

H o r i z o n t a l

a92

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M a c h i n i n g C e n t e r

H o r i z o n t a l



M a c h i n i n g C e n t e r

a92

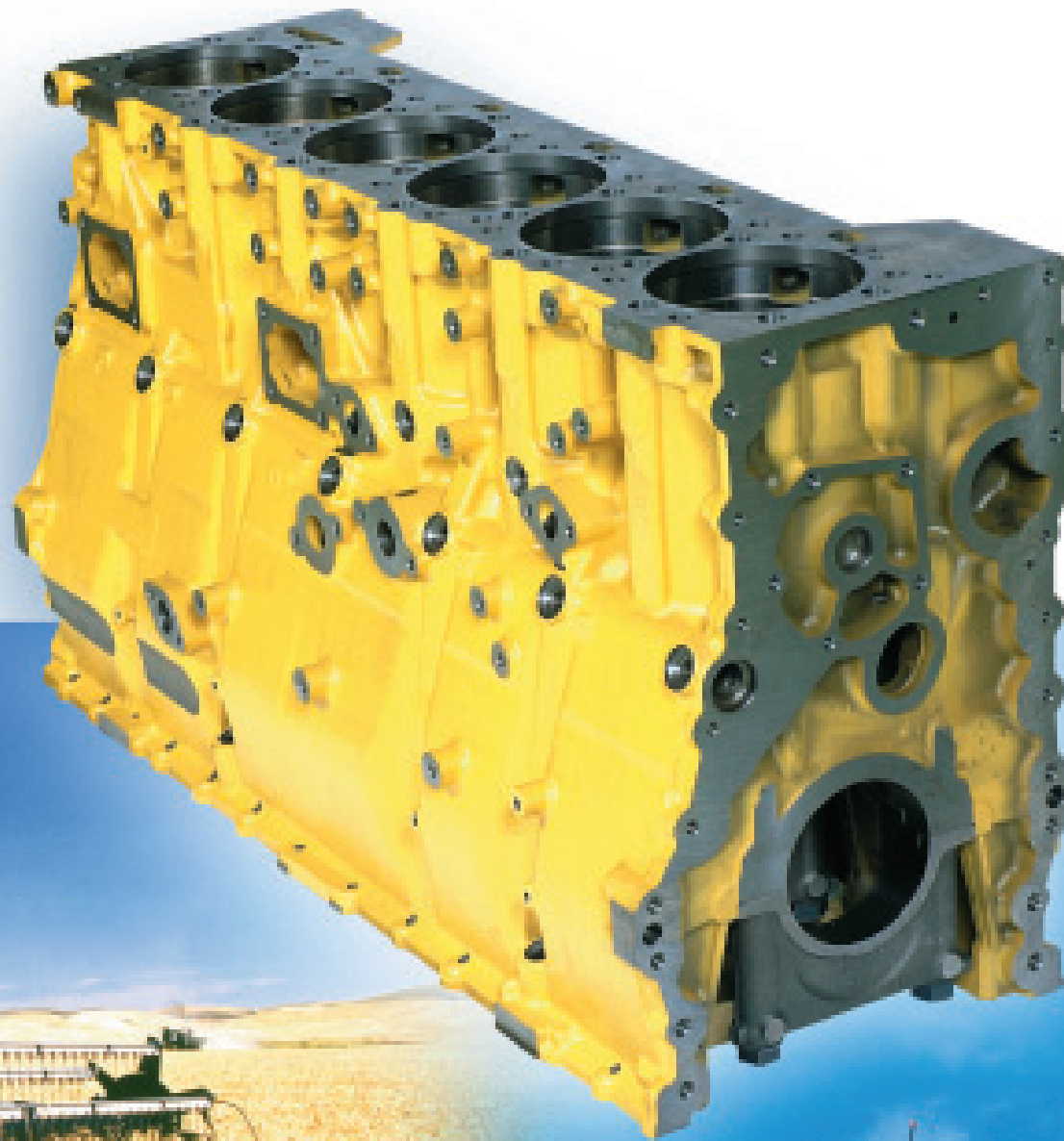
For enhanced manufacturing capabilities

The task of achieving the highest possible production efficiency and quality within a limited time frame is a constant challenge for the shop floor.

Makino machining centers consistently demonstrate the greatest potential for meeting this challenge by operating quickly and efficiently to cut materials fast, smoothly and accurately. On top of this essential performance, Makino machines are carefully designed and engineered for superior reliability, such as by incorporating unique features to prevent chips from getting into the spindle taper.

At Makino, we believe that this fusion of a meticulously built machine and outstanding fundamental performance results in the optimum production tools.

When it comes to enhancing manufacturing capabilities, Makino machining centers contribute effectively in many valuable ways.



a92 Horizontal Machining Center

Answer the requirements of machining Large components for Trucks, Agricultural machinery, construction equipments and structural parts for aerospace industry.

With optimal features the a92 is most suitable especially for cylinder blocks and heads of In-line 6 cylinder Diesel engines.

Travels
1520x 1250x1350mm

Pallet size
800x1000mm

Maximum workpiece size (dia. x height)
1500x1500mm

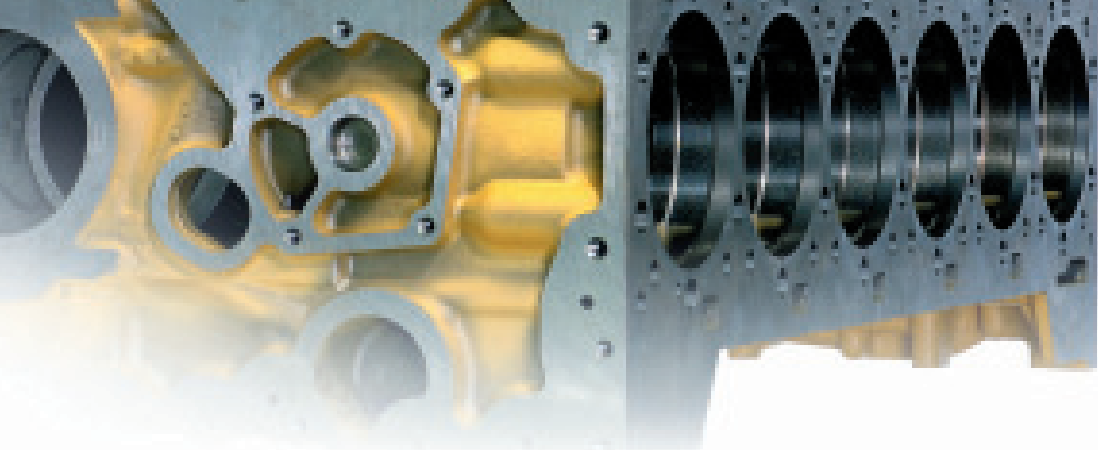
High-torque spindle
1009N·m

Maximum tool diameter
356mm

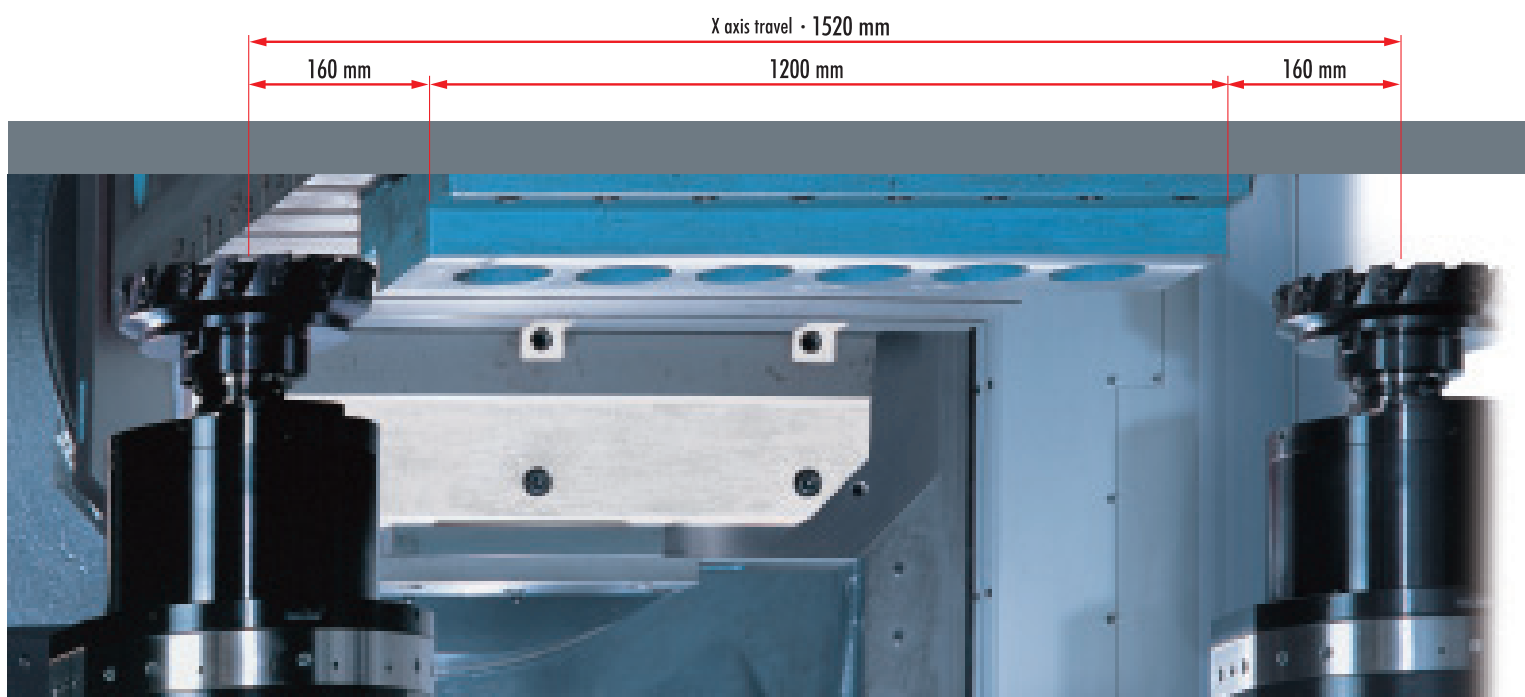
Maximum tool length
900mm

Maximum tool weight
30kg

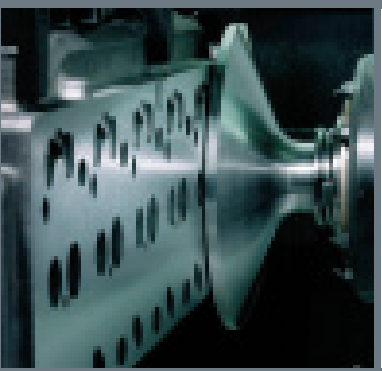
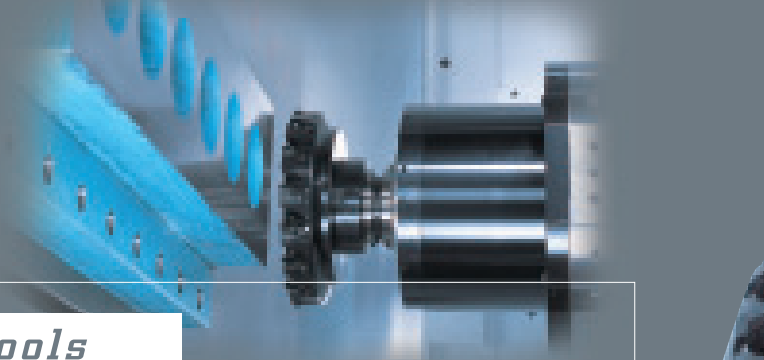




X axis stroke of 1520mm ensures the best solution for machining the Deck face of Big size In-line 6 cylinder engines



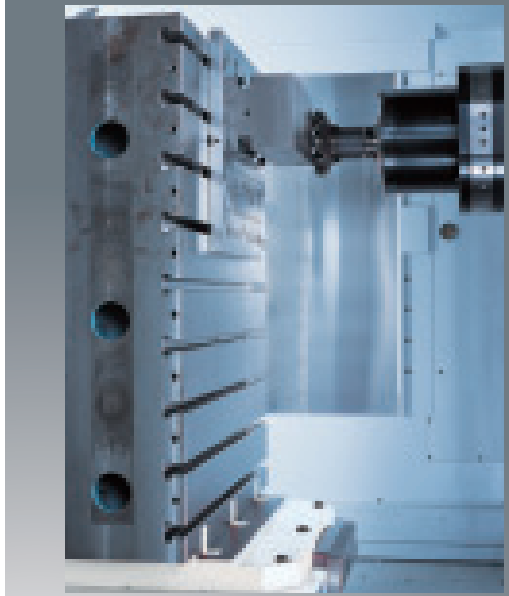
Optimal Deck face milling of Big size cylinder blocks and heads can be performed using a Large diameter face mill which exceeds 300 mm dia. Carefully designed with an ideal X stroke of 1520mm, the α92 allows "Feed on, feed off" machining process along the same axis direction even using large diameters face mill.



