

超精密高速ブラシレスモータスピンドル / Ultra-Precision, High-Speed Brushless Motor Spindle

HES810

取扱説明書 / OPERATION MANUAL

日本語 : P1 - P18 / English : P21 - P40



Thank you for purchasing the Ultra-Precision, High-Speed Brushless Motor Spindle " HES810 ". The Brushless Motor Spindle is designed for use on machining centers without rotating the machining center's main spindle, for small diameter drilling and milling. The E3000 CONTROLLER, Motor Cord and Air Line Kit are required to drive this Brushless Motor 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 referred to for reference at any time.

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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
 DANGER	Existence of a hazard that could result in personal death or serious injury, if the safety precautions are not followed.
 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.

DANGER

Do not rotate the machining centers' main spindle while the Brushless Motor Spindle is installed. Rotating the machining centers' main spindle with the Brushless Motor Spindle installed can cause the Motor Cord to become tangled, pulling the CONTROLLER off its mounting and cause severe damage to the motor cable and its connections. This will lead to a severe injury.

WARNING

- ① Installing the Brushless Motor Spindle should be performed by a person with experience with machining center operation and compressed air plumbing.
- ② This Brushless Motor Spindle is not a hand tool. It is designed to be used install this Brushless Motor Spindle to the machining center's machines or milling machine machines.
- ③ Do not touch the cutting tool while it is running. It is very dangerous.
- ④ Wear safety glasses, dust mask, and use a protective cover around the Brushless Motor Spindle whenever the Brushless Motor Spindle is rotating.
- ⑤ Never connect, disconnect or touch the Power Cord Plug or Motor Cord Plug with wet hands. This may cause an electric shock.
- ⑥ Never operate or handle the Brushless Motor Spindle until you have thoroughly read the Operation Manuals and safe operation has been confirmed.
 - 1) To prevent injuries / damages, check the Brushless Motor Spindle and cutting tool for proper installation, before operating the Brushless Motor Spindle.
 - 2) Before disconnecting the Brushless Motor Spindle, always turn the control power off and turn the compressed air supply to the CONTROLLER off. Then it is safe to remove the Brushless Motor Spindle.
- ⑦ When installing a Brushless Motor Spindle to a fixed base, make sure the fixed base is grounded in order to avoid the risk of an electric shock.
- ⑧ 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.
- ⑨ 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.
- ⑩ Do not exceed the maximum recommended allowable tool speed. For your safety, use speeds below the maximum allowable speed.
- ⑪ Do not apply excessive force. This may cause tool slippage, tool damage, injury to the operator or loss of concentricity and precision.

CAUTION

- ① Do not drop or hit this Brushless Motor Spindle, as shock can damage to the internal components.
- ② 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.

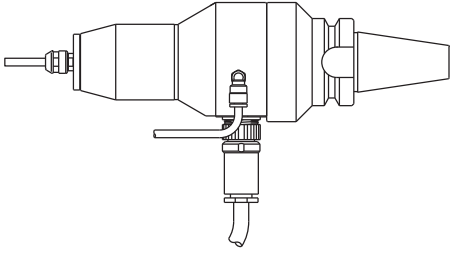
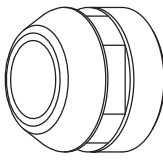
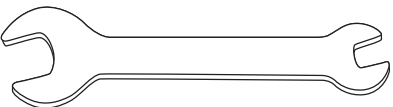
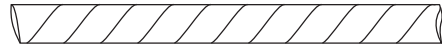
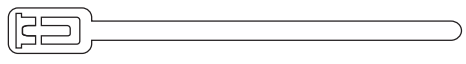
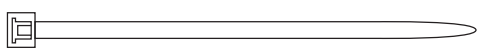
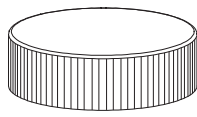
CAUTION

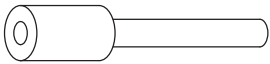
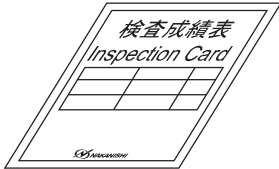
- ③ When cleaning a Brushless Motor Spindle, stop the Brushless Motor Spindle and remove debris with a soft brush or a cloth. Do not blow air into the dust proof cover area (refer to section " 6 - 2 Outside View ") with compressed air as foreign particles or cutting debris may get into the ball bearing.
- ④ Always clean the tool shank before installing the tool in the spindle.
- ⑤ When sizing the correct collet size to the tool shank diameter, a tolerance of $+0 \sim -0.01\text{mm}$ is strongly recommended.
A tool shank within the $+0 \sim -0.1\text{mm}$ range is mountable, however, this may cause poor concentricity and or insufficient tool shank gripping force.
- ⑥ Check to make sure the Brushless Motor Spindle is properly and securely mounted in the machine's spindle prior to use. If the Brushless Motor Spindle is not properly aligned or there is excessive play, do not use the Brushless Motor Spindle until this situation is corrected.
- ⑦ Select suitable products or tools for all applications. Do not exceed the capabilities of the Brushless Motor Spindle or tools.
- ⑧ Do not stop the supplied cooling air to the Brushless Motor Spindle during operation of the machine.
Removing the air pressure from the Brushless Motor Spindle causes a loss of purging, allowing the Brushless Motor Spindle to ingest coolant and debris. This will cause damage to the Brushless Motor Spindle.
- ⑨ Carefully direct coolant spray directly on the tool. Do not spray directly on the Brushless Motor Spindle collet nut. Large amounts of coolant sprayed directly on the Brushless Motor Spindle may cause excess load of the Brushless Motor Spindle, causing a loss of durability and longevity of the Brushless Motor Spindle.
- ⑩ Stop working immediately when abnormal rotation or unusual vibration are observed. Immediately, please check the content of section " 14. TROUBLESHOOTING ".
- ⑪ Always check if the tool, collet, collet nut, connection hose and supply air hose for damage before and after operating.
- ⑫ If the collet or collet nut show signs of wear or damage, replace them before a malfunction or additional damage occurs.
- ⑬ After installation, repair, initial operation, or long periods of non operation, please refer to section " 12. BREAK-IN PROCEDURE " detailed in Table. 2. When checking the Brushless Motor Spindle, no vibration or unusual sound should be observed during rotation.
- ⑭ Do not disassemble, modify or attempt to repair this Brushless Motor Spindle. Additional damage will occur to the internal components. Service must be performed by NSK NAKANISHI or an authorized service center.
- ⑮ When using this Brushless Motor Spindle for mass production, please consider the purchase of an additional Brushless Motor Spindle to be used as a back-up in case of emergency.
- ⑯ Securely connect the compressor supply connection hose to the Air Line Kit, and connect the air hose to the Air Line Kit, CONTROLLER and the Brushless Motor Spindle to avoid accidental disconnection during use.

