

Mazak

# VARIAXIS C-600

[ 5-Axis Vertical Machining Center ]



# VARIAXIS C-600

Manufacturing innovation in a 5-axis machining center with AI, digital twins and automation

The manufacturing environment is changing rapidly through innovative production processes based on data and digital technologies.

Mazak's next-generation VARIAXIS C-600 5-axis Vertical Machining Center incorporates automation, AI and digital twins to support digitalization as well as to enhance machine specifications.

## MAZATROL SMOOTH*Ai*



Shown with optional  
MAZATROL SmoothAi dual monitor

- ### Ai
- Optimal programming through AI analysis
  - Ensures high-quality, high-accuracy machining

- ### DIGITAL TWIN
- MAZATROL TWINS software performs digital setup on office PCs
  - Reduce machine setup time and improve machining efficiency with initial products and prototypes

- ### AUTOMATION
- Wide variety of automation equipment available, including a 2-pallet changer, Multi-Pallet Pool (MPP), robot and hydraulic/pneumatic fixtures

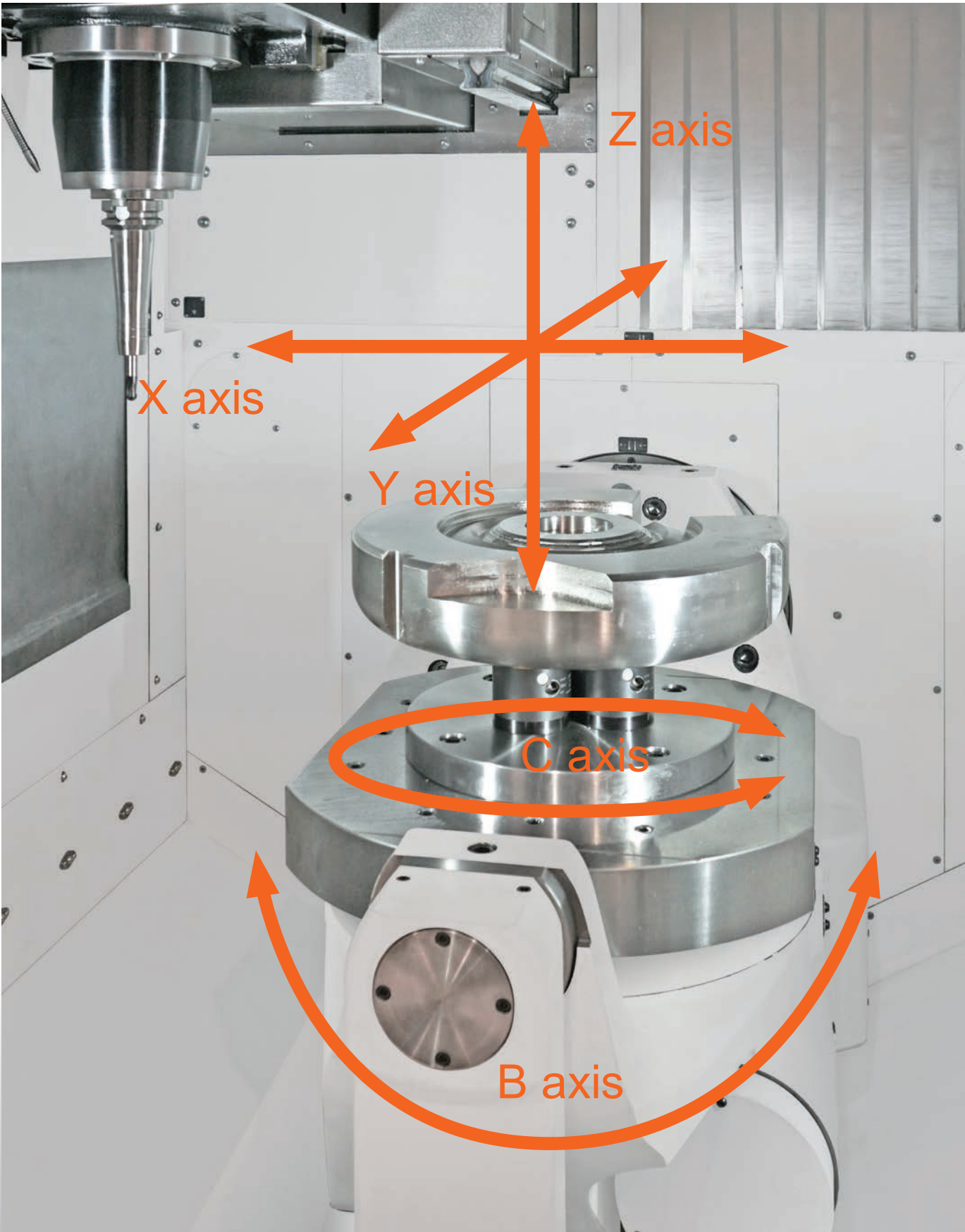


Shown with optional equipment



2-pallet changer (option)