Smart Tools

Face Grinding / Super abrasive Honing
Smart tools enable to grinding the Deck face of cylinder blocks and heads and to perform Honing operation of the cylinder bore in the same machining center, avoiding the use of Special Purpose machines.

High torque spindle of 1009 N-m provides superior cutting performance for especially hard, tough-to-cut materials



■ Workpiece material — Ductile cast iron (FCD450)
Machining in upper range of Y-axis
■ Spindle speed — 360 min⁻¹
■ Feedrate — 1000mm/min
■ Depth / width of cut — 5.0 / 120mm
Metal removal rate: **600** cm³/min

Tool used: 160 mm dia. face mill (9 inserts)



■ Workpiece material — CGI (Compacted Graphite Iron)
■ Spindle speed — 400 min⁻¹
■ Feedrate — 810mm/min
■ Depth / width of cut — 10.0 / 120mm
Metal removal rate: **972** cm³/min

Machining in lower range of Y-axis
■ Spindle speed — 360 min⁻¹
■ Feedrate — 1000mm/min
■ Depth / width of cut — 10.0 / 120mm
Metal removal rate: **1200** cm³/min

Tool used: 160 mm dia. face mill (26 inserts)

■ Workpiece material — CGI (Compacted Graphite Iron)
■ Spindle speed — 400 min⁻¹
■ Feedrate — 3120 mm/min
■ Depth / width of cut — 3.0 / 120mm
Metal removal rate: **1123** cm³/min



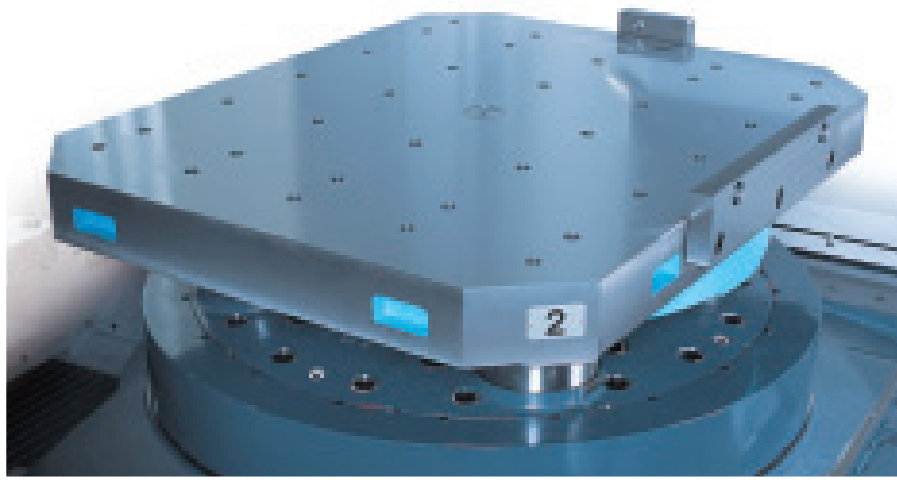
M a c h i n i n g p e r f o r m a n c e

Optimum pallet size for machining the cylinder blocks and heads of big size in-line 6-cylinder engines

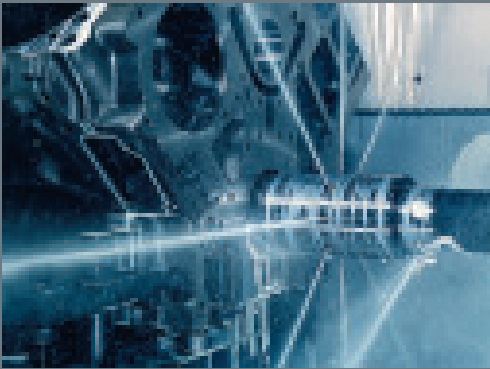
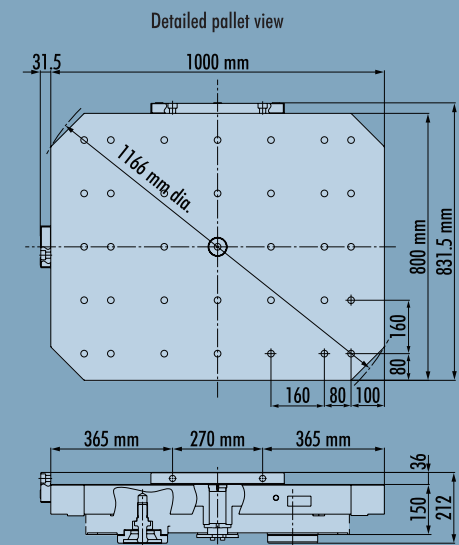
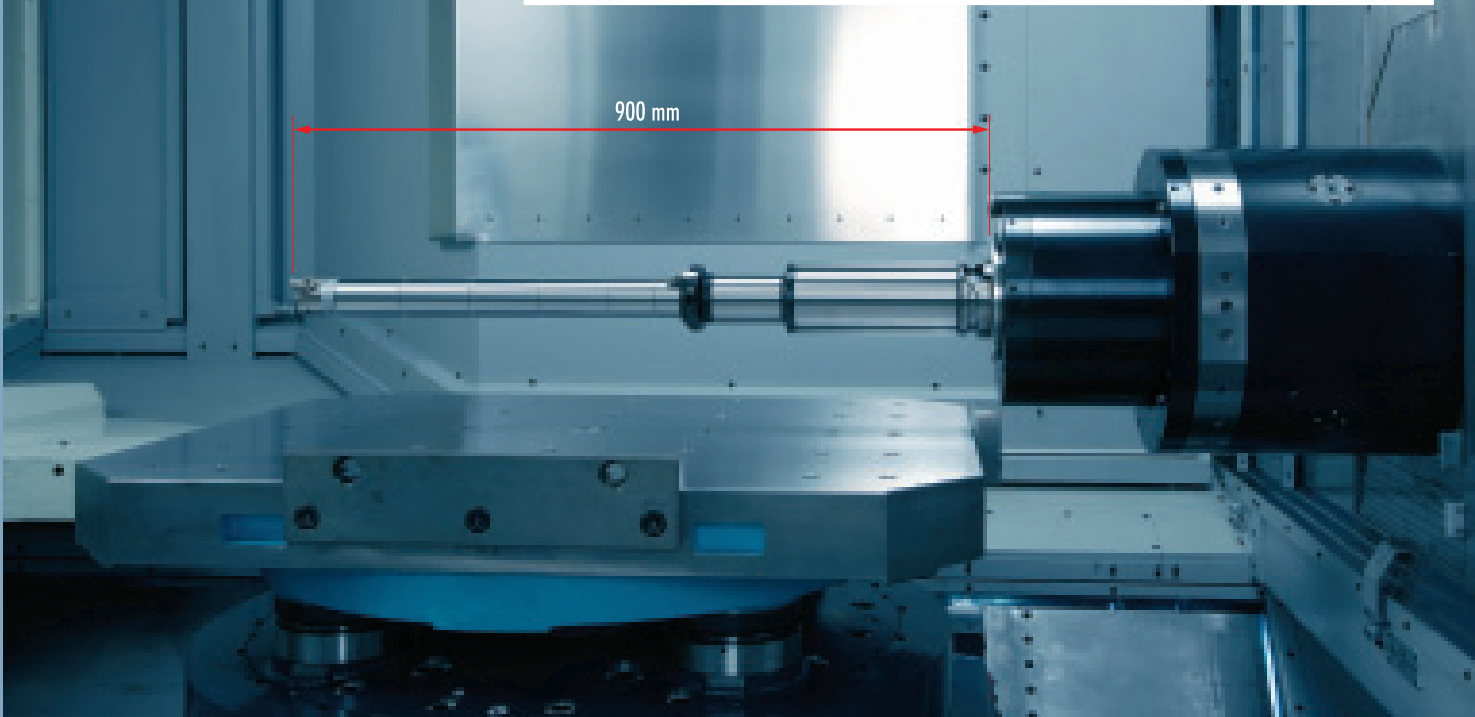
The a92 features a pallet size of 800 x 1000 mm that is optimally suited for machining the cylinder blocks and heads of in-line 6-cylinder engines.

Maximum tool length of 900 mm

Boring bars up to 900 mm in length can be changed automatically. This long length makes it possible to machine through holes in large workpieces from one side.



The photo shows the pallet when turned 90°.

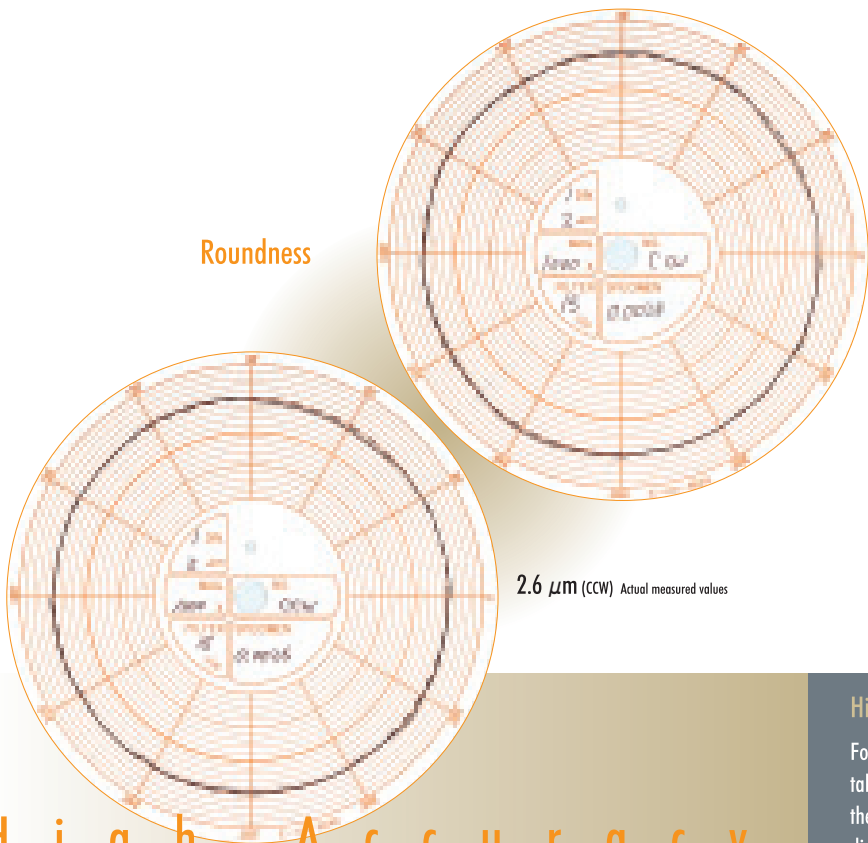


Smart Tools



This horizontal machining center a92 demonstrates the potential of tools dedicated to "Smart Tool"

The machining center has a hydrostatic boring bar which is used in conjunction with the original dedicated jig to guarantee position, coaxial accuracy and precision finish required for machining crankshafts.



High Accuracy

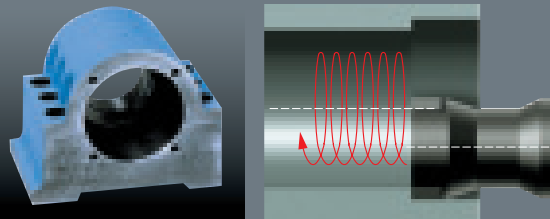
Static accuracy

Positioning accuracy (Full travel)	(without scale feed back)	• ± 0.0025 mm
	(with scale feed back*)	• ± 0.0020 mm
Repeatability (Full travel)	(without scale feed back)	• ± 0.0015 mm
	(with scale feed back*)	• ± 0.0010 mm

Guaranteed value: tolerance at Makino's assembly plant (daily temperature change: $\pm 1^{\circ}\text{C}$) *: Optional specification

High contouring accuracy facilitates process concentration

For boring the machinery parts, many tools are required and it may take much time and bothered the operator to manage and maintain them. By contouring, only one tool cutter can be drilled the different diameter holes, the operator improve the machining productivity.

