

# Air Motor Spindle

## SMS401

### OPERATION MANUAL

OM-K0563E 001

Thank you for purchasing Air Motor Spindle "SMS401". This Air Motor Spindle is a pneumatic spindle which is put on the main shaft of milling machine or machining center, without rotating the main shaft. The Air Line Kit and compressor are required to drive this Air 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 followed.
<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 SMS401 Air Motor Spindle installed. Rotating the machining center's main spindle with the SMS401 Air Motor Spindle installed can cause the Supply Air/ Oil Hose to become tangling will lead to a big accident.

#### WARNING

- Handling to this Air Motor Spindle should be performed by a person with experience with machining center and air compressors.
- This Air Motor Spindle is not a hand tool. It is designed to be used install this Air 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 Spindle whenever the Spindle is rotating.
- Never operate or handle the Air Motor Spindle until you have thoroughly read the Operation Manuals and safe operation has been confirmed.
  - To prevent injuries / damages, check the Air Motor Spindle and cutting tool for proper installation, before operating the Air Motor Spindle.
  - Before disconnecting the Air Motor Spindle, always turn the control power off and turn the compressed air off. Then it is safe to remove the Air Motor Spindle.
- 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 spindle.
- Do not use bent, broken, chipped, out of round or sub-standard tools as they may cause shatter or explode. The tool with cracked, bended may cause some injury to 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 Air Motor Spindle, as shock can damage to the internal components.
- Before use, carefully read "Air Line Kit Operation Manuals" regarding the correct connection, operation and cautions when using the Air Line Kit.
- Be sure to clean the collet chuck and chuck nut, the inside of the spindle before replacing the tool (cutting 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 Air Motor Spindle, stop the Air 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 3 - 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.
- Need Lubricator for use. If not, the motor speed will be down and decrease life.
- Check the air filter regularly and drain any moisture to prevent water contamination of the Air Motor Spindle.
- Check to make sure the Air Motor Spindle is properly and securely mounted in the machine's quill prior to use. If the Air Motor Spindle is not properly aligned or there is excessive play, do not use the Air Motor Spindle until this situation is corrected.
- When sizing the correct collet chuck size to the tool shank diameter, a tolerance of  $+0 \sim -0.01\text{mm}$  is strongly recommended. A tool shank within the  $+0 \sim -0.1\text{mm}$  range is mountable, however, this may cause poor concentricity and or insufficient tool shank gripping force.
- Select suitable products or tools for all applications. Do not exceed the capabilities of the Air Motor Spindle or tools.
- Carefully direct coolant spray to the tool. Do not spray directly on the motor Air Motor Spindle body.
- Stop working immediately when abnormal rotation or unusual vibration are observed. Immediately, please check the content of section "10. TROUBLESHOOTING".
- Always check if the tool, collet chuck or chuck nut, Supply Air/ Oil Hose are damaged before and after operating. Rotate the spindle by hand and check the feel the bearings, they should rotate freely and without any scratchy feel, check the air regulator for proper air pressure settings, check if the filter is clean and contains on water.
- If the collet chuck or chuck nut show signs of wear or damage, replace them before a malfunction or additional damage occurs.
- After installation, repair, initial operation, or long periods of non operation, please carry out break -in as follow. Start rotating slowly and over a short period of 15 - 20minutes, increase speed gradually until allowable maximum speed.
- Do not disassemble, modify or attempt to repair this Air 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 Air Motor Spindle for mass production, please consider the purchase of an additional Air Motor Spindle to be used as a back-up in case of emergency.

#### 2. FEATURES

- The varieties of shanks are "Taper shank (BT30, BT40, NT30, NT40)" and "Straight shank ( $\phi 20, \phi 25, \phi 25.4$ )".
- The Air Motor Spindle housing is made from precision ground, hardened, stainless steel (SUS).
- Realize short in body length, as the air inlet / exhaust is laid on the side.
- Various sizes of collet chucks are available CHA 0.5mm - 6.35mm. Standard collet chuck is CHA 4.0mm.
- Can use for a long with less heat generation, because of fully air drive.
- Can use for milling machine with small diameter endmill or drill. (less than  $\phi 1\text{mm}$ ).