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

Brushless Motor Spindle • • 1pc. 	Collet Nut (CHN - A) • • 1pc.* 
Wrench (8 x 5), (9 x 11) • • 1pc. Each. 	Lock Bar • • 1pc. 
Spiral Tube • • 1pc. 	Ring • • 1pc. 
Plastic Tie (Repeat Type) • • 1pc. 	Plastic Tie • • 3pcs. 
Plastic Tie • • 1pc. 	Electrical Plug Cap • • 1pc.* 

Air Plug • • 1pc.* 	Inspection Card • • 1pc. 
Operation Manual • • 1set 	

* The Collet Nut, Electrical Plug Cap and Air Plug are attached to the Brushless Motor 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.

- ① Defect in manufacturing.
- ② Any shortage of components in the package.
- ③ 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.	: +1 800 585 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

- ① Small diameter drilling and milling which is very difficult with large machines can easily be achieved with the Brushless Motor Spindle.
- ② Use of a high-performance brushless DC motor and ceramic bearings in the spindle makes the Brushless Motor Spindle extremely accurate and durable.
- ③ Low vibration, low noise and low heat generation dramatically extends cutting tool life.
- ④ Wide speed range from 20,000 - 80,000 min⁻¹ (rpm) makes extremely precise work possible.
- ⑤ A wide variety of shank types are available (BT30, BT40, BT50, NT40, HSKA63, IT40, ST32, CAT40 and CAT50) (For U.S. market : BT30, BT40, BT50, NT40, HSKA63, ST32, CAT40 and CAT50).

6. SPECIFICATIONS AND DIMENSIONS

6 - 1 Specifications

Model		HES810								
		BT30	BT40	BT50	NT40	HSKA63	IT40	ST32	CAT40	CAT50
Motor Rotation Speed		20,000 - 80,000min ⁻¹ (rpm)								
Spindle Accuracy		Less than 1μm								
Taper Shank Types		BT30	BT40	BT50	NT40	HSKA63	IT40	ST32	CAT40	CAT50
Max. Output		350W								
Weight	Main Body	2.0kg	2.2kg	4.9kg	2.3kg	2.6kg	2.4kg	2.3kg	2.4kg	4.3kg
	Motor Cord and Air Hose	425g								
Noise Level at 1m distance		Less than 70dB (A)								

	Temperature	Humidity	Atmospheric Pressure
Operation Environment	0 - 40°C	MAX.75% (No condensation)	700 - 1,060hPa
Transportation and Storage Environment	-10 - + 50°C	10 - 85%	500 - 1,060hPa

<Option>

Motor Cord *Note 1	Length : 4.0m, 6.0m, 8.0m (The Air Hose (φ4mm) of the same length is attached.)
Collet (CHA - □□) *Note 2	φ0.5mm - φ6.0mm in 0.1mm increments and φ2.35mm, φ3.175mm.
Collet Nut	CHN - A

*Note 1 : Motor Cord is sold separately.

Please select the suitable motor cord length for your application.

*Note 2 : Collet is sold separately. Please select the suitable collet size for your application.

