NAKANISHI

Ultra-precision High-Speed Air Turbine Spindle

HTS1501S

OPERATION MANUAL

OM-K0389E 002

Thank you for purchasing the Ultra-Precision, High-Speed Air Turbine, HTS1501S. HTS1501S was designed for use on machining centers without rotating the machine's main spindle. HTS1501S 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) is used to drive HTS1501S.
Read this and all the associated component Operation Manuals carefully before use.

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 HTS1501S is not a hand tool. It is designed to be used on machines.
② Never rotate the main spindle of the machining center.
③ Never touch the motor, spindle or cutting tools when the spindle is rotating.
④ Wear safety glasses, dust mask, and use a protective cover around the Air Turbine Spindle whenever the Air Turbine Spindle is rotating.
⑤ Do not apply excessive force (deep per pass cuts, high feed rates). This may cause tool slippage or spindle damage.
⑥ Do not use unbalanced or low precision tools.
⑦ Use less than ϕ10mm square end mill, less than R0.5mm ball end mill, or less than ϕ4.0mm grindstone for tools to avoid danger.

⚠ CAUTION

① Do not drop or hit HTS1501S, as shock can damage to the internal components.
② Check that the collet has been securely tightened prior to each use.
③ Always clean the Collet. if ground particles or metal chips stick to the inside of spindle or the Collet, this will cause damage to the Collet or spindle and loss of precision.
④ Do not over-tighten the Collet. This will cause spindle damage.
⑤ An Air Line Kit is necessary for sue with HTS1510S.
The motor speed will be decreased and the lifetime will be shortened without the use of an Air Line Kit.

⚠ CAUTION

⑥ Always drain water from the air filter (Air Line Kit). Water or ground particles will cause rust or damage to the internal parts of the turbine.
⑦ Select suitable products or tools for the application. Do not exceed the capabilities of the spindles or cutting tools.
⑧ Stop working immediately when abnormal rotations or unusual vibrations occur.
⑨ If the spindle has not been used for a long period of time, in excess of one month, start at a low air pressure and run the spindle as slowly as possible. Over a period of 15-20 minutes, raise the air pressure and spindle speed incrementally until you reach the maximum allowable speed. Check for abnormal noises, vibration or heat.
⑩ Always check if the tool and collet are damaged before and after operating.

2. FEATURES

① A wide variety of shank types are available.
② A wide selection of Collets are available depending on application requirements.
③ Air driven system generates extremely little heat, even after many hours of continuous use.
④ Designed for use with the attachment of less than ϕ1.0mm square end mill or less than R0.5mm Ball end mill.

3. SPECIFICATIONS AND DIMENSIONS

3 - 1 Specifications

Motor speed	150,000min^{-1} (rpm) (at 0.5MPa)
Appropriate Air Pressure	0.5MPa (5.0kgf/cm^2)
Spindle Accuracy	Within 1 μm
Taper type	BT30・BT40・BT50・HSK E25・HSK E32・HSK E40・ HSK E50・HSK A63・HSK F63・Straight Type (M2040)
Air Consumption	90Nℓ /min
Weight	1,030g (HTS1501S - BT30) 1,700g (HTS1501S - BT40)
Standard Collet (CHA-4.0)	ϕ4.0mm
Air Inlet Hose	ϕ6.0mm (OD) × 4m
Tools Sizes	Less than ϕ1.0mm Square End Mill Less than R0.5mm Ball End Mill Less than ϕ4.0mm Grindstone

Standard Accessories	
・Collet ϕ4.0 mm (provided)・・1pc.	・Collet nut (provided)・・1pc.
・Wrench (8 × 5)・・1pc.	・Wrench (11 × 9)・・1pc.
・Air hose with filter joint(4m)・・1pc.	・Operation Manual・・1set.

