

a5Inx·a6Inx

Horizontal Machining Centers | No.40 Spindle Taper



Makino Milling Machine Co., Ltd.

Head Office

3-19 Nakane 2-chome, Meguro-ku, Tokyo 152-8578, Japan Tel: +81(0)3-3717-1151 Fax: +81(0)3-3725-2105 URL <http://www.makino.co.jp>

Atsugi Works International Operation Department

4023 Nakatsu, Aikawa-machi, Aiko-gun, Kanagawa 243-0303, Japan Tel: +81(0)46-284-1536 Fax: +81(0)46-286-4334

Makino J Co., Ltd.

4007 Nakatsu, Aikawa-machi, Aiko-gun, Kanagawa 243-0303, Japan Tel: +81(0)46-286-8350 Fax: +81(0)46-286-8385

Makino Inc.

7680 Innovation Way, Mason, Ohio, 45040, U.S.A.
Tel: +1-513-573-7200 Fax: +1-513-573-7360 URL <http://www.makino.com>

Makino Inc. Auburn Hills

2600 Superior Court, Auburn Hills, MI 48326
Tel: +1-248-232-6200 Fax: +1-248-6201 URL <http://www.makino.com>

Makino GmbH (Hamburg)

Essener Bogen 5, 22419 Hamburg, Germany
Tel: +49(40) 298 090 Fax: +49(40) 298 09 400 URL <http://www.makino.de>

Makino GmbH (Kirchheim)

Kruichling 18, 73230 Kirchheim unter Teck, Germany
Tel: +49(7021) 503 0 Fax: +49(7021) 503 400 URL <http://www.makino.de>

Makino France S.A.S.

Z.A. Les Bordes, 21, rue Gustave Madiot 91070 Bondoufle, France
Tel: +33(169) 116396 Fax: +33(169) 116399 URL <http://www.makino.fr>

Makino Italia Srl

Strada Privata delle Orobie, 5
Località S. Maria in Campo I-20873 Cavenago Brianza (MB)
Tel: +39 02 / 95 948290 Fax: +39 02 / 95 948241 URL <http://www.makino.it>

Makino s.r.o.

Tuhovská 31, 83106 Bratislava, Slovakia
Tel: +421 2 496 12 100 Fax: +421 2 496 12 400 URL <http://www.makino.sk>

Makino Asia Pte Ltd

2 Gul Avenue, Singapore 629649
Tel: +65-6861-5722 Fax: +65-6861-1600 URL <http://www.makino.com.sg>

Makino Asia Pte Ltd Indonesia office

Gading Mediterania Residences Unit RK/008/D
Jl.Boulevard Bukit Gading Raya Jakarta 14240 Indonesia.
Tel: +62(0)21-3004-1022 Fax: +62(0)21-3004-1023

Makino Asia Pte Ltd Vietnam office

9th Fl - Vinaconex Building - 47 Dien Bien Phu St - Da Kao Ward - Dist 1 - HCMC - VN.
Tel: +84(0)8-39104832 Fax: +84(0)8-39104994

Makino India Private Limited

No.11, Export Promotion Industrial Park, Whitefield Road, K.R.Puram,Bangalore 560 066, India
Tel: +91(0)80-2841- 9500 Fax: +91(0)80-2841-0538 URL <http://www.makinoindia.co.in>

Makino Thailand Co., Ltd.

57/23 Moo 4, Ramintra Road, km 2, Anusaowaree, Bangkhen, Bangkok 102 20 Thailand
Tel: +66(0)2971-5750 Fax: +66(0)2971-5751 URL <http://www.makino.com.th>

Makino China Co., Ltd.

No.2, Mu Ye Road, Yushan Town, Kunshan City, 215 316, China
Tel: +86(0)512-5777-8000 Fax: +86(0)512-5777-9900 URL <http://www.makino.com.cn>

Makino Korea Co., Ltd.

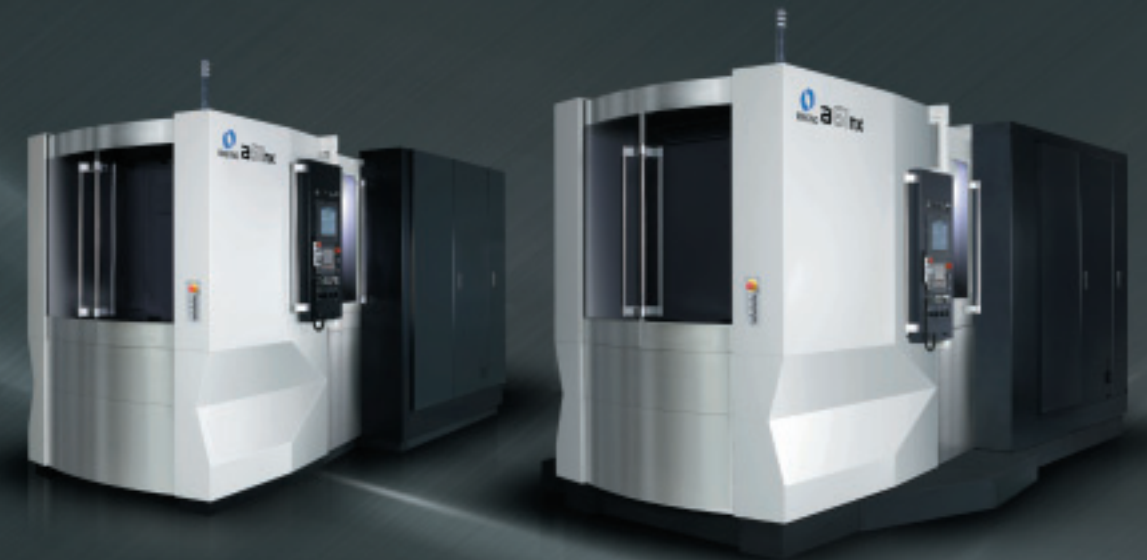
335-12, Dokusan-Dong, Geumcheon-Gu, Seoul, Korea
Tel: +82(0)2-856-8686 Fax: +82(0)2-856-8555 URL <http://www.makinoseoul.co.kr>



*The specifications in this catalog may be changed without prior notice to incorporate improvements resulting from ongoing R&D programs.