#### 3. SPECIFICATIONS AND DIMENSIONS

##### 3 - 1 Specifications

Model	SMS401								
	M2040	M2540	H2540	BT30	NT30	NT30M	BT40	NT40	NT40M
Maximum Motor Rotation Speed	40,000min <sup>-1</sup> (rpm) (at 0.4MPa)								
Spindle Accuracy	Less than 1 $\mu\text{m}$								
Maximum Output Power	52W								
Appropriate Air Pressure	0.3 - 0.5MPa								
Air Consumption	120N $\ell$ / min								
Weight	555g	705g	715g	935g	965g	975g	1,555g		1,285g
Air hose Diameter	Outside Diameter $\phi 6.0\text{mm} \times 2\text{m}$								

##### Standard Accessories

- Collet Chuck  $\phi 4.0\text{mm}$  (CHA - 4.0) · · 1pc.
- Chuck Nut (CHN - A) · · 1pc.
- Wrench (8 x 5) · · 1pc.
- Wrench (9 x 11) · · 1pc.
- Filter Joint (FJ - 01) · · 1pc.
- Supply Air/ Oil Hose (K - 215) · · 1pc.
- Operation Manual · · 1set.

\*The collet chuck and chuck nut are attached to the Air Motor Spindle.

##### < Option >

Collet Chuck (CHA - □□)	$\phi 0.5 - \phi 4.0\text{mm}$ in 0.1mm increments and $\phi 2.35\text{mm}, \phi 3.175\text{mm}, \phi 6.35\text{mm}$
Grindstone Axia (AGM - 01A)	For grinding wheel with I.D. of $\phi 5\text{mm}$

