

# Ultra-Precision, High-Speed Brushless Motor Spindle

# HES510

## OPERATION MANUAL

OM-K0480E 003

Thank you for purchasing the Ultra-Precision, High-Speed Brushless Motor Spindle " HES510 ". The HES510 Brushless Motor Spindle is designed for use on machining centers without rotating the machine's main spindle, for small diameter drilling and milling. The E3000 CONTROLLER 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 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
<b>DANGER</b>	Existence of a hazard that could result in personal death or serious injury, if the safety precautions are not fo.
<b>WARNING</b>	A safety hazard could result in bodily injury or damage to the device if the safety instructions are not properly followed.
<b>CAUTION</b>	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 center's main spindle with the HES Brushless Motor Spindle installed. Rotating the machining center's main spindle with the HES Brushless Motor Spindle installed can cause the motor cord to become tangled and pull the control unit off it is mounting. This may cause lead to a big accident.

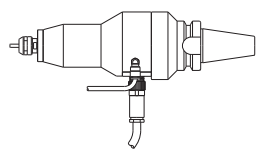
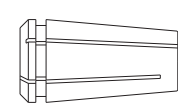
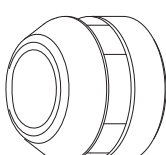
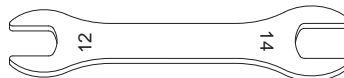
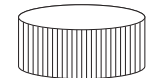
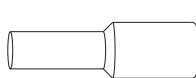

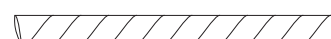


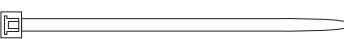

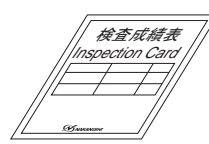

- WARNING**
- NAKANISHI product's are intended for use by trained, knowledgeable, highly experienced professionals only.
  - This Brushless Motor Spindle is not a hand tool. It is designed to be used install this Brushless Motor Spindle to the machining center's machines or milling machine machines.
  - 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 HES Brushless Motor Spindle whenever the HES Brushless Motor 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 HES Brushless Motor Spindle until you have thoroughly read the Operation Manuals and safe operation has been confirmed.
    - To prevent injuries / damages, check the HES Brushless Motor Spindle and cutting tool for proper installation, before operating the HES Brushless Motor Spindle.
    - Before disconnecting the HES 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 HES Brushless Motor Spindle.
  - When installing a HES Brushless Motor 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 chuck correctly and check again the collet chuck and chuck nut before use. Do not over-tighten the collet chuck. This may cause damage to the HES Brushless Motor 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 drop or hit this HES Brushless Motor Spindle, as shock can damage to the internal components.
  - Be sure to clean the collet chuck and chuck 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 chuck, damage to the collet chuck or spindle can occur due to the loss of precision.
  - When cleaning a HES Brushless Motor Spindle, stop the HES510 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.
  - Always clean the tool shank before installing the tool in the spindle.
  - Be sure to drain moisture and condensation from the Air Line Kit (air filter bowl) regularly to avoid moisture being carried to the HES Brushless Motor Spindle. This may cause damage to the HES Brushless Motor Spindle.
  - Check to make sure the HES Brushless Motor Spindle is properly and securely mounted in the machine's quill prior to use. If the HES Brushless Motor Spindle is not properly aligned or there is excessive play, do not use the HES Brushless Motor Spindle until this situation is corrected.
  - When sizing the correct collet chuck 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 HES Brushless Motor Spindle or tools.
  - Do not stop the supply cooling air for motor during operation of the machine. Removing the air pressure from the HES Brushless Motor Spindle causes a loss of purging, allowing the HES Brushless Motor Spindle to ingest coolant. This will cause damage to the HES Brushless Motor Spindle.
  - Carefully direct coolant spray to the tool. Do not spray directly on the HES Brushless Motor Spindle body. If large amount splay directly on the HES Brushless Motor Spindle, it may cause excess load of the motor rotation with loss of durability to the HES Brushless Motor 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 chuck, chuck nut, connection hose and air hose for damaged before and after operating.
  - Always check if the tool, collet chuck, chuck nut, connection hose and air hose for damaged before and after operating.
  - 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 spindle, no vibration or unusual sound should be observed during rotation.
  - Do not disassemble, modify or attempt to repair this HES Brushless Motor Spindle. Additional damage will occur to the internal components. Service must be performed by NSK NAKANISHI or an authorized service center.
  - When using this HES Brushless Motor Spindle for mass production, please consider the purchase of an additional HES Brushless Motor Spindle to be used as a back-up in case of emergency.
  - Securely connect the compressor supply connection hose and the air hose to the Air Line Kit and the HES 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.  * Figure is HES510 - BT30	Collet Chuck $\phi$ 4.0mm (CHK - 4.0) · · 1pc. (For U.S. market · · $\phi$ 3.175mm (CHK - 3.175)) 	Chuck Nut (K - 265) · · 1pc. 
Wrench (12 × 14) · · 2pcs. 	Electric Connector Cap · · 1pc. 	Air Cap · · 1pc. 
Lock Bar · · 1pc. 	Spiral Tube · · 1pc. 	Ring · · 1pc. 
Plastic Tie (Repeat Type) · · 1pc. 	Plastic Tie · · 3pcs. 	Plastic Tie · · 1pc. 
Inspection Card · · 1pc. 	Operation Manual · · 1set 	