ENGLISH

*Dust Proof Cover Area



④ HES810 - NT40

*Dust Proof Cover Area

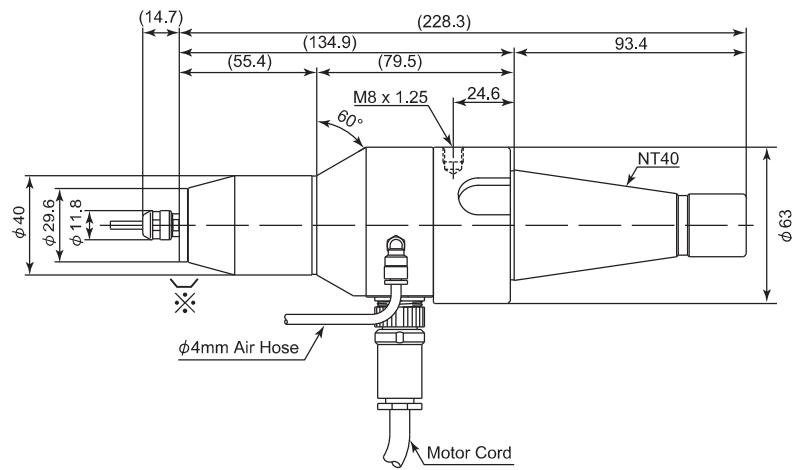


Fig. 4

⑤ HES810 - HSKA63

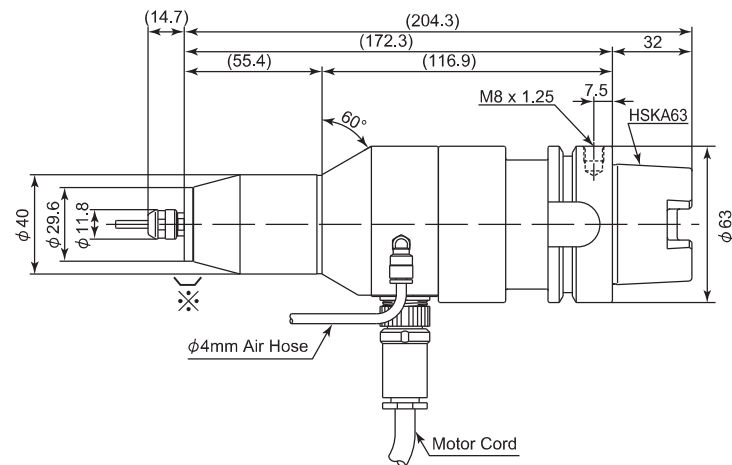


Fig. 5

⑥ HES810 - IT40

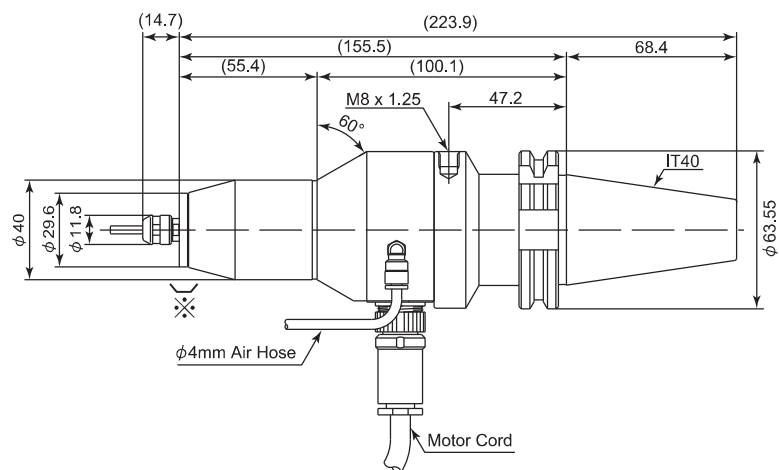


Fig. 6

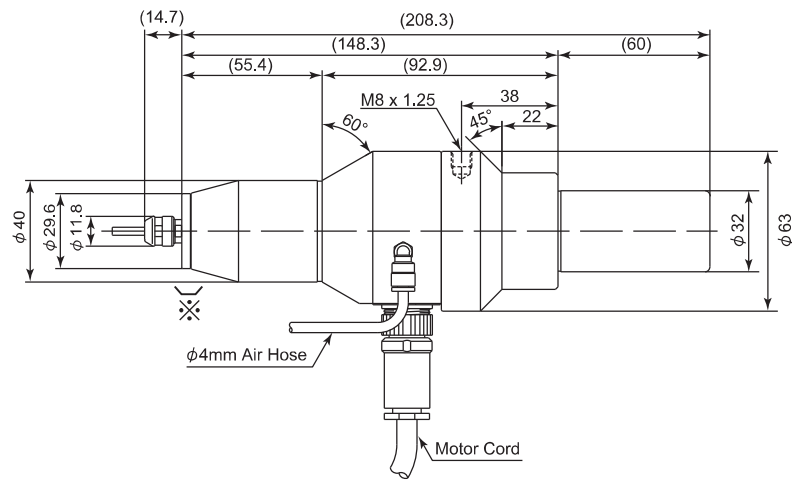


Fig. 7

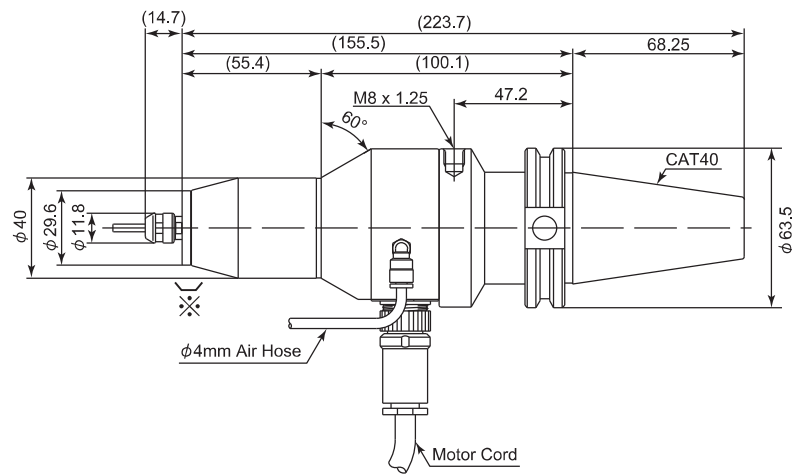


Fig. 8

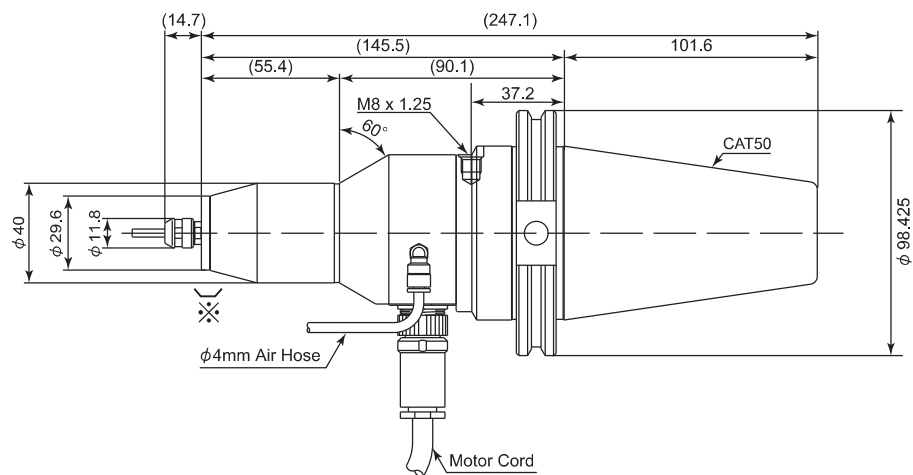


Fig. 9

7. 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.

- ① Set the provided 8mm wrench on the spindle shaft.
- ② Place the provided 11mm 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).
- ③ Clean the collet and collet nut, then insert the new tool and tighten the collet by turning clockwise. Do not over-tighten.

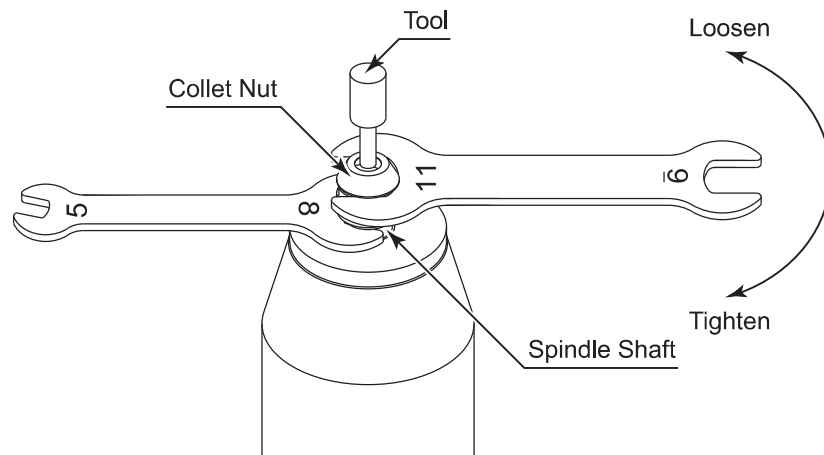


Fig. 10

8. REPLACING THE COLLET

⚠ CAUTION

When installing the collet into the collet nut, be sure to fully engage the latch inside the collet nut to the groove on the collets outer diameter area. In addition, remember 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 damage to the collet or the spindle.

