OM-KK1016MA 000

エアータービンスピンドル / Air Turbine Spindle

HTS1500ZZ Series

取扱説明書 / OPERATION MANUAL

Thank you for purchasing Air Turbine Spindle " HTS1500ZZ Series ". This Air Turbine Spindle is designed for use on machining center's without rotating the machine's main spindle.
These HTS1500ZZ Series uses an Ultra-precision collet system and is ideal for use with small diameter end mills in mold making applications.
The air line kit (with Lubricator) and compressor are required to drive this Air Turbine 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.

CONTENTS

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 center's main spindle with the Air Turbine Spindle installed. Rotating the machining center's main spindle with the Air Turbine Spindle installed can cause the supply air / oil hose to become tangling will lead to a big accident.

⚠ WARNING

① Handling to the Air Turbine Spindle should be performed by a person with experience with machining center and air compressors.

② This Air Turbine Spindle is not a hand tool. It is designed to be used install this Air Turbine Spindle to the machining center's machines or milling 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 Air Turbine Spindle whenever the Air Turbine Spindle is rotating.

⑤ Never operate or handle the Air Turbine Spindle until you have thoroughly read the Operation Manuals and safe operation has been confirmed.

1) To prevent injuries / damages, check the Air Turbine Spindle and cutting tool for proper installation, before operating the Air Turbine Spindle.

2) Before disconnecting the Air Turbine Spindle, always turn the control power off and turn the compressed air supply off. Then it is safe to remove the Air Turbine Spindle.

⑥ 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.

⑦ 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.

⑧ Do not exceed the maximum recommended allowable tool speed. For your safety, use speeds below the maximum allowable speed.

⑨ 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 Air Turbine Spindle, as shock can damage to the internal components.

② Before use, carefully read " Air Line Kit Operation Manuals " regarding the correct connection, operation and cautions when using the Air Line Kit.

③ 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

④ When cleaning a Air Turbine Spindle, stop the Air Turbine Spindle and remove debris with a soft brush or a cloth. Do not blow air into the End of Spindle Area (refer to section 6 - 2 " Outside View ") with compressed air as foreign particles or cutting debris may get into the ball bearing.

⑤ Always clean the tool shank before installing the tool in the spindle.

⑥ When sizing the correct collet size to the tool shank diameter, a tolerance of + 0 ～ - 0.01mm is strongly recommended. A tool shank within the + 0 ～ - 0.1mm range is mountable, however, this may cause poor concentricity and or insufficient tool shank gripping force.

⑦ Operating the Air Turbine Spindle in low Lubricant conditions will cause low rotation speed, damage to the internal components and shorter life of the Air Turbine Spindle.

⑧ Be sure to drain moisture and condensation from the Air Line Kit (air filter bowl) regularly to avoid moisture being carried to the Air Turbine Spindle. This may cause damage to the Air Turbine Spindle.

⑨ Select suitable products or tools for all applications. Do not exceed the capabilities of the Air Turbine Spindle or tools.

⑩ Do not stop the Air Turbine Spindle while coolant spray is being applied to the cutting tool.
Removing the air pressure from the Air Turbine Spindle causes a loss of purging, allowing the Air Turbine Spindle to ingest coolant. This will cause damage to the Air Turbine Spindle.

⑪ Carefully direct coolant spray to the tool. Do not spray directly on the Air Turbine Spindle body.

⑫ Stop working immediately when abnormal rotation or unusual vibration are observed. Immediately, please check the content of section " 15. TROUBLESHOOTING ".

⑬ Always check if the tool, collet, collet nut, connection hose and air / oil supply hose for damage before and after operating.

⑭ If the collet or collet nut show signs of wear or damage, replace them before a malfunction or additional damage occurs.

⑮ After installation, repair, initial operation, or long periods of non operation, please carry out break-in as follow. Start rotating slowly and over a short period of 15 - 20 minutes, increase speed gradually until allowable maximum speed.

⑯ Do not disassemble, modify or attempt to repair this Air Turbine Spindle. Additional damage will occur to the internal components. Service must be performed by NSK NAKANISHI or an authorized service center.