\* The Collet Chuck, Chuck Nut, Electric Connector Cap and Air Cap 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.

- 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)  
U.S. Toll Free No. : 800-585-4675  
Telephone No. : 847-843-7664  
Fax No. : 847-843-7622  
Web Address : www.nskamericacorp.com
- For Europe Market  
Company Name : **NSK Europe GmbH**   
Industrial Div.  
Business Hours : 8:00am to 17:00pm  
(closed Saturday, Sunday and Public Holidays)  
Telephone No. : +49 619677606 57  
Fax No. : +49 619677606 29  
Web Address : www.germany.nsk-dental.com/
- For Other Markets  
Company Name : **NAKANISHI INC.**   
Business Hours : 8:00am to 17:00pm  
(closed Saturday, Sunday and Public Holidays)  
Telephone No. : +81 (0) 289-64-3520  
Web Address : webmaster-ie@nsk-nakanishi.co.jp

### 5. FEATURES

- Small diameter drilling and milling which is very difficult with large machines can easily be achieved with the HES Brushless Motor Spindle.
- Use of a high-performance brushless DC motor and ceramic bearings in the spindle makes the HES Brushless Motor Spindle extremely accurate and durable.
- Low vibration, low noise and low heat generation dramatically extends cutting tool life.
- Wide speed range from 5,000 ~ 50,000 min<sup>-1</sup> (rpm) makes extremely precise work possible.
- A wide variety of Shank Types are available. (BT30, NT30, BT40, NT40, BT50, NT50, HSK A63, HSK A100, CAT40, CAT50, IT40, IT50, ST32, R8)
- Various sizes of collet chucks are available CHK 0.5mm - 6.35mm. Standard collet chuck is CHK 4.0mm or CHK 3.175mm (For U.S. market CHK 3.175mm).

### 6. SPECIFICATIONS AND DIMENSIONS

#### 6 - 1 Specifications

Model	HES510	
Rotation speed	5,000 - 50,000min <sup>-1</sup> (rpm)	
Spindle Accuracy	Within 1 $\mu$ m	
Shank types	BT30, NT30, BT40, NT40, BT50, NT50, HSK A63, HSK A100, CAT40, CAT50, IT40, IT50, ST32, R8	
Max. Output	340W	
Weight	BT30 Motor Cord and Air Hose	2.2kg 425g
Noise Level at 1m distance	Less than 70 dB	

#### <Options>

Collet Chuck (CHK - □□)	$\phi$ 0.5mm - $\phi$ 6.0mm in 0.1mm increments $\phi$ 2.35mm, $\phi$ 3.175mm, $\phi$ 6.35mm.
Motor Cord (including Air Hose) *Note	4m, 6m, 8m
Chuck nut	K - 265

\*Note : Motor Cord is sold separately.

Please select the suitable motor cord length for your application.

