

クーラントスルーモータスピンドル / Coolant Through Motor Spindle

CTM - 4020

取扱説明書 / OPERATION MANUAL

日本語 : P1 - P21 / English : P23 - P46



Thank you for purchasing the Coolant Through Motor Spindle " CTM-4020 ". This Brushless Motor Spindle is designed for small diameter drilling, small diameter end milling, grinding, etc. The E4000 CONTROLLER and Air Line Kit are required to drive this 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
⚠ 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**

- (1) This Motor Spindle is not a hand tool. It is designed to be used on CNC machines or special purpose machines.
- (2) Do not touch the cutting tool while it is running. It is very dangerous.
- (3) Wear safety glasses, dust mask, and use a protective cover around the Motor Spindle whenever the Motor Spindle is rotating.
- (4) Never connect, disconnect or touch the Connector or Motor Cord Plug with wet hands. This may cause an electric shock.
- (5) Never operate or handle the Motor Spindle until you have thoroughly read the Operation Manuals and safe operation has been confirmed.
 - 1) To prevent injuries / damages, check the Motor Spindle and cutting tool for proper installation, before operating the Motor Spindle.
 - 2) Before disconnecting the 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 Motor Spindle.
- (6) Whenever installing a Motor Spindle to a fixed metal base, ensure that the fixed metal base is grounded in order to avoid risk of an electric shock.

⚠ WARNING

- (7) 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.
- (8) 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.
- (9) Do not exceed the recommended maximum allowable speed of the tool. For your safety, use speeds below the maximum allowable speed.
- (10) Do not apply excessive force. This may cause injury to the operator by slippage or damage of the tool, or loss of concentricity and precision of the Motor Spindle.
- (11) When operating the high-pressure pump, take safety measures by using protective covers for the high-pressure pump and hose fitting and other parts.
- (12) When using coolant, check the operating pressure before connecting the coolant hose and fittings. If the maximum operating pressure of the coolant hose or fittings is exceeded, they may burst open and cause injury.
- (13) Connect the coolant hose and fittings securely. A leak in the coolant may cause injury or damage the device.
- (14) When using an oil-based coolant, the coolant may be dispersed as a fine mist that could ignite. Implement fire prevention measures such as the use of dust collectors and automatic fire extinguishers.
- (15) If there is residual pressure in the high-pressure pump, the drill may pop out, resulting in injury. Make sure that there is no residual pressure before replacing the drill.

⚠ CAUTION

- (1) A coolant supply is required when operating this Motor Spindle.
If the product is used without supplying coolant, premature wear to the internal parts, abnormal noise, excess heat generation and internal oil leaks may occur and damage the product.
- (2) Use coolant with an ISO viscosity grade of VG22 or lower.
- (3) Do not drop or hit this Motor Spindle, as shock can damage to the internal components.
- (4) 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.
- (5) When cleaning a Motor Spindle, stop the 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 - 3 Outside View ") with compressed air as foreign particles or cutting debris may get into the ball bearing.
- (6) Always clean the tool shank before installing the tool in the spindle.
- (7) It is strongly recommended to use a tool having a shank tolerance of +0 to -0.01 relative to the nominal diameter of the collet. Although a tool having a shank tolerance within the range of +0 to -0.1 mm is mountable, this may cause poor concentricity and or insufficient tool gripping force.
- (8) Select suitable products or tools for all applications. Do not exceed the capabilities of the Motor Spindle or tools.
- (9) To prevent dust from entering while the machine is operating, do not stop the supply of cooling air from the motor. If the supply of cooling air is stopped while the coolant, cutting fluid is being supplied, the air purge will be lost and the the coolant, cutting fluid may enter the spindle and cause damage.
- (10) When using an external supply of cutting fluid in addition to the coolant, ensure that the cutting oil is sprayed directly on the cutting edge while machining is performed. Do not direct the cutting oil spray towards the spindle or the collet nut. A large amount of cutting oil may cause excess load on the spindle to result in a loss of durability.
- (11) Stop working immediately when abnormal rotation or unusual vibration are observed. Immediately, please check the content of section " 17. TROUBLESHOOTING ".
- (12) Connect the coolant Air Hose securely. The hose may come loose and go out of control.

⚠ CAUTION

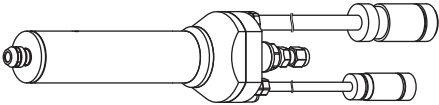
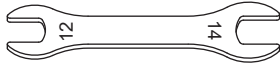
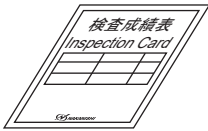

- (13) Always check the tool, collet, collet nut, drain hose, coolant hose or oil mist hose and Hose fittings for damage before and after operating.
- (14) The collet and collet nut are consumable parts. If the collet or collet nut shows signs of wear or damage, replace it before a malfunction or additional damage occurs.
- (15) When storing this product, wipe off any moisture, etc. that may have adhered to it. Failure to do so may cause rusting.
- (16) After installation, repair, initial operation, or long periods of non operation, please refer to section " 14 BREAK-IN PROCEDURE " detailed in Table. 3. When checking the Motor Spindle, no vibration or unusual sound should be observed during rotation.
- (17) Do not disassemble, modify or attempt to repair this Motor Spindle. Additional damage will occur to the internal components. Service must be performed by NAKANISHI or an authorized service center.
- (18) When using this Motor Spindle for mass production, please consider the purchase of an additional Motor Spindle to be used as a back-up 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

<p>Motor Spindle • • 1pc.</p> 	<p>Wrench (12 × 14) • • 2pcs.</p> 
<p>Inspection Card • • 1pc.</p> 	<p>Operation Manual • • 1set</p> 

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 : 8:30am 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 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
e-mail Address : webmaster-ie@nsk-nakanishi.co.jp

5. FEATURES

- (1) Coolant can be supplied and discharged from a cutting drill with a coolant hole, enabling deep hole drilling and high-efficiency machining.
- (2) The spindle supports a coolant pressure of up to 30 MPa.
- (3) The Brushless Motor Spindle has a 40 mm diameter housing made of heat treated stainless steel (SUS) with a polished finish.
- (4) Use of a high-speed Brushless Motor eliminates the need for frequent carbon brush replacement.

6. SPECIFICATIONS AND DIMENSIONS

6 - 1 Specifications

<Specification of the Motor Spindle>

Model	CTM-4020
Maximum Motor Rotation Speed	20,000min ⁻¹
Spindle Accuracy	Less than 1 μm
Max. Output	1,200W
Quick Disconnect Cord Length	2m
Weight	2.6kg
Noise Level at 1m distance	Less than 65dB (A)
IP Code	Motor Spindle : IP57 (While cooling air is supplied), Motor Cord : IPX7

<Specifications for the Coolant>

Coolant Type Supply	Coolant
Pressure	0.5 - 30.0MPa
Filtration Rating	Less than 5 μm
Supply Hose / Fittings (Prepared by Customer)	Pressure resistance of 30.0 MPa or more
Drain Hose Dimensions (Prepared by Customer)	Drain Hose : OD. φ 6.0mm x ID. φ 4.0mm

	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-OH- □□) *Note1	Collet Nut
φ 3.0mm, φ 3.175mm, φ 4.0mm, φ 5.0mm, φ 6.0mm, φ 6.35mm	K-265

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

Motor Cord * Note 2	EMCD-4000-□M (Motor Power Line)	Length : 2m, 4m, 6m (The Air Hose (φ 6mm) of the same length is attached.)
	EMCD-4000S-□M (Motor Signal Line)	Length : 2m, 4m, 6m

* Note 2 : Motor Cord is sold separately.
Please select the suitable motor cord length for your application.