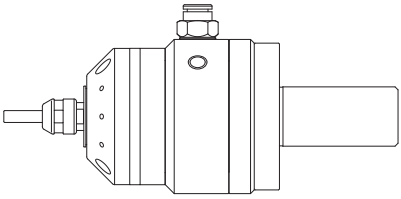
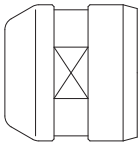
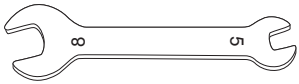
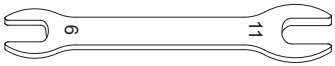
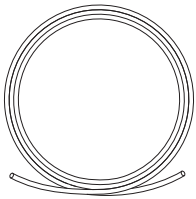
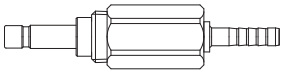
⑰ When using this Air Turbine Spindle for mass production, please consider the purchase of an additional Air Turbine Spindle to be used as a back-up in case of emergency.

⑱ Securely connect the compressor supply connection hose and the air / oil supply hose to the Air Line Kit and the Air Turbine 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

Spindle・・1pc. 	Collet φ4.0mm (CHA - 4.0)・・1pc. 
Collet Nut (CHN - AA)・・1pc. 	Wrench (8 × 5)・・1pc. 
Wrench (9 × 11)・・1pc. 	Supply Air / Oil Hose (K - 247：4m)・・1pc. 
Filter Joint (FJ - 01)・・1pc. 	Baffle・・1pc. 
Operation Manual・・1set. 	Inspection Card・・1pc. 

* The Collet and Collet Nut is attached to the Air Turbine 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 The Air Turbine Spindle housing is made from precision ground, hardened, stainless steel (SUS).
② No heat is generated for long continuous use due to air driven operation.
③ Designed for use with the attachiment of less than ϕ1.0mm Square End Mill of less than R0.5mm Ball End Mill.
④ Various sizes of collet are available CHA 0.5mm - 4.0mm. Standard collet is CHA 4.0mm.

6. SPECIFICATIONS AND DIMENSIONS

6 - 1 Specifications

Model	HTS1500ZZ			
	M2040	PCD385	PCD520	PCD530
Maximun Motor Rotation Speed	150,000min^{-1}			
Spindle Accuracy	Less than 1μm			
Appropriate Air Pressure	0.4 ～ 0.5MPa			
Air Consumption	175NL / min			
Weight	860g	640g	700g	690g
Supply Air / Oil Hose Diameter	Outside Diameter ϕ6.0mm × 4m			
Tool Sizes	Standard End Mill : Less than ϕ1.0mm Ball End Mill : Less than R0.5mm Grindstone : Less than ϕ4.0mm			

	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（CHA- □□）	ϕ 0.5 ～ ϕ 4.0mm in 0.1mm increments and ϕ 2.35mm, ϕ 3.175mm
Collet Nut	CHN - AA