#### 6 - 2 Outside View

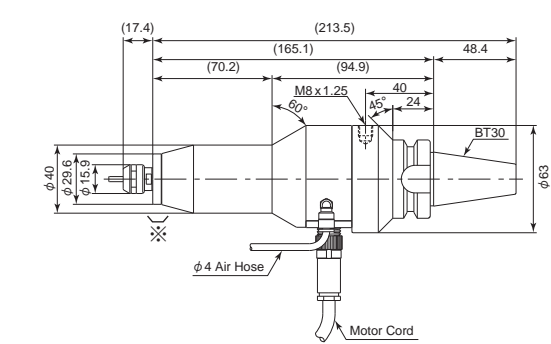


Fig. 1 HES510 - BT30

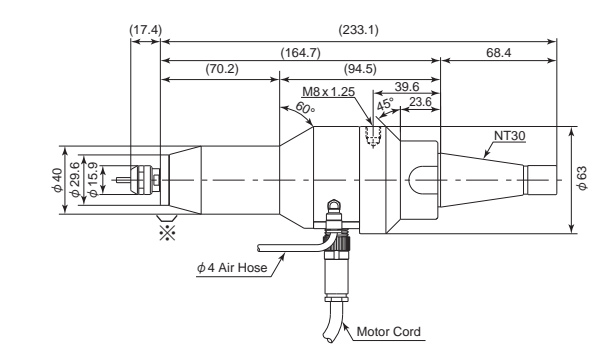


Fig. 2 HES510 - NT30

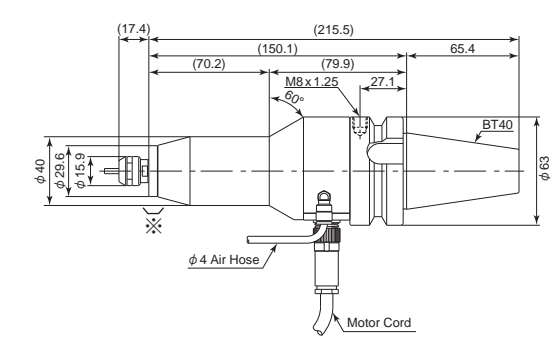


Fig. 3 HES510 - BT40

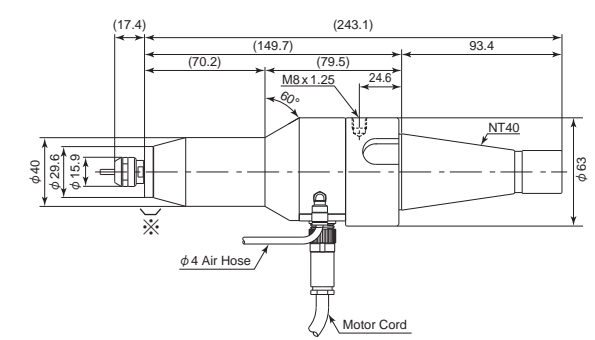


Fig. 4 HES510 - NT40

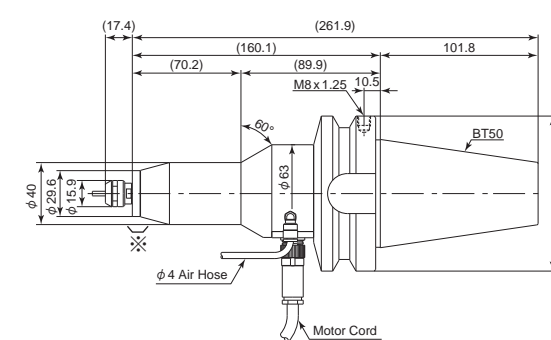


Fig. 5 HES510 - BT50

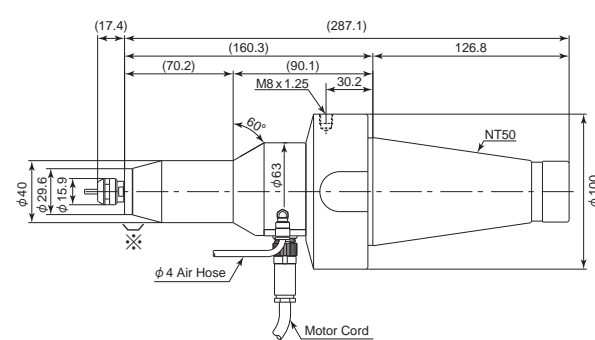


Fig. 6 HES510 - NT50

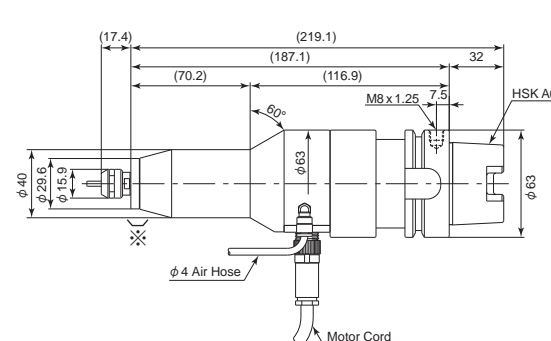


Fig. 7 HES510 - HSK A63

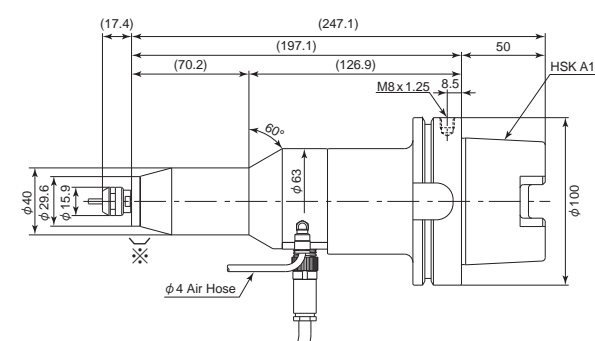


Fig. 8 HES510 - HSK A100

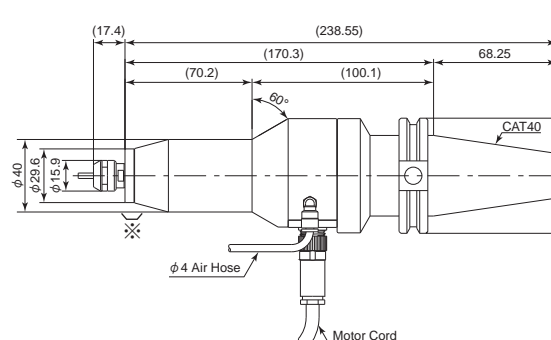


Fig. 9 HES510 - CAT40

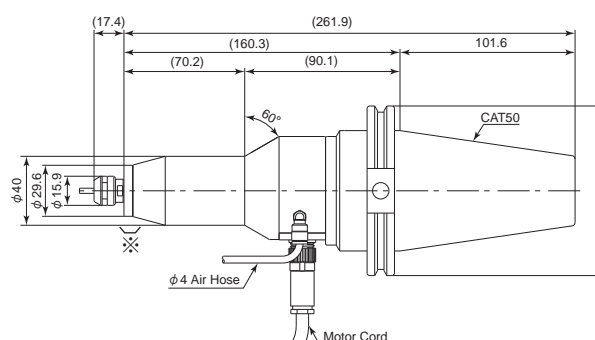


Fig. 10 HES510 - CAT50

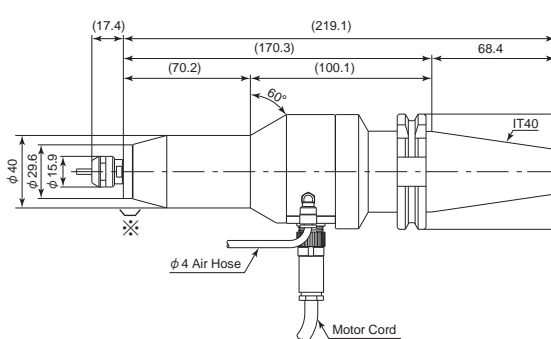


Fig. 11 HES510 - IT40

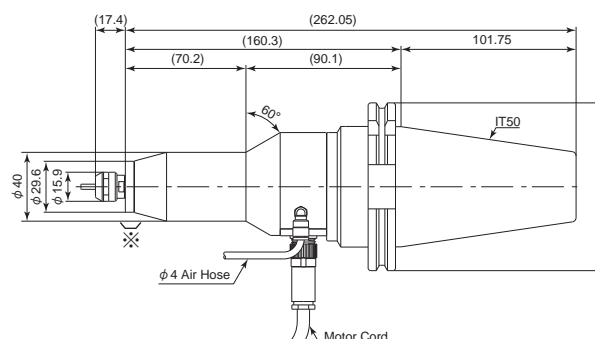


Fig. 12 HES510 - IT50

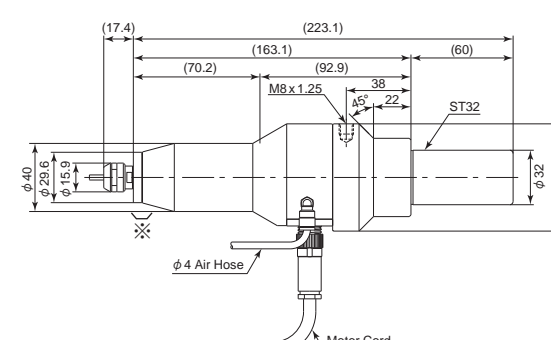


Fig. 13 HES510 - ST32

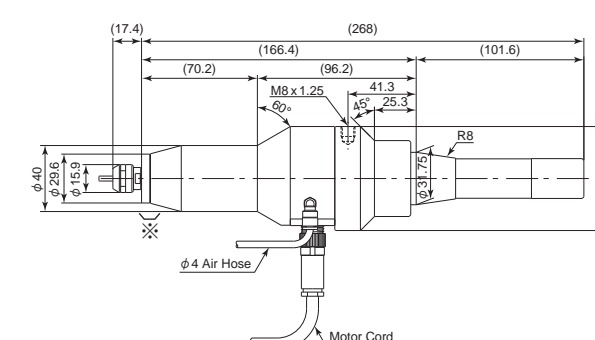


