

High-speed Integrated Motor Spindle for Machining Centers

Spindles with ISO-40 equivalent taper deliver high-speed performance of operating speeds up to 20 000 min⁻¹ while reducing energy consumption and noise using NSK's new grease replenishing system.



Patent Pending





World-class performance with the highest available speed

The highly functional High-speed Integrated Motor Spindle for Machining Centers maximizes the machining ability of Class #40 high-speed machining centers. NSK realized the world's highest speed performance of 20 000 min⁻¹ by thoroughly developing heavy cutting ability, ultra low noise, and lower environmental load.

1 Best-in-class speed

NSK's ROBUST Series bearings and FANUC's integrated, high-performance motor deliver the highest speed for this class of spindle. The maximum speed of 20 000 min⁻¹ ($d_m n$ 1.7×10⁶) was achieved under position-preloaded grease lubrication.

Bearing technology + design technology
Up to 20 000 min⁻¹ ($d_m n$ 1.7×10⁶)
under position-preloaded grease lubrication.

2 Ultra low noise

NSK's design technology combined with its outstanding bearing technology and proven expertise result in ultra low noise of 69 dB with reduced vibration at 20 000 min⁻¹.

Design technology + lubrication technology
69 dB^{*1} at 20 000 min⁻¹

*1: Actual measured value for Type S at 20 000 min⁻¹



Four technologies supporting NSK high-speed spindles



The highly functional High-speed Integrated Motor Spindle for Machining Centers facilitates heavy cutting ability, ultra low noise, and low environmental loads far beyond conventional high-speed spindles by combining NSK's premier technologies in bearings, lubrication, integrated motor utilization, and design.

Integrated motor utilization technology

Lubrication technology

3 Low environmental load

Air consumption was cut back by 70% with oil consumption brought down to zero, significantly reducing both energy consumption and waste.



Lubrication technology
Air consumption reduced by **70%**
Oil consumption reduced to **zero**

4 Wide-range heavy cutting

Boasting high-speed performance of 500 cm³/min for steel and 3 700 cm³/min for aluminum, NSK Integrated Motor Spindle supports the machining of dies and aluminum parts over a wide range of machining performance, from low to high speeds.

Bearing technology + built-in motor technology
Steel: **500 cm³/min^{*2}**
Aluminum: **3 700 cm³/min^{*2}**

*2: Actual measured value for Type L at 20 000 min⁻¹



MACHINING CENTER

Integrated Motor Spindle

Superior machining performance in Class #40

Wide range of machining performance for extensive machining needs, from low-speed heavy cutting to high-speed machining.



Face mill $\phi 80$

Work material: S50C
Rotational speed: 1 200 min^{-1}
Metal removal rate: 504 cm^3/min



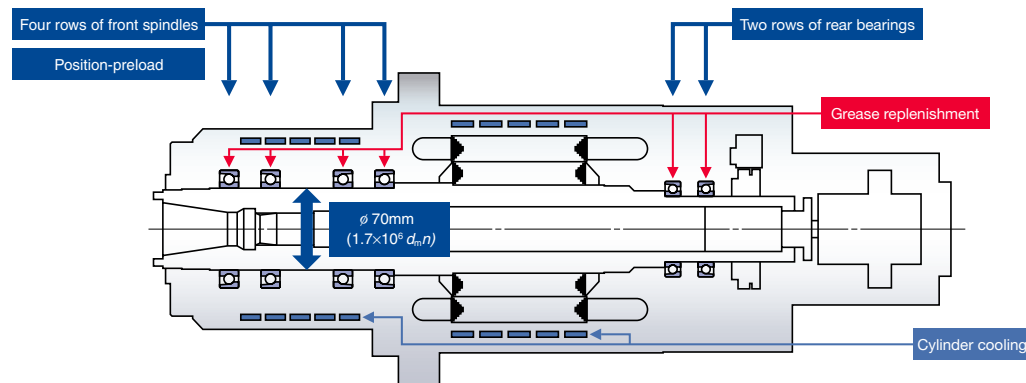
End mill $\phi 60$

Work material: A5052
Rotational speed: 8 000 min^{-1}
Metal removal rate: 3 780 cm^3/min

Work material: A5052
Rotational speed: 20 000 min^{-1}
Metal removal rate: 2 500 cm^3/min

Mounted with a highly rigid bearing for the highest performance in its class

A high rotational speed of 20 000 rpm was achieved under position-preloaded bearings of $\phi 70$ mm in bore diameter. In addition, four rows of front bearings and two rows of rear bearings, for a total of six rows, were adopted to dramatically enhance spindle rigidity.