- ① Remove the tool according to the section " 7. CHANGING THE TOOL " procedure above and remove collet nut assembly (Fig. 11).
- ② 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. 12).
- ③ To install the collet, hold the collet at a slight angle, and insert it into the collet nut (Fig. 13). Press the collet in the collet nut by positioning the collet in the collet nut and pressing down on flat surface (Fig. 12). Be sure to fully engage the latch inside the collet nut into the groove on the collet's outer circumference area (Fig. 14).

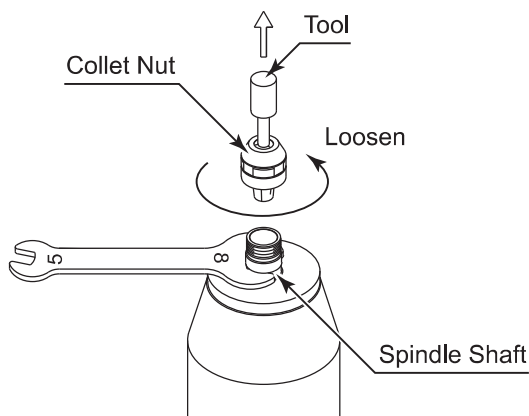


Fig. 11

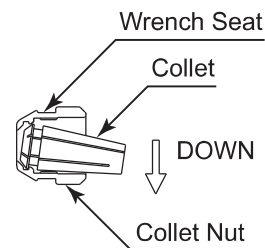


Fig. 12

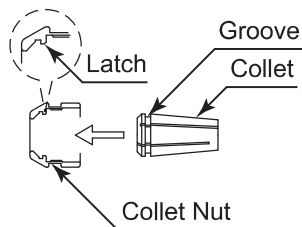


Fig. 13

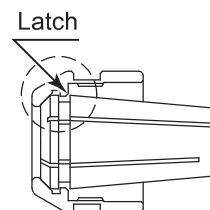


Fig. 14

9. INSTALLATION INTO THE MACHINE

DANGER

Do not rotate the machining centers' main spindle while the Brushless Motor Spindle is installed. Rotating the machining centers' main spindle with the Brushless Motor Spindle installed can cause the Motor Cord to become tangled, pulling the CONTROLLER off its mounting and cause severe damage to the motor cable and its connections. This will lead to a severe injury.