Fig. 14 HES510 - R8

## 7. CHANGING THE TOOL

### CAUTION

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

### 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 chuck nut and turn it counterclockwise to loosen the collet chuck and remove the tool. (The first turn will loosen the chuck nut, but the tool will not release and turning will become stiff. Keep turning through the stiffness and the collet chuck will open.)
- Clean the collet chuck and chuck nut, then insert the new tool and tighten the collet chuck by turning clockwise. Do not overtighten.

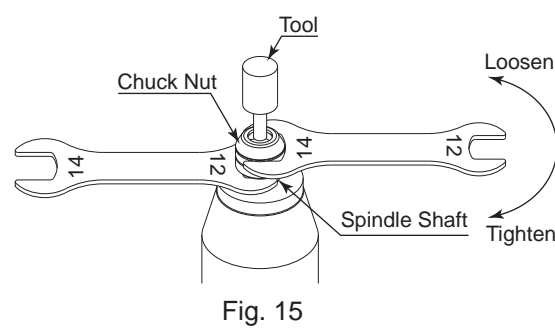


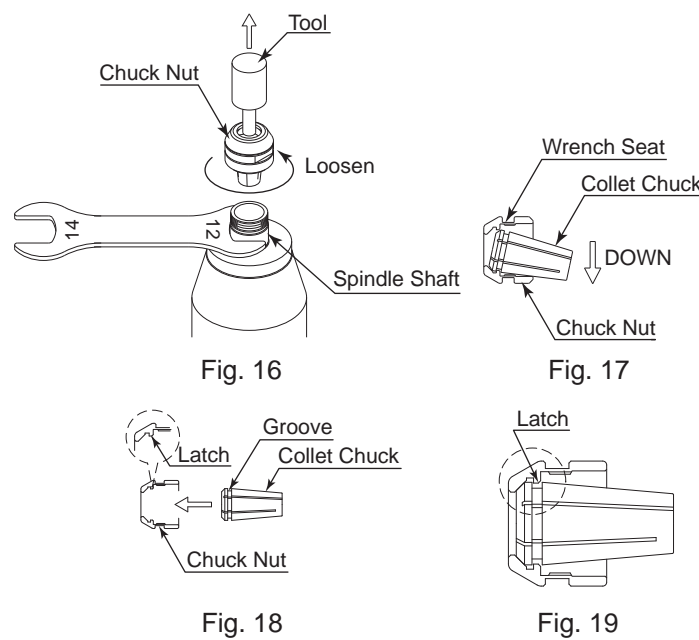
Fig. 15

## 8. REPLACING THE COLLET CHUCK

### CAUTION

When installing the collet chuck into the chuck nut, be sure to fully engage the latch inside the chuck nut to the groove on the collet chucks outer diameter area. In addition, remember that if the collet chuck is attached without being engaged with the latch of the chuck nut, the collet chuck cannot be removed and this may cause damage to the collet chuck or the spindle.

- Remove the tool according to the section "7. CHANGING THE TOOL" procedure above and remove chuck nut assembly. (Fig. 16)
- The collet chuck and chuck nut are secured by a groove in the collet chuck and a flange in the chuck nut. To remove the collet chuck hold the chuck nut in one hand and push diagonally down on the collet chuck. The collet chuck should be released (Fig. 17).
- To install the collet chuck, hold the collet chuck at a slight angle, and insert it into the chuck nut (Fig. 18). Press the collet chuck in the chuck nut by positioning the collet chuck in the chuck nut and pressing down on flat surface. (Fig. 17) Be sure to fully engage the latch inside the chuck nut into the groove on the collet chucks outer circumference area (Fig. 19).