NSK's state-of-the-art precision bearing technology

Incorporates the ROBUST Series, proven bearings for machine tools. Ceramic balls are used for higher speed, high rigidity, and high reliability.



Cool running

Optimization of internal design realizes cool running.

Improved anti-seizure property

Improved heat robustness to handle changes in ambient temperatures.

Ceramic ball

Adopts a high-precision ceramic ball for the rolling element to provide high speed, high precision, and high rigidity.

New grease replenishing system supports 10 000 hours of maintenance-free performance

NSK's new proprietary, environmentally friendly grease replenishing system automatically delivers a small quantity of grease into the bearing interior at intermittent intervals.

Improved grease life

Continuous fresh supply of lubricant to components improves grease life.

Ultra low noise

Eliminates grating wind noise caused by oil-air lubrication and reduces noise level to as low as 69 dB at 20 000 min^{-1} .

Reduced energy consumption

With air consumption lowered by at least 70%, as little as 50 NL/min of air is required.

Environmentally sound

No oil is consumed, and therefore no oil particles are released into the air.



Built-in motor structure results in low vibration

Direct-drive system with no gears or couplings produces low vibration.

Low vibration

Provides improved quality in cut surface and extends tool life.

Compact

The spindle incorporates motor between bearings at front and rear and is therefore lighter and more compact than direct-coupled units.

Simplified assembly

Incorporating spindle shaft and motor into single unit eliminates need for centering and aligning spindle shaft and motor.

Easier maintenance

Unique cartridge structure allows components to be quickly replaced.

Highly functional integrated motor delivers strong output

Motor mounted with FANUC NC gives the highest possible motor performance.

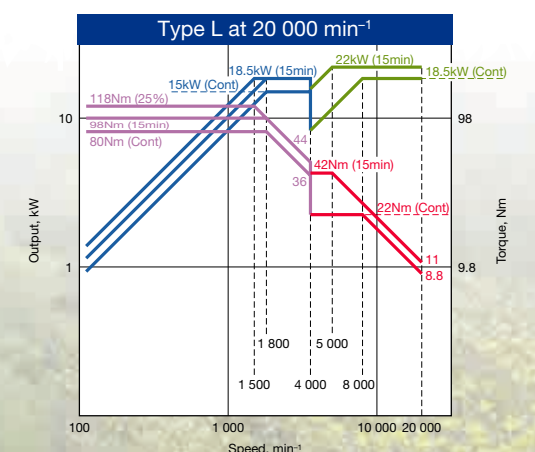
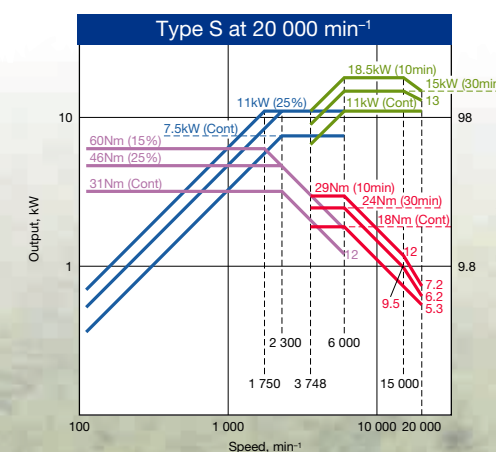
FANUC α i series

Cool running

Adopts optimum core shape design and state-of-the-art low iron loss material. Current ripple is lowered with HRV2 control.

Winding switching system

Winding switching system supports a wide power band range, from low to high speeds.



Test amplifier: SPM-30i

A wide variety of peripheral devices are offered in an all-in-one format for “plug-and-play” ease of use.

Extremely easy maintenance

All-in-one cartridge structure for spindle components significantly shortens downtime.