#### 3 - 2 Outside View

① SMS401 - M2040 / M2540 / H2540

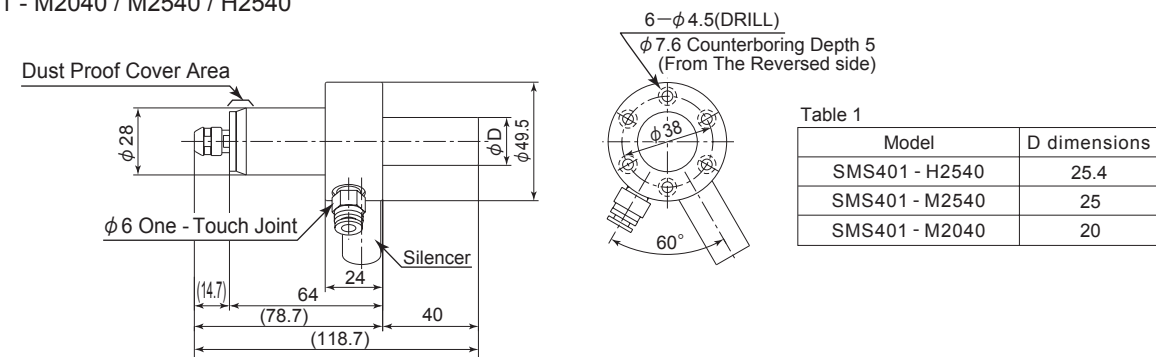


Fig. 1

② SMS401 - BT30

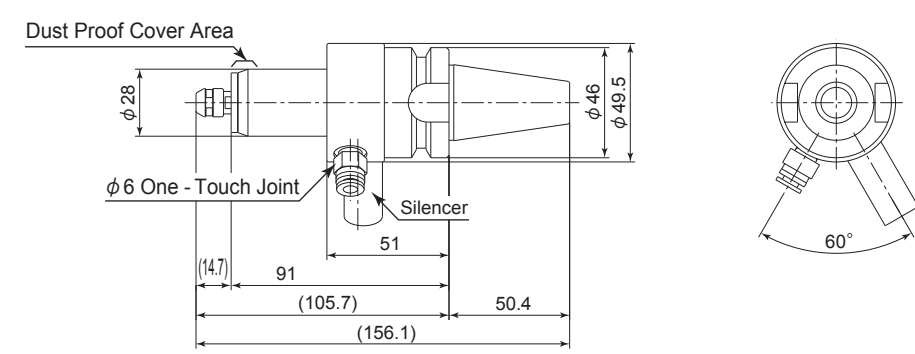


Fig. 2

③ SMS401 - BT40

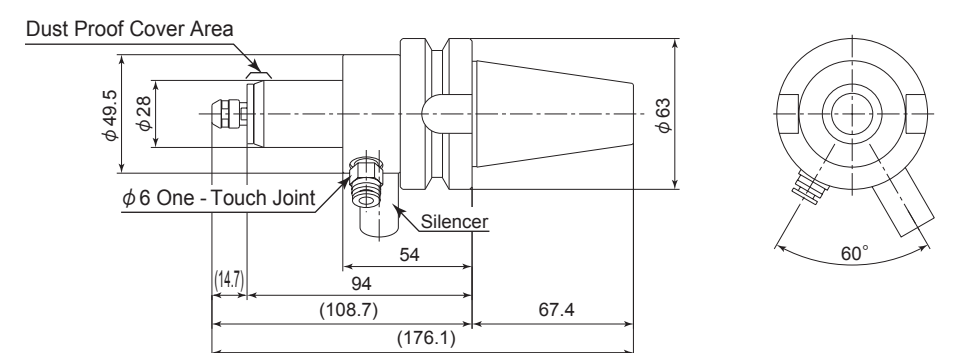


Fig. 3

④ SMS401 - NT30 (M)

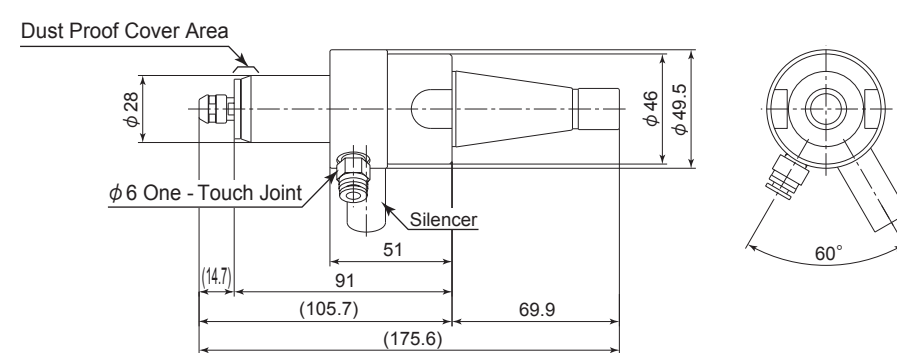


Fig. 4

⑤ SMS401 - NT40 (M)

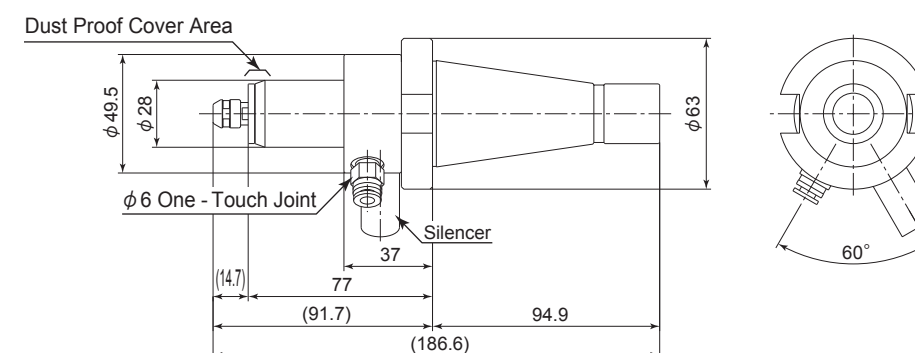


Fig. 5

#### 3 - 3 Torque Characteristics

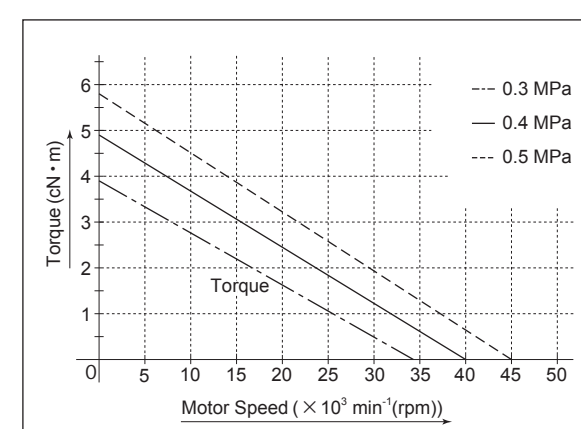


Fig. 6

#### 4. 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 minimize the tool overhang amount to maintaining high accuracy.

- Set the provided 8mm wrench on the spindle.
- Place the provided 11mm 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 over-tighten.