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Collet (CHA - □□)	ϕ0.5mm - ϕ4.0mm in every increments, ϕ2.35mm, ϕ3.175mm
Collet nut	CHN - A

3 - 2 Dimensions

① HTS1501S - BT30

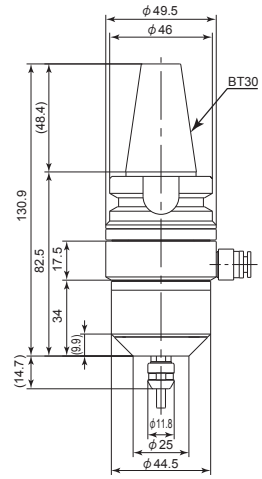

Fig. 1

② HTS1501S - BT40

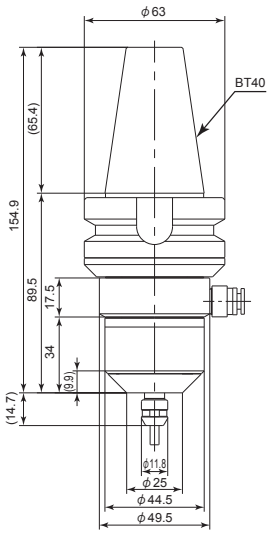

Fig. 2

③ HTS1501S - BT50

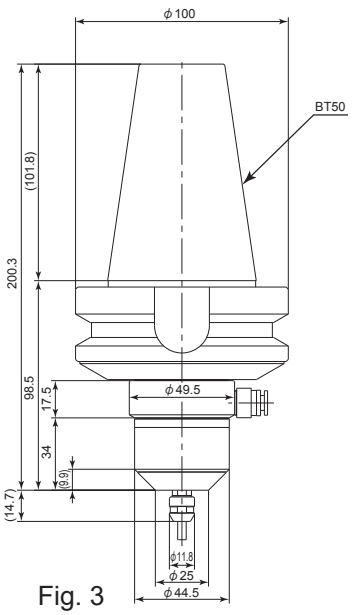

Fig. 3

④ HTS1501S - M2040

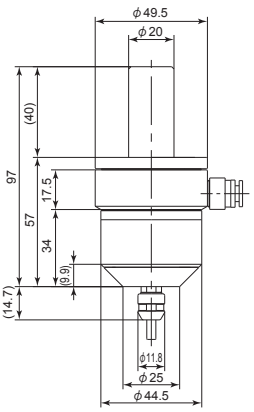

Fig. 4

⑤ HTS1501S - HSK E25

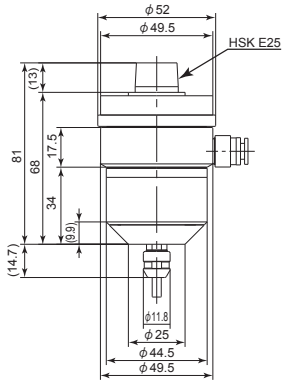

Fig. 5

⑥ HTS1501S - HSK E32

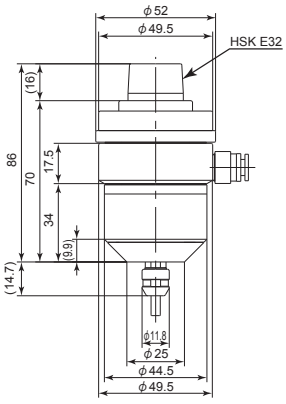

Fig. 6

⑦ HTS1501S - HSK E40

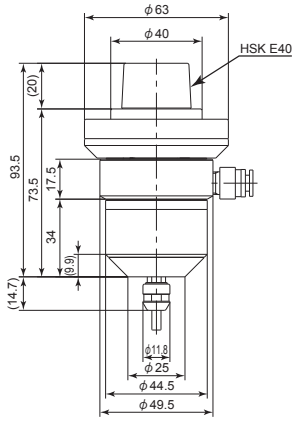

Fig. 7

⑧ HTS1501S - HSK E50

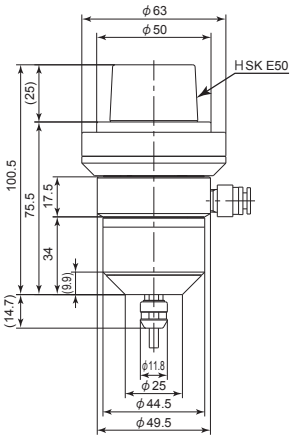

Fig. 8

⑨ HTS1501S - HSK A63

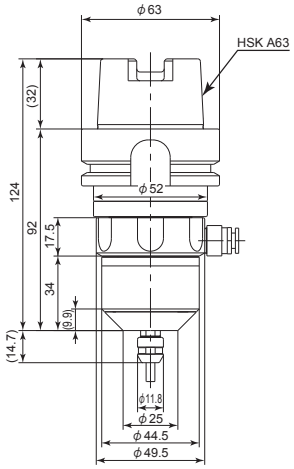

Fig. 9

⑩ HTS1501S - HSK F63

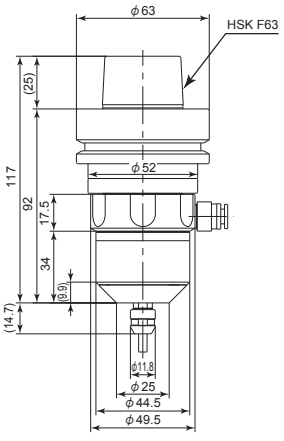

Fig. 10

4. REPLACEMENT OF TOOLS

⚠ CAUTION

Never install a collet into the spindle quill without first assembling it in the Collet nut. Do not tighten the collet without mounting a cutting tool or test bar as this will result in a damage to the collet, spindle and collet nut and make it impossible to remove the collet.

Replace the tools according to the following procedure.

① Place the provided 8mm spanner on the spindle shaft to fasten.

② Place the provided 11mm spanner on the Collet nut, and turn it counterclockwise to loosen the Collet. And pull out the tool. (The Collet nut will loosen but the collet will not release the tool after one turn, turn it more, and the Collet will open.)