6 - 2 Outside View

① HTS1500ZZ - M2040

※ End of Spindle Area

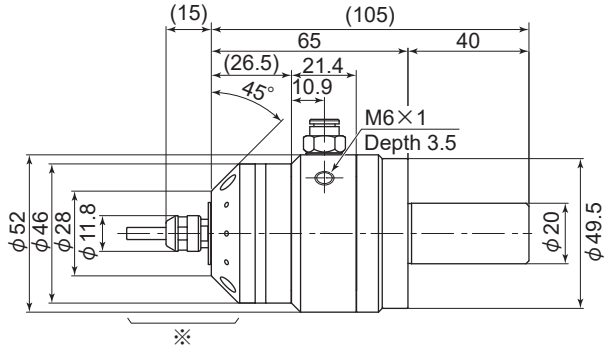


Fig. 1

② HTS1500ZZ - PCD385

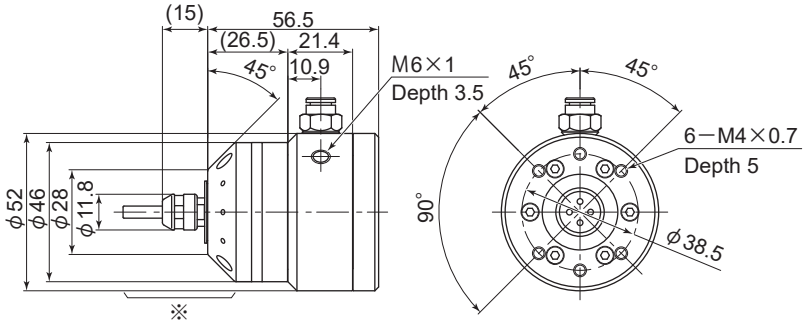


Fig. 2

English

③ HTS1500ZZ - PCD520 ※ End of Spindle Area

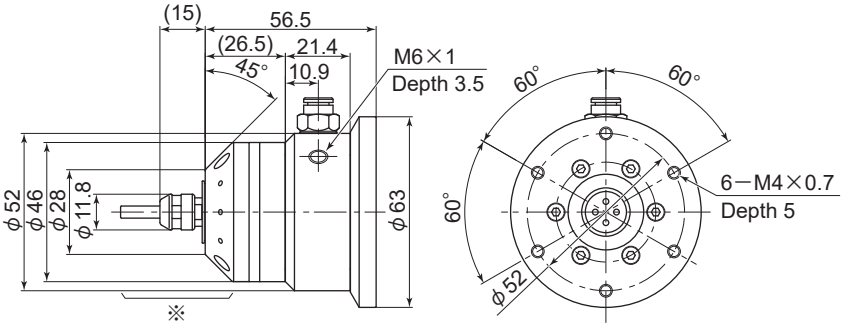


Fig. 3

④ HTS1500ZZ - PCD530

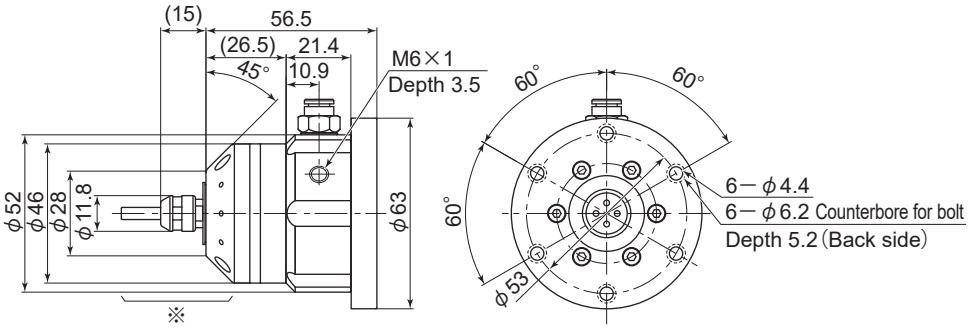


Fig. 4

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.

RECOMMENDATIONS

Please minimize the tool overhang amount to maintaining high accuracy.

(1) Set the provided 8mm wrench on the spindle.
(2) Place the provided 11mm wrench on the collet nut and turn it counter-clockwise 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.
(Reference tightening torque: 4 N・m)

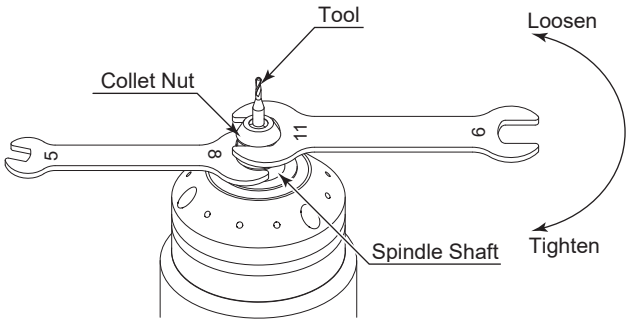


Fig. 5

8. REPLACING THE COLLET

⚠ CAUTION

When installing the collet in the collet nut, make sure to fully engage the latch inside the collet nut to the groove on the collet outer circumference 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. 6).

(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. 7).

(3) To install the collet, hold the collet at a slight angle, and insert it into the collet nut (Fig. 8). Press the collet in the collet nut by positioning the collet in the collet nut and pressing down on flat surface (Fig. 7).
Be sure to fully engage the latch inside the collet nut into the groove on the collet outer circumference area (Fig. 9).