CAUTION

- Motor Cords (EMCD-4000-8M / EMCD-4000S-8M) cannot be used with the Motor Spindle.

6 - 2 Compatibility

The CONTROLLER is compatible with the following overseas safety standard.

- Safety standard in North America (UL,CSA)
UL1004-1



- European Directive
Low Voltage Directive



6 - 3 Outside View

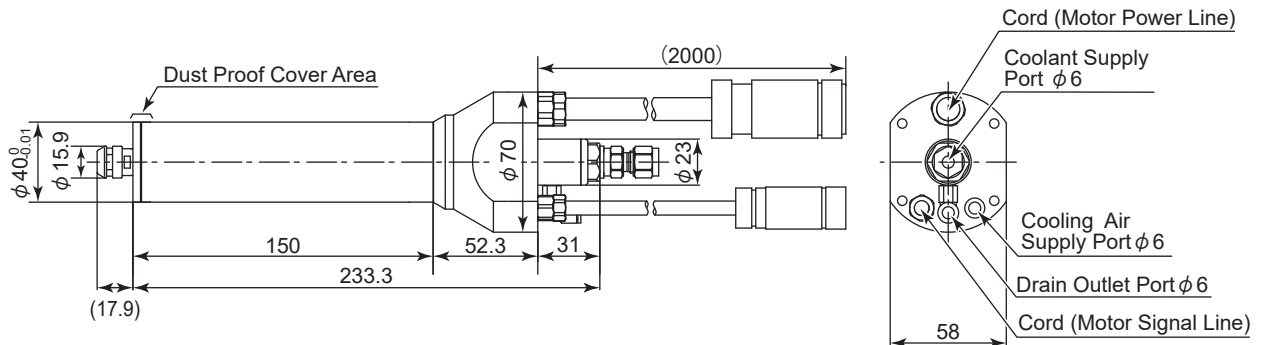


Fig. 1

6 - 4 Torque Characteristics

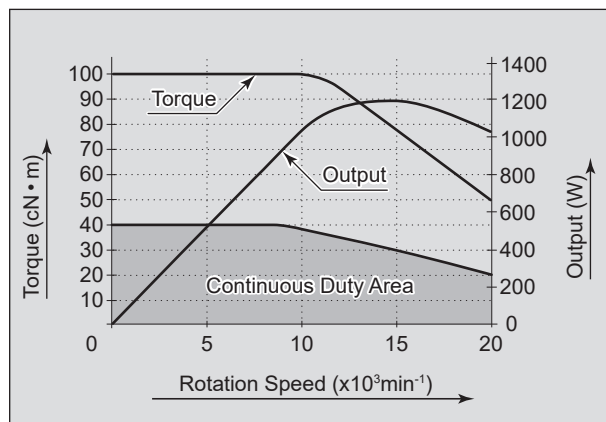


Fig. 2

6 - 5 Air Supply

Supply clean, dry, regulated air for Motor Spindle cooling. Regulate air pressure to between 0.2 - 0.35MPa (29 - 50.7psi). When using the Motor Spindle for continuous use, supply regulated air to CONTROLLER and set the air pressure to 0.35MPa (50.7psi).

7. INSTALLING THE COLLET AND THE TOOL

⚠ CAUTION

- Be sure to clean the collet, the collet nut and the inside of the spindle before installing the collet or the tool. If ground particles or metal chips stick to the inside of the spindle or the collet, damage to the collet or spindle can occur due to the loss of precision.
- When installing the collet in the collet nut, make sure that the tabs of the collet nut are properly seated in the groove of the collet. If the tabs are not properly seated when you tighten the collet nut, the collet may become stuck inside the spindle.
- Never tighten the collet nut without inserting a tool in the collet. Excessively tightening the collet may damage the tabs that hold the collet in the collet nut, making it difficult to remove the collet from the spindle.
- When the "Tool Mounting Depth" is insufficient, coolant will leak from the collet. Always be sure that the tool is deeply inserted into the collet for at least 20 mm from the face of the collet.
- Keep the overhang length to a minimum when installing the tool. If the overhang length is too long, the tool may bend and cause injury.

- (1) Hold the collet nut in one hand, and install the collet. (Fig. 3)

If the collet is difficult to install, tilt the collet to one side when inserting it, so that the tabs can more easily be seated in the groove. (Fig. 3, Fig. 4)

At this time, make sure that the tabs of the collet nut are properly seated in the groove of the collet. (Fig. 5)

- (2) Insert the cutting drill into the collet, and attach the cutting drill and the collet nut to the spindle shaft.(Fig. 6)

The "Tool Mounting Depth" of the tool is 20 mm or more from the face of the collet.

- (3) Fit the supplied 12mm wrench to the spindle shaft to secure it in place.

- (4) Place the provided 14mm wrench on the collet nut and turn the collet nut clockwise to secure the tool.

(Reference tightening torque : 7N·m)

- (5) Check the runout of the tool. If the runout is large, loosen the collet and turn it by 90° and tighten the collet to re-check the runout. If the runout is still large, clean the collet and repeat the above process.

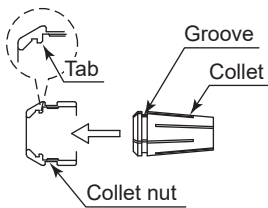


Fig. 3

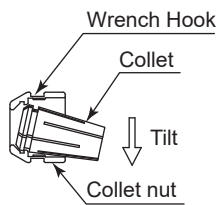


Fig. 4

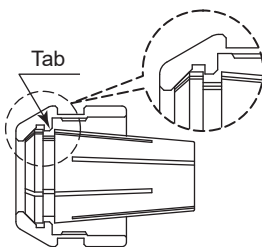


Fig. 5

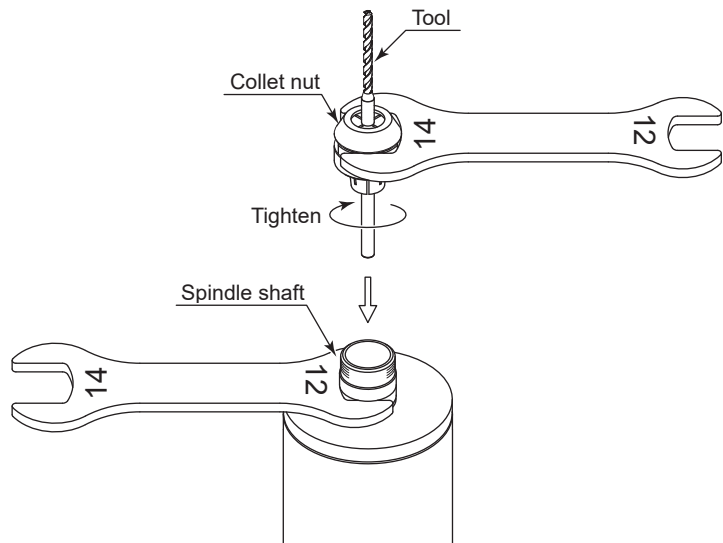


Fig. 6

8. CHANGING THE TOOL

⚠ WARNING

- If there is residual pressure in the high-pressure pump, the drill may pop out, resulting in injury. Make sure that there is no residual pressure before replacing the drill.