*The machines displayed in this catalog include the optional specifications and equipment.

*The products include technical data and software, may be subject to the Foreign Exchange and Foreign Trade Control Law in Japan.
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Capable of handling diverse machining components

(components for mass production, small and medium batch production, prototypes, automotive and aerospace components)

capable for die and mold machining.

Machining time: 87.5 min

Material: Titanium alloy Ti-6Al-4V
Size: 207 × 152 × 90 mm
Mount bracket
Machine: a61nx
Spindle: High torque 14000 min⁻¹ spindle (302 N·m)*

Metal removal rate: 1206 cm³/min

Material: Aluminum A6061

Spindle speed: 10600 min⁻¹

Feedrate: 7420 mm/min

25 mm diameter end mill

Axial depth of cutting: 6.5 mm

Radial depth of cutting: 25 mm

Machining time: 10.4 min

Material: Aluminum
Size: 200 × 130 × 135 mm
Bracket
Machine: a51nx
Spindle: High torque 14000 min⁻¹ spindle (302 N·m)*

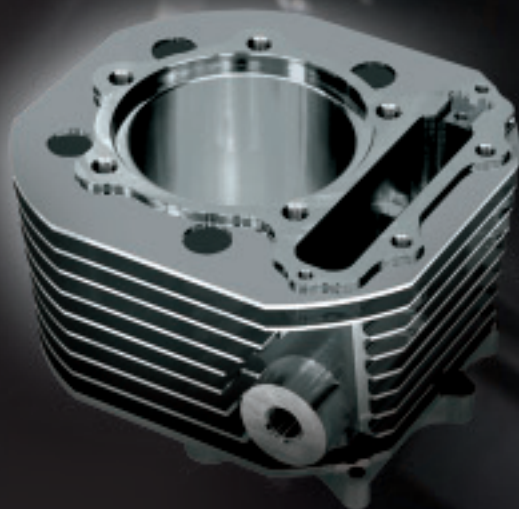
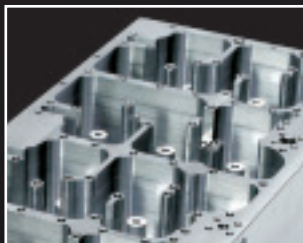
Metal removal rate: 588 cm³/min

Material: Grey cast iron FC250

Spindle speed: 585 min⁻¹

Feedrate: 117 mm/min

80 mm diameter drill



*: optional specification

*: optional specification

Spindle variations

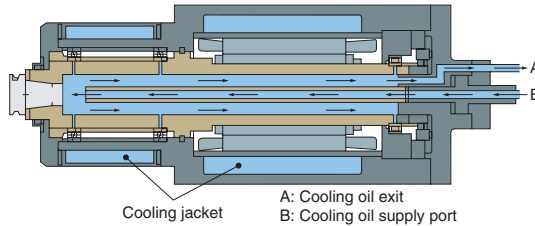
			Standard spindle	High torque spindle*	
			150000 min ⁻¹	14000 min ⁻¹ (240 N-m)*	14000 min ⁻¹ (302 N-m)*
Speed		min ⁻¹	50 ~ 15000	50 ~ 14000	←
Motor rated output power	25%ED / cont.	kW	11 / 22	30 / 22	←
			18.5 (10 min.) / 15 (30 min.)	26 (15 min.)	37 (15%ED) / 26 (15 min.)
Torque	15%ED / cont.	N-m	99 / 42	240 / 119	260 / 119
			120 (10%ED) / 66 (25%ED)	20 4 (25%ED) / 147 (15 min.)	302 (10%ED) / 204 (25%ED) /147 (15 min.)
Bearing diameter inner / outer		mm	70 / 110	85 / 130	←
Acceleration time 14000 min ⁻¹		second	1.3 (15000 min ⁻¹)	1.7	1.8
7000 min ⁻¹			0.4 (8000 min ⁻¹)	0.6	0.5

			High speed spindle (core cooling)*	
			20000 min ⁻¹ *	30000 min ⁻¹ *
Speed		min ⁻¹	50 ~ 20000	300 ~ 30000
Motor rated output power	cont.	kW	11	22
			18.5 (10 min.)	30 (25%ED) / 25 (30 min.)
Torque	15%ED / cont.	N·m	98 / 42	80 / 48
			—	68 (25%ED)
Bearing diameter inner / outer		mm	70 / 110	←
Acceleration time 20000 min ⁻¹ 10000 min ⁻¹		second	2.8	5.0 (30000 min ⁻¹)
			0.6	0.8

High speed spindle with low thermal distortion/vibration

Spindle core cooling/under race lubrication

Makino's unique spindle core cooling system circulates a large volume of temperature-controlled cooling oil through the center of the rotating spindle to cool it directly from the inside. With under race lubrication, the cooling oil, which is circulated through the spindle also flows through the holes in the inner bearing races to lubricate the spindle bearings.



The adoption of this cooling and lubrication system achieves higher reliability, accuracy and speed. Additionally, it also facilitates the spindle for continuous operation at top speed without any concern about limitations on spindle usage. This spindle cooling and lubrication system is adopted only when 20000 min⁻¹ or 30000 min⁻¹ spindle* is selected.