Tool clamping unit

Equipped with a spiral disk spring to maintain balance, and a monitor switch for checking tool presence.

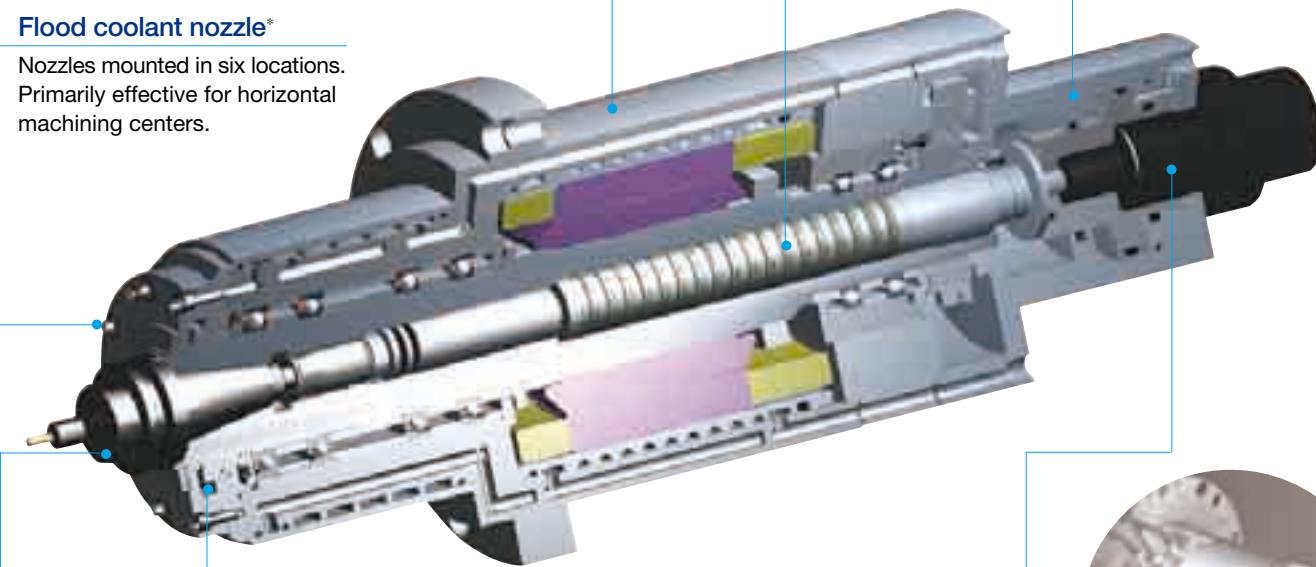
Tool releasing cylinder

Equipped with switches for upper and lower position limits.



Flood coolant nozzle*

Nozzles mounted in six locations. Primarily effective for horizontal machining centers.



Tool holder

BT40/HSK-A63

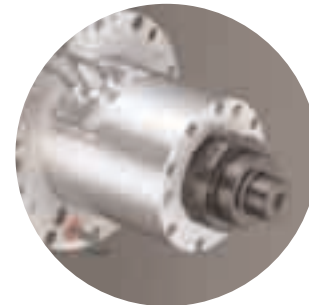


Completely prevents coolant intrusion

Quadruple structure consists of the labyrinth seal, the sealing spacer, the air seal, and the slinger seal.

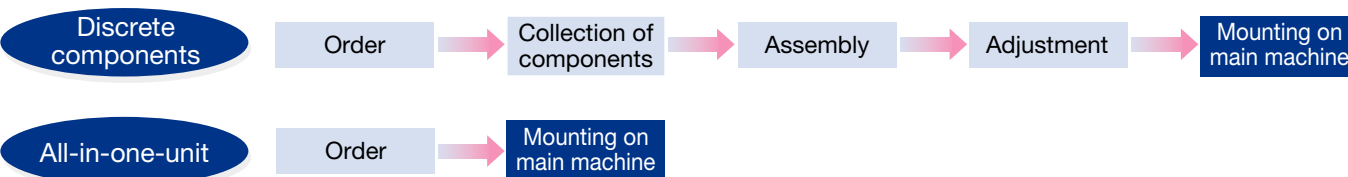
Rotary union*

Supplies through-spindle coolant under high pressure (7 MPa). Also suitable for MQL processing



* Optional feature

Advantages of all-in-one spindle unit



Reduced production lead time

- Significantly reduces time from order to completion of spindle adjustment.
- Also reduces running stock.