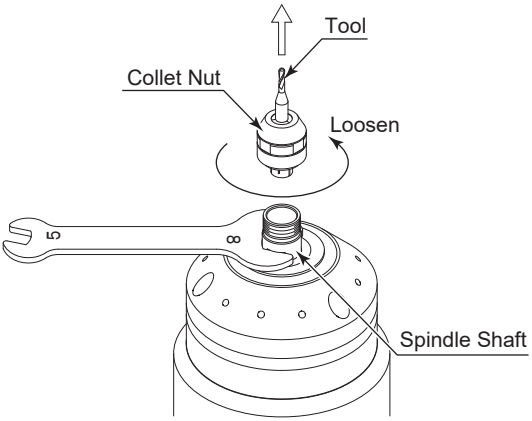


Fig. 6

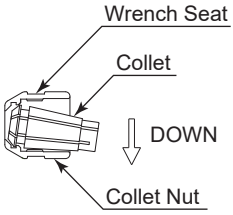


Fig. 7

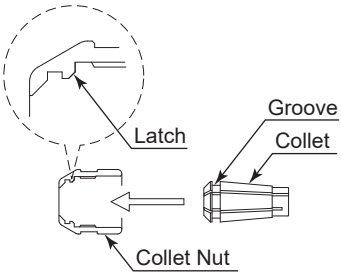


Fig. 8

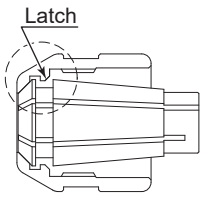


Fig. 9

9. ATTACHING TO A MACHINING CENTERS MAIN SPINDLE

⚠ DANGER

Do not rotate the machining center's main spindle with the Air Turbine Spindle installed. Rotating the machining center's main spindle with the Air Turbine Spindle installed can cause the supply air hose to become tangling will lead to a big accident.

⚠ WARNING

- **If the main spindle of the machining center is rotate by mistake, stop the main spindle immediately.**
  Make sure the not damaged to the machine, unit and supply air / oil hose. Afterward, please carry out break-in as follow. Start rotating slowly and over a short period of 15 - 20 minutes, increase speed gradually until allowable maximum speed.
- **Confirm there is not a heat near aupply air / oil hose, as supply air / oil hose might melt by heat.**

（1）Insert and Clamp the Air Turbine Spindle to the main spindle of the machining center.
（2）Allow an ample length of supply air / oil hose to allow for axis movement of the machining center.
（3）Secure the supply air / oil hose to the machine. Do not allow damage to the supply air / oil hose.

10. USING THE ANTI-ROTATION BAR

⚠ CAUTION

Use the Anti-Rotation Bar (Included) and Block (Not Included) for your safety. If the main spindle is rotated by mistake, the Anti-Rotation System will prevent the tangling of supply air / oil hose.

Screw in the Anti-Rotation Bar into the Outward Rotation Ring before use. Refer to Fig. 10.

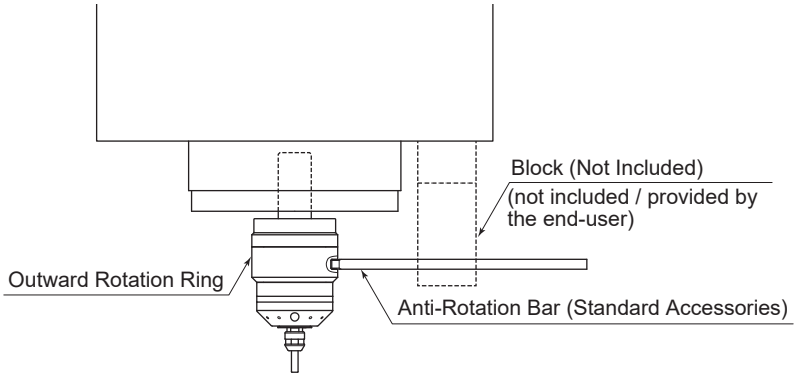


Fig. 10

11. CONNECTION TO THE AIR LINE KIT

⚠ CAUTION

Make sure to turn the compressed air supply to the Air Line Kit is OFF, before replacing the Lubricating Oil or draining the water in Lubricating Oil.

(1) Connect the supply air / oil hose to the ϕ6mm One - Touch Joint on the Air Turbine Spindle (Fig. 11 ①).
(2) Connect the Filter Joint of the supply air / oil hose to the Secondary Joint (ϕ6 One - Touch Joint) of the Air Line Kit (Fig. 11 ②).
(3) Fill Oil Reservoir through the Oil Filler Cap with recommended NAKANISHI Lubricating Oil (K - 211 : Air Line Kit's standard accessories) to Upper Limit. Disconnect from air supply prior to opening Oil Filler Cap. Do not over or under fill.
(4) Connect the connection hose (Air Line Kit's standard accessories) to the Primary Joint of the Air Line Kit and Compressor (Fig. 11 ③).
(5) Supply air from the air compressor and turn the Regulator Knob to set air pressure 0.5 MPa.
(6) Turn the ON / OFF Valve and rotate the Air Turbine Spindle with recommended proper air pressure.
Adjust the Oil Drip Rate to the recommended volume which is 1 drop / min. (Commercially Air Line Kit is same Oil Drip Rate).
(If using the " AL - 0304 " Air Line Kit, adjust the proper Oil Drip Rate to 30 - 40 drops / min). (Refer to " AL - 0304 " of the Air Line Kit Operation Manuals).