⚠ CAUTION

- Do not tighten the collet without inserting the test bur or the tool shank into the collet, as this will damage the collet, spindle or collet nut, causing difficulty removing the collet.
- When the "Tool Mounting Depth" is insufficient, oil will leak from the collet. Always be sure to insert the tool into the collet so the tool extends at least 20 mm from the face of the collet.
- Keep the overhang length to a minimum when installing tool. If the overhang length is too long, tool may bend and cause injury.

- (1) Fit the supplied 12mm wrench to the spindle shaft to secure it in place.
- (2) Place the provided 14 mm wrench on the collet nut and turn it counterclockwise to loosen the collet and remove the drill. (The first turn of the collet holder is stiff. Keep turning through the stiffness and the collet will open.)
- (3) Insert another tool. The "Tool Mounting Depth" for the tool should be more than 20 mm or more from the face of the collet.
- (4) The new tool and tighten the collet by turning clockwise. Do not over-tighten. (Reference tightening torque : $7\text{N}\cdot\text{m}$)
- (5) Check the runout of the tool. If the runout is large, loosen the collet and turn it by 90° and tighten the collet to re-check the runout. If the runout is still large, clean the collet and repeat the above process.

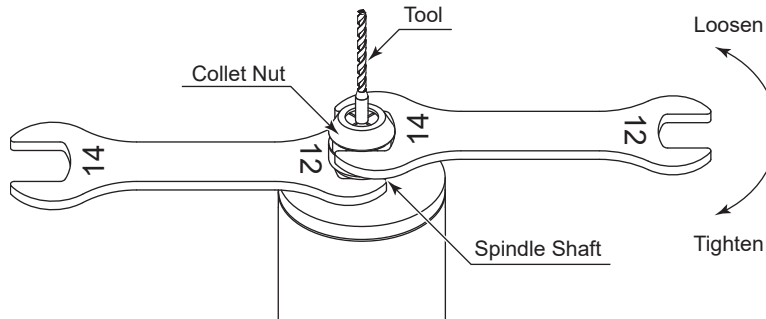


Fig. 7

9. REPLACING THE COLLET

⚠ CAUTION

- The collet and collet nut are consumable parts and will wear out with use. Replace the collet or collet nut if collet force decreases or there are signs of wear or scratches.
- 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 " 8. CHANGING THE TOOL " procedure above and remove collet nut assembly (Fig. 8).
- (2) The collet and collet nut are secured by a groove in the collet and a flange in the collet nut. If the collet is not released, try tilting it to the other side of the wrench seat. (Fig. 9).
- (3) To install the collet, hold the collet at a slight angle, and insert it into the collet nut (Fig. 10). Press the collet in the collet nut by positioning the collet in the collet nut and pressing down on flat surface (Fig. 9). Be sure to fully engage the latch inside the collet nut into the groove on the collet's outer circumference area (Fig. 11).

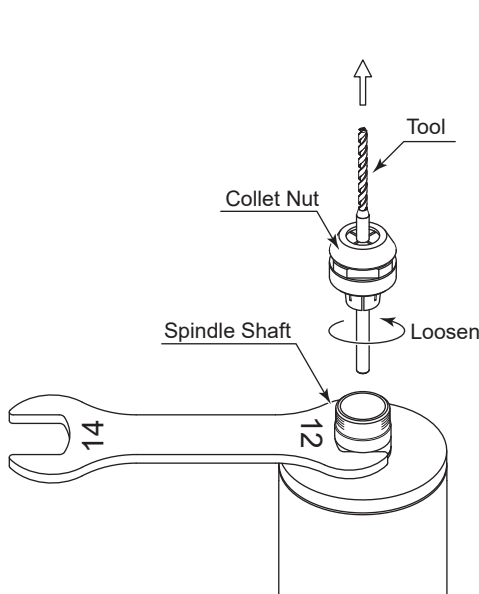


Fig. 8

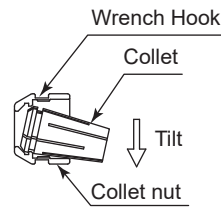


Fig. 9

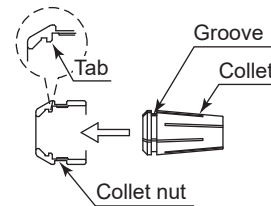


Fig. 10

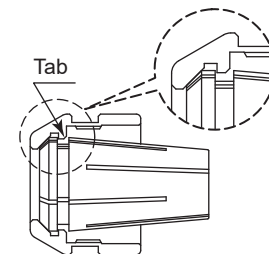


Fig. 11

10. CONNECTION OF MOTOR CORD

⚠ CAUTION

- Before connecting the Motor Cord to the Motor Spindle and CONTROLLER, verify the Main Power Switch on the CONTROLLER is turned OFF. If the Main Power Switch on the CONTROLLER is ON while connecting the Motor Cord, damage to the CONTROLLER is possible.
- Install the Protective Cap etc. to prevent damage or contamination to the Motor Cord Connector when not in use.

- (1) Remove the Protective Cap of the Motor Cord Connector (Motor Power Line and Motor Signal Line) and keep it for use when not using the Motor Spindle to keep the connector pins safe and clean.

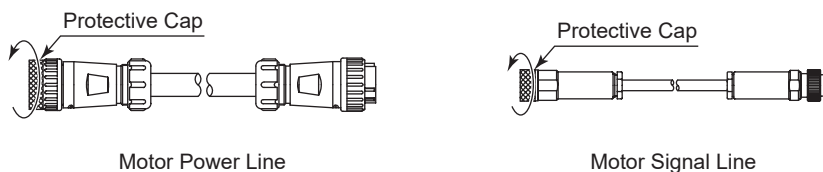


Fig. 12

- (2) Carefully insert the Alignment Pin of the Motor Cord into the Alignment Hole of the Motor Spindle, then push straight the Alignment Pin into the Alignment Hole.