## 9. INSTALLATION INTO THE MACHINE

### DANGER

Do not rotate the machining center's main spindle with the HES Brushless Motor Spindle installed. Rotating the machining center's main spindle with the HES Brushless Motor Spindle installed can cause the motor cord to become tangled and pull the control unit off it is mounting. This may cause lead to a big accident.

### WARNING

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

- Insert and Clamp the HES Brushless Motor Spindle to the main spindle of the machining center.
- Remove the Electric Connector Cap from the HES Brushless Motor Spindle by turning counterclockwise (Fig. 20).
- Remove the Air Cap from the HES Brushless Motor Spindle's Air Joint (Fig. 20).
- Install the  $\phi$  4mm air hose on the HES Brushless Motor Spindle's Air Joint (Fig. 21).
- Detach the plug cap for motor cord and install the motor cord to the HES Brushless Motor Spindle's plug. Please make sure to align the pin on the plug and the groove on the motor cord connector. Turn the motor cord connector clockwise to tighten (Fig. 21, 22).
- Fixture the Emergency Connector in the machine. Route the motor cord and air hose and hold them securely with enough slack to allow for quill travel. The Emergency Connector should be positioned horizontally and the air hose should not have any severe bends. Make sure air can pass freely through the air hose. If the motor cord and air hose are not held properly, the emergency connectors may not separate properly in an emergency (Fig. 23).

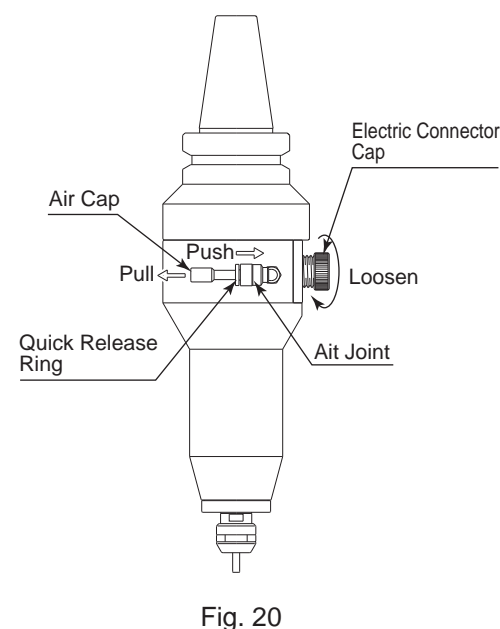


Fig. 20

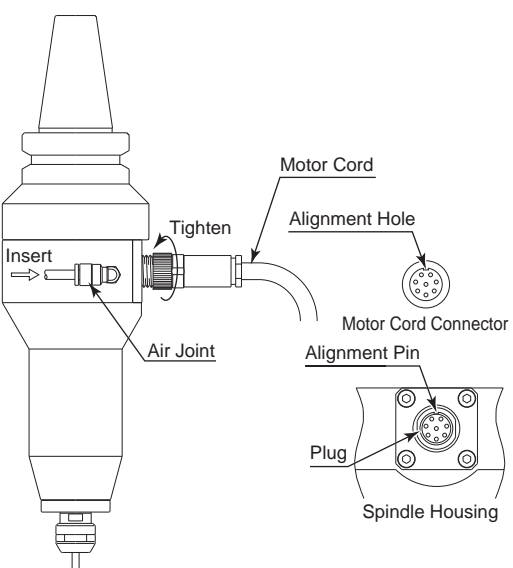


Fig. 21

Fig. 22

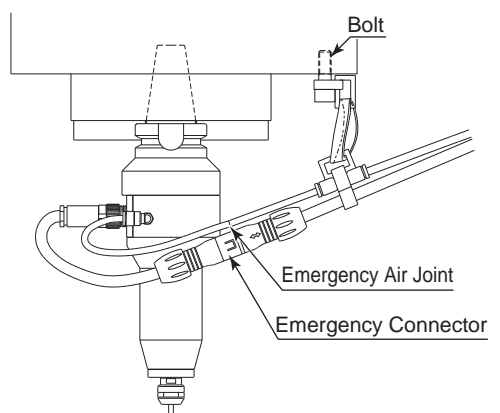


Fig. 23

### CAUTION

When not using the HES Brushless Motor Spindle please replace the Electric Connector Cap and air cap to protect the connectors from contaminants with HES Brushless Motor Spindle body. And reset the plug cap for motor cord to motor cord. Check that the Motor Cord Connector, Air Hose and Emergency Connector have been tightened properly before operation. DO NOT separate the emergency connector manually. It is not a quick disconnect connector. Emergency System: If the machine'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 prior to use.