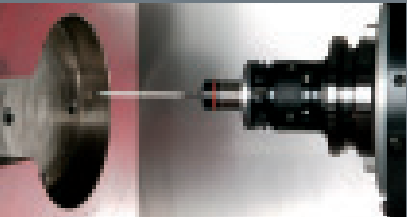


The process by lathe can be replaced with the contouring by machining center. This concentrated process of machining substantially reduces setup time greatly.



Automatic workpiece measuring device

Automatic workpiece measurement boosts productivity by minimizing the need for operator intervention to check and adjust machined diameters.

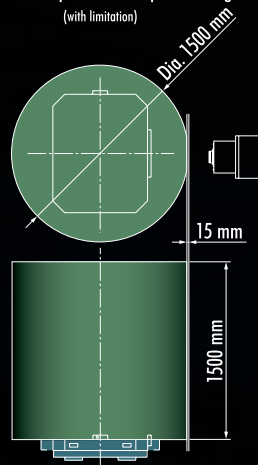


a92 Horizontal Machining Center

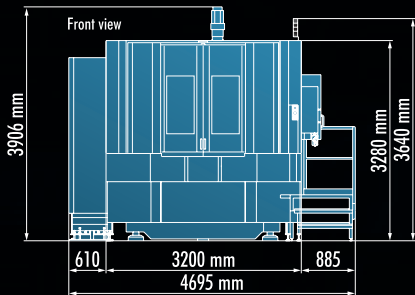
Axis travels (XYZ)	• 1520 x 1250 x 1350 mm
Pallet working area	• 800 x 1000 mm
Maximum workpiece size (dia. x height)	• 1500 x 1500 mm
Maximum pallet load	• 2000 kg (3000 kg ^{*1})
Max. tool length	• 900 mm
Max. tool weight	• 30 kg (35 kg ^{*2})

(^{*1}) Optional specification (^{*2}) 92 or larger tools magazine

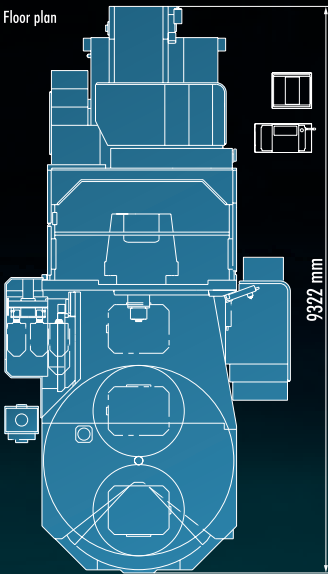
Maximum workpiece size for pallet changes
(with limitation)

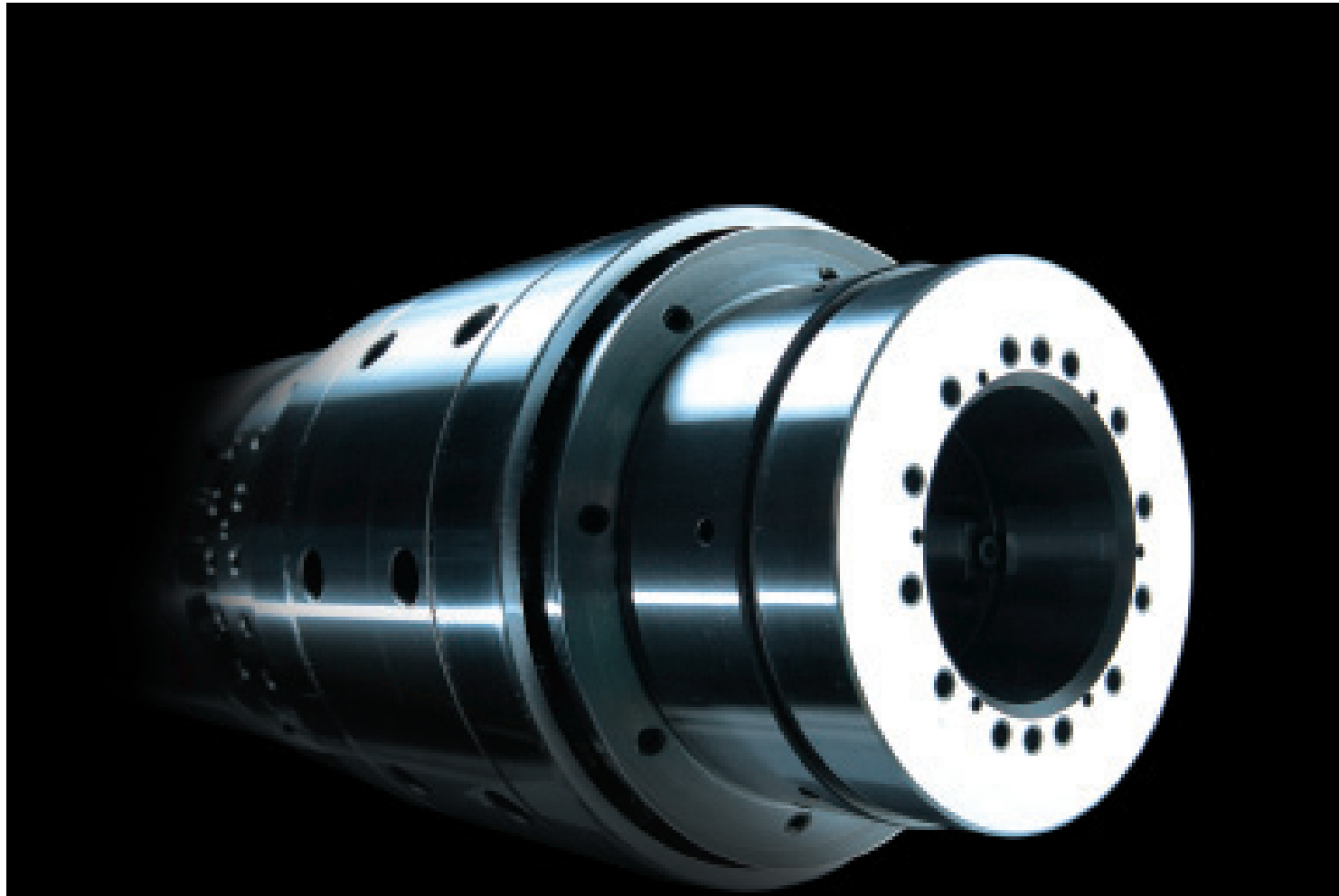


Machine size



Floor plan





"Makino's Engines" offer the highest level of machining performance

The engine of a machine center is the spindle.

Makino meticulously developed and produced its own spindle since foundation.

In 1984 Makino introduced in the market a No40 taper spindle (14000 min⁻¹) and in 1990 a No50 taper Spindle (15000 min⁻¹).

Makino's spindle reflects a philosophy that the most important virtues of a spindle are reliability, performance, long life and less vibration. So we select the most premium materials and most rigid components and utilize superior manufacturing technology with assembly accuracy controlled to the sub-micron level. These solutions enable the spindle to suppress rotational vibrations of the tool tip of both long boring bar and large-diameter tools and thereby produced excellent surface finishes of high uniform quality.

Four types of spindle variations, designed for use in a variety machining fields under the severest conditions, can be select on the a92 machines.

All these spindles are integrated with the rotor of the drive motor to reduce vibration during high-speed operation and to achieve faster acceleration and deceleration which contributes to reduce the non-cutting time.

Makino's unique spindle technology fits on a92 contributes effectively to ensure success for your manufacturing operations.

Standard spindle

The standard spindle is well suited to handling a wide variety of machining jobs, ranging from high-volume cast iron parts for automobiles, construction equipment and agricultural machinery to steel and aluminum components. Providing powerful output of 35 kW, the standard spindle achieves low vibration for superior machining quality. This spindle delivers an optimum balance of impressive cutting capabilities in many different machining fields, including rigid tapping at 3000 min⁻¹.

Spindle speed range	• 20 –10000 min ⁻¹
Spindle drive motor (15 min/cont.)	• 35 / 25 kW
Spindle bearing inner / outer diameter	• Dia. 110 / 170 mm
Spindle starting time 10000 min ⁻¹	• 3.8 sec
5000 min ⁻¹	• 1.4 sec
Spindle torque characteristic (25%ED/ cont.)	• 488 / 304 N·m

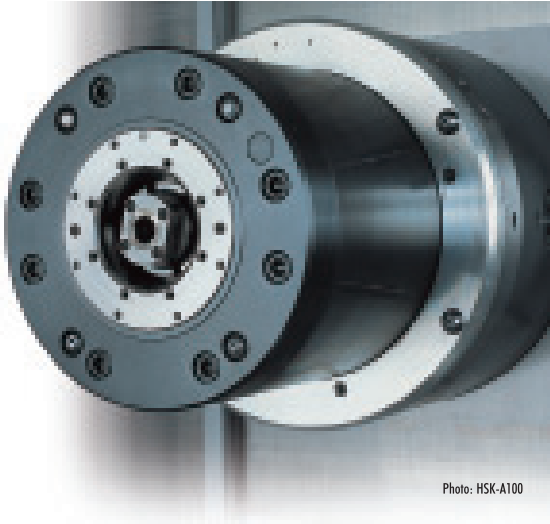
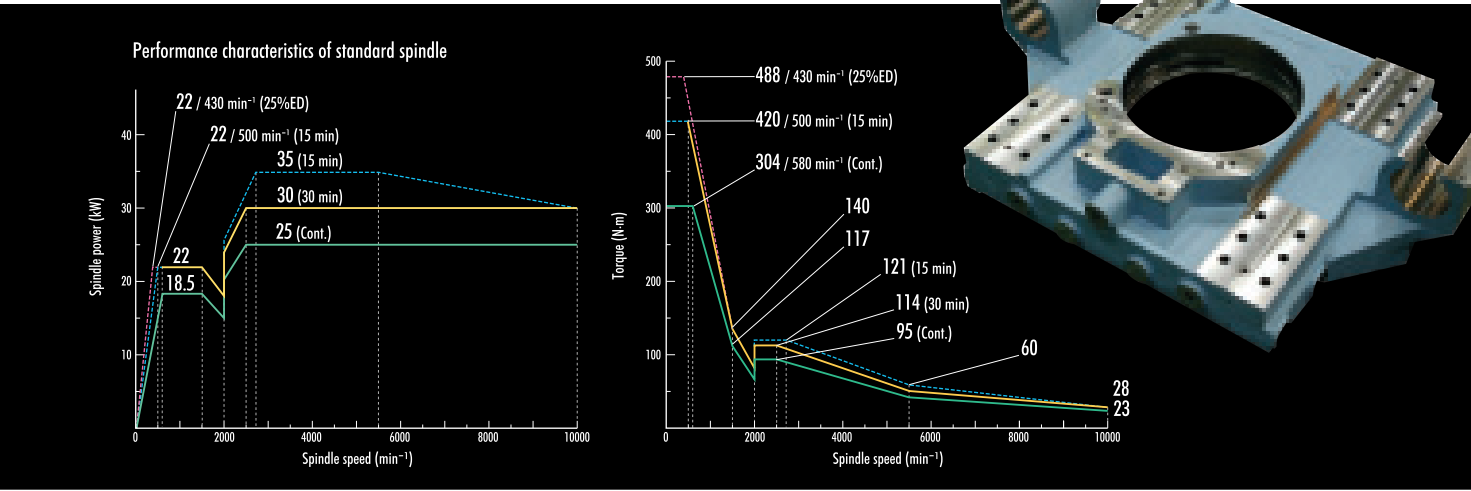


Photo: HSK-A100



M a c h i n i n g p e r f o r m a n c e



[Drilling]

Standard spindle: 488 N·m (25%ED), BT50

- Workpiece material — Gray cast iron (FC250)
- Tool used — Dia. 68 mm insert drill
- Spindle speed — 935 min⁻¹
- Feedrate — 187 mm/min

Metal removal rate: 679 cm³/min

High torque spindle : 1009 N·m (15%ED), BT50

- Workpiece material — Ductile cast iron (FCD450)
- Tool used — Dia. 68 mm insert drill
- Spindle speed — 702 min⁻¹
- Feedrate — 106 mm/min