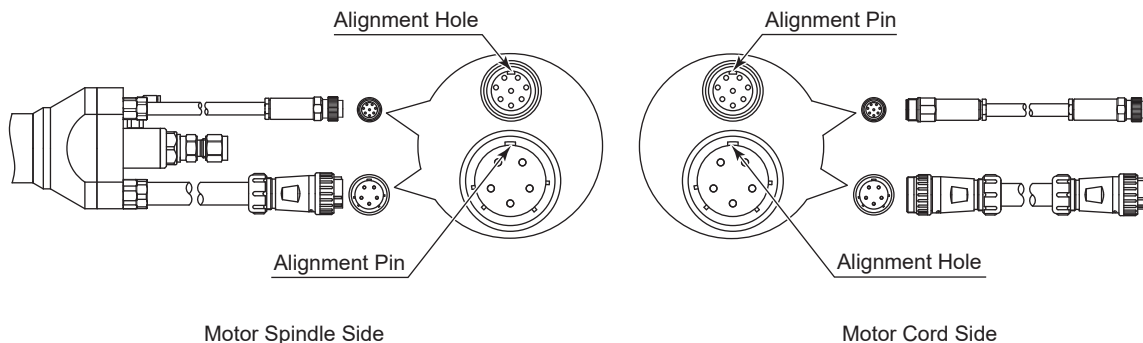


Fig. 13

- (3) Tighten the Connector Nut with clockwise.

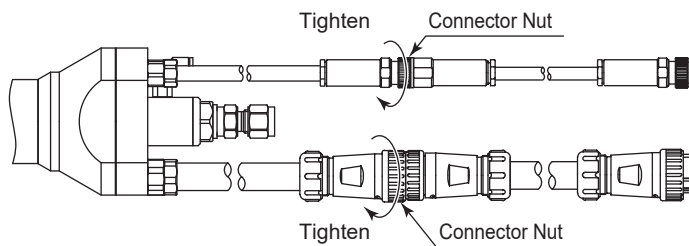


Fig. 14

- (4) Insert the Air Hose of the Motor Cord side into the Dry Air Cooling Supply Port ($\phi 6$) on the rear of the Motor Spindle.

* The coolant Air Hose is attached to the Motor Spindle.

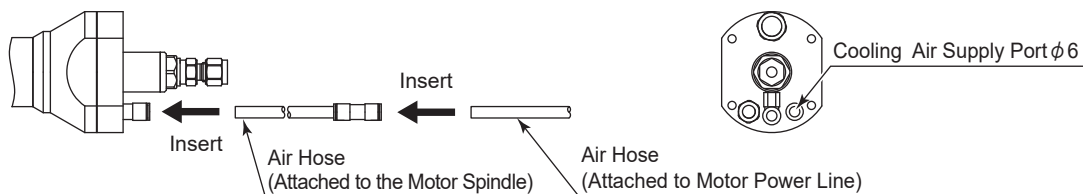


Fig. 15

- (5) Insert the Drain Hose (Air Hose ($\phi 6$)) into the Drain Outlet Port on the rear of the Motor Spindle.

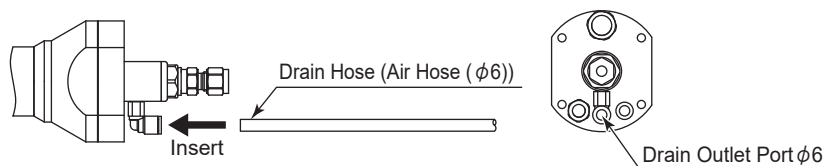


Fig. 16

11. INSTALLING THE HIGH-PRESSURE PUMP, COOLANT HOSE AND FITTINGS

WARNING

- When operating the high-pressure pump, take safety measures by using protective covers for the high-pressure pump and hose fitting and other parts.
- When using coolant, check the operating pressure before connecting the coolant hose and fittings. If the maximum operating pressure of the coolant hose or fittings is exceeded, they could burst and cause injury.
- Connect the coolant hose and fittings securely. A coolant leak could cause injury or damage the device.
- When using an oil-based coolant, the coolant may be dispersed as a fine mist that could ignite. Implement fire prevention measures such as the use of dust collectors and automatic fire extinguishers.

CAUTION

- A high-pressure pump, filter and high-pressure coolant hoses are required in order to use this spindle. Procure these items separately before use. Install a relief valve or a safety valve as a safety measure.
- Install the manifold block in the machine tool, and connect the manifold block to this spindle using a high-pressure coolant hose. Allow some extra length in the hose to prevent the hose and fittings from being damaged if the machine tool table is moved.
- The high-pressure pump, filter and high-pressure coolant hose serial numbers are examples of those that we use. Select and prepare the items with the specifications that you require. Read each Operation Manual for the high-pressure pump, filter and high-pressure coolant hose that you use.

<Reference example of recommended items to prepare>

Item	Product Number (Example)	Manufacturer
High-pressure pump	Hydro pump • CHP150-1200	RIX CORPORATION
Intake filter, intake hose	(CHP150-1200 accessory)	RIX CORPORATION
Filter	Line filter • 3501-04A-2-3CH	Taisei Kogyo Co., Ltd.
High-pressure coolant hose	NH hose • NH3-K6-□-K6 (□: length, unit: m)	ASK Corporation
High-pressure coolant fitting	Swagelok Tube fitting • SS-6M0-1-2RS (included with this spindle)	Swagelok Company
Coolant hose Hose fittings	NH hose • NH4-K6-□-K6 (□: length, unit: m)	ASK Corporation
	Levex series hose • NWP3506	The Yokohama Rubber Co., Ltd.
Manifold block	Block manifold • BMZSR1-Q2-G2	MISUMI Group Inc.
Relief valve	Pressure relief valve • SS-4R3A5-RT Spring kit • 177-R3A-K1-H	Swagelok Company

* Prepare appropriate fittings for connections.

* When using the "CHP150-1200" hydro pump, the maximum pressure varies depending on the viscosity of the coolant and the tool used.

Maximum coolant pressure (approximate)

- Water soluble : 20 MPa
- Oil soluble : 30 MPa

11 - 1 Installing and Connecting the High-pressure Pump

- (1) Install the manifold block so that it does not interfere with other components in the machine tool.
- (2) Install the high-pressure pump, and place the intake filter in the coolant tank of the machine tool.
- (3) Install the filter (filtration accuracy of 5 μm or less) and connect it to the high-pressure pump, the relief valve, and the manifold block with the coolant hose and fittings.
- (4) Connect the relief valve to the high-pressure pump or high-pressure pump flow path, and connect the coolant hose to the discharge side of the relief valve. The coolant hose should be installed so that the coolant can be discharged into the coolant tank.

