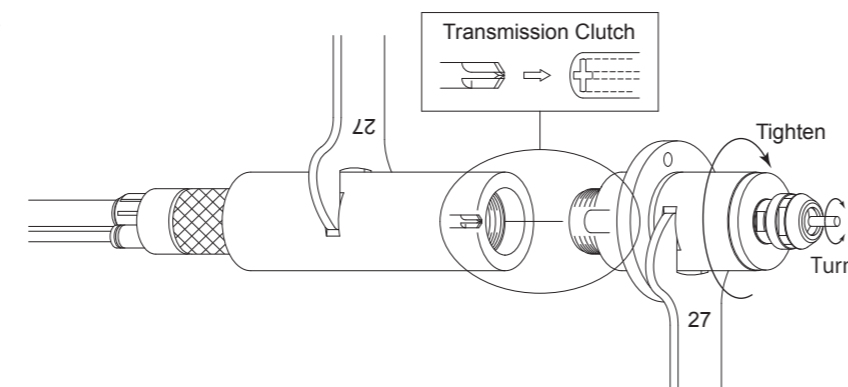


Fig. 2

8. CHANGING THE TOOL

CAUTION

Do not tighten the collet without inserting a tool or dummy bur, as this will damage the collet, spindle or collet nut, causing difficulty removing the collet.

RECOMMENDATION

Please set the cutting tools to minimize the overhang amount. 13mm is the maximum amount of overhang to maintain high accuracy and safety.

- Set the provided 12mm wrench on the spindle.
- Place the provided 14mm wrench on the collet nut and turn it counterclockwise to loosen the collet and remove the tool. (The first turn will loosen the collet nut, but the tool will not release and turning will become stiff. Keep turning through the stiffness and the collet will open.)
- Clean the collet and collet nut, then insert the new tool and tighten the collet by turning clockwise. Do not over tighten.

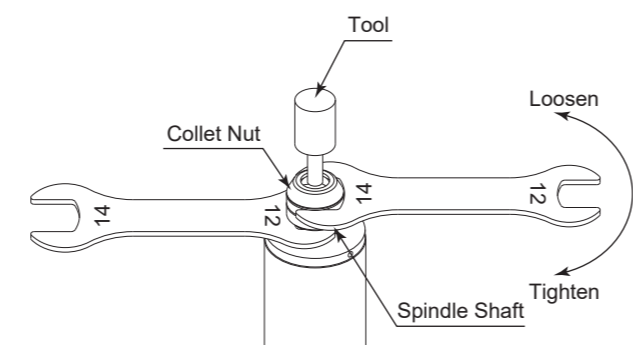


Fig. 3

9. REPLACING THE COLLET

- Remove the tool according to the section "8. CHANGING THE TOOL" procedure above and remove collet nut assembly. (Fig. 4)
- The collet and collet nut are secured by a groove in the collet and a flange in the collet nut. To remove the collet hold the collet nut in one hand and push diagonally down on the collet. The collet should be released. (Fig. 5)
- Install the new collet in the collet nut by positioning the collet in the collet nut and pressing down on a flat surface. (Fig. 5)

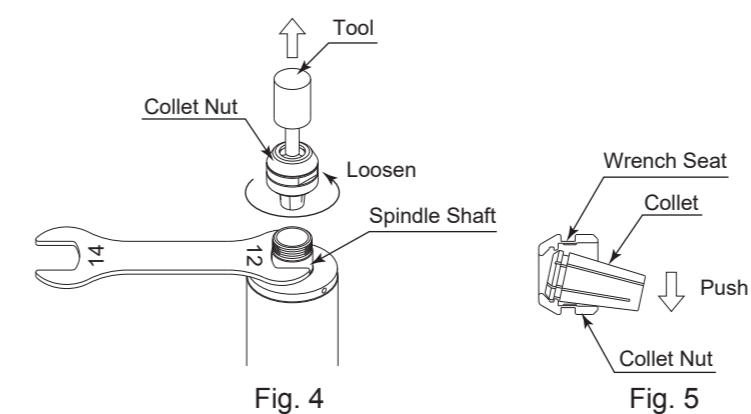


Fig. 4

Fig. 5

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

Do not allow set screws and the slit to come directly in contact with the spindle body as shown in Fig. 7, as this will result in damage to the spindle housing and internal components. And, do not hit, drop or cause shock to the spindle.

A spindle can be installed with a flange, without fastening a sleeve over the housing diameter section. This is designed to eliminate deformation/damage of the spindle when performing the installation.

- Insert the spindle housing diameter section into the machines tool plate bore.
- Secure the spindle through the counter-sunk holes (3 locations) on the flange using bolts (M4) as shown in Fig. 6.