*: optional specification

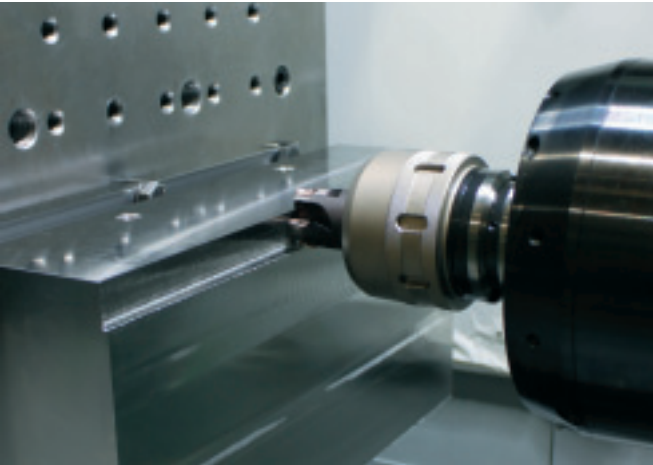
Metal removal rate: 3600 cm³/min
Material: Aluminum A5052
Spindle speed: 10000 min⁻¹
Feed rate: 9000 mm/min

25 mm diameter end mill
Axial depth of cutting: 20 mm
Radial depth of cutting: 20 mm
Spindle: High torque 14000 min⁻¹ spindle (302 N-m)*

15000 min⁻¹ standard spindle



↑ **Metal removal rate: 454 cm³/min** **Spindle speed: 1200 min⁻¹**
Material: Carbon steel S55C
Feed rate: 2520 mm/min
80 mm diameter face mill
Axial depth of cutting: 3 mm
Radial depth of cutting: 60 mm

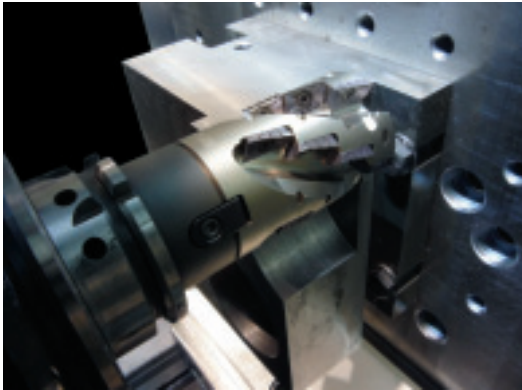


↑ **Metal removal rate: 131 cm³/min** **Spindle speed: 1500 min⁻¹**
Material: Carbon steel S50C
Feed rate: 1500 mm/min
32 mm diameter end mill
Axial depth of cutting: 2.5 mm
Radial depth of cutting: 20 mm

High torque 14000 min⁻¹ spindle (302 N-m)*



*: optional specification



↑ **Metal removal rate: 550 cm³/min**
Material: Gray Cast Iron FC250
Spindle speed: 764 min⁻¹
Feed rate: 367 mm/min
50 mm diameter end mill
Axial depth of cutting: 30mm
Radial depth of cutting: 50 mm

← **Metal removal rate: 632 cm³/min**
Material: Gray Cast Iron FC250
Spindle speed: 585 min⁻¹
Feed rate: 702 mm/min
125 mm diameter end mill
Axial depth of cutting: 10mm
Radial depth of cutting: 90 mm

1G acceleration feed* (X and Y axis)

This is available only when a51nx. When a61nx, please contact Makino representative in your area.

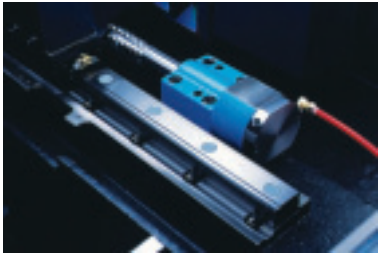
Linear axis travels (X×Y×Z)

a51nx: 560×640×640 mm

a61nx: 730×650 or 730*×800 mm

Rapid traverse: 60 m/min

Cutting feed: 1 ~ 50 m/min



1 degree indexing table (standard specification)

Minimum index angle : 1 degree

Indexing time (90 degree) a51nx: 1.4 sec

a61nx: 1.6 sec (500kg pallet loading weight)

1.7 sec (700kg pallet loading weight)

Rotary table (DD motor)*

Inertia Active Control optimizes table indexing based on work weight. (patent pending)