WARNING

Whenever installing a Brushless Motor Spindle to a metal fixed base, ensure that the fixed base is grounded in order to avoid risk of an electric shock.

CAUTION

- Install the provided Protective Cap to prevent damage or contamination to the Motor Cord Plug on the spindle and cable when not in use.
- Check that the Motor Cord Connector, Air Hose and Emergency Connector have been tightened and properly secured before operation.
- DO NOT separate the Emergency Connector manually. It is not a quick disconnect connector, it is an Emergency System : If the machining center's main spindle is rotated by mistake, the Emergency Connector on the motor cord will separate. If the hanger for the Emergency Connector is too loose, the Emergency Connector can slip out of position during high speed rotation and cause the Emergency System to malfunction. Please check the integrity of the Emergency Connector and suspension properly prior to use (SEE Fig. 18).
- If the Emergency Connector is separated, check the motor cord and air hose for damage, air leakage, rips, torn insulation or any other damage before reconnecting the Emergency Connector. If the Emergency Air Joint is separated, you may reconnect using a small amount of Super Glue to reattach it. Check the air system for leaks. If everything checks ok you can proceed with use. If problems exist in either the Emergency Air Joint or the Emergency Connector, please send the unit to NAKANISHI for service. Do not manually disconnect the Emergency Air Joint.

- ① Insert and Clamp the Brushless Motor Spindle into the machining center's main spindle.
- ② Remove the Electrical Plug Cap from the Brushless Motor Spindle by turning it counterclockwise (Fig. 15).
- ③ Carefully remove the Air Plug from the Brushless Motor Spindle's Air Joint by pressing in the Release Bush in the quick disconnect while pulling on the end of the Air Plug (Fig. 15).

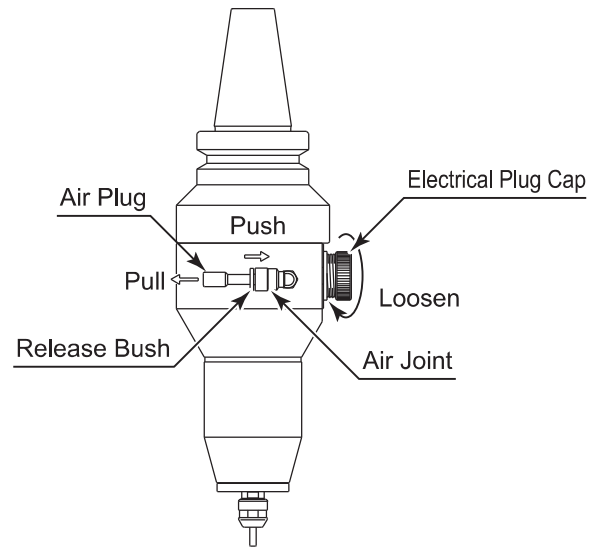


Fig. 15

- ④ Insert the $\phi 4\text{mm}$ air hose to the Air Joint on the side face of the Brushless Motor Spindle (Fig. 16).
- ⑤ Remove the Electrical Protective Cap of the Motor Cord and keep it for use when not using the Motor / Spindle to keep the connector pins safe and clean.
- ⑥ Carefully insert the Alignment Pin on the Motor / Spindle into the Alignment Hole on the Motor Cord, then push the connector straight into the Electrical Connection of the Motor / Spindle (Fig. 17).
- ⑦ Tighten the Connector Nut of the Motor Cord in a clockwise direction (Fig. 16).

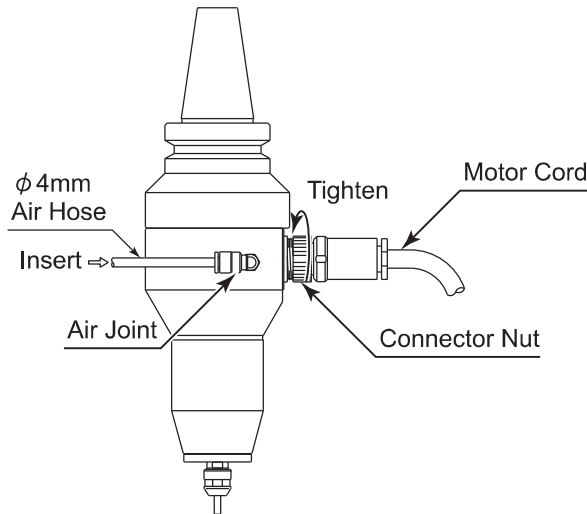


Fig. 16

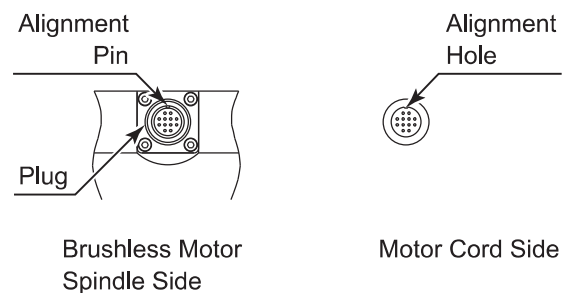


Fig. 17

- ⑧ Secure the Emergency Connector to the machine, being sure to correctly, horizontally position the Emergency Connector and Air Line.
- * Route the Motor Cord and Air Hose and hold them securely with enough slack to allow for machines' axis travel (Do not pinch and severely bend the air hose) (SEE Fig. 18).
If the positioning and fixation of the Motor Cord and Air Hose are loose, the Emergency Connector may not separate correctly as intended.