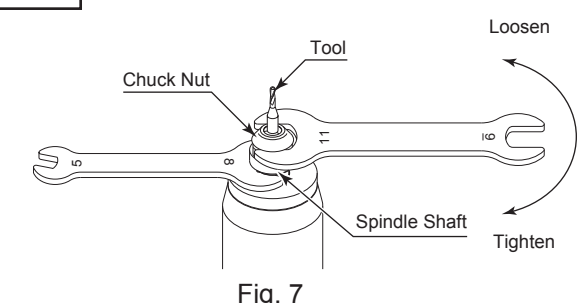


Fig. 7

#### 5. REPLACING THE COLLET CHUCK

##### CAUTION

When installing the collet chuck in the chuck nut, make sure to fully engage the latch inside the chuck nut to the groove on the collet chucks outer circumference 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 "4. CHANGING THE TOOL" procedure above and remove chuck nut assembly (Fig. 8).
- 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. 9).
- To install the collet chuck, hold the collet chuck at a slight angle, and insert it into the chuck nut (Fig. 10). Press the collet chuck in the chuck nut by positioning the collet chuck in the chuck nut and pressing down on flat surface (Fig. 9). Be sure to fully engage the latch inside the chuck nut into the groove on the collet chucks outer circumference area (Fig. 11).

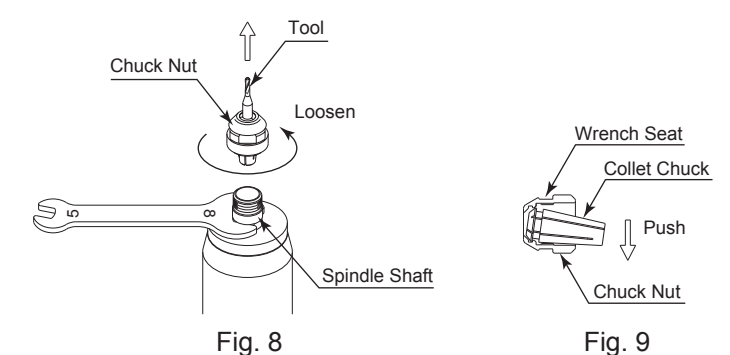


Fig. 8

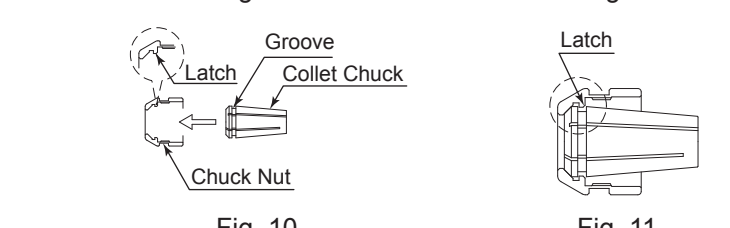


Fig. 9

Fig. 10

Fig. 11

## 6. ATTACHMENT TO MAIN SPINDLE OF MACHINING CENTER'S

### ⚠ DANGER

Do not rotate the machining center's main spindle with the SMS401 Air Motor Spindle installed. Rotating the machining center's main spindle with the SMS401 Air Motor Spindle installed can cause the Supply Air/ Oil Hose to become tangling will lead to a big accident.

### ⚠ WARNING

Confirm there is not a heat near Supply Air/ Oil Hose, as Supply Air/ Oil Hose might melt by heat.

### ⚠ CAUTION

Do not tighten the part of straight shank directly with screw, because there is a bearing inside the shank. This may cause the damage to the shank or heat generation.

- Attach the Air Motor Spindle to the main spindle of the machining center.
  - Hold the Supply Air/ Oil Hose length to the length of moving range of the main spindle.
  - Fix the Supply Air/ Oil Hose to the machine. Do not damaged to the Supply Air/ Oil Hose.
    - If the main spindle 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 - 20minutes, increase speed gradually until allowable maximum speed.