Metal removal rate: 384 cm³/min



[Face milling]

Standard spindle: 488 N·m (25%ED), BT50

- Workpiece material — Ductile cast iron (FCD450)
- Tool used — Dia. 125 mm insert drill
- Spindle speed — 630 min⁻¹
- Feedrate — 1320 mm/min

Machining in upper range of the Y-axis

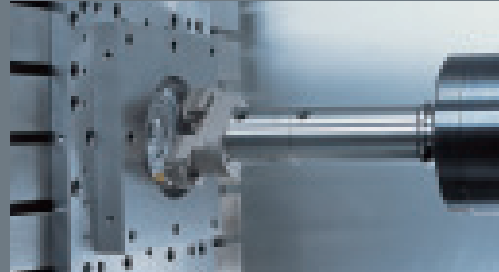
- Depth / width of cut — 4 / 100 mm

Metal removal rate: 528 cm³/min

Machining in nearby –200mm of the Y-axis

- Depth / width of cut — 5 / 100 mm

Metal removal rate: 660 cm³/min



[Boring]

Standard spindle: 488 N·m (25%ED), BT50

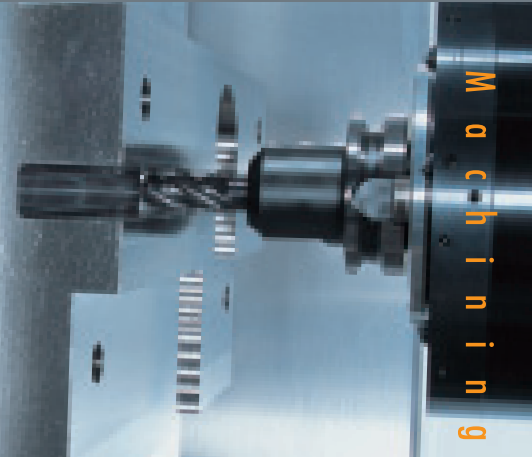
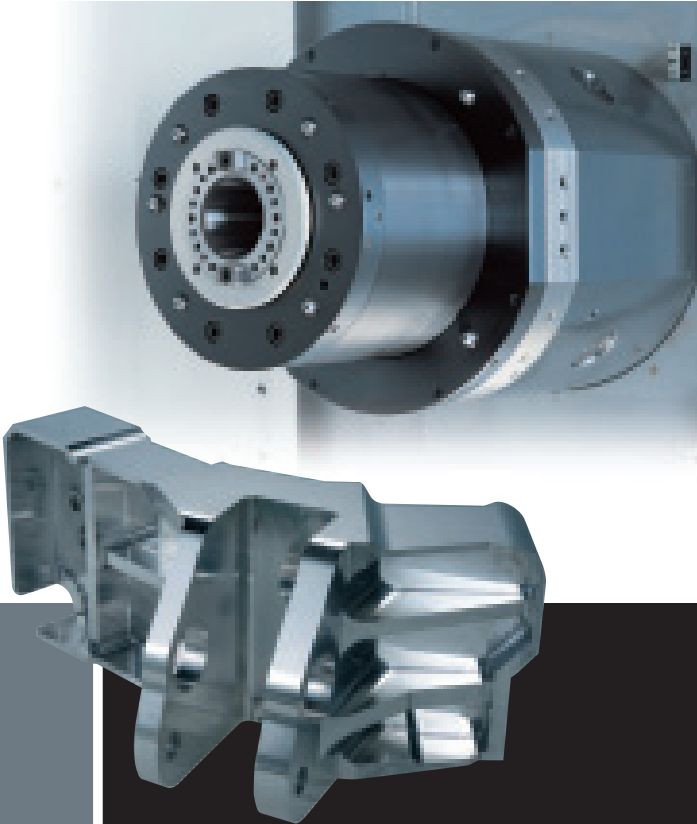
- Workpiece material — Ductile cast iron (FCD450)
- Tool used — Dia. 190 mm boring
- Tool length — 465 mm
- Spindle speed — 167 min⁻¹
- Feedrate — 67 mm/min
- Stock removed (One side) — 5.0 mm

High-torque spindle

(Optional specifications)

This spindle generates 1009 N·m of torque, unprecedented performance for a gearless construction that integrates the spindle and the rotor of the drive motor. It features large-diameter bearings with an inner diameter of 120 mm, which fully bring out the spindle’s superior capabilities in jobs requiring exceptionally high levels of torque. These include large-diameter boring, large diameter tapping and large-diameter face milling of the cast-iron

Spindle speed range	• 20 –8000 min ⁻¹
Spindle drive motor (30 min / cont.)	• 37 / 30 kW
Spindle bearing inner / outer diameter	• Dia. 120 / 180 mm
Spindle starting time (8000 min ⁻¹ / 4000 min ⁻¹)	• 4.3 sec / 1.5 sec
Spindle torque characteristic (15%ED/ cont.)	• 1009 / 504 N·m



[Slotting]

- Workpiece material — Ti-6Al-4V
- Tool used — 25 mm dia. solid carbide end mill
- Spindle speed — 1020 min⁻¹
- Feedrate — 367 mm/min
- Depth / width of cut — 25 / 25 mm

Metal removal rate: 229 cm³/min

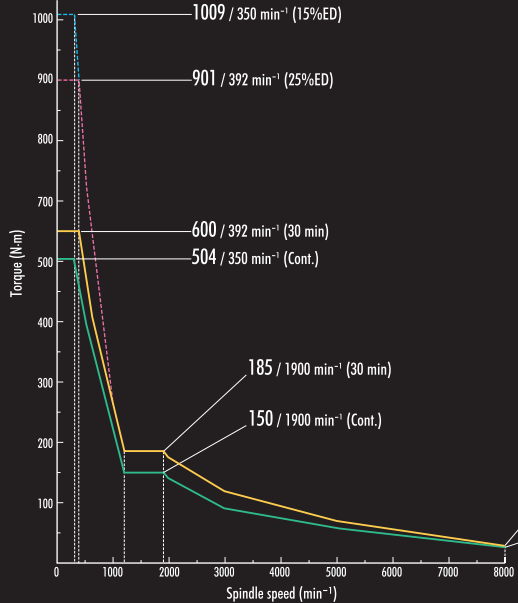
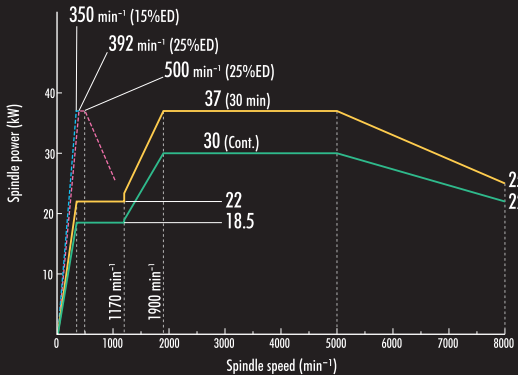
[Face milling]

- High torque spindle: 1009 N·m (15%ED), BT50
- Workpiece material — Ductile cast iron (FCD450)
 - Tool used — Dia.200 mm face mill
 - Spindle speed — 320 min⁻¹
 - Feedrate — 1280 mm/min
 - Depth / width of cut — 4 / 175 mm

Metal removal rate: 896 cm³/min

performance

Performance characteristics of high-torque spindle

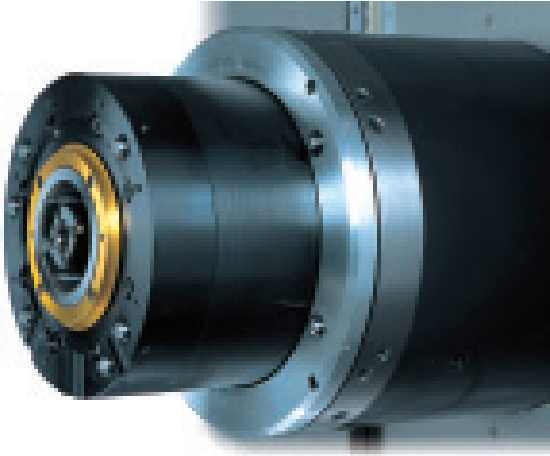


20000 min⁻¹ spindle (Spindle core cooling)

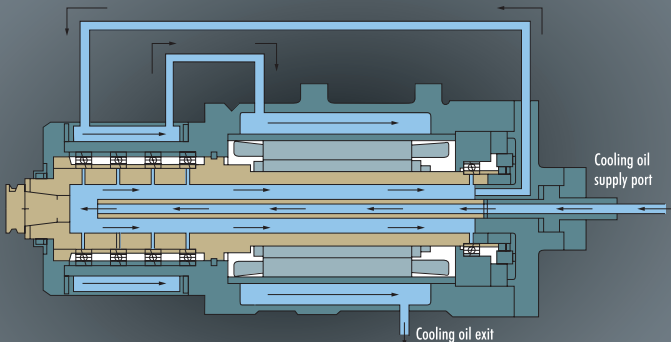
20000 min⁻¹ high-power spindle (Spindle core cooling)

(Both spindles are optional specification)

Makino’s unique spindle core cooling and under race lubrication system is used to cool and lubricate the spindle. This advanced system effectively minimizes spindle thermal distortion in high-speed operation to maintain stable high accuracy even over long hours of continuous machining. The machine is ideally suited to the pre-cutting of aluminum parts that involve deep cavity machining, such as vacuum chambers, landing gears and others. Moreover, the 20000 min⁻¹ high-power spindle also delivers high spindle power of 55 kW for impressive machining performance.



Spindle speed range	• 50 –20000 min ⁻¹	
Spindle taper hole	• HSK-A100	
Spindle drive motor	• 20000 min ⁻¹ spindle (10 min / cont.) • 20000 min ⁻¹ high-power spindle (10 min / cont.)	• 30 / 25 kW • 55 / 50 kW
Spindle bearing inner / outer diameter	• Dia. 100 / 150 mm	
Spindle starting time	• 20000 min ⁻¹ spindle (10000 / 20000 min ⁻¹) • 20000 min ⁻¹ high-power spindle (10000 / 20000 min ⁻¹)	• 6.5 / 22.0 sec • 4.4 / 10.4 sec
Spindle torque characteristic	• 20000 min ⁻¹ spindle (10 min / cont.) • 20000 min ⁻¹ high-power spindle (25%ED/ cont.)	• 350 / 238 N·m • 350 / 190 N·m



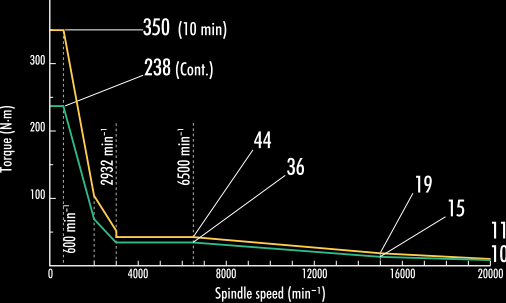
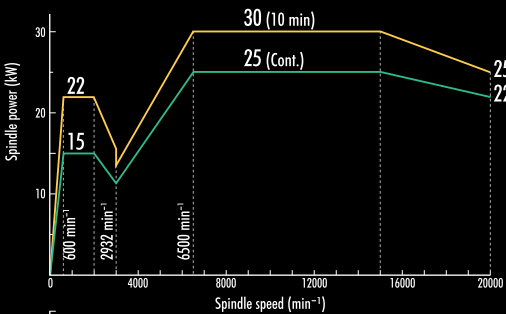
Spindle cooling and lubrication system

Makino’s 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. This unique system effectively minimizes thermal distortion even during high-speed operation of the rigid spindle with its large 100 mm inner diameter bearings.