③ Shorten the length of max. tool mounting as possible when inserting another tool.

④ Turn the Collet nut clockwise to fasten the tool.

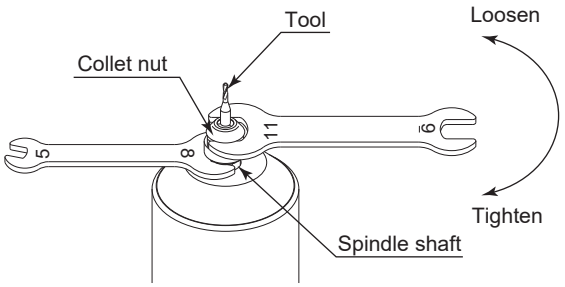

Fig. 11

5. REPLACEMENT OF THE COLLET

Replace the Collet according to the following procedure.

① The Collet nut is loosened together with the tool according to the "4. REPLACEMENT OF TOOLS" procedure above. And unscrew the Collet nut and remove the collet and Collet nut. Then remove the tool from the Collet. (Fig. 12)

② Hold the Collet nut in one hand and push the collet diagonally toward the spanner flat to remove the collet from the Collet nut. (Fig. 13)

③ The new Collet can be attached by inserting the new Collet diagonally toward the spanner flat (Fig. 13) and pressing straight down.

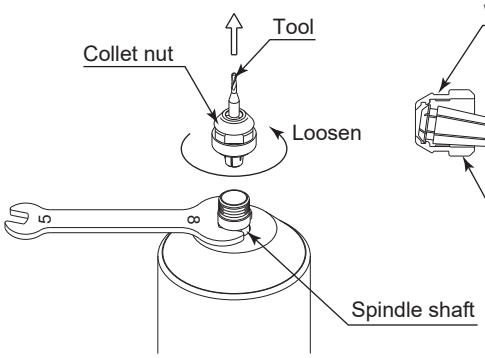

Fig. 12

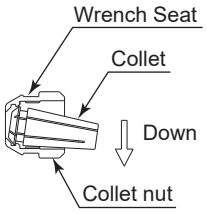

Fig. 13

6. ATTACHMENT OF THE MAIN SPINDLE ON MACHINING CENTER

⚠ WARNING

When HTS1501S is used, never rotate the main spindle on the machining center. Rotating the main spindle will damage HTS1501S and could cause personal injury.

① Attach HTS1501S into the quill of the machining center.

② Secure the air hose to a suitable place on the machining center and check that you have allowed enough slack for the quill's full range of motion.

* If the main spindle is rotated by mistake, check the air hose and machining center for damage. And use it only after test-running.