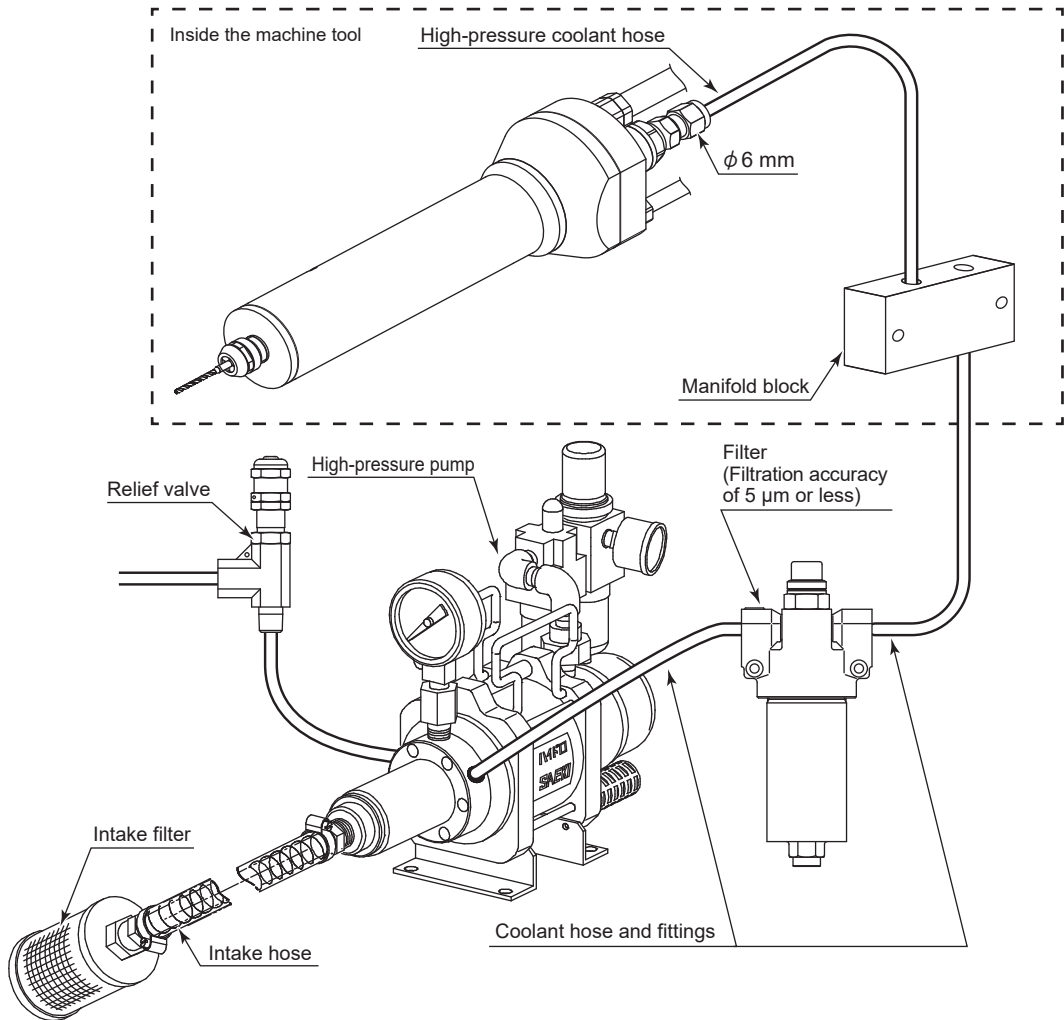


Fig. 17 Coolant hose and fitting connection example

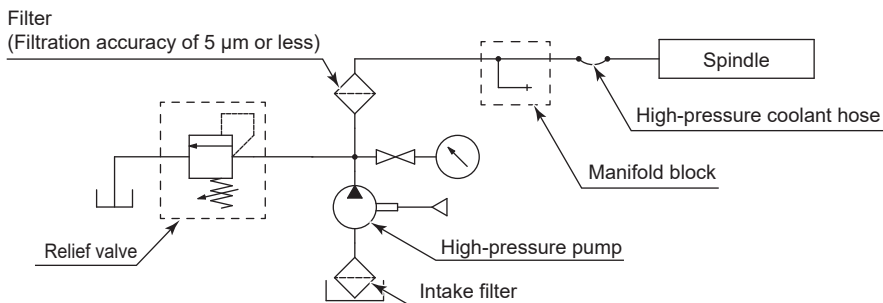


Fig. 18 Reference circuit diagram

11 - 2 Connecting the High-pressure Coolant Hose

- (1) Insert the high-pressure coolant hose (diameter $\phi 6$ mm) fully into the coolant supply port (diameter $\phi 6$ mm), and turn the joint nut clockwise to tighten it. (Fig. 19)

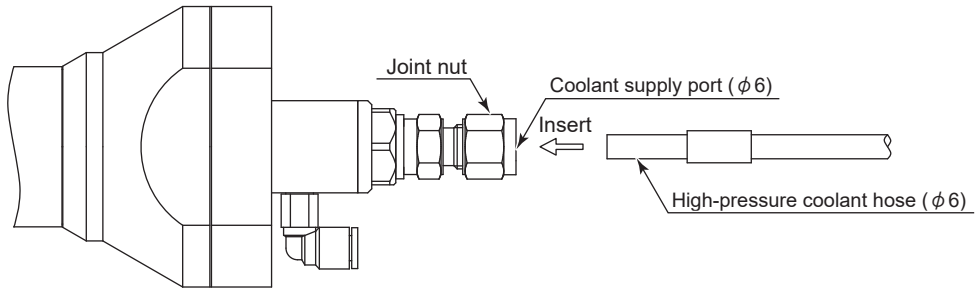


Fig. 19

- (2) Fit an adjustable wrench on the elbow surface (shaded area) of the high-pressure coolant fitting to hold it in place, and use another adjustable wrench to tighten the joint nut $1 - 1/4$ turns. (Fig. 20)

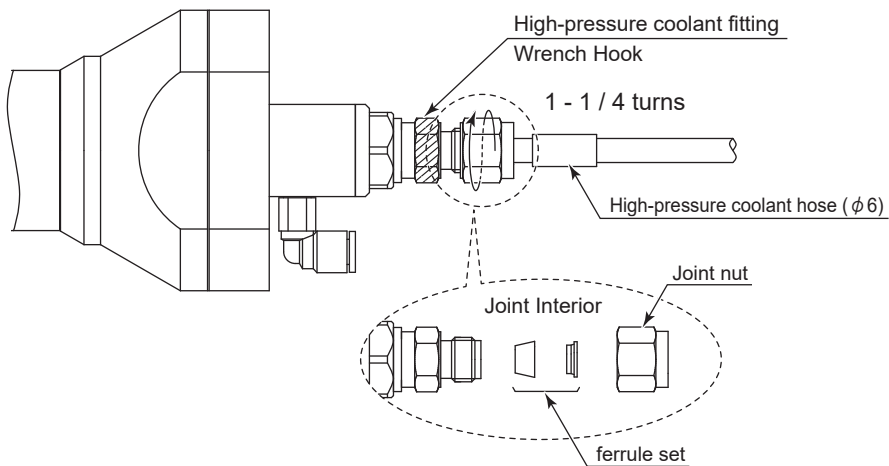


Fig. 20

11 - 3 Disconnecting and Reconnecting the High-pressure Coolant Hose

11 - 3 - 1 Disconnecting the Hose

- (1) Before loosening the joint nut, put a mark on the high-pressure coolant hose (diameter $\phi 6$ mm) at the end of the joint nut.
- (2) Draw a straight line on the flat part of the joint nut and the elbow surface of the high-pressure coolant fitting. (This line will be used later to check the position of the joint nut when it is retightened.)
- (3) Loosen the joint nut and disconnect the high-pressure coolant hose (diameter $\phi 6$ mm). (The ferrule set is fastened to the high-pressure coolant hose.)