### CAUTION

If the Emergency Connector is separated, check the motor cord and air hose for damage, leaks, rips, torn insulation or any other damage before reconnecting the Emergency Connector. If the Air Emergency Connector is separated, you may reconnect using a small dab of Super Glue to reattach it. Check air system for leaks and if everything checks ok you can proceed with use. If problems exist in either the Air Emergency Connector or the Motor Cord Emergency Connector please send the unit to NAKANISHI for service. Do not disconnect the Air Emergency connector expect in an emergency.

- Installation of the provided lock bar  
Screw the lock bar into the tapped hole on the spindle housing as shown in Fig. 24

### CAUTION

The lock bar is not intended to stop the main spindle from rotating; it is only intended to be used as a precautionary measure. If it is not needed, it does not need to be installed.

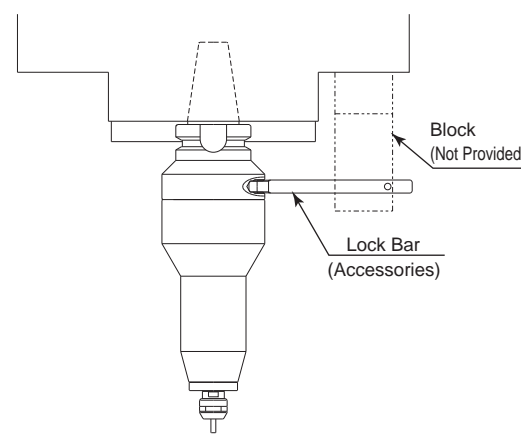


Fig. 24

## 10. CONNECTING TO THE CONTROLLER

- Connect the Motor Cord and Air Hose as shown in Fig. 25.
- An Air Line Kit such as NAKANISHI'S (AL-C1204) must be used. The CONTROLLER and the HES Brushless Motor Spindle must be supplied with clean, dry air regulated to between 0.25MPa - 0.3MPa Connect the output of the Air Line Kit to the CONTROLLER's Air In connector. If you are not using NAKANISHI'S Air Line Kit, you must use a regulator and air filter or dryer to supply clean, dry, regulated air to the CONTROLLER and the HES Brushless Motor Spindle. Water contamination in the air will cause damage to the Brushless motor and spindle. \* For details of the operation and connections of the CONTROLLER and Air Line Kit please refer to their respective Operation Manuals.
- Do not attempt to start the HES Brushless Motor Spindle until you have completed and double checked all the procedures described in this Operation Manual. Absolutely DO NOT ROTATE the MACHINE'S MAIN SPINDLE after installing the HES Brushless Motor Spindle.