Minimum index angle : 0.0001 degree

Indexing time (90 degree) a51nx: 1.00 sec

a61nx: 0.98 sec

Maximum speed : 125 min⁻¹

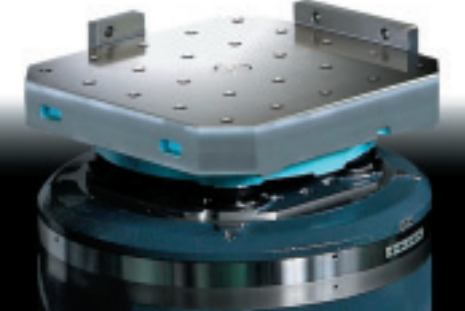
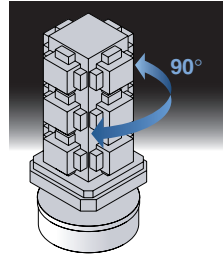
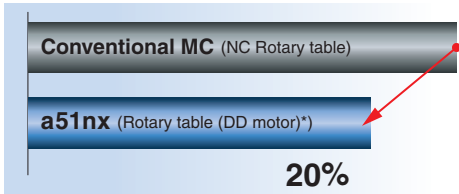
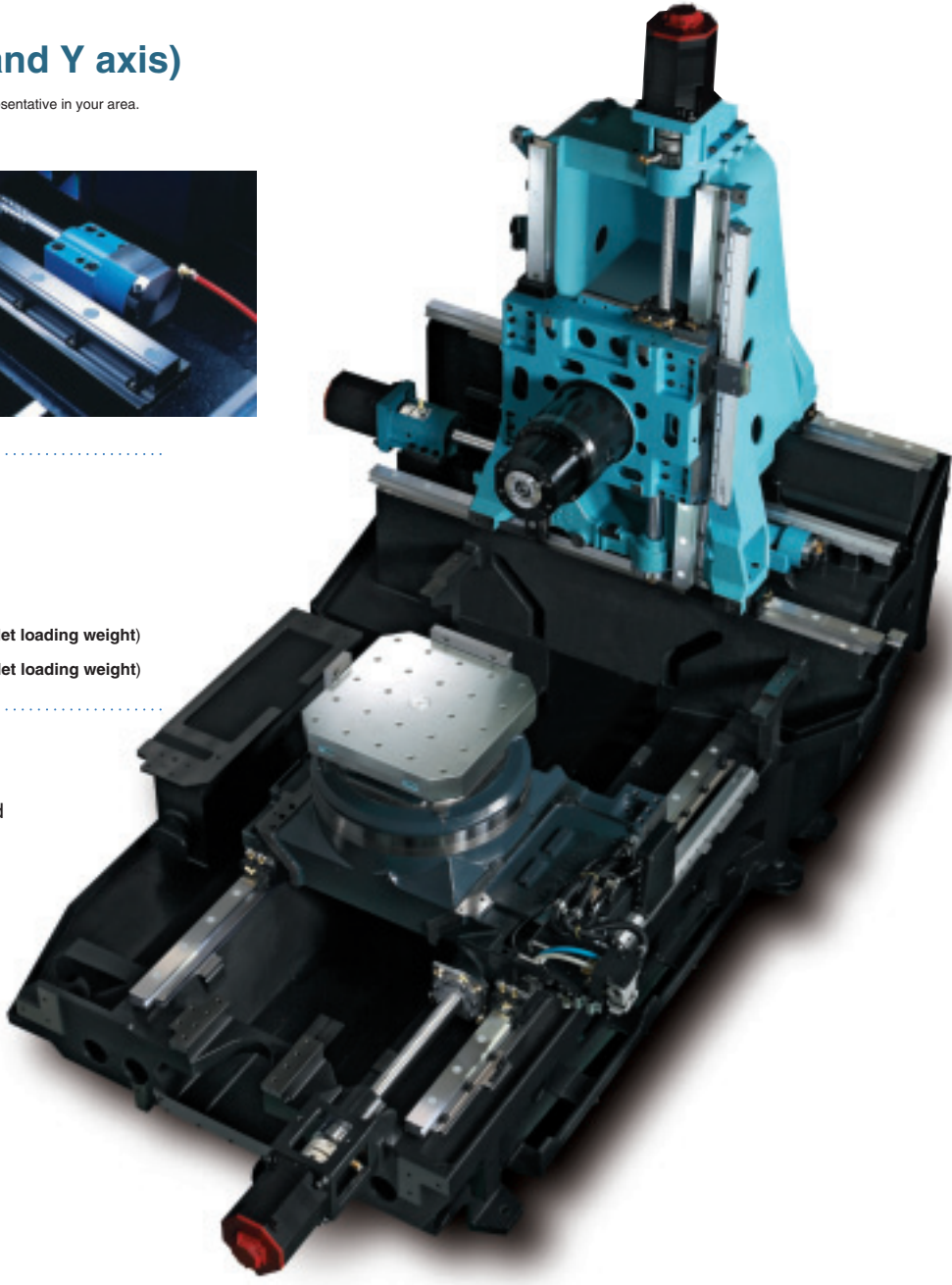


Photo: Rotary table (DD motor)*



NX machines feature a direct drive motor for the B axis. Rotary table (DD motor)* performance brings down the cycle time by 20 % by reducing the time of table indexing from 0 to 90 degree. This design eliminates backlash and wear leading to long term accuracy and superior reliability compared to a traditional NC rotary table. Heat generated by the high-performance table is removed through cooling jackets, which are placed around bearing and table direct drive motor.

*: optional specification



Rigid Construction

Slant column

The two X axis guides under the column are at different heights. This stepped design enhances rigidity of the machine structure by redirecting cutting forces back into the bed casting. This type of superior structure design supports the machine to move at high speed and high acceleration mode by reducing the weight of column without compromising the rigidity of the machine in Z axis direction.

Advanced axis cooling system

Heat generation in the axis during high speed machining can affect accuracy and performance of the machine. The nx machine has the core cooling technology of ball screws and ball screw support bearing. Cooling oil temperature maintained as per the bed casting temperature and circulated through to the ball screws and end support bearings.

Roller type linear guides

Cylindrical roller guides are used in the X and Y, Z axis. Rollers provide line contact area, which enhances the rigidity and load capacities, precision of the machines.

3 points support

Rigidity of the nx machine comes from the design, where the entire machine structure is allowed to sit on the shop floor by only three point support. The three point support reduces the installation time and allow easy deployment of the machine at production site.

GI.4 control

It is the control technology that moves the axis travels smoothly along the commanded tool path, a high response servo and high machine rigidity work in concert to deliver superb machining accuracy that does not change even at high cutting speeds.

..... High accuracy

Radical Mode M255 High-Efficiency Mode M251 High-Accuracy Mode M250 Super-High Accuracy M252

High speed <.....



Super GI.4 control (optional specification)

Super GI.4 control remarkably increases the capacity for processing tiny blocks of NC data in 3D machining jobs. These control features delivers the proper shape accuracy of the component with no error and also improves machined surface quality even at high cutting feeds. Super GI.4 control is ideal technology for die and mold machining with the aim to eliminate the polishing at the post machining stage.