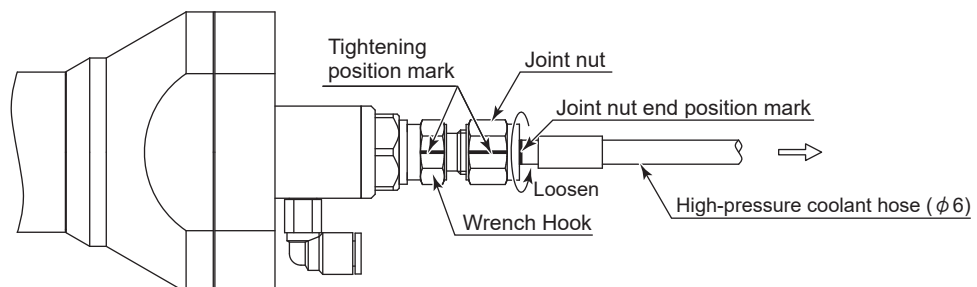


Fig. 21

11 - 3 - 2 Reconnecting the Hose

- (1) Insert the high-pressure coolant hose (diameter $\phi 6$ mm) so that the tapered surface of the ferrule set fastened to the high-pressure coolant hose (diameter $\phi 6$ mm) fits tightly against the tapered surface of the high-pressure coolant fitting. (Fig. 22)

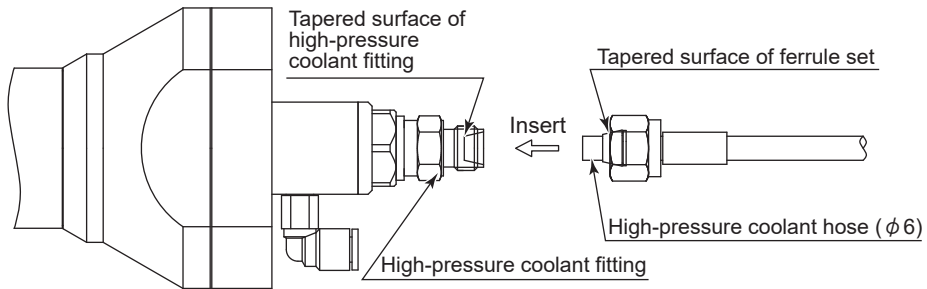


Fig. 22

- (2) Fit an adjustable wrench on the elbow surface (shaded area) of the high-pressure coolant fitting to hold it in place, and use another adjustable wrench to tighten the joint nut to its original tightening position. (Check that the matching lines are aligned and the end of the joint nut is aligned with the mark on the hose). (Fig. 23)

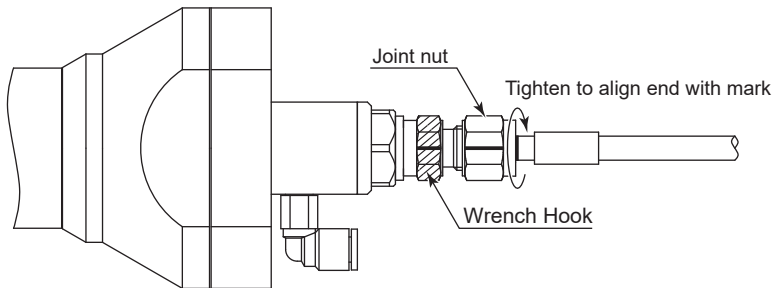


Fig. 23

- (3) Tighten the joint nut slightly more than before (by an amount equivalent to the thickness of the line). (Fig. 24)

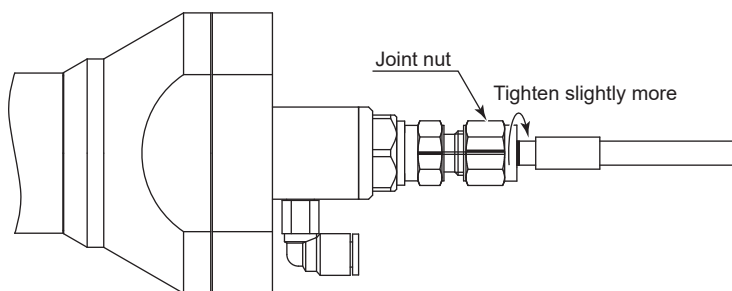


Fig. 24

12. SUPPLYING THE COOLANT

⚠ CAUTION

- A coolant supply is required when operating this Motor Spindle. If this Motor Spindle is used without supplying coolant, the generated heat could damage the components.
- Use coolant with an ISO viscosity grade of VG 22 or lower. The lower the viscosity, the easier it is for the coolant to be released.
- When operating the high-pressure pump, take safety measures by using protective covers for the high-pressure pump and hose fittings and other parts. If the coolant is supplied without first supplying the coolant air, the air purge will be lost and the coolant may enter the Motor Spindle and cause damage.
- Coolant must be filtered to a filtration accuracy of 5 µm or less.

12 - 1 Operation

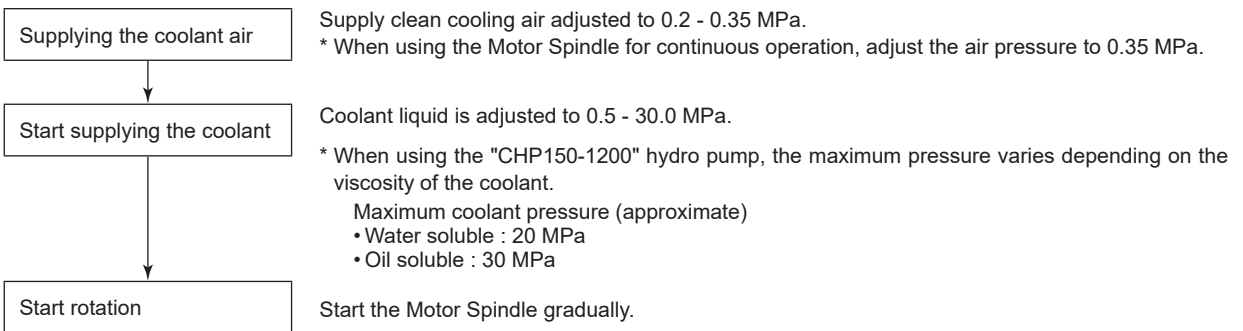


Fig. 25

⚠ Cautions for Discharging Drainage

- Never extremely bend or break the Drain Hose ϕ 6mm, causing a restriction to the drainage discharge. If the drainage cannot be easily discharged, seeping of the drainage into the inside of the Motor Spindle will occur, causing extreme damage to internal components, which will result in a malfunction.
- After stopping the supply of the coolant, be sure to allow at least 5 minutes of cooling air into the unit to allow adequate time to purge the Motor Spindle. If the drainage is allowed to remain inside the unit, damage will result causing a malfunction to the Motor Spindle.