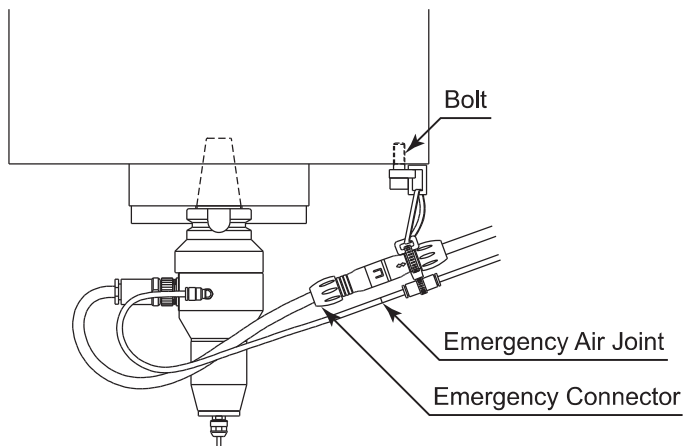


Fig. 18

<Installation of the provided Lock Bar>

⚠ CAUTION

- The Lock Bar is not intended to stop the machining center's main spindle from rotating, it is only intended to be used as a precautionary measure only. If it is not needed, it is not required to be installed.
- The Block shown in the Fig. 19 is not provided with the Brushless Motor Spindle, it must be provided by the customer.

Install the Lock Bar by screwing the Lock Bar into the threaded hole provided on the taper shank as shown in Fig. 17.

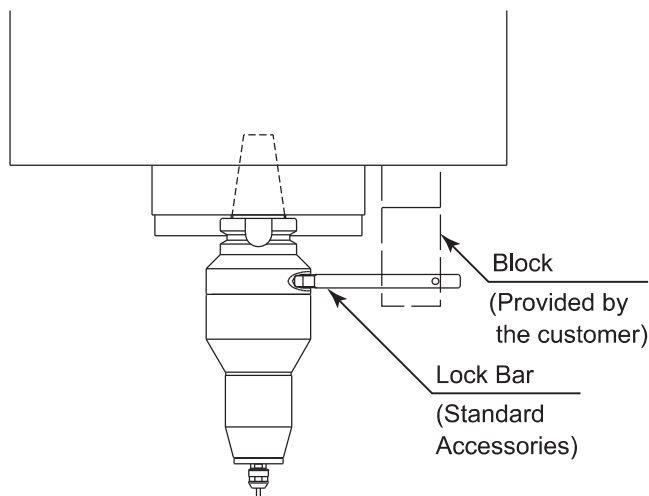


Fig. 19

10. CONNECTION TO THE CONTROLLER

- ① Connect the Motor Cord and Air Hose as shown in Fig. 20.
- ② Be sure to use the NAKANISHI Air Line Kit (AL - C1204). The CONTROLLER and the Brushless Motor Spindle must be supplied with clean, dry air, regulated to between 0.25 - 0.3MPa (36.2 - 43.5psi). Connect the 6mm air hose from the Air Line Kit (AL - C1204) secondary joint to the CONTROLLER's Air Input Joint. If not using the NAKANISHI Air Line Kit (AL - C1204) a filter / regulator must be installed to supply clean, dry and regulated air to the CONTROLLER and the Brushless Motor Spindle.

* Refer to the " E3000 CONTROLLER " and the " Air Line Kit (AL - C1204) " Operation Manuals.

- ③ Start-up of the Brushless Motor Spindle.

Refer to the " E3000 CONTROLLER ", the " Air Line Kit (AL - C1204) " and this Operation Manuals for connection and startup instructions.

ABSOLUTELY DO NOT ROTATE the machining center's main after installing the Brushless Motor Spindle.