## 7. CONNECTION OF AIR LINE KIT

### ⚠ CAUTION

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

- Connect the Filter Joint to the Secondary Joint ( φ6 One - Touch Joint) of the Air Line Kit.
  - Connect the other side of the Supply Air/ Oil Hose to the φ6 One - Touch Joint of the Air Motor Spindle.
  - Fill Oil Reservoir through the Oil Filler Cap with recommended NAKANISHI Lubricating Oil (K - 211 : Air Line Kit's Standard Accessories) to Upper Limit of the Fig. 14. Disconnect from air supply prior to opening Oil Filler Cap. Do not over or under fill.
  - Connect the φ6mm air hose (Air Line Kit's Standard Accessories) to the Primary Joint of the Air Line Kit and Compressor.
  - Supply air from the air compressor and turn the Regulator Knob (H direction : increased) to set air pressure between 0.3 - 0.5 MPa.
  - Turn the ON / OFF Valve and rotate the Air Motor Spindle with recommended proper air pressure.
- Adjust the Oil Drip Rate to the recommended volume which is 1 to 3 drops / min. (Commercially Air Line Kit is same Oil Drip Rate).  
 \*If using the "AL - 0304 " or " K - 239 " Air Line Kit, adjust the proper Oil Drip Rate to 30 - 40 drops / min. (Refer to " AL - 0304 " or " K - 239 " of the Air Line Kit Operation Manuals.
- Be sure to adjusted to proper Oil Drip Rate before using the Air Motor Spindle.

### ⚠ 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 Motor Spindle. Using compressed air containing excessive moisture could result in malfunction or failure of the Air Motor Spindle. If excessive moisture or condensation are found in Air Filter Bowl (Filter Regulator 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 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 air / oil hose to rupture.
- Make sure operation air pressure is less than 1.0MPa before connecting the air / oil hose. If operation air pressure is exceeded the 1.0MPa, this may cause injury to the operator by accidental disconnection during use.
- Before use, carefully read " Air Line Kit Operation Manuals " regarding the correct connection, operation and cautions when using the Air Line Kit.

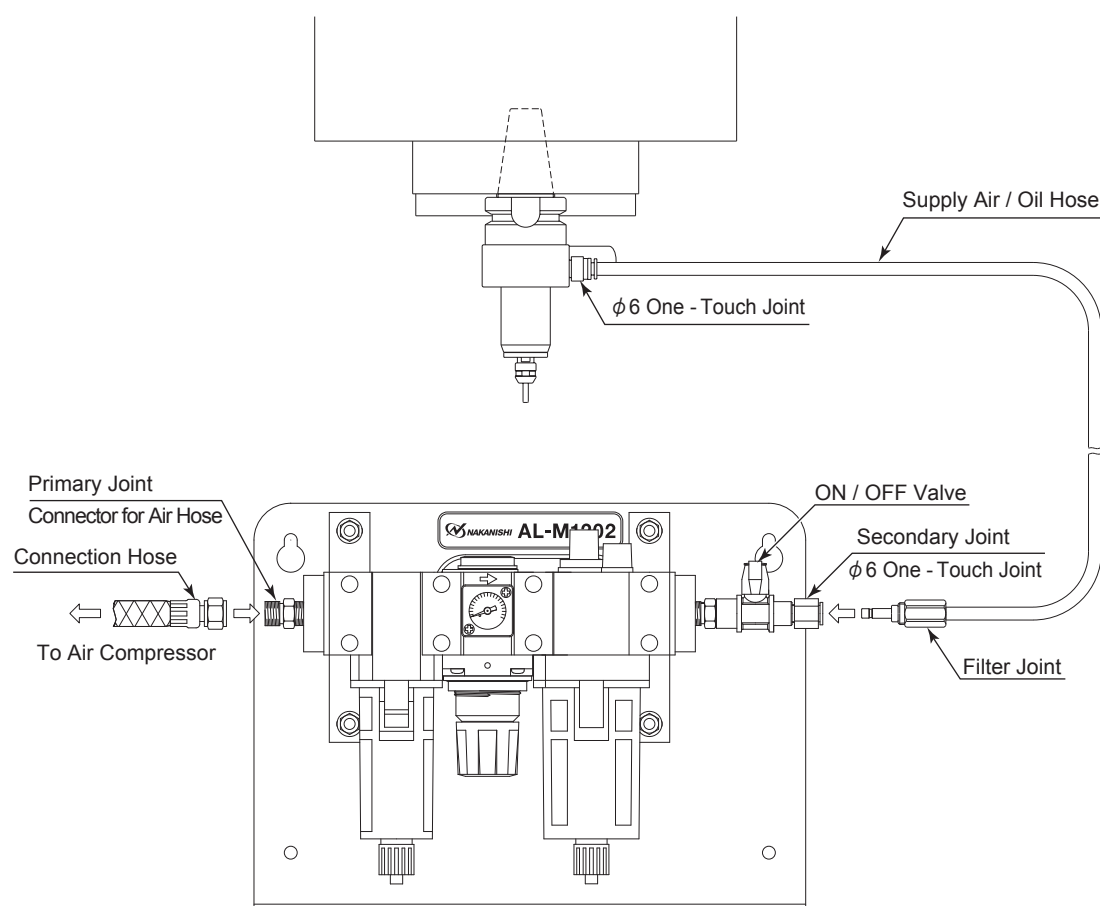


Fig. 12 Connection of Air Line Kit "AL - M1202 (Sold Separately)"

## 8. AIR LINE KIT OPERATION

- Draining from Air Filter (Fig. 13)
  - Opening and closing the Drain Valve.
  - O direction : Draining.
  - S direction : Stop Draining.