Curbs maintenance costs

- Spindles can be used for different machines in the factory.
- Reduces spare unit inventory.

Specifications of High-speed Integrated Motor Spindle

The following numbers will be included in the specification drawing of supplied products. When ordering, please mention the reference numbers for the product you would like to purchase.

Reference number example: **W-B 11 00-0 4 1 3 3 0**

Motor model 11: α112S/20 000iB
12: α112L/20 000iB

Flange 0: Standard position 1: Special position

Spindle taper/rotational speed 0: BT40/15 000 1: BT40/20 000
3: HSK-A63/15 000 4: HSK-A63/20 000

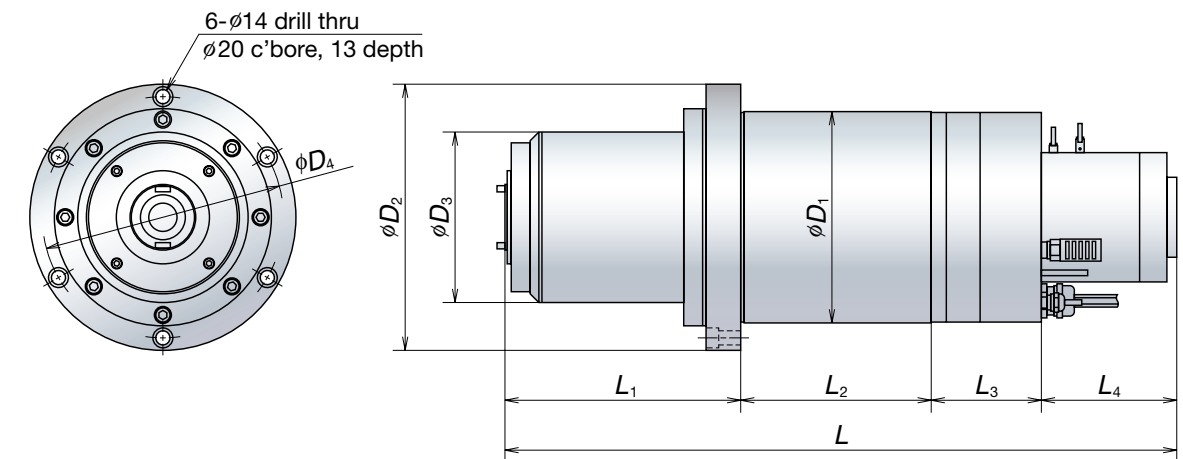
Lubrication system 0: Packed grease 1: Automatic grease replenishment

Seal 0: Standard seal

Monitor switch
0: None 1: Monitor switch
2: Upper and lower position limits of the tool releasing cylinder
3: Monitor switch/ Upper and lower position limits of the tool releasing cylinder

Coolant (Option)
0: None 1: Through-spindle coolant
2: Flood coolant nozzle
3: Through-spindle coolant / Flood coolant nozzle

Dimensions



	Item	Unit	Type S		Type L	
			Standard	High-speed	Standard	High-speed
Main specification	Tool shank		BT40/HSK-A63	←	BT40/HSK-A63	←
	Rotational speed	(min ⁻¹)	15 000	20 000	15 000	20 000
	Output (short time/continuous)	(kW)	18.5 (10 min) /11	←	22 (15 min) /18.5	←
	Torque	(Nm)	60	←	118	←
Boundary dimension	D ₁	(mm)	210	←	230	←
	D ₂	(mm)	265	←	285	←
	D ₃	(mm)	170	←	170	←
	D ₄	(mm)	240	←	260	←
	L	(mm)	670	←	800	←
	L ₁	(mm)	235	←	235	←
	L ₂	(mm)	190	←	320	←
	L ₃	(mm)	110	←	110	←
L ₄	(mm)	135	←	135	←	