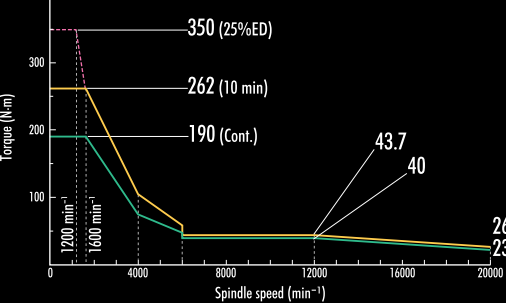
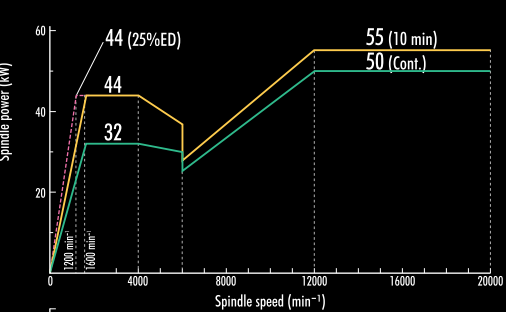
The cooling oil increases slightly in temperature as it flows through the spindle core and is then circulated to the outer housing. The resulting temperature difference always keeps the spindle cooler than the housing. This temperature difference and the superior effect of spindle core cooling enable the spindle bearings to be amply preloaded to facilitate heavy-duty cutting even of steel.

With under race lubrication, the cooling oil circulated through the spindle flows through holes in the inner bearing races to lubricate the bearings as well. Since the rotating bearings are lubricated from the inner races, centrifugal force acts to provide reliable lubrication even when the bearings are turning at high speed. (Patents approved)

Performance characteristics of 20000 min⁻¹ spindle



Performance characteristics of 20000 min⁻¹ high-power spindle



Horizontal Machining Center that achieves both heavy duty cutting ability and speed.

High-rigidity bed minimizes machine attitude changes

The bed is built with thick walls and reinforced with optimally placed ribs to secure high rigidity. It robustly supports the inertial forces produced by the column and the table during high-speed movement.

Moreover, the bed's high rigidity allows the use of a three-point support system, eliminating the need for leveling maintenance. The three-point support system also facilitates quick installation of the machine, as well as easy relocation if the shop layout is changed.

Dual ball screws and twin servomotors in the Z-axis

The Z-axis feed mechanism for moving the table longitudinally adopts dual ball screws and twin servomotors, enabling large workpieces weighing up to 3000 kg (optional specification) to be moved quickly. This machine construction allows a 600 mm-wide center chip trough to be placed directly under the table for efficient removal of large volumes of chips.

Ball screw core cooling



High-speed movement of the ball screws during long hours of operation generates heat that can affect accuracy and machining performance. To suppress heat generation, cooling oil controlled to the bed temperature is circulated through the hollow ball screws used in all the axes. In addition, cooling oil is also circulated to the inside of the feed servomotors bracket so as to isolate the heat generated by the motors.



Pallet

Maximum pallet load	· 2000 kg (3000 kg*)
Pallet size	· 800 x 1000 mm
Indexing	(Index Table) · ± 2 sec (NC rotary Table *) · ± 4 sec
Indexing repeatability	(Index Table) · ± 1 sec (NC rotary Table *) · ± 3 sec

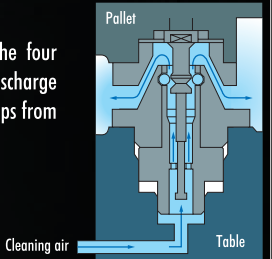
*: Optional specification

Pallet positioning method 4 tapered cone bushings

The pallet is positioned with high accuracy by four tapered cones. Each tapered cone incorporates a clamping mechanism and pallets are securely clamped with a total force of 20 tons. The well-balanced support system enhances cutting capabilities in the uppermost region of the machining range.



When pallets are changed, the four tapered cones on the table discharge strong jets of air to prevent chips from getting into the spindle taper.

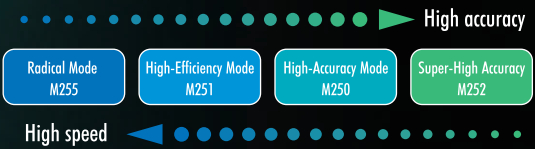


Feed mechanism

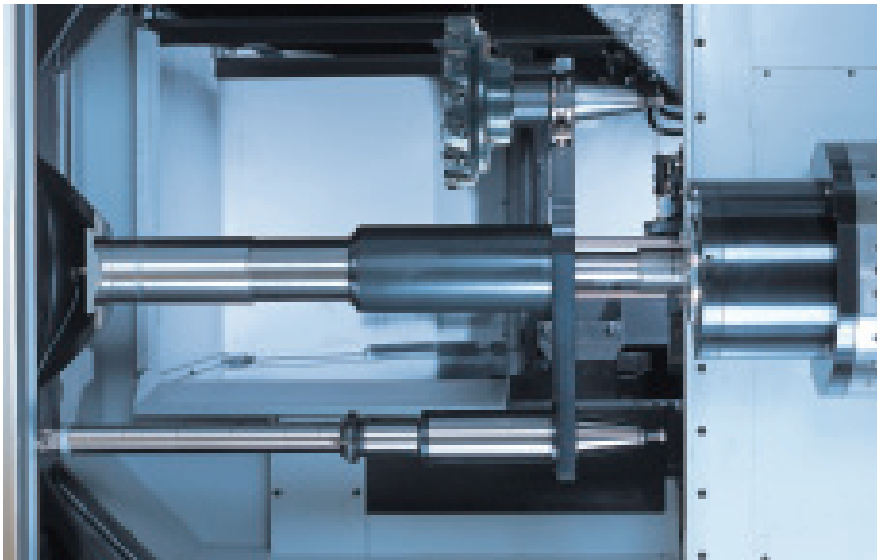
Rapid traverse	· 50 m/min	Cutting feed	· 50 m/min
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G1.4 control

The a92 is equipped with G1.4 control that maintains excellent shape accuracy even at high cutting feeds. Four control modes can be selected to match the machining job, depending on whether speed or accuracy is the priority.



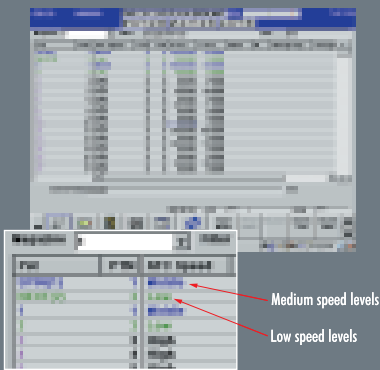
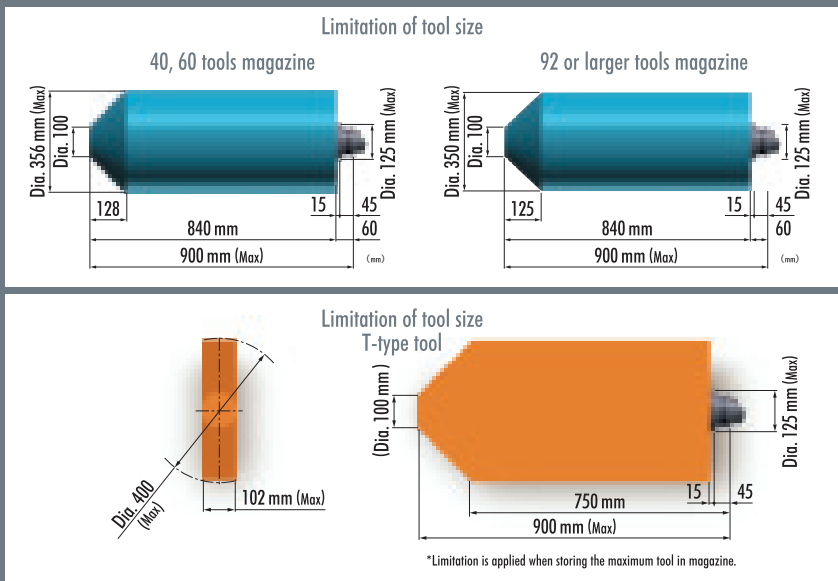
Class-leading tool changing capacity



Tool preparation time (min / max)	<ul style="list-style-type: none">6/10 sec (40 tools magazine)6.5/11 sec (60 tools magazine)15/19 sec (92 or larger tools magazine)
Tool-to-tool	<ul style="list-style-type: none">1.9 sec (12 kg, not including motion of shutter)4.8 sec (35 kg, not including motion of shutter)
Chip-to-Chip (MAS measurement method)	<ul style="list-style-type: none">5.4 sec (in case of High Torque Spindle: 12 kg)8.4 sec (in case of High Torque Spindle: 35 kg)

Maximum tool size for automatic tool changes

Maximum tool diameter	<ul style="list-style-type: none">Dia. 356 mm (40, 60 tools magazine)Dia. 350 mm (92 or larger tools magazine)
Maximum tool length	<ul style="list-style-type: none">900 mm
Maximum tool weight	<ul style="list-style-type: none">30 kg (40 or 60-tool magazine)35 kg (92 or larger tools magazine)
Maximum tool moment of inertia	<ul style="list-style-type: none">45.0 N·m (40 or 60-tool magazine)50.0 N·m (92 or larger tools magazine)



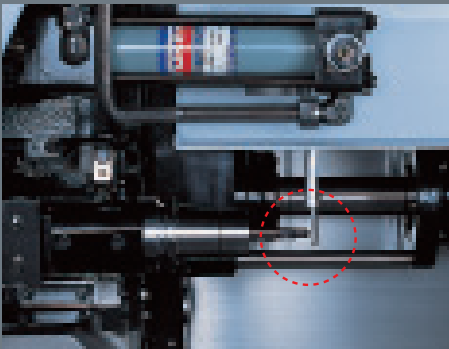
Selection of tool changing speed

The automatic tool changer (ATC) can be set to operate at three different speed levels (normal setting is high speed). Medium and low speed levels can be selected when changing heavy or unbalanced tools or when changing the head used for making measurements.

Broken tool sensor in tool magazine

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

Max.measurement tool length	<ul style="list-style-type: none">900 mm (BT / HSK)
Min.measurement tool length	<ul style="list-style-type: none">50 mm
Max.measurement tool diameter	<ul style="list-style-type: none">100 mm



Retractable tool length measurement device



[Metrol probe]

The measurement head is retracted to a position lower than the table surface so that there is almost no interfere with the tool during machining.

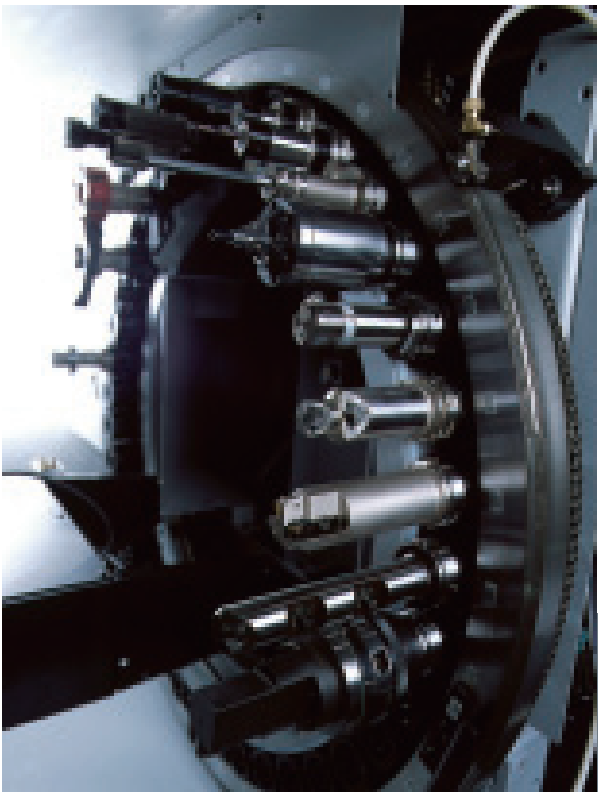
Large-capacity materix-type tools magazine (Patented)

Large-capacity matrix-type tools magazine (Patented)

Tool storage capacity · 92*, 148*, 204*, 316* tools

Because servomotors are used in all axes for fast operation, the time for preparing the next tool can be minimized. A tool loading station is also available to support safe and highly efficient operation.

* Option



High-speed ring-type tools magazine

Tool storage capacity · 40, 60* tools

After a machining operation is completed, the tool is always returned to its original position. This facilitates easy confirmation of changed tools, thereby reducing the problem of tools being put in the wrong pot.

Tool loading station



A tool loading station is also provided to support safe and efficient tool replacements. (Standard With 92 or larger tools magazine)

4 standard features indispensable to reliable chip removal

- 8-nozzle coolant supply device
- Overhead shower coolant system
- Center chip trough
- Lift up chip conveyor (with built-in filtration system)

High-speed machining at a high rate of productivity generates incredibly large volumes of chips. To remove such chip volumes effectively, the machining chamber is constructed almost entirely of slanted panels, and coolant is discharged from the spindle head and ceiling to flush chips into the center chip trough positioned directly under the table.