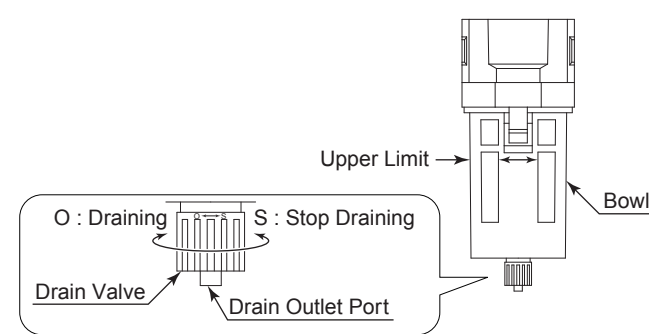


Fig. 13

- Regulator (Fig. 14)
  - < Lock and Release of the Regulator Knob >
  - Regulator Knob is equipped with Lock mechanism.
  - Release : Pull the Regulator Knob OUT to unlock.
  - Lock : Push the Regulator Knob IN to the Lock position.

### < Adjusting Air Pressure >

Turn the Regulator Knob while watching pressure gauge increase or decrease.  
 H direction : Air pressure is increased.  
 L direction : Air pressure is decreased.

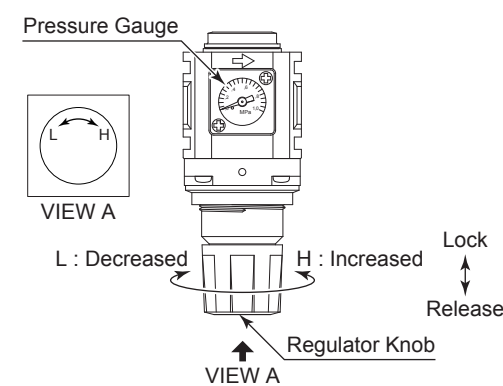


Fig. 14

- Lubricator

### ⚠ 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.
- Check the Lubricating Oil level everyday and before use. If Lubricating Oil level is low, Fill the oil bowl with Lubricating Oil up to the Upper Oil Limit on the bowl.
- If collected water in the lubricator taints Lubricating Oil, replace the Lubricating Oil immediately.

### < Oil Amount (Fig. 15) >

Check the Oil Amount in the Window.  
 If the Lubricating Oil level is low, add additional oil.  
 (Supply Lubricating Oil to Upper Oil Level Limit of Fig. 15.)

### < Replacing the Lubricating Oil and draining the water in the Lubricating Oil (Fig. 15) >

Opening and closing the Hand Operating Knob.  
 O direction : Draining.  
 S direction : Stop Draining.

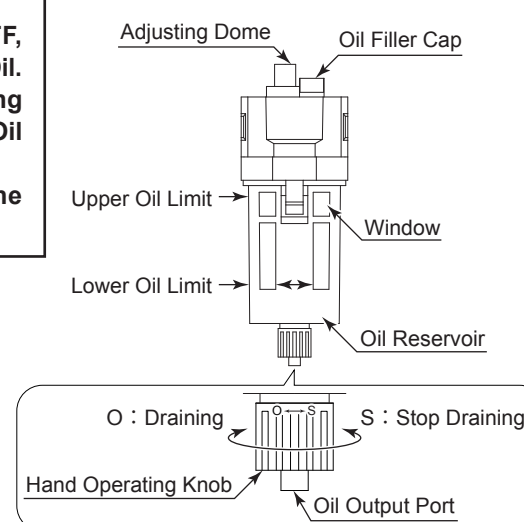


Fig. 15

### < Adjustment of Oil Drip Rate (Fig. 16) >

Set the air pressure to the Air Motor Spindle recommended maximum air pressure. Turn the adjusting dome and adjust the Oil Drip Rate to the recommended volume which is 1 to 3 drops / min (If using the "AL - 0304 " or " K - 239 " Air Line Kit, adjust the proper Oil Drip Rate to 30 - 40 drops / min).