Tolerance

Positioning accuracy (with scale feedback/without scale feedback)

±2.0 μm / ±2.5 μm

Repeatability (with scale feedback/without scale feedback)

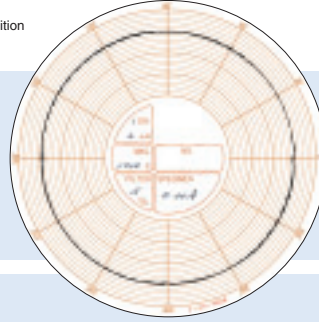
±1.0 μm / ±1.5 μm

The tolerance value can be guaranteed under the condition setting ±1 degree (°C) temperature in Makino facility.

Roundness 1.8 μm

(when machining the outer of 50 mm diameter.)

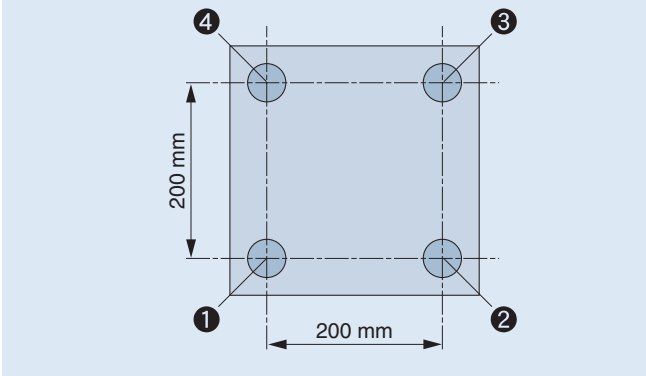
Actual value measured in Makino facility.



Pitch accuracy

Measured positions	Target values	Measured values	Error
① — ②	200.0000	200.0021	0.0021
③ — ④	200.0000	200.0011	0.0011
① — ④	200.0000	199.9999	-0.0001
② — ③	200.0000	199.9998	-0.0002
① — ③	282.8427	282.8417	-0.0010
② — ④	282.8427	282.8452	0.0025

Actual value measured in Makino facility.



Improved productivity

Comparison of machining times with currently used programs

Gear Box Housing

Machining description
· ATC 27 times
· Burnishing Reamer
· Drill
· Step Bore & Chamfer
· Boring Bar
· Face Mill

Conventional MC: 285 sec

a61nx*: 255 sec

10.5%



*Comparison of machining times for identical machining conditions and program.

Large volumes of chips in various sizes are evacuated quickly and effectively.

**Through spindle coolant
(1.5/2.2 MPa) and air**

8-nozzle coolant supply

Overhead shower coolant

Base coolant (center trough)

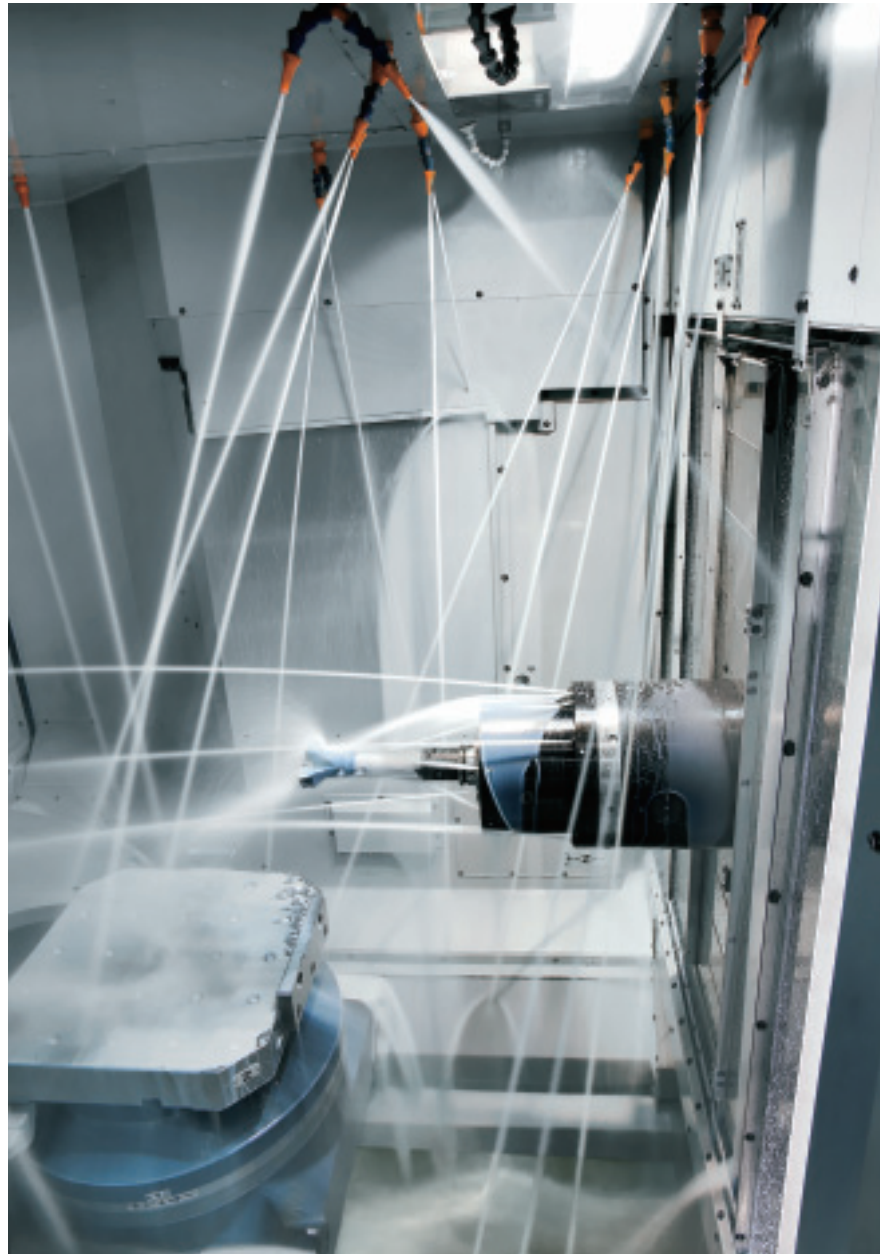
Chip Conveyor (with drum filter)

High productive machining centers generate large volumes of chips. To ensure efficient and reliable chip removal, the machining envelope is constructed almost entirely on the slanted panels.