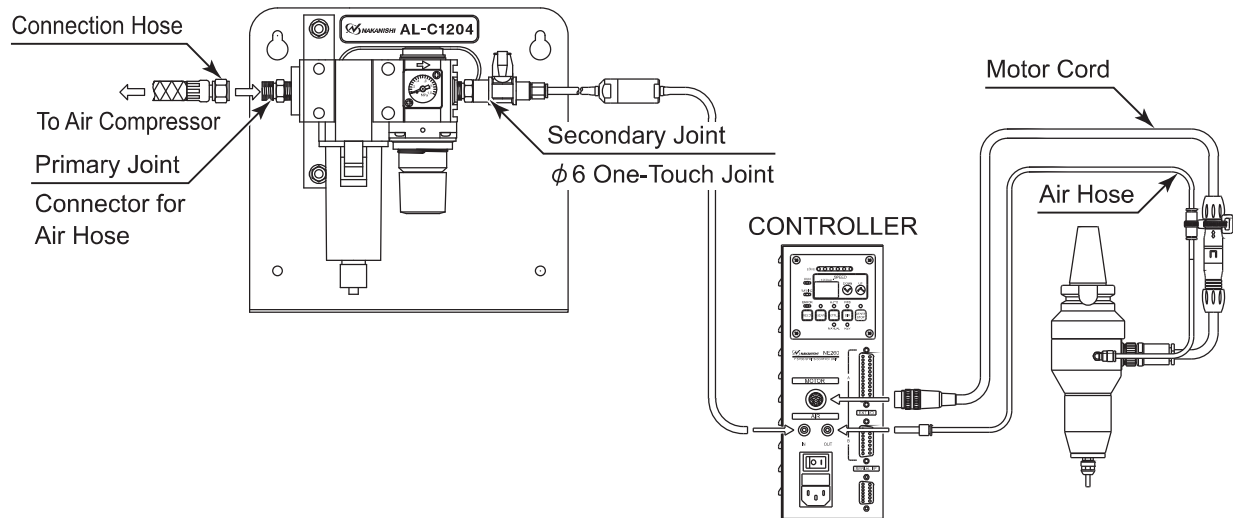


Fig. 20

11. CENTERING ALIGNMENT

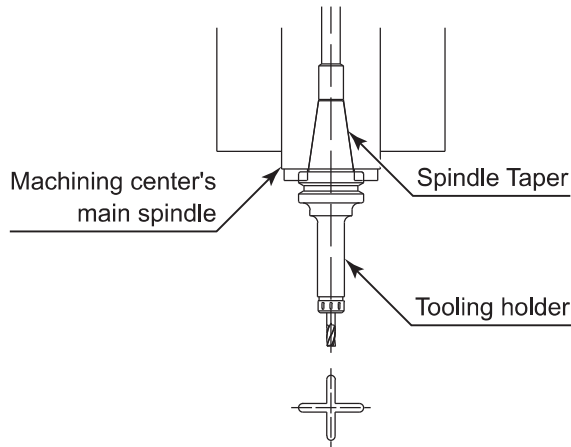
⚠ CAUTION

If processing a workpiece by mounting the Brushless Motor Spindle to the machining center's main spindle it could be difficult to achieve perfect centering alignment by hand loading the Brushless Motor Spindle.

- * The taper of the machining center's main spindle and Brushless Motor Spindle are within range of applicable standard, but taper housing is slightly different by machine's manufacturer.
- * If the taper face has been damage or worn, it may occur deviation of centering as against machine's core.

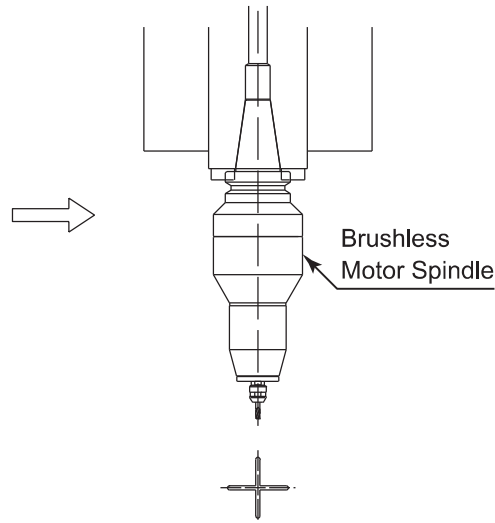
The Brushless Motor Spindle is a spindle that is used after the machining center's main spindle stops. Once the centering alignment is completed, processing can be done without any problems. However in order to achieve the perfect centering alignment, follow the steps below.

- ① **ALIGNMENT INSTRUCTIONS** : To find machining center's main spindle center in relation to the Brushless Motor Spindle, mount a tool in a high-precision endmill holder or collet.
Milling a cross pattern on the workpiece as described in Fig. 21.
- ② Measure the center (Fig. 21).
- ③ Installing the Brushless Motor Spindle to the machining center's main spindle and mount the same end-mill to the Brushless Motor Spindle.
With the main spindle of the machining center stopped, start the Brushless Motor Spindle.
Machine the cross pattern in the same way as the previously working mill (①), using the same work material (Fig. 22).
Measure the difference in the X - Y cross.
If there is no difference in the measurement, an alignment is not necessary.



Mill an X - Y cross pattern in a scrap piece of material and measure the X - Y intersection.

Fig. 21



Install the same end-mill to the Brushless Motor Spindle.
Stop the machining center's main spindle, and re-install the Brushless Motor Spindle.
Re-machine the cross pattern in the same way as the previously milled (①), using the same work material position (Fig. 22).
Measure the position difference in the X - Y axis cross.

Fig. 22

* If there is difference in the measurement, adjust the Brushless Motor Spindle centerline. With the Brushless Motor Spindle installed in the machining center's main spindle, use a dial gauge on the test pin originally provided in the collet. Slightly loosen the 6 bolts that hold the taper housing together, then slightly tap the spindle to reposition the X - Y concentricity. Rotate the machine's main spindle by hand to verify the concentricity. Carefully re-tighten the 6 bolts that were previously loosened (Fig. 23).

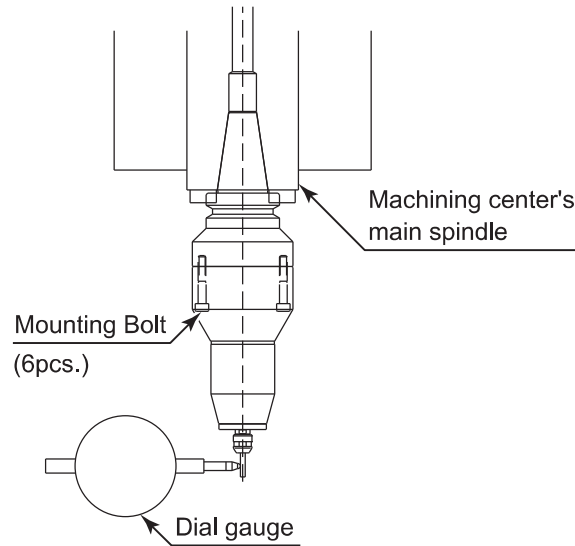


Fig. 23

12. BREAK-IN PROCEDURE

During transportation, storage or installation, the grease inside the bearings will settle. If the Brushless Motor 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

Steps	1	2	3	4	5	6
Rotation Speed (min ⁻¹) (rpm)	15,000	30,000	40,000	50,000	60,000	80,000
Rotation Time (min)	15	10	10	10	10	10
Items to Check	No Abnormal Noises.	The Brushless Motor 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 Brushless Motor 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 Brushless Motor Spindle for proper installation.			The Brushless Motor Spindle housing temperature during the break-in process should not exceed 25 degrees C (45 degrees F) above ambient temperature.	