12 - 2 Stopping Operation

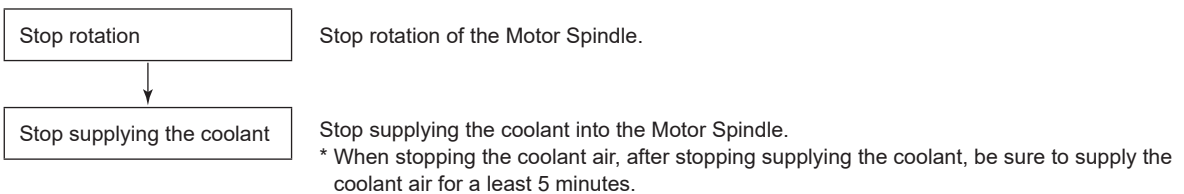


Fig. 26

13. INSTALLATION OF THE MOTOR SPINDLE

⚠ WARNING

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

⚠ CAUTION

- When installing a Motor Spindle, do not hit, drop or cause shock to the Motor Spindle. This may cause damage to internal components and result in malfunctions.
- When mounting the Motor Spindle, be sure to secure within Clamping Area etched on the Motor Spindle O.D. If the Motor Spindle is installed incorrectly, damage to the internal components is possible.
- Cautions when tightening the securing bolts on to a Split Type Holder
Do not over-tighten the bolt. This will cause damage to Motor Spindle's precision.
Tighten the bolt until the Motor Spindle body can not be rotated 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.

(1) When mounting a Motor Spindle, refer to the Clamping Area etched on the Motor Spindle (Fig. 27).

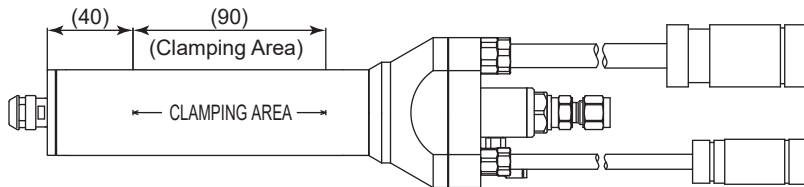


Fig. 27

* When installing the Motor Spindle, it is recommended to use a "Grip Ring GR - 40 (sold separately (Fig. 28))". If the Grip Ring GR - 40 cannot be used due to the restriction of dimension and space, install as shown in (2) below.

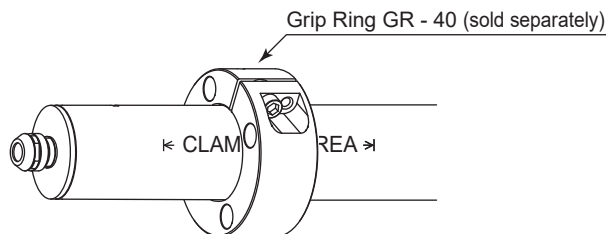


Fig. 28

- (2) When installing a Motor Spindle to the holder, recommended installation method is shown Fig. 29. Refer to " (3) How to fabricate the Split Type Holder ". If this is not possible, install as shown in Fig. 30.

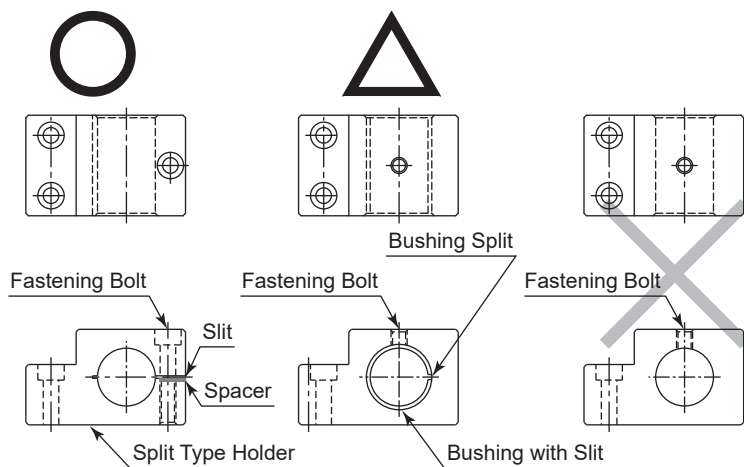


Fig. 29

Fig. 30

Fig. 31

⚠ CAUTION

Do not allow set screws to come directly in contact with the Motor Spindle body as shown in Fig. 31, as this will result in damage to the Motor Spindle housing and internal components.

When installing, never clamp directly over the bearings, as this will result in bearing damage (Refer to Fig. 32).

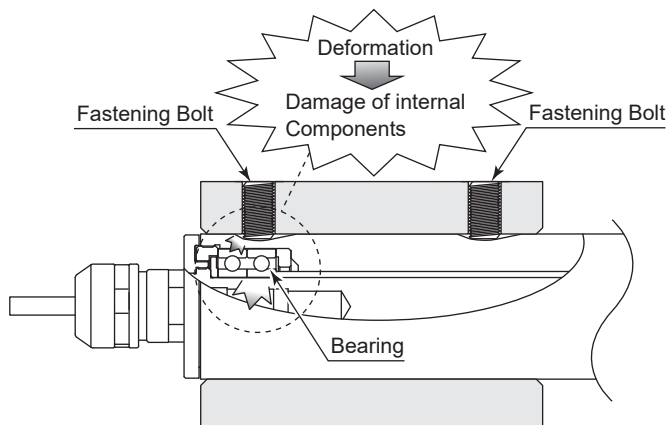


Fig. 32

- (3) How to fabricate the Split Type Holder
- 1) BeRough bore the inside diameter of the Split Type Holder.
 - 2) Cut a slit. (Ex. Slit 2 mm) wide.
 - 3) Tighten the Screw for Removal and Force Open the Slit Area.
 - 4) Insert a spacer (Ex. thickness = 2 mm) into the Slit Area.
 - 5) Loosen the Screw for Removal, and tighten the fastening bolt with its specified (recommended) torque.
 - 6) Finish the Split Type Holder so that the inside diameter of the Split Type Holder is $\phi 40$ with its tolerance range from - 0.01 mm to - 0.015 mm, and its roundness and cylindricity of less than 5 μm .
 - 7) When inserting the Motor Spindle loosen the Fastening Bolt, and tighten the Screw for Removal, widening the Slit Area.

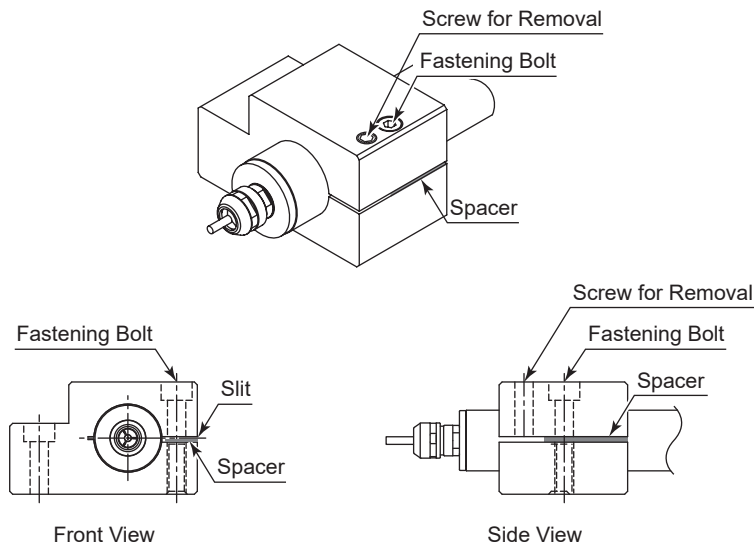


Fig. 33

⚠ CAUTION

- How to confirm the correct tightening or clamping of the Motor Spindles in the holder. Fasten the holder so that the increase in the no-load current value (during rotation at the maximum rotation speed) with the Motor Spindle fastened is 50mA (for type 200V / 230V) or less, compared to the no-load current value (during rotation at the maximum rotation speed) without fastening the Motor Spindle. Do not over-tighten the Fastening Bolt. It may damage Motor Spindle's precision and shorten the life of the bearings.
- 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 Motor Spindle is installed. NAKANISHI offers Motor Spindle with a wide variety of capabilities and specifications. Please carefully check the Motor Spindle's specifications against the requirements of your equipment and verify suitability and safety of the Holder prior to initial use.