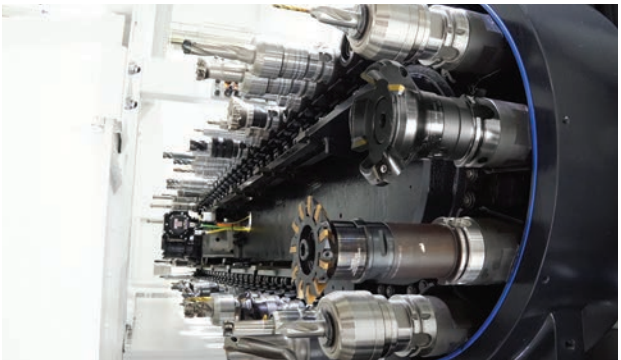
Tool Magazine

The standard tool magazine stores 30 tools, with 60, 90 and 120-tool options.

- Max. tool length (from tool tip to gauge line): 300 mm (11.81")
- Tool diameter: 80 mm (3.15")  
[130 mm (5.12") with adjacent pockets empty]
- Max. tool weight: 8 kg (18 lbs)  
[120 kg (265 lbs) total weight of tools in magazine]



30-tool magazine



60-tool magazine (option)

High-Rigidity Table

Rigid support on both ends of the tilting rotary table ensures high-speed, high-accuracy machining. To eliminate backlash, both the B axis and C axis use a roller gear cam.



High-Speed Automatic Tool Changer

Automatic tool changer with cam-driven double-arm design drastically reduces chip-to-chip time to 4.5 seconds.







Spindle Specifications to Meet a Wide Variety of Machining Requirements

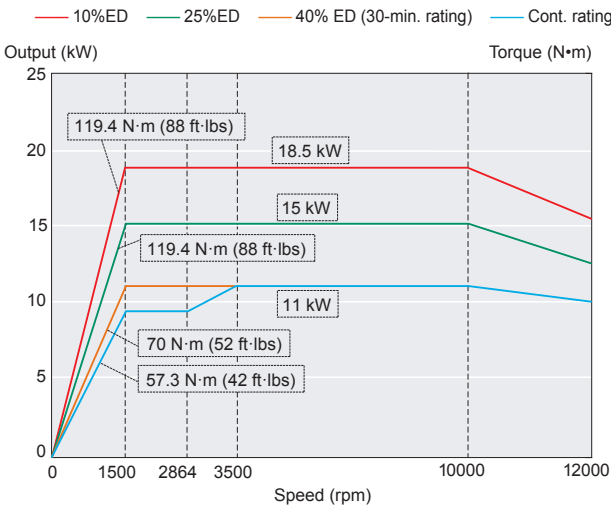
The high-rigidity spindle can perform heavy-duty machining of steel as well as high-speed machining of non-ferrous materials, such as aluminum. High-speed and high-torque specifications are available as options.

Speed	Standard	High torque <span>OPTION</span>	High speed <span>OPTION</span>	
	12000 rpm	15000 rpm	18000 rpm	20000 rpm
Output [40% ED (30-min. rating)]	11 kW (15 HP)	46 kW (62 HP)	30 kW (40 HP)	42 kW (56 HP)
Max. torque [40% ED (30-min. rating)]	70 N·m (52 ft·lbs)	200 N·m (148 ft·lbs)	105 N·m (77 ft·lbs)	161 N·m (119 ft·lbs)
Tool shank	No. 40/BBT-40*/ HSK-A63*	No. 40/BBT-40*/ HSK-A63*	No. 40/BBT-40*/ HSK-A63*	No. 40/BBT-40*/ HSK-A63*

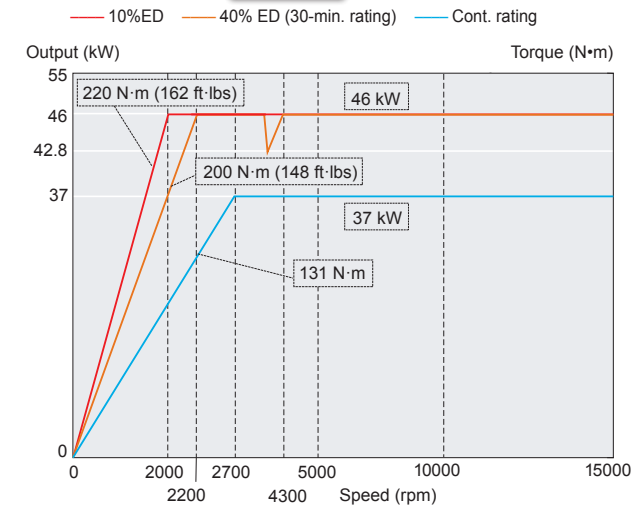
\*Option

Spindle output · Torque diagram

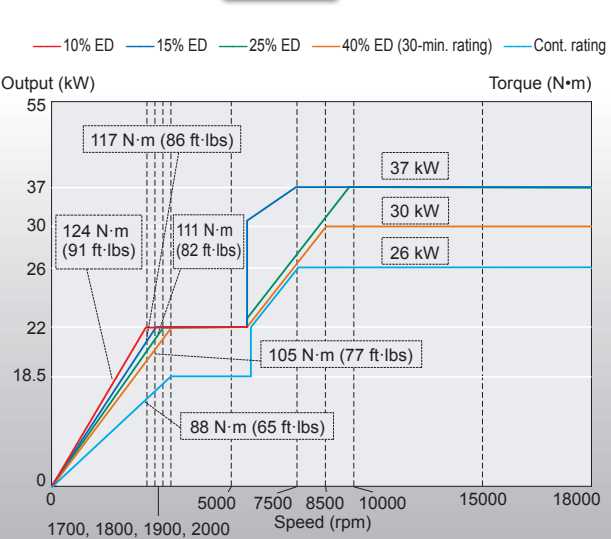
12000 rpm spindle



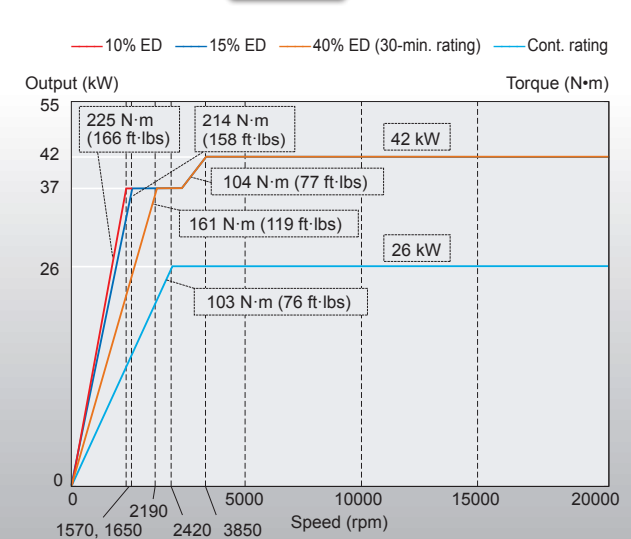
15000 rpm spindle OPTION



18000 rpm spindle OPTION



20000 rpm spindle OPTION

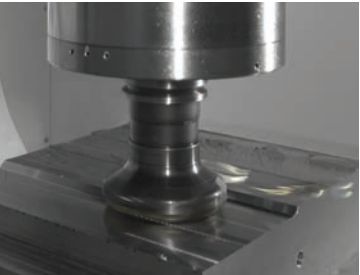


Machining Example (Test Results)

15000 rpm high-torque spindle  
ø80 mm (ø3.15") face mill  
(6 teeth)

Speed: 995 rpm  
Feedrate: 1552 mm/min (61 IPM)  
Depth of cut: 5.8 mm (0.23")  
Material: C45

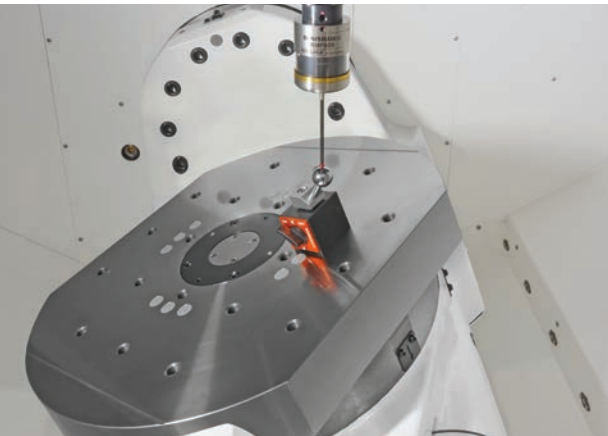
Material removal rate: **581 cm³/min (35.45 in.³/min)**



For high-accuracy 5-axis machining

5-Axis Calibration – MAZA-CHECK

Automatically measure and compensate for position misalignment and incline of the rotary axes and for the center of rotation of both the C and B axes.

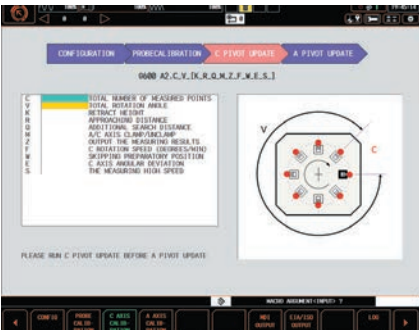


Shown with RMP600 wireless touch probe (optional equipment)

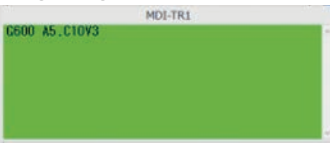
Select measurement item



Select measurement information



Automatic measurement program generation



Convenient screen display assists measurement operation

Ai Thermal Shield

To ensure even higher machining accuracy, new algorithms automatically determine the amount of compensation to be applied automatically based on temperature changes.



Machining



Workpiece inspection



Simulation

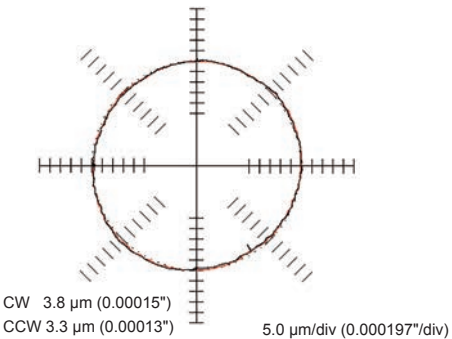
High-rigidity construction and the MAZATROL SmoothAi CNC ensure high-accuracy machining

DBB (Test Results)

X-Y plane measured results

3.8  $\mu\text{m}$  (0.00015") (CW)  
3.3  $\mu\text{m}$  (0.00013") (CCW)

Machine	VARIAXIS C-600
Diameter	200 mm (7.87")
Feedrate	560 mm/min (22 IPM)



Positioning Accuracy and Repeatability (Test Results)

Mazak precision results

Positioning accuracy	X axis	1.17 $\mu\text{m}$ (0.000046")
	Y axis	1.56 $\mu\text{m}$ (0.000061")
	Z axis	1.15 $\mu\text{m}$ (0.000045")

Positioning repeatability	X axis	0.99 $\mu\text{m}$ (0.000039")
	Y axis	1.52 $\mu\text{m}$ (0.00006")
	Z axis	0.68 $\mu\text{m}$ (0.000027")

Note: The inspection was conducted following ISO-230 on a recommended foundation with room temperature controlled to 22°C±1°C after the machine reached operating temperature.

Continuous Inverted Boring Accuracy (Test Results)

Mazak test results

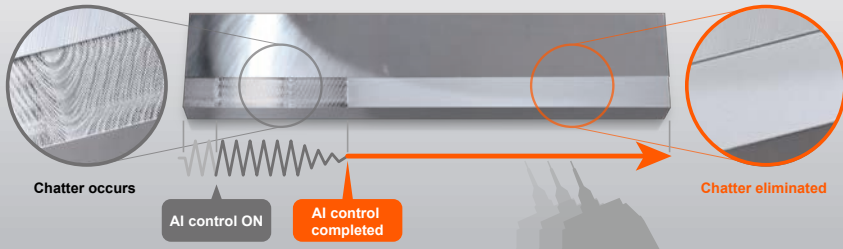
X-axis deviation (max.)	3 $\mu\text{m}$ (0.000118")
Y-axis deviation (max.)	