13. CAUTIONS WHEN USING GRINDSTONES AND TOOLS

⚠ 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 manufacturer's recommendations.

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

- ① The proper surface speed for general grindstones is 10 - 30m / s.
- ② Do not exceed 13mm of overhang for mounted grindstones as shown in Fig. 24. If the overhang must exceed 13mm, reduce the Brushless Motor Spindle speed in accordance with Table. 3.
- ③ Dress the grindstone prior to use.
- ④ Do not use cutting tools with bent or broken shanks, cracks or excessive run-out.
- ⑤ 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.
- ⑥ Always operate cutting tools within the allowable recommended speed of the cutting tools. Use of a cutting tool outside of the allowable speed of the cutting tools could cause damage to the spindle and injury to the operator.
- ⑦ Keep the cutting tool shank and collet clean. If contaminants are left in the collet or collet nut, excessive run-out will cause damage to the cutting tool and or spindle.
- ⑧ Do not strike or disassemble the Brushless Motor Spindle.
- ⑨ Please set the cutting tools to minimize the overhang amount. 13mm is the maximum amount of overhang to maintain high accuracy and safety.

Table. 3 Overhang and Speed

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

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

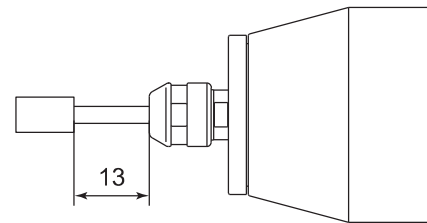


Fig. 24

14. TROUBLESHOOTING

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

Trouble	Cause	Inspection / Corrective Action
Brushless Motor Spindle does not rotate.	Power is not supplied.	• Make sure to turn ON the Main Power Switch on the front of the CONTROLLER. • Insert the power cord plug correctly into the Main Power Inlet with Power Supply Fuses of the CONTROLLER. • Check if a fuse is blown.
	Motor Cord Plug is not connected to the Brushless Motor Spindle and CONTROLLER.	Connect the Motor Cord plug correctly to the Brushless Motor Spindle and CONTROLLER.
	Control Button (CTRL) is set to Manual mode but trying to start with an External Command Signal through Input / Output Connector A.	Start with the Start / Stop Button (START / STOP), or set the Control Button (CTRL) on the Control Panel to Auto mode.
	Control Button (CTRL) is set to Auto mode but trying to manually start with the Start Button (START / STOP) on the Control Panel.	Start with an External Command Signal or set the Control Button (CTRL) on the Control Panel to Manual mode.
	Emergency Stop Signal on External Input / Output Connector B is OFF (Open).	Set Emergency Stop Signal to be " ON " (close).
	An Error has occurred. (Error LED is lit.)	Check and correct the source of the Error Code.
	Low air pressure.	Adjust to the air pressure 0.25 - 0.3MPa (36.2 - 43.5psi).
	The spindle ball bearings have been damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
Can not set the increase or decrease of the Motor Rotation Speed.	The motor has been damaged.	Replace the motor. (Return to NAKANISHI dealer service.)
	Motor Fixed Speed is set in $P3$ parameter.	Release parameter $P3$.
Can not set the motor speed to its maximum allowable speed.	Either the required speed value is higher than the maximum rotation speed of the motor, or the upper limit of the rotational speed has been set in parameter $P4$.	Set the Maximum Rotation Speed to a value less than the Motor Rotation Speed set in Parameter $P4$.

Trouble	Cause	Inspection / Corrective Action
Can not set the motor speed to its maximum allowable speed.	Air Input Monitoring Override is set in the $P7$ parameter to on and the motor's maximum speed has been limited to 30,000min ⁻¹ (rpm).	Check the setting of parameter $P7$.
A blinking dot appears on Digital Speed Indicator. Cannot set the desired rotation speed.	Gear Ratio is set to a value other than " 1.0 " .	Check the setting of Gear Ratio.
Overheating during rotation.	Cutting debris has contaminated the ball bearings, and the ball bearings are damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
	Low air pressure.	Check air hose connection and air pressure.
Abnormal vibration or noise during rotation.	The tool shank is bent.	Replace the tool.
	Cutting debris has contaminated the ball bearing.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
	The spindle ball bearings have been damaged.	
Tool slippage.	Collet or collet nut are not correctly installed.	Check and clean the collet and collet nut. Reinstall the collet and collet nut.
	The collet and the collet nut are worn.	Replace the collet and collet nut.
High run-out.	The tool is bent.	Change the 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 taper and spindle.
	The spindle ball bearings have been damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.)

Refer to the E3000 CONTROLLER and Air Line Kit (AL - C1204) Operation Manuals.

15. DISPOSAL OF THE BRUSHLESS MOTOR SPINDLE

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

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