Coolant from the spindle head and ceiling of the guard flush the chips into the center trough directly under the table. High volume base coolant in the center trough washes the chips towards the lift up chip conveyor with the flow rate of 30 L/min.

Spindle head washing coolant nozzle for chip removal from spindle top

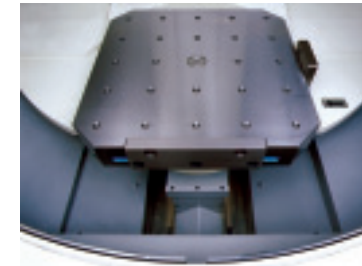
Two fixed coolant nozzles are provided to wash the top of the spindle to prevent chips from entering the spindle taper when the tool is changed.



Coolant draw back

(patented)

The through spindle coolant includes a unique coolant drawback circuit. The coolant stop command activates a draw back system that sucks excess coolant from the tool and spindle. This system reduces the time to change tool and minimizes coolant contamination on the tool magazine. It also prevents the spindle inner bearings from coolant contamination inside of the spindle and hence increases the spindle life.



Clean enviroment

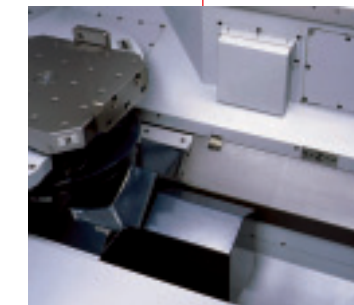
The center trough chip evacuation system extends under the pallet loading station(PLS) in the front of the machine. This construction keep PLS area clean by allowing chips to fall into the center trough where they are flushed away by the base coolant.



The machining envelope is constructed almost entirely on the slanted or vertical panels to prevent chip build up inside the machine. Removing chips from the machining chamber improves the machining conditions.

Axis travel covers

Precise guide-ways are protected from chips and coolant by innovative single panel guide covers. X and Z axis single piece cover construction eliminates the risk of damage from chip contamination and mechanical wear and tear. This design was first implemented in 2002 and has virtually eliminated guide cover failure. The moving part elements also support the high speed axis movement by reducing the complex design. On the other hand, for Y axis telescopic cover, each panel is driven by a pantograph to prevent collision with adjacent panels.



Chips are flushed into the wide center trough and reliably removed from the machine by large volume of base coolant.

Lift up chip conveyor

with stainless steel wire mesh filter

- Prevents clogging of the hose and pipe by chip accumulation.
- Prevents filter damage.

Please contact Makino representative in your area when the other exclusive chip conveyor for cast iron or non water soluble (oil based) coolant etc. is needed.



Shorter time to change tool

Servo driven ATC shutter can synchronize the opening distance to match the tool lengths. This can reduce the time to change tool (chip to chip) and the contamination of chip and coolant in the tool magazine.

Tool-to-tool: 0.9 sec

Chip-to-chip a51nx: 2.2 sec / a61nx: 2.4 sec (MAS measurement system)

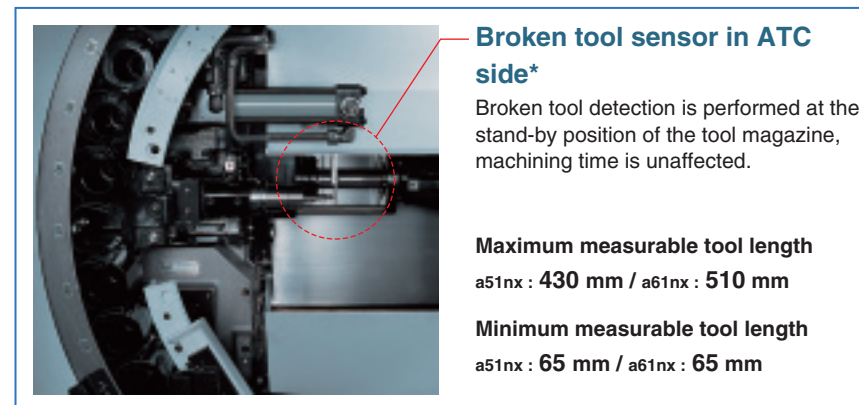


High speed ring type tool magazine

Tool preparation time : 2.9 seconds at minimum
(only when 40 tools magazine)

Tool storage capacity: 40 or 60*

60* tools magazine in this photo is optional specification.



Broken tool sensor in ATC side*

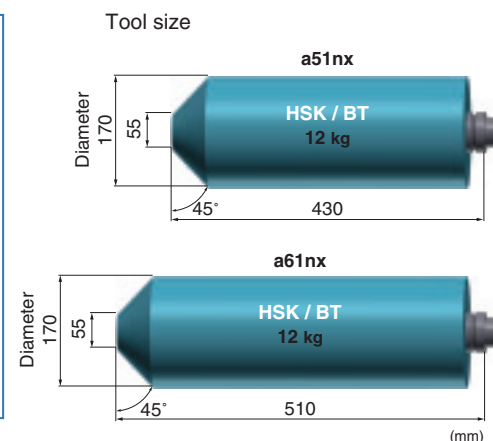
Broken tool detection is performed at the stand-by position of the tool magazine, machining time is unaffected.