※ Refer to the Operation Manual of the air line kit for detailed information.

Lubricating Oil
Use ISO VG15 Liquid Paraffin (Shell Ondina Oil #15) in the Air Line Kit lubricator bowl. (For U.S.A. specification, use Chevron Superla #9).

Model
• Lubricating Oil (K - 211) 70cc
• Lubricating Oil (K - 202) 1 L

⚠ CAUTIONS IN USING AIR LINE KIT

- **When connecting the Compressor and Air Line KIt, recommended install the air filter or air dryer to between Compressor and Air Line Kit in order to supply clean dry air to the Air Turbine Spindle. Using compressed air containing excessive moisture could result in malfunction or failure of the Air Turbine Spindle. If excessive moisture or condensation are found in Air Filter Bowl, it will be necessary to install a dryer and larger Air Filter on the Primary Joint side of the Air Line Kit to prevent and remove excessive moisture.**
- **Connect the input air supply connection hose and supply air / oil hose securely to avoid accidental disconnection during use. Input air pressure should never exceed 1.0MPa. Air pressure exceeding 1.0MPa may cause the supply connection hose and or air / oil hose supply to rupture.**

⚠ CAUTIONS IN USING AIR LINE KIT

- **Make sure operation air pressure is less than 1.0MPa before connecting the input supply connection hose and air / oil supply hose. If operation air pressure is exceeds 1.0MPa, injury to the operator may occur by accidental disconnection before or during use.**
- **Before use, carefully read " Air Line Kit Operation Manuals " regarding the correct connection, operation and cautions when using the Air Line Kit.**

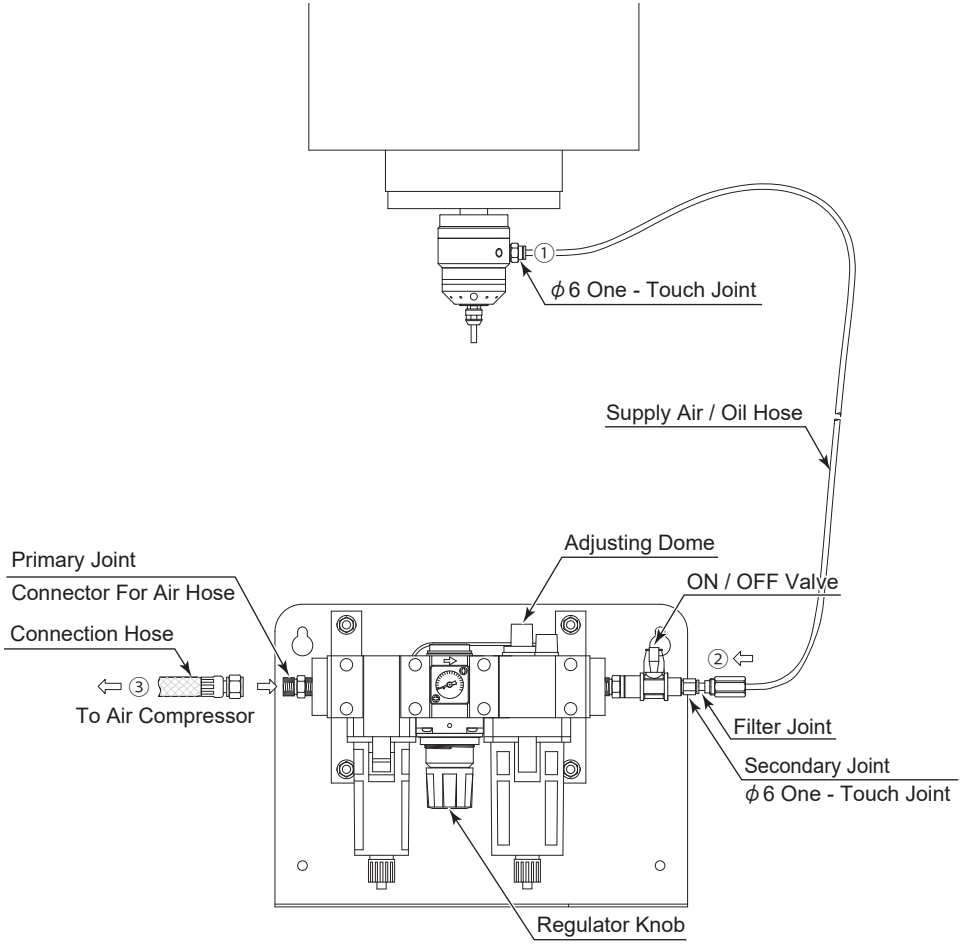


Fig. 11 Connection of Air Line Kit " AL - M1202 (Sold Separately) "