- O direction : Increase
- S direction : Decrease

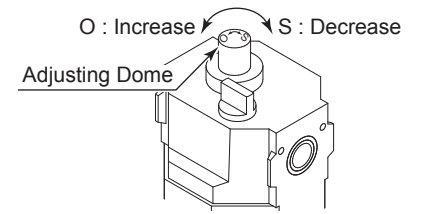


Fig. 16

- 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) 1ℓ

## 9. CAUTIONS WHEN USING GRINDSTONES AND TOOLS

### ⚠ CAUTION

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

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

- The proper surface speed for general grindstones is 10 - 30m / s.
- Do not exceed 13mm of overhang for mounted grindstones as shown in Fig. 17. If the overhang must exceed 13mm, reduce the motor speed in accordance with Table 2.
- Dress the grindstone prior to use.
- Do not use cutting tools with bent or broken shanks, cracks or excessive run-out.
- For grinding, the maximum depth of cut should not exceed 0.01mm radially or axially. Reciprocate the tool several times after each pass to eliminate tool pressure.
- 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.
- Keep the cutting tool shank and collet chuck clean. If contaminants are left in the collet chuck or chuck nut, excessive run-out will cause damage to the cutting tool and or spindle.
- Do not strike or disassemble the spindle.
- Please minimize the tool overhang amount to maintaining high accuracy. 13mm is the maximum amount of overhang to maintain high accuracy and safety.

Table 2. Overhang and Speed

Overhang (mm)	Max. Speed (min <sup>-1</sup> ) (rpm)
20	N x 0.5
25	N x 0.3
50	N x 0.1

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

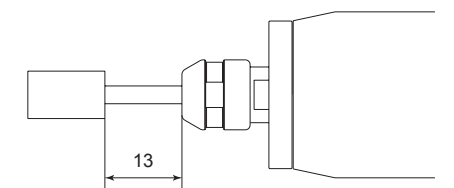


Fig. 17

## 10. 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 Motor Spindle.	Check if air / oil hose is broken, bent or disconnected. Check connection of air / oil hoses. Check the compressor power supply and the air compressor output. Check the Regulator and set to the correct air pressure. Check all air / oil hose connections.
	The spindles 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.)
Motor speed decrease.	The air / oil hose has been damaged.	Replace air / oil hose.
	Bad connection of air / oil hose.	Check all threaded joints and re-tighten if necessary.
	Poor air flow and air pressure.	Check if the air circuit is damaged.
	Low Lubricating Oil.	Check lubricator for proper lubricant level. Set the Oil Drip Rate from 1 to 3 drops / min. *If using the "AL - 0304 " or " K - 239 " Air Line Kit, adjust the proper Oil Drip Rate to 30 - 40 drops / min.
	No Lubricating Oil.	Clean inside of the motor use the Lubricating Oil. Removing the Filter Joint from Air Line Kit, supply a small amount of Lubricating Oil directly into the Filter Joint. Afterwards, supply air pressure and rotate the Air Motor Spindle. Flush dirt in the motor and repeatedly do this work about three times. When the improvement is not seen, return to NAKANISHI dealer service.
	Excess oil drips.	An excessive amount of oil drips into the system will cause the bearings to flood, slowing the speed or causing the Air Motor Spindle speed to fluctuate . Drain the Lubricating Oil in the bowl to the proper level by loosening Drain Valve. Use the Adjusting Dome to adjust the Oil Drip Rate.
Unequal motor speed.	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.
Overheating during rotation.	Lubricator inclined or upside down. (Air Line Kit "AL - 0304 " or " K - 239 " only.)	Inclined or upside down lubricator will flood spindle with Lubricating Oil.
	Over filled lubricator. (Air Line Kit "AL - 0304 " or " K - 239 " only.)	Draining the Lubricating Oil from reservoir to within indicated levels. Excess lubricant will flood spindle.
Abnormal vibration or noise during rotation.	Cutting debris has contaminated the ball bearings, and the ball bearings are damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
	The tool shank is bent.	Replace the tool.
Tool slippage.	Cutting debris has contaminated the ball bearing.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
	The spindles bearings have been damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.)
High run-out.	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.
	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.	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 bearings has been damaged.	Replace the ball bearings. (Return to NAKANISHI dealer service.)

## 11. DISPOSAL OF THE AIR MOTOR SPINDLE

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