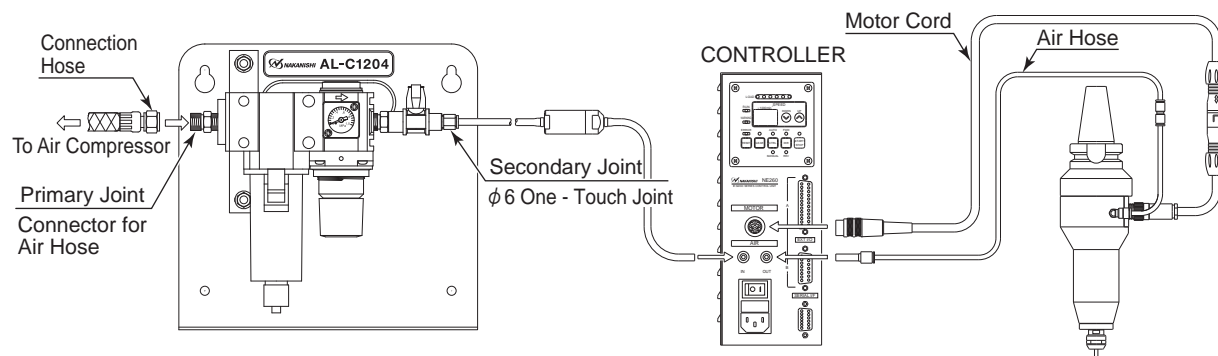


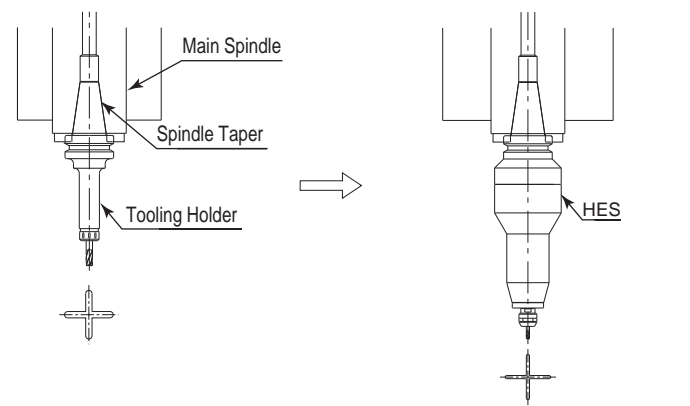
Fig. 25

## 11. THE HES BRUSHLESS MOTOR SPINDLE CENTERING ALIGNMENT

### CAUTION

It is important to align the HES centerline to the machining center's centerline prior to using the HES Brushless Motor Spindle. The HES Brushless Motor Spindle and taper housing are precision machined to the exacting tolerances of the applicable standard for each taper. However, since no tolerance is +0, -0 it could be difficult to initially achieve perfect centerline alignment just by hand loading the spindle. Please follow the steps below to ensure proper centerline alignment.

- To find the main spindle's center, mount a tool in a highprecision end mill holder and machine the pattern described below and measure the center. Or use a 1/4" collet chuck (Option) and mount an edgefinder in the collet chuck to determine the true centerline of the HES Brushless Motor Spindle.



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

Fig. 26

Mount the HES Brushless Motor Spindle in the quill and mill the same cross pattern with a smaller diameter tool inside the previously milled pattern. Measure the difference in the X-Y intersections.

Fig. 27

- To adjust the HES centerline, mount the HES Brushless Motor Spindle in the machining center's quill and use a dial gauge on a test pin. Loosen the six bolts that hold the taper housing together, slightly and tap out the X-Y eccentricity. Rotate the machining center's spindle by hand to Main Spindle verify concentricity. (Fig. 28)

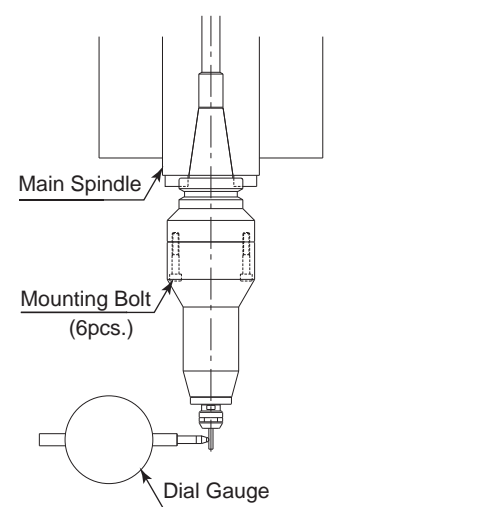


Fig. 28

## 12. 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.

Steps	1	2	3	4	5
Rotation Speed (min <sup>-1</sup> ) (rpm)	12,000	24,000	32,000	40,000	50,000
Rotation Time (min)	15	10	10	10	10
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.			

## 13. TROUBLESHOOTING

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

< CONTROLLER or Motor >

Trouble	Cause	Inspection / Corrective Action
Motor does not run.	Power is not supplied.	<ul style="list-style-type: none"> <li>Make sure to turn ON the Main Power Switch on the front (rear) of the CONTROLLER.</li> <li>Insert the power cord plug correctly into the Main Power Inlet with Power Supply Fuses of the CONTROLLER.</li> <li>Check if a fuse is blown.</li> </ul>
	Motor Cord Plug is not connected to the Motor, CONTROLLER.	Connect the Motor Cord plug correctly to the Motor 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 on the Control Panel to Manual mode.
	Emergency Stop Signal on External Input / Output Connector B is OFF (Open).	Check the setting of parameter (P3).
	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.
Can not set the increase or decrease of the Motor Rotation Speed.	Motor Fixed Speed is set in (P3) parameter. Turn this Parameter OFF to allow rotational speed changes.	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).
	Air Input Monitoring Override is set in the (P7) parameter to ON and the motor's maximum speed has been limited to 30,000 min <sup>-1</sup> (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.

Refer to the E3000 CONTROLLER Operation Manual.

< Spindle >

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

## 14. 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.