7. CONNECTION & INSTRUCTION OF AIR LINE KIT (AL - M1202)

⚠ 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.

① Connect the Filter Joint of the supply air / oil hose to the Secondary Joint (ϕ6 One - Touch Joint) of the Air Line Kit. (Fig. 14)
② Attach the other end of the Air Intake Hose to the easy connection joint on the HTS1501S.
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. 14)
⑤ Supply air from the air compressor and turn the Regulator Knob to set air pressure between 0.3 - 0.5 Mpa (43.5 - 72.5psi).
⑥ Turn the ON / OFF Valve and rotate the HTS1501S with recommended proper air pressure.
Adjust the Oil Drip Rate to the recommended volume which is 1drops / min.）(Commercially Air Line Kit is same Oil Drip Rate).
⑦ Be sure to adjusted to proper Oil Drip Rate before using the HTS1501S.

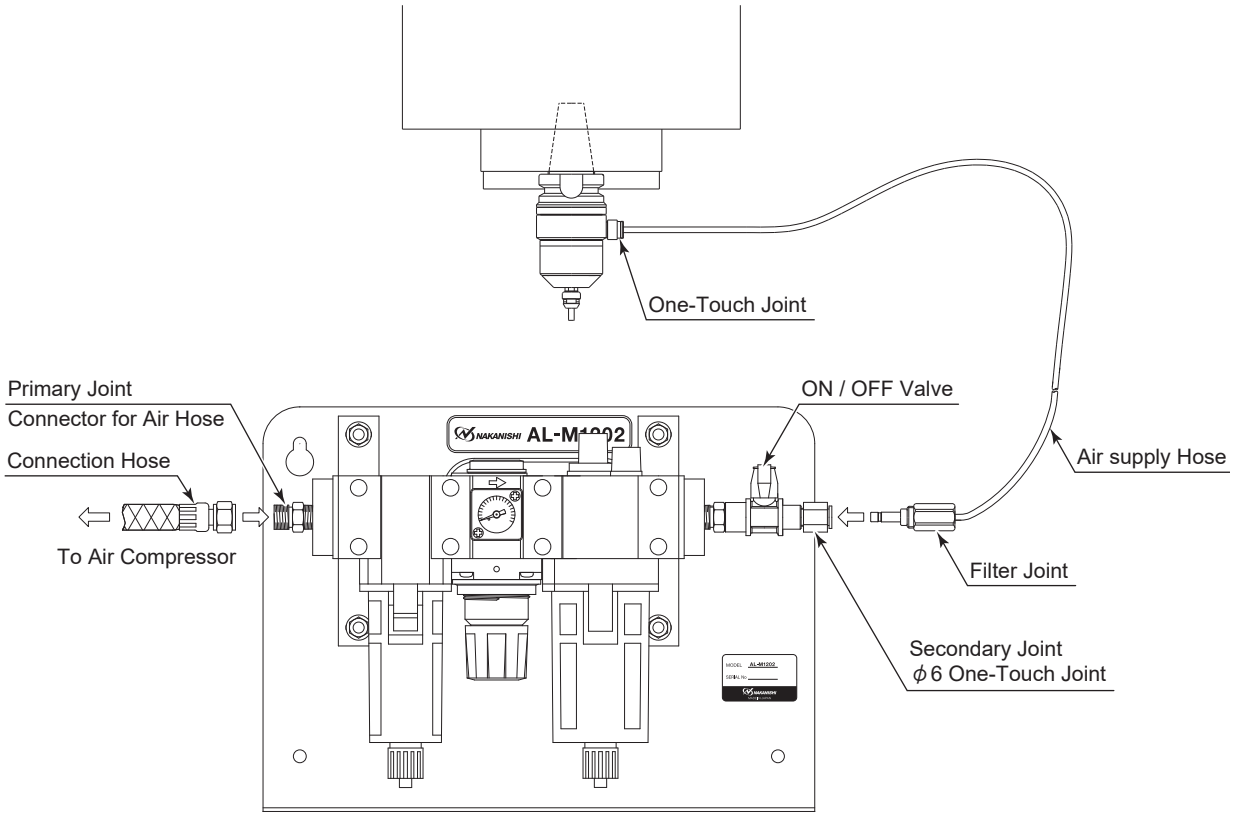

Fig. 14 Connection of Air Line Kit " AL - M1202 (Sold Separately) "

⚠ CAUTIONS FOR AIR LINE KITS

① 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.