Maximum measurable tool length

a51nx : 430 mm / a61nx : 510 mm

Minimum measurable tool length

a51nx : 65 mm / a61nx : 65 mm



Large capacity matrix magazine

Tool storage capacity: 133* or 218*, 313*

Even large tool can be set and removed easily by this tool loading station (TLS).



133* tools magazine



313* tools magazine

*: optional specification



Excellent spindle accessibility

The L-shape operator door provides convenient spindle and tool access easily.



Pallet loading station

Opening the door at the pallet load station provides easy access to the crane when loading fixtures and components without any obstruction.



Control panel

The control panel is mounted on the left side of the operator door and can be rotated 180°. This provides ideal visibility to the tool, fixture, and work piece during process prove out.



Easy maintenance

Units that require daily inspection are placed together on the rear panels of the machine. An automatic grease lubrication system is provided as standard equipment.

Automation boosts productivity

Flat pallet magazine

- 7 pallets + 1 WSS
- 8 pallets + 8 WSS

Vertical 2-tier pallet magazines

- 14 pallets + 1 WSS
- 12 pallets + 2 WSS

Vertical 3-tier pallet magazines

- 21 pallets + 1 WSS
- 18 pallets + 2 WSS

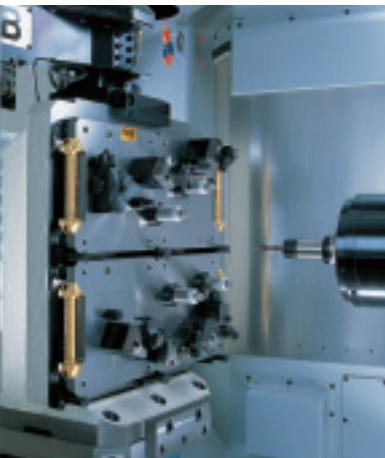
Robot automation specification

(Please contact Makino representative to discuss automation of your specific application)

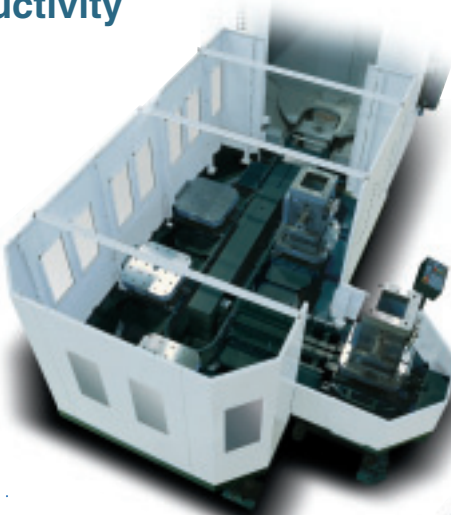


μMMC (only available with a61nx)

This system combines an automatic pallet handling system and maximum 21 pallets to facilitate continuous unmanned operation.



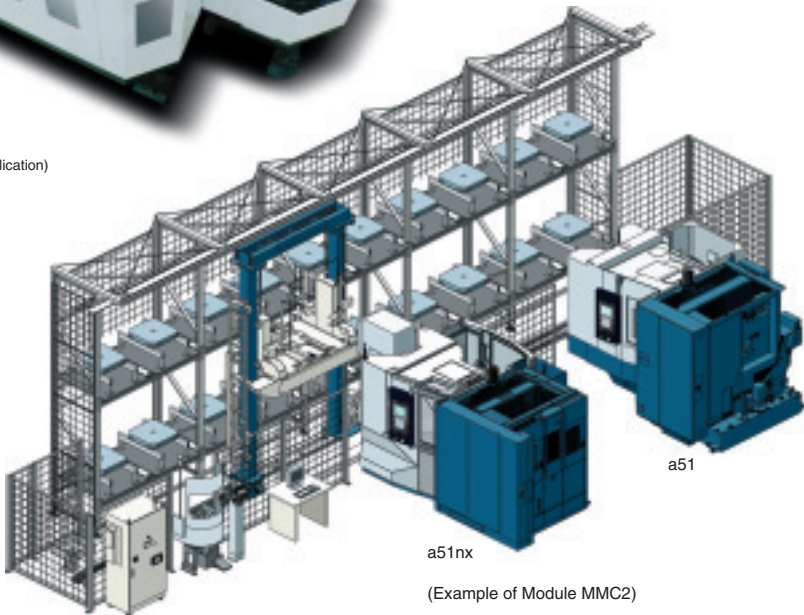
The all items shown on page 13 are optional specifications.



Track type pallet magazine
I or T type

6 or 8,10, 12 pallets + 1 WSS

Photo: I type 6 pallets Track type pallet magazine



a51nx

a51

(Example of Module MMC2)

Module MMC2

The nx family of machines can be integrated into Makino's MMC2 flexible manufacturing system. Existing MMC2 systems can be expanded by combination of the a51nx and a51 machines or the a61nx and a61 machines. The nx machines share a common pallet, design with the previous model (with conditions for a61nx and its pallet).

CPH upper on-line type hydraulic and pneumatic pipe

6 + 6 ports, 12 + 12 ports

A maximum of 12 ports per pallet can be used to supply hydraulic and pneumatic. One more port is also available for supplying jig wash coolant.

Jig controller for CPH

The jig controller for CPH consists of the hydraulic unit for supplying hydraulic to the jigs, the CPH control panel, and the control unit.

Automatic coupling

Through Pallet Hydraulic and Pneumatic coupler

Trough pallet hydraulic or pneumatic can be supplied through the bottom of the pallet by automatic couplers. The fixture, the customers design and supply must include check valve to maintain the pressure during pallet is changed.