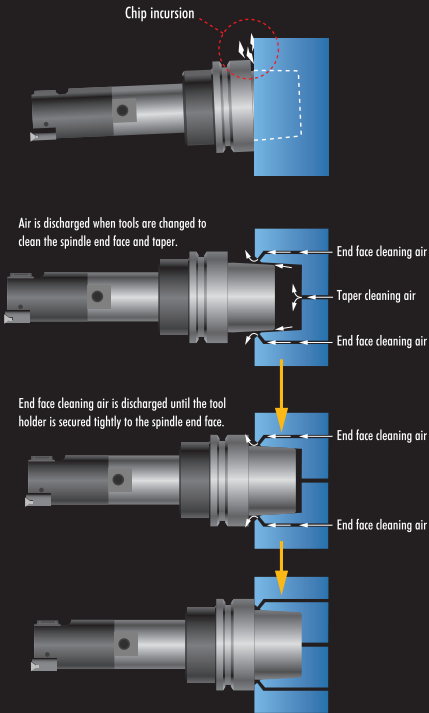
A filtration system is built into the lift-up chip conveyor to circulate clean coolant constantly. All of these features are provided as standard equipment for enhanced reliability in continuous machining operation.

Terrace washing coolant
(Opt. Equipment)

Spindle head washing coolant nozzle for preventing chip incursion

Two fixed coolant nozzles are provided to wash the top of the spindle head to prevent chips from getting caught in the spindle taper when the ATC operates.

Designed for zero chip incursion (HSK spindle)

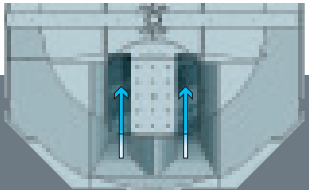


*Includes a function for confirming secure attachment in the unlikely event chips get into the taper.

Machining chamber free of chip build up

Center trough conveyor

Chip trough (patent pending) is positioned directly under the table for efficient and reliable chip removal. All chips and coolant are completely evacuated outside the machine by a hinged conveyor inside the trough.

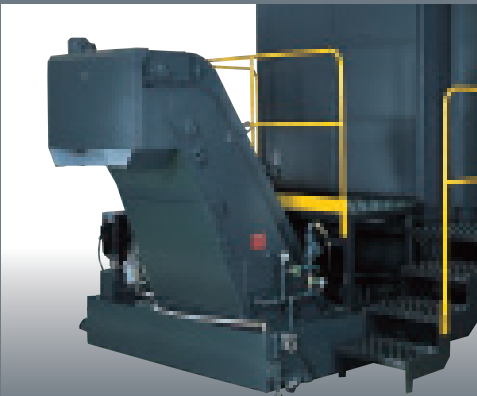


Two large chip evacuation openings are provided in the pallet stocker, making it easy to clean the area above the stocker oil pan. Chips fall through the openings into the center trough directly below for efficient evacuation from the machine.

Two-level lift-up chip conveyor with built-in filtration system

(Optional specifications)

The conveyor inside the machine evacuates chips and coolant into the lift-up conveyor in the coolant tank. Large chips are transported by a hinged conveyor positioned at the upper level. Fine chips that fall through this conveyor are entirely swept out by a scraper conveyor located at the lower level and evacuated into the chip bucket. The coolant is filtered by a rotary drum filtration unit built into the lift-up chip conveyor and flows through the inside of the drum into the clean tank.



1600L Tank Capacity

Hydraulic pressure and compressed air supply compatible with various fixture designs

CPH upper on-line type (optional specification)

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 pressure and compressed air. One more port is also available for supplying washing coolant.

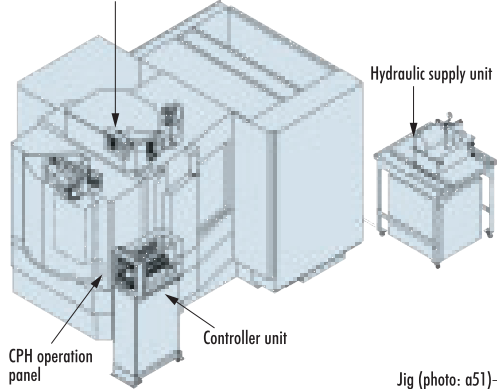
Users are asked either to provide a hydraulic pressure unit for supplying hydraulic pressure to workpiece jigs and a control unit for controlling the operation of the jigs or to select the jig controller for CPH (optional specification).

Jig controller for CPH (optional specification)

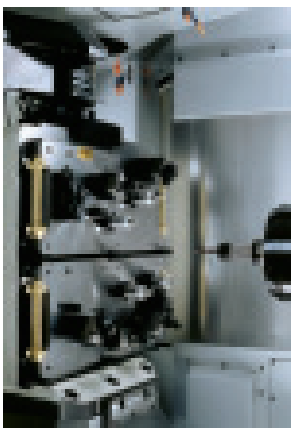
When the CPH upper on-line type hydraulic and pneumatic pipe (optional specification) is selected, the jig controller for CPH (optional specification) choices in the chart below can be selected.

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

CPH upper on-line type hydraulic and pneumatic pipe



Jig (photo: a51)→



	Max. hydraulic pressure	Pipe details (H: hydraulic P: pneumatic)	
		H	P
For 6 + 6 ports	7 MPa	(H : 4 + P : 2) × 2	
	21 MPa	(H : 4 + P : 2) × 2	
For 12 + 12 ports	7 MPa	(H : 8 + P : 4) × 2	
	21 MPa	(H : 8 + P : 4) × 2	

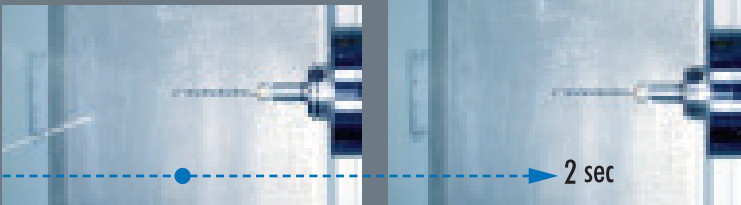
* Users are asked to design and manufacture their own workpiece jigs.
* The workpiece height is limited when using the CPH upper on-line type hydraulic and pneumatic pipe. Please refer to the Specification for detailed information.

Through-spindle coolant (1.5 MPa / 2.2 MPa : 50 Hz / 60 Hz)



A 1.5 MPa through-spindle coolant system is standard feature for substantially reducing hole machining time.
(optional specifications: 3MPa or 7MPa)

Coolant recovery function (Patented)



A unique mechanism is provided in the coolant supply channel for immediately sucking back any coolant remaining in the spindle and tool holder at the moment the coolant pump shuts down. Subsequently, the mechanism also prevents coolant in the ATC from leaking into the spindle taper, thereby keeping it clean and reducing non-cutting time as well.

Outstanding operating ease

Accessibility and visibility

Because the spindle moves to the operator's side, it is easy to check for tool wear, attach measuring instruments or perform other tasks.

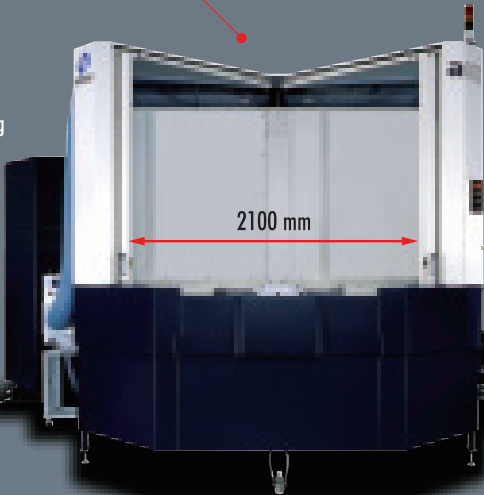


Integrated splash guard door and ceiling

The splash guard door and ceiling are opened together to create a large opening. This allows light to enter the machining chamber for better visibility when doing setup work. Moreover, it prevents coolant from dripping onto the operator from the ceiling.

The sliding doors on the right and left sides are constructed of two panels. This design lightens the weight of each door, making it easier to open and close them with one hand. It also minimizes the storage space needed for the doors when they are open.

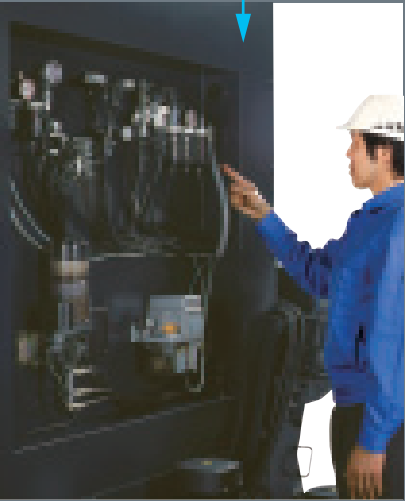
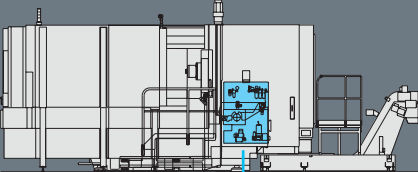
The splash guard enclosing the machining chamber and pallet stoker is a stand-alone type that is separated from the machine.



The front sliding door has a wide opening of 2100 mm for easier loading and unloading of large workpieces without any interference.

Easy maintenance and inspection

Units that require daily checking of oil levels or air pressures are concentrated in one location for easy confirmation.



Compatible with automation

Automation boosts productivity



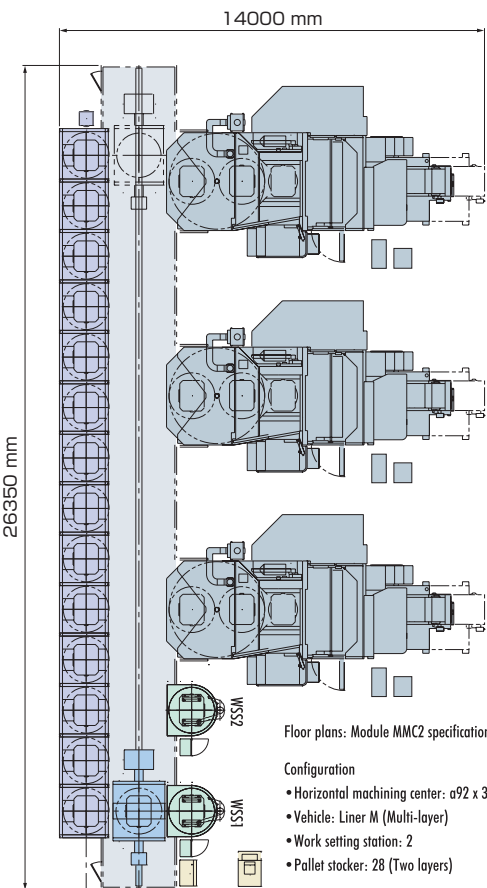
● T type-Track type pallet magazine
(Photo: WSS safety guard specification)



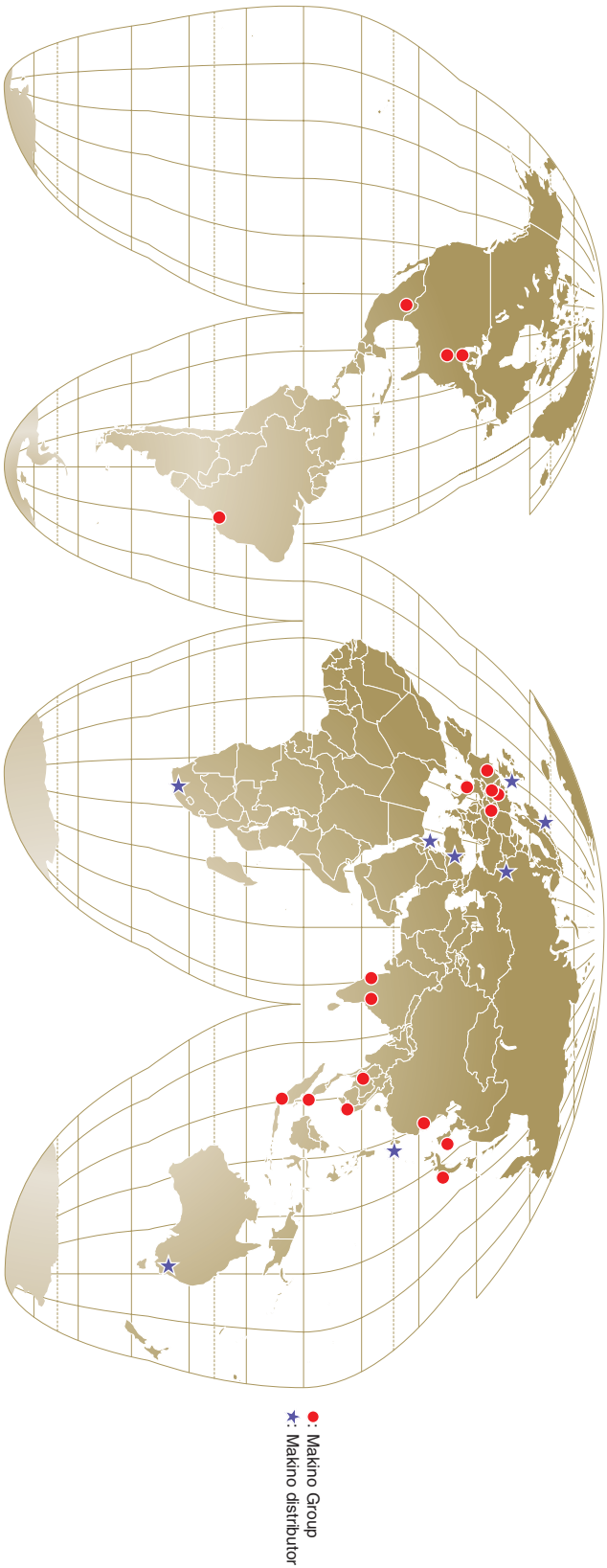
● I type-Track type pallet magazine
(Photo: WSS safety guard specification)

New Concept Machining Center with Economical Unattended Machining System

Module MMC
MAKINO Machining Complex



*Please consult Makino about the Module MMC2.



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Makino distributor	
Kaspo Maskin A/S (Norway)	
NCMT Limited (U.K.)	
ZAO IRLen Engineering (Russia)	
CNC Ileri Teknoloji Muhendislik Sanayi Ve Ticaret limited Sirketi (Turkey)	
CNC Advanced Technology Marketing Ltd. (Israel)	
Edwin Roth & Co. (Pty) Ltd. (South Africa)	
Ea-sun Precision Technology Corporation (Taiwan)	
Jet Bright Corporation (Taiwan)	
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Headland Machinery Pty.Ltd. (Australia)	

*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 are fitted with optional equipment.

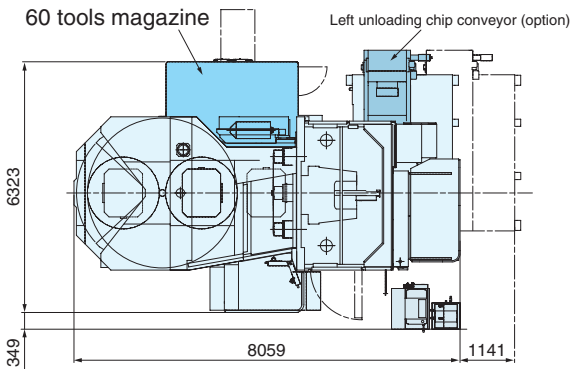
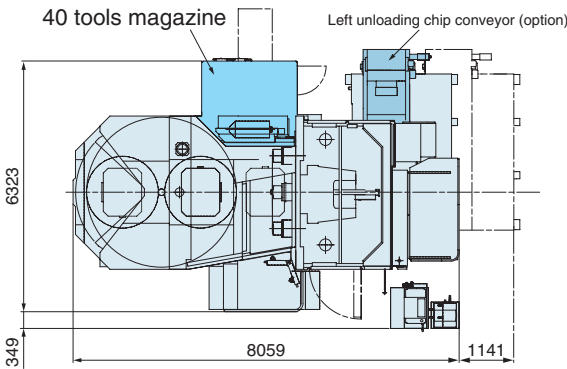
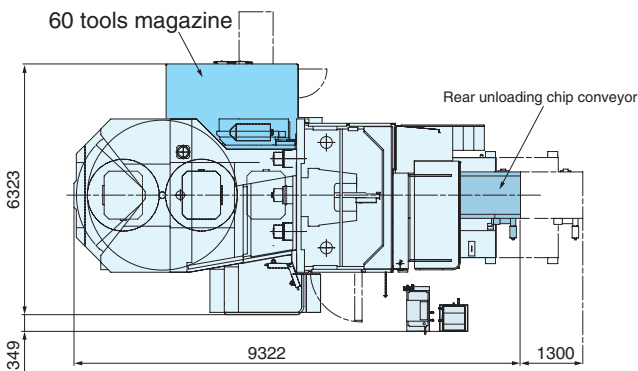
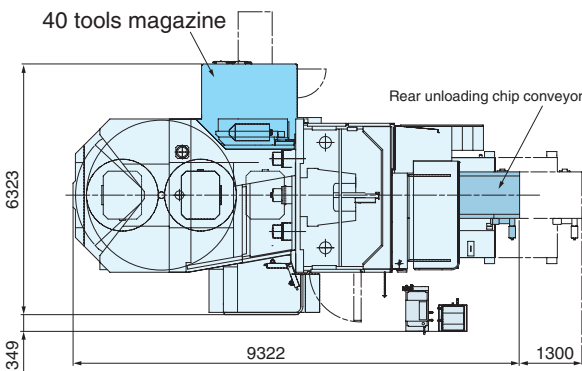
*This product, including technical data and software, may be subject to the Japanese Foreign Exchange and Foreign Trade Law.

Prior to any re-sale, re-transfer or re-export of controlled items, please contact Makino to obtain any required authorization or approval.

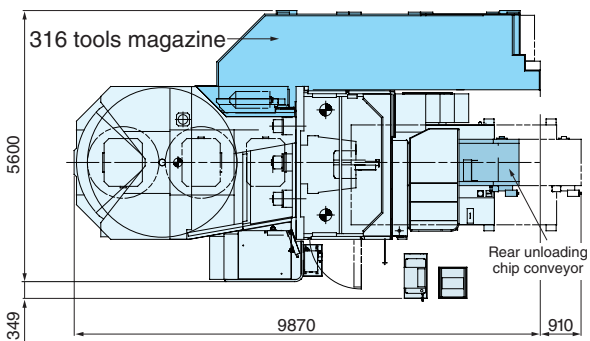
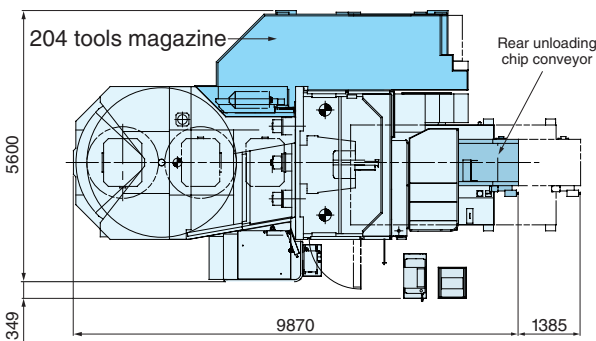
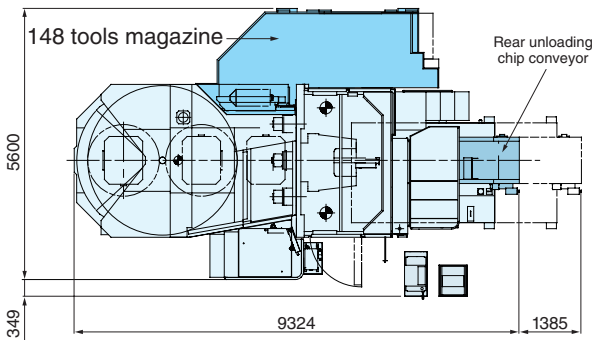
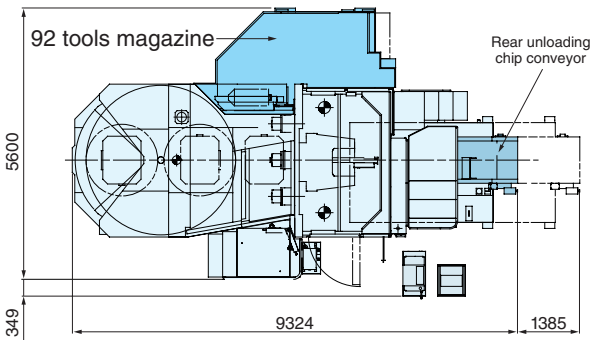
Floor plans

(mm)

40, 60 tools magazine



92, 148, 204, 316 tools magazine



Machine Specifications

Travels	X, Y, Z axes	1520 x 1250 x 1350 mm
	Distance from pallet surface to spindle center	100 – 1350 mm
	Distance from pallet center to spindle gauge line plane	150 – 1500 mm
Pallet	Pallet working area	800 x 1000 mm
	Maximum workpiece size (dia. x height)	1500 x 1500 mm
	Maximum workpiece weight (Evenly distributed)	2000 kg (3000 kg*)
	Minimum pallet indexing angle	1° (0.0001° for NC rotary table*)
	Pallet indexing time (90°/180°)	4.2 / 5.0 sec (Indexing table)
	Height to pallet surface	1400 mm
	Pallet positioning method	4 taper cone bushings
Spindle	Spindle speed range	20 – 10000 min ⁻¹
	Spindle taper hole	7/24 No. 50 taper (HSK-A100*)
	Spindle bearing inner/outer diameter	Dia. 110 / Dia. 170 mm
	Spindle drive motor (30 min/cont.)	35 / 25 kW
	Spindle torque (25% ED / cont.)	488 / 304 N·m
Feedrates	Rapid traverse	50000 mm/min
	Cutting feed	1 – 50000 mm/min
Automatic tool changer	Type of tool shank	JIS B6339 50T (MAS403 BT50)
	Type of retention knob	JIS B6339 50P (MAS403 P50T)
	Tool storage capacity	40 tools (60*, 92*, 148*, 204*, 316* tools)
	Maximum tool diameter (without / with limitation)	Dia. 115 / Dia. 356 mm (40, 60* tools magazine) Dia. 100 / Dia. 350 mm (92 or larger tools magazine)*
	Maximum tool length	900mm
	Maximum tool weight	30 kg (40, 60 tools magazine), 35 kg (92 or larger tools magazine)*
	Tool changing time (Tool-to-tool / Chip-to-chip)	1.9 / 5.4 sec (MAS measurement method**)
Automatic pallet changer	Number of pallets	2
	Pallet changing time	23 sec
Accuracy <small>*Tolerances measured at Makino's assembly plant</small>	Positioning accuracy (without / with scale feedback)	±0.0025 / ±0.0020 mm
	Repeatability (without/with scale feedback)	±0.0015 / ±0.0010 mm
Machine size (Standard)	Machine height	3906 mm (3832 mm: High-torque spindle)
	Machine footprint	6323 x 9322 mm
	Machine weight (Including NC unit)	33000 kg (40 tools magazine)
	Leveling method	3-point support

*) Optional **) High-torque spindle. Tool weight:12 kg

Standard Specifications

- 10000 min⁻¹ spindle (BT50)
- Spindle temperature controller
- 40 tools magazine
- Ball screw core cooling
- Coolant supply device (8 nozzles)
- Through-spindle coolant and air (1.5 MPa)
- Overhead shower coolant system
- Center Trough conveyor (Hinge Type)
- Chip conveyor BSW 1600
- 360-division indexing table
- Pallets with tapped holes (2 pallets)
- Pallet changer
- Pallet changer safety cover
- Tool loading station
- APC door interlock
- Operator door lock (operation mode)
- Splash guard lighting device (1 fluorescent bulb)
- I/O interface and 100 V power outlet
- Portable Manual pulse generator with the handle enable button
- Tool life monitoring function
- ECO mode functions
- Automatic fire extinguisher interface
- Spindle-table interface preventive function
- Standard tool length function
- Automatic power shutoff
- Signal lights (3 levels)
- Data center
- Custom macro (common variables 100)
- Rigid tap (3000 min⁻¹)
- G1.4 Control
- CE regulation (European area)

Optional Specifications (•) & Equipment (★)

- | | |
|--|---|
| <input type="checkbox"/> • HSK-A100 spindle | <input type="checkbox"/> • Tilttable chip bucket |
| <input type="checkbox"/> • 8000 min ⁻¹ High torque spindle (1009 / 504 N-m) | <input type="checkbox"/> • Mist collector |
| <input type="checkbox"/> • 20000 min ⁻¹ spindle (HSK-A100: Spindle core cooling) | <input type="checkbox"/> ★ Mist collector interface (without connecting port) |
| <input type="checkbox"/> • 20000 min ⁻¹ high-power spindle (HSK-A100: Spindle core cooling) | <input type="checkbox"/> • Connecting port for mist collector
(operator door, pallet changer safety cover, ATC door) |
| <input type="checkbox"/> • 60 tools magazine (ring type) | <input type="checkbox"/> ★ Operator door lock & APC door lock (with power shut off) |
| <input type="checkbox"/> • 92, 148, 204, 316 tools magazine (matrix type)*1 | <input type="checkbox"/> • ATC door lock (with power shut off)
(operator & APC door lock is required with option) |
| <input type="checkbox"/> • Moire scale feedback: 0.1μm | <input type="checkbox"/> • Rotary wiper for splash guard window |
| <input type="checkbox"/> • NC rotary table: 0.0001° | <input type="checkbox"/> • Positioning block |
| <input type="checkbox"/> • T-slot type pallet specification (2 pallets) | <input type="checkbox"/> • Automatic workpiece measuring device (Marposs probe) |
| <input type="checkbox"/> • Pallet position confirmation function | <input type="checkbox"/> • Automatic workpiece measuring device
(Renishaw probe OMP 60) |
| <input type="checkbox"/> ★ Pallet random call function | <input type="checkbox"/> • Retractable tool length measuring device (Marposs probe) |
| <input type="checkbox"/> ★ 4-face program call function | <input type="checkbox"/> • Retractable tool length measuring device (Metrol probe) |
| <input type="checkbox"/> • CPH upper on-line type hydraulic pressure pipe: 6 + 6 ports | <input type="checkbox"/> • Broken tool sensor on ATC side |
| <input type="checkbox"/> • CPH upper on-line type hydraulic pressure pipe: 12 + 12 ports | <input type="checkbox"/> • Automatic grease supply system |
| <input type="checkbox"/> • Hydraulic fixture control package: 7 MPa | <input type="checkbox"/> ★ Air dryer |
| <input type="checkbox"/> • Hydraulic fixture control package: 16 MPa | <input type="checkbox"/> ★ Portable Manual pulse generator
with tool position display |
| <input type="checkbox"/> • Module MMC specification | <input type="checkbox"/> ★ Lighting device inside the electric enclosure
and 100V outlet |
| <input type="checkbox"/> ★ Air blower | <input type="checkbox"/> ★ Run hour meter |
| <input type="checkbox"/> ★ Workpiece washing gun (Pallet stocker and/or Operator door's side) | <input type="checkbox"/> ★ Warmup timer |
| <input type="checkbox"/> ★ Coolant temperature controller | <input type="checkbox"/> ★ Circuit breaker |
| <input type="checkbox"/> • Through-spindle coolant and air: 3 MPa, 7 MPa | <input type="checkbox"/> ★ Super G1.3 control |
| <input type="checkbox"/> • Terrace washing coolant | <input type="checkbox"/> ★ Super G1.4 control |
| <input type="checkbox"/> • 8-nozzle coolant flow switch | <input type="checkbox"/> • Special customer-specified machine colors |
| <input type="checkbox"/> • Through-spindle coolant flow switch | |
| <input type="checkbox"/> • Chip Conveyor LSW 1600 *2 | |
| <input type="checkbox"/> • Chip Conveyor LDW 1600 *2 | |
| <input type="checkbox"/> • Chip Conveyor BDW 1600 | |
| <input type="checkbox"/> • Magnet drum chip converter (for cast iron) C-BSW1885 | |

*1) Chip conveyor type Back discharge only *2) Available only with 40 or 60 tools magazine

Professional 5 Specifications

■ NC Specifications

Standard (●) / Opt. Equipment (□)

Controlled axes

- Simultaneous 3 axes
- ☐ Simultaneous 4 axes (NC rotary)
- ☐ Simultaneous 5 axes

Programmings

- Programming unit (0.0001 mm)
- Programmable maximum ± 9 digits (99999.9999)
- Absolute/incremental programming (G90 / G91)
- Decimal point programming
- Pocket calculator type decimal point programming
- Tape code ISO / EIA automatic recognition
- ☐ Inch/metric conversion (G20 / G21)

Interpolations function

- Positioning (G00)
- Linear (G01)
- Circular (G02, G03)
- Nano
- ☐ Helical (Circular + 2 axis liner, G02, G03)
- ☐ Polar coordinate (G12.1, G13.1)
(NC rotary unit is required)
- ☐ Cylindrical (G07.1)
(NC rotary unit is required)
- ☐ Involute
- ☐ NURBS
- ☐ Conical/spiral

Feeds function

- Cutting feed F5-digit
- Dwell (G04)
- Rapid traverse override
- Cutting feed override (0 - 200 %)
- Feedrate override cancel (M49 / M48)
- ☐ 1-digit F code feed (F1 - F9)
- ☐ Automatic corner override (G62)
- ☐ Inverse time feed (G93)

Program storage & Editing

- Part program storage size (Total): 320m
- ☐ Additional: 640 m*
- ☐ Additional: 1280 m*
- ☐ Additional: 2560 m*
- ☐ Additional: 5120 m*
- ☐ Additional: 10240 m*
- ☐ Additional: 20480 m*
- (*) Total, includes standard quantity
- Number of registerable programs: 63
- ☐ Additional: 250*
(Only for 320 m part program storage)
- ☐ Additional: 500*
(Only for 640 m part program storage)
- ☐ Additional: 1000*
(Only for over 1280 m part program storage)
- ☐ Additional: 2000*
(Only for 2560 m part program storage)
- ☐ Additional: 4000*
(Only for over 5120 m part program storage)
- (*) Total, includes standard quantity
- Editing
- Program number search
- Sequence number search
- Address word search

Display

- Manual data input
- Clock function
- Operation history display
- ☐ Machining time stamp
- ☐ Run hour and parts count display

I/O

- RS232 interface
- ☐ HSSB connection kit
(for μ Cell Expert, μ Cell Expert+ or μ DMS5)

S/T/M functions

- S speed function
(Direct commanding, S5 digit)
- T function: T4 digit
- ☐ T function: T8 digit
- M function

Tool compensation

- Length offset (G43, G44 / G49)
- Radius offset (G41, G42 / G40)
- Tool offset pairs: 99
- ☐ Additional: 200*
- ☐ Additional: 400*
- ☐ Additional: 499*
- ☐ Additional: 999*
- (*) Total, includes standard quantity
- Type A memory
- ☐ Type B memory
- ☐ Type C memory
- ☐ 3 Dimensional tool offset

Coordinate

- Manual reference position return
- Automatic reference position return (G28)
- 2nd reference position return (G30)
(2nd reference point return is a fixed position on machine tool (ATC etc.) and cannot be altered arbitrary.)
- ☐ 3rd / 4th reference position return
- Reference position check (G27)
- Retrieve position (G29)
- Coordinate system setting (G92)
- Machine coordinate system setting (G53)
- Select work coordinate system (G54 - G59)
- Local workpiece coordinate system setting (G52)
- ☐ Floating reference position return (G30.1)
- ☐ Addition of work coordinate system 48-pairs
- ☐ Addition of work coordinate system 300-pairs
- ☐ Work coordinate system preset (G92.1)

Operating support functions

- Label skip
- ☐ High-speed skip
- Control in / out
- Single block
- Program stop (M00)
- Optional stop (M01)
- Optional block skip 1(/)
- ☐ Additional optional block skip (/ 1 - / 9)
- Dry run

- Machine lock
- Freeze Z axis
- Auxiliary function lock (S/T/M)
- Mirror image (M21, M22 / M23)
- Manual absolute
- ☐ Program restart
- Measurement of tool length
- Data protection key
- ☐ Handle interrupt
- ☐ Sequence number comparison and stop

Programming support functions

- Circular interpolation by R programming (12 dibit)
- Canned cycle
- Sub program call (10 folds nested)
- Exact stop check (G09)
- Exact stop check mode (G61)
- Tapping mode (G63)
- Cutting mode (G64)
- Rigid Tap
- Programmable data input (G10)
- Tape format for FS-15M
- ☐ Custom macro (Common variables (Total): 100)
- ☐ Addition of custom macro
(Common variables (Total): 600)
(Requires Custom macro)
- ☐ Optional chamfering corner R
- ☐ Programmable mirror image(G51.1 / G50.1)
- ☐ Scaling (G51 / G50)
- ☐ Coordinate system rotation (G68 / G69)
- ☐ Figure copying (G72.1 / G72.2)
- ☐ Polar coordinate command (G15 / G16)
- ☐ Normal direction control
- ☐ Chopping function (G81.1)
(When selects this function, please contact to us)

Error compensations

- Pitch
- Backlash
- ☐ Single direction positioning (G60)

Maintenance & Safety

- Emergency stop
- Over travel
- Stored stroke check 1
- ☐ Stored stroke check 2
- Self-diagnostics function
- ECO mode functions*¹
- ☐ TSC 7.0 MPa Inverter Drive Specification*¹
(Available only for through spindle coolant 7 MPa)
- ☐ ECO mode of air consumption volume*¹
- ☐ Power consumption monitoring*¹
- Interlock
- Alarm history display (25 events)
- Help function

* Except for a51/a61

Professional 5 Specifications

Standard (●) / Opt. Equipment (□)

■ Specifications for MTC

Display

- 12.1 inches color TFT LCD

High speed, High precision

- GI.4 control
- ☐ Super GI.3 control
- ☐ Super GI.4 control
- ☐ Nano smoothing (Requires Super GI.4 control)

Editing function

- Program Preview
- Back ground editing
(Equivalent to FANUC "Background editing")
- Cut & Paste and Replace function
(Equivalent to FANUC "Extended part program editing")
- 2-program simultaneous edit function
- G code Insert function
- M code Insert function
- Fixed program Insert function
- Final MDI program Insert function
- Coordinate value Insert function
(Equivalent to FANUC "Playback")
- Other program Insert function
- ☐ Alphanumeric Program file name input (32 characters)

Monitor

- Spindle load display
- Spindle load monitoring function (SL)
- Tool life monitoring function (TL)
- Direct spare tool selection function
- Product count function *1
(Equivalent to FANUC "Run hour and parts count display")
- Machining result function *2
(Equivalent to FANUC "Machining time stamp")
- ☐ Adaptive control function (AC)

Data input/output

- Data center (Standard memory: 4 MB)
- File management function (NC programs, various data files)
- DNC simple schedule function (Multiple main programs executable)
- Automatic fire extinguisher interface
- ☐ Data center memory extension function A (Total 360 MB)
- ☐ Data center memory extension function B (Total 800 MB)
- ☐ Twist-pair cable (10 m)
- ☐ Twist-pair cable (20 m)
- ☐ Twist-pair cable (30 m)
- ☐ Twist-pair cable (40 m)
- ☐ Twist-pair cable (50 m)
- ☐ 8-port HUB
- ☐ Special User I/O Interface

Easy push-button -operation

- Registered tool automatic selection and changing function
- All axis automatic return to reference point
- Automatic return to work setting position
- Z axis retraction
- ☐ Automatic Z-axis retract and restart function

Guidance

- Self-diagnostics and instruction display
- Number and position of limit switches and solenoid display for alarm
- Alarm History function (Machine side and NC side)
- Automatic display for regular maintenance advice
- User create function for regular maintenance

Software

- ☐ Pallet random program calling
- ☐ 4-Face program calling function
- ☐ FF-PATH Package
(Including custom macro and helical interpolation)
- ☐ External setting type orientation
- ☐ Function of the coordinate calculation and setting based on the rotary axis angle
(Requires custom macro <common variables 100>)

Module MMC specification

- ☐ Ethernet I/F

For μCell Expert and μDMS5

- ☐ HSSB I/F

(★1) However, if the run hour and parts quantity are got by using the FANUC FOCAS Library, FANUC "Run hour & Parts quantity display" option is required.
(★2) However, if the machine time is got by using the FANUC FOCAS Library, FANUC "Machining time stamp function" option is required.

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