② Check that all hose connections are secure and strong to avoid accidental disconnection during operation. Do not exceed 1.0MPa for incoming air pressure to tha Air Line Kit. Incoming air pressure from the compressor in excess of 1.0MPa may cause the air hose to burst.

③ About connection, operation and cautions of Air Line Kit, refer to " Air Line Kit Operation Manual".

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

8. CAUTIONS WHEN USING GRINDSTONES AND TOOLS

⚠ CAUTION

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

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

① The proper surface speed for general grindstones is 10 - 30m / s.
② Do not exceed 13mm of overhang for mounted grindstones as shown in Fig.15.
③ If the overhang must exceed 13mm, reduce the air motor speed in accordance with Table.1.
④ Dress the grindstone prior to use.
⑤ Do not use cutting tools with bent or broken shanks, cracks or excessive run-out.
⑥ 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.
⑦ 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.
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 or disassemble the Air Turbine Spindle.
⑩ Please set the cutting tools to minimize the overhang amount. 13mm is the maximum amount of overhang to maintain high accuracy and safety.

Table 1. 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.

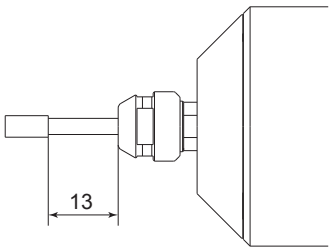

Fig. 15

9. USE OF COOLANT

HTS1501 is designed to prevent coolant from entering the motor/spindle by using the air used for driving the turbine as an air purge. Never spray coolant directly on the HTS1501S main body, because coolant may enter the motor/spindle. Coolant or foreign particle contamination of the spindle's internal components will dramatically shorten bearing life.

⚠ CAUTION

Do not stop the supplied cooling air to the air motor while coolant spray is being applied to the cutting tool.
Removing the air pressure from the air motor causes a loss of purging, allowing the HTS1501S to ingest coolant. This will cause damage to the HTS1501S.

10. TROUBLESHOOTING

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

Trouble	Cause	Inspection / Corrective Action
Low Rotation Speed	Partial disconnection of hose or leaking connection.	Check all joints and re-tighten seal connections.
	Broken Hose.	Replace the hose.
	Low air flow or pressure.	Check the air circuit.
	No or low oil supply.	Check lubricator for proper lubricant level. Set the Oil Drip Rate from 1 drops /min.
	Inclined or vibrating lubricator.	If the lubricator is inclined or subject to vibration, a large volume of oil will flow and the spindle will rotate irregularly.
	Excessive oil in oil reservoir.	A large volume of oil will flow and the spindle will rotate irregularly. Drain oil to the appropriate volume by loosening the valve.
	Excessive oil drip rate.	Decrease drip rate to stabilize motor speed.
	Moisture in the oil reservoir.	Drain moisture from the lubricator and replace oil.
	Moisture in the air filter.	Drain moisture in the air filter.
No Rotation	No air flow.	Check the regulator and set at the appropriate air pressure. Check all hose connections.
		Check air compressor power supply and air outlet. Check hoses for leaks,bends or disconnections.
	Damaged motor bearings.	Return to NAKANISHI dealer service.
Excessive Runout	Contaminants inside the Collet or the spindle.	Clean the inside of the Collet and the spindle.
	Collet nut is not properly positioned.	Set the Collet the Collet nut properly.
	Ball bearing is worn out.	Return to NAKANISHI dealer service.
	Cutting tool is bent.	Replace cutting tool.
Noise or vibration during rotation	Ground Particles stuck in the Collet or spindle. Ball bearing is worn out.	Return to NAKANISHI dealer service.
	Use the bent tool.	Change the tool.

Refer to the Air Line Kit (AL - M1202) Operation Manual.

11. DISPOSAL OF THE Air Turbine Spindle

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

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