Specifications

			a51nx	a61nx
Travels	X, Y, Z axis	mm	560 x 640 x 640	730 x 650 or 730* x 800
	B axis (pallet table rotation)	degree	360	
	Distance to spindle center from pallet surface	mm	80 ~ 720	80 ~ 730 or 810*
	Distance to spindle gauge line from pallet center	mm	100 ~ 740	100 ~ 900
Pallet	Size	mm	400 x 400, 500 x 500* (only with tapped hole)	500 x 500 (not common to a51nx)
	Maximum work size (diameter x height)	mm	630 x 900	800 x 1000
	Maximum pallet loading weight	kg	400	500 or 700 (selectable)
	Pallet surface configuration		24 x M16 tapped hole (14mm T slots*)	24 x M16 tapped hole (18mm T slots*)
	Index angle	degree (division)	1 (360)	
	Indexing time 90 / 180 degree (when rotary table (DD motor)* is selected.)	second	1.4 (1.00*) / 1.7 (1.21*)	1.6 (0.98*) / 2.1 (1.19*) only when below 500 kg
	Height to pallet surface	mm	1100	1200
Spindle	Speed range	min ⁻¹	50 ~ 15000	
	Taper hole		7 / 24 No.40 (HSK-A63*)	
	Motor rated output power (25%ED / 10 / 30 min / continuous)	kW	22 / 18.5 / 15 / 11	
	Torque (10 / 15 / 25%ED / continuous)	N•m	120 / 99 / 66 / 42	
	Acceleration time (15000 / 8000 min ⁻¹)	second	1.3 / 0.4	
	Lubrication / cooling		Oil air / Jacket	
Feedrates	Rapid traverse	mm/min	60000	
	Cutting	mm/min	1 ~ 50000	
Automatic tool changer	Number of tool storage capacity		40 (60*, 133*, 218*, 313*)	
	Maximum tool diameter no condition / with condition	mm	70 / 170	
	Maximum tool length	mm	430 (420* when HSK-A63*)	510
	Maximum tool weight	kg	12	
	Maximum tool moment	N•m	11.76	
	Tool change time tool to tool (excludes shutter time) / chip to chip (MAS method)	second	0.9 / 2.2	0.9 / 2.4
Machine size standard specification	Width x Depth	mm	2684 x 4236	2910 x 4888
	Height	mm	2722	3342
	Weight when 40 tools magazine	kg	8700	12000
	Number of support point		3	

*: optional specification

Standard specifications

- 15,000 min⁻¹ spindle
- Spindle temperature controller
- Core cooling ball screw and support bearing
- 1 degree (360 division) index table
- 2 pallets with tapped hole
- 40 tools magazine
- (Automatic) Pallet changer (APC) with guard
- Through spindle coolant (1.5 / 2.2 MPa: 50/60 Hz) and air
- 8-nozzle coolant supply
- Overhead shower coolant
- Terrace washing coolant
- Base coolant (center trough)
- Chip Conveyor LSW 515/880 (a51nx / a61nx, left discharge, scraper)
- Splash guard with 1 LED lamp
- Operator door lock (operation mode)
- APC (guard) door lock
- ATC door interlock
- Automatic grease supply unit
- Portable manual pulse generator with handle enabling button
- Signal light (3-layer)
- Interface for automatic fire extinguisher
- Rigid tap
- GI.4 control
- Tool life monitoring function
- Data center
- Spindle-table crash avoidance function
- ECO mode functions
- Automatic power shut off

Optional specifications (■) / Optional equipment (■)

- High torque 14000 min⁻¹ spindle (240 N•m)
- High torque 14000 min⁻¹ spindle (302 N•m)
- 20000 min⁻¹ spindle (spindle core cooling)
- 30000 min⁻¹ spindle (spindle core cooling)
- HSK-A63 spindle
- BIG PLUS (BBT40)
- Scale feedback(X,Y,Z axis,0.05 μm)
- Feed axis acceleration X/Y=1G/1G
- Rotary table (DD motor)
- Pallet clamp confirmation function
- 1, 2, 4-face angle plate (T-slots)
- High rigid 2-face angle plate (tapped hole)
- Through spindle coolant (3.0 / 7.0 MPa) and air
- Chip Conveyor BSW 990 (rear discharge, scraper)
- Chip Conveyor LDW 955 (rear discharge, double: scraper and hinge)
- Chip Conveyor BDW 1030 (rear discharge, double: scraper and hinge)
- Magnet drum Chip Conveyor (for cast iron) C-LSW 955 (left discharge, scraper)
- *Magnet drum Chip Conveyor (for cast iron) C-BSW 1030 (rear discharge, scraper)
- Chip Conveyor LSO 850 (a51nx) / 1200 (a61nx) (left discharge, scraper, oil based)
- *Chip Conveyor BSO1200 (rear discharge, scraper, oil based)
- *Chip Conveyor LDO975 or 1200 (left discharge, double: scraper and hinge, oil based)
- *Chip Conveyor BDO1200 (rear discharge, double: scraper and hinge, oil based)
- Center trough conveyor (hinge, double chip conveyor has to be selected with this.)
- Workpiece washing gun
- Coolant temperature controller
- Chip bucket (Tilttable handcart)
- Mist collector
- MQL (mist blow)
- Operator door lock & APC door lock (with power shut off)
- ATC door lock (with power shut off, operator door lock & APC door lock has to be selected with this.)
- Retractable automatic tool length device
- Automatic workpiece measuring device
- Air dryer
- Portable manual plus generator with tool position display and handle enable button
- Super G.I 4 control
- Customer specified machine color

*: available only when a61nx.