14. BREAK-IN PROCEDURE

⚠ CAUTION

Always apply cooling air 0.2 - 0.35 MPa (29 - 50.7 psi) first, and then supply the coolant before initiating the " BREAK-IN PROCEDURE ".

If using the Motor Spindle without supplying sufficient cooling air pressure, coolant, will cause wear to the internal components, abnormal noise, abnormal heat generation and oil leaks in the Motor Spindle.

During transportation, storage or installation, the grease inside the bearings will settle. If the 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
Rotation Speed (min ⁻¹)	5,000	10,000	15,000	20,000
Rotation Time (min)	15	10	10	15
Items to Check	No Abnormal Noises.	The Motor Spindle housing temperature during the break-in process should not exceed 20 degrees C (68 degrees F) above ambient temperature. Should the Motor Spindle exceed this limit, rest the 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 (68 degrees F) above ambient temperature, check the Motor Spindle for proper installation.		The Motor Spindle housing temperature during the break-in process should not exceed 20 degrees C (68 degrees F) above ambient temperature.

15. 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.

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

- Keep the overhang length to the minimum when installing a tool. If the overhang length is too long, the tool may break and cause injury.
- When a long drill is used, increase rotation speed gradually to prevent any damage.
- The longer the drill length, the greater the chance of the tool to break and cause damage due to the runout. In order to avoid this, start the drilling after processing a center hole or guide hole. (Refer to <Example of deep-hole drilling>).

- (1) The spindle RPM depends on the tool diameter and the workpiece material.
- (2) Please follow the manufacturer's recommended feeds and speeds.
Using tools outside of the manufacturer's maximum recommended rotational speed may cause damage to the spindle or injury to the operator.
- (3) When increasing the tool overhang, reduce the motor speed. (Table. 3, Table. 4)
- (4) Always clean the tool shank before installing the tool in the spindle.
Foreign matter in the collet or collet nut may cause excessive run-out that could damage the tool or spindle.
- (5) Use after checking the runout.
- (6) Do not strike, drop the spindle or the attached tool.

Table. 3 Relationship Between Drill Overhang Length and RPM

Overhang Length (mm)	Max RPM (min ⁻¹)
Drill diameter x 10	100 % of the RPM
Drill diameter x 20	60 % of the RPM
Drill diameter x 20 or more	30 % or less of the RPM

Table. 4 Relationship Between Drill Overhang Length and RPM

Overhang Length (mm)	Max RPM (min ⁻¹)
Shank diameter x 5	100 % of the RPM
Shank diameter x 10	50 % of the RPM
Shank diameter x 10 or more	30 % or less of the RPM

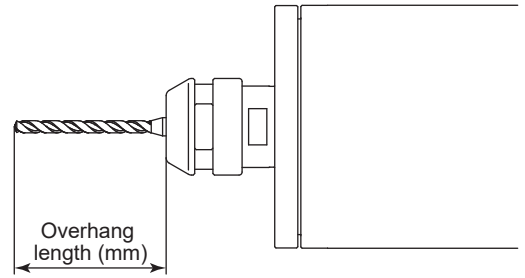


Fig. 34

<Example of deep-hole drilling>

- (1) Drill guide hole (same diameter drill)

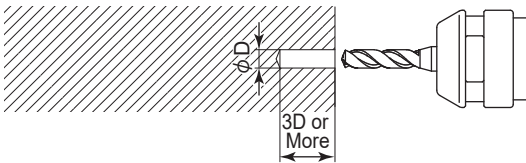


Fig. 35

- (2) Insert into the guide hole at low rpm

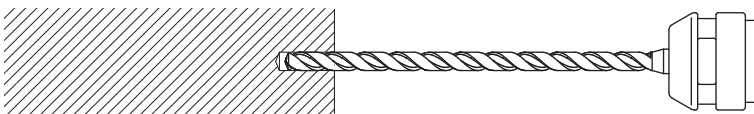


Fig. 36

- (3) Deep-hole drilling at cutting speed

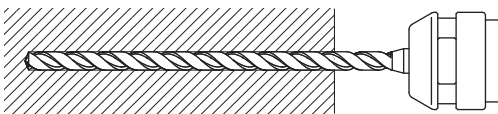


Fig. 37

*Use under conditions and handling recommended by the tool manufacturer.

16. 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.

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

- (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. 35.
- (3) To ensure machining accuracy, keep the tool overhang length to the minimum when installing the tool.
- (4) If the overhang must exceed 13mm, reduce the Motor Spindle speed in accordance with Table. 5.
- (5) Dress the grindstone prior to use.
- (6) Do not use cutting tools with bent or broken shanks, cracks or excessive run-out.
- (7) 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.
- (8) 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.
- (9) Do not strike, drop the spindle or the attached tool.

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.

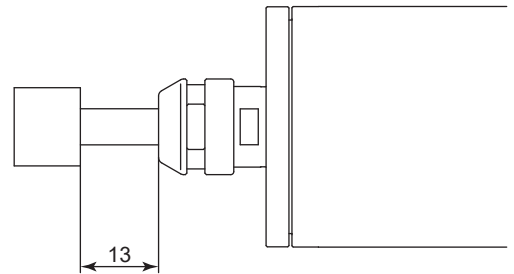


Fig. 38

17. TROUBLESHOOTING

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

Trouble	Cause	Inspection / Corrective Action
Motor Spindle does not rotate or rotate smoothly.	The spindle 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.)
	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 is 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.)
Coolant does not flow from the tip of tool.	Tool is damage or tool is clogged.	Replace the cutting tool.
	Low pressure of the coolant.	Check and adjust the pressure of the coolant.
	The high-pressure pump is damaged.	Contact the manufacturer for repair.
	Coolant filter is clogged.	Clean or replace the filter.
A large amount of coolant is leaking from the Drain Outlet Port.	The motor has been damaged.	Replace the motor. (Return to NAKANISHI dealer service.)
The oil leaking from the collet.	" Tool Mounting Depth " is less than 20mm from the collet face.	Be sure to insert the tool, to a depth of 20mm or more from the collet face.
	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.

Refer to the E4000 CONTROLLER Operation Manual.

18. DISPOSAL OF THE MOTOR SPINDLE

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

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