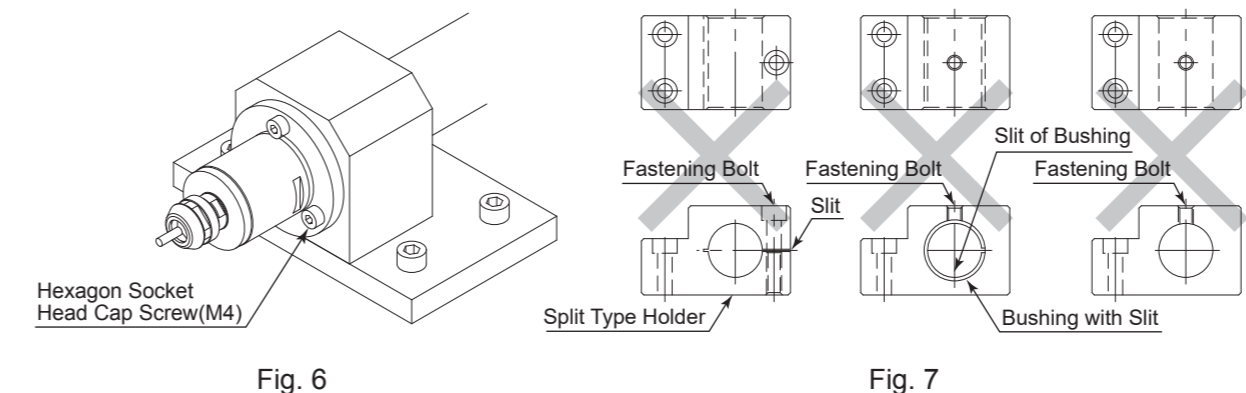


Fig. 6

Fig. 7

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 excessive heat 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

Steps	1	2	3	4	5
Rotation Speed (min ⁻¹)	15,000	30,000	40,000	50,000	60,000
Rotation Time (min)	15	10	10	10	10
Items to Check	No Abnormal Noises	Spindle Housing no hotter than 20°C. If hotter than 20°C stop for at least 20 minutes, check installation and restart Break-In procedure.		Spindle Housing less than 20°C.	

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.

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

- The spindle RPM depends 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 x 10 times	100% of the RPM
Drill diameter x 20 times	70% of the RPM
Drill diameter x 20 times or more	50% or less of the RPM

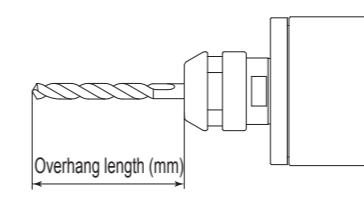


Fig. 8

Table. 4 Relationship between end mill overhang length and RPM

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

13. CAUTIONS WHEN USING GRINDSTONES

CAUTION

The maximum surface speed or rpm is always specified for a grindstone. Do not exceed the maximum speed with reference to the calculating chart below. Always follow the grindstone manufacturers recommendations.

$$\text{Surface Speed (m/s)} = \frac{3.14 \times \text{Diameter (mm)} \times \text{rotation speed (min}^{-1}\text{)}}{1,000 \times 60}$$

- The proper surface speed for general grindstones is 10 - 30 m/s.
- Do not exceed 13mm of overhang for mounted grindstones as shown in Fig. 9. If the overhang must exceed 13mm, reduce the motor speed in accordance with Table. 5.
- Dress the grindstone prior to use.
- Do not use cutting tools with bent or broken shanks, cracks or excessive run - out.
- For grinding, the maximum depth of cut should not exceed 0.01mm radially or axially. Reciprocate the tool several times after each pass to eliminate tool pressure.
- 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.
- Please set the tools to minimize the overhang amount. 13mm is the maximum amount of overhang to maintain high accuracy and safety.

Table. 5 Overhang and Speed

Overhang (mm)	Max. Speed (min ⁻¹)
20	N x 0.5
25	N x 0.3
50	N x 0.1

* N=Max. Operating Speed with 13mm overhang.

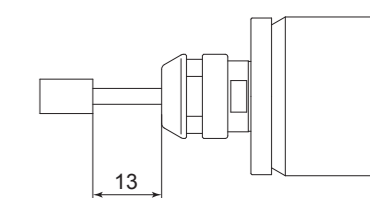


Fig. 9

14. TROUBLESHOOTING

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

Trouble	Cause	Inspection / Corrective Action
Spindle does not run.	The ball bearings are damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
	Motor is broken.	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.	Using bent tool.	Replace the cutting tool.
	Cutting debris has contaminated the ball bearings.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
Tool slippage.	The ball bearings are worn.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
	Collet or collet nut are not correctly installed.	Check and clean the collet and collet nut. And, tighten the collet accurately again.
High run-out.	The collet and the collet nut are worn.	Replace the collet and the collet nut.
	The cutting tool is bent.	Change the cutting tool.
	Collet nut is not correctly installed.	Secure the collet and the collet nut correctly.
	The collet and the collet nut are worn.	Replace the collet and the collet nut.
	Inside of the spindle is worn.	Replace the spindle shaft. (Return to NAKANISHI dealer service.)
	Contaminants inside the collet and the collet nut or the spindle.	Clean the collet, collet nut and the inside of the spindle.
	The ball bearings are worn.	Replace the ball bearings. (Return to NAKANISHI dealer service.)

Refer to the E3000 CONTROLLER Operation Manual.

15. 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.