12. BREAK-IN PROCEDURE

Always perform a break-in procedure before the first operation or after installation. For the break-in procedure, gradually increase the pressure from low pressure to working pressure over a period of about 10 minutes.

13. 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.

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

① The spindle RPM depends on the tool diameter and the workpiece material.
② Please follow the manufacturer's recommended feeds and speeds. Applying tools outside of manufacturer's maximum recommended rotational speed may cause damage to the spindle or injury to the operator.
③ In order to maintain tolerance and safety, set cutting tools inside the collet maximizing the contact with the cutting tool shank and reducing excess and unnecessary cutting tool overhang. This will increase rigidity and accuracy while decreasing deflection and minimizing tool breakage.
④ When increasing the cutting tool overhang, reduce the motor speed.
⑤ Keep the cutting tool shank and collet clean. Any contaminants in the collet or collet nut will cause excessive runout and will therefore cause damage to the cutting tool and or spindle.
⑥ Do not strike, drop or disassemble the spindle.

Table. 2 Relationship between drill overhang length and RPM

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

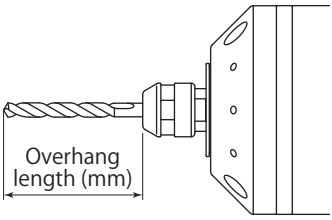


Fig. 12

Table. 3 Relationship between end mill overhang length and RPM

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

14. 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.

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

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. 13. If the overhang must exceed 13mm, reduce the Air Turbine Spindle speed in accordance with Table 4.
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 Air Turbine Spindle.
⑨ Please minimize the tool overhang amount to maintaining high accuracy. 13mm is the maximum amount of overhang to maintain high accuracy and safety.

Table 4. 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.

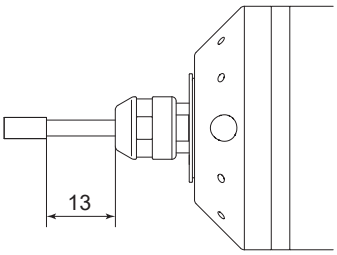


Fig. 13

15. TROUBLESHOOTING

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

Trouble	Cause	Inspection / Corrective Action
Spindle does not rotate or rotate smoothly.	Air flow does not reach the Air Turbine Spindle.	Check if input supply connection hose or air / oil supply hose is broken, bent or disconnected.
		Check connection of the input supply connection and air / oil supply hoses.
		Check the compressor power supply and the air compressor output.
		Check the Regulator and set to the proper air pressure. Check all connections input supply and air / oil supply hose.
	The spindles ball bearings have been damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
Air Turbine Spindle speed is too slow.	The connection hose or air / oil supply hose have been damaged.	Replace the input supply and or air / oil supply hoses.
	Poor connection of input supply or air / oil supply hose.	Check all threaded joints and re-tighten if necissary.
	Low air pressure.	Check the Compressor, Air Circuit, and Regulator.
	Low Lubricating Oil.	Check lubricator for proper lubricant level. Set the Oil Drip Rate 1 drop / min. * If using the " AL - 0304 " Air Line Kit, adjust the proper Oil Drip Rate to 30 - 40 drops / min.
	Water, dirt and debris are collected in the Air Filter.	Drain water, dirt and debris from the Air Filter Bowl.
	Water in Lubricating Oil Reservoir.	Drain water from Lubricating Oil Reservoir and replace with clean Lubricating Oil.

Trouble	Cause	Inspection / Corrective Action
Oscillating Air Turbine Spindle rotation.	Excessive Oil Drip Rate flooding the bearings.	Oil drip rate exceeds the recommended amount. Adjust for the proper Oil Drip Rate.
	Over filled lubricator. (Air Line Kit " AL - 0304 " only.)	Drain the Lubricating Oil from Reservoir to meet indicated levels. Excess lubricant will flood spindle.
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 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 has been damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.)

16. DISPOSAL OF THE AIR TURBINE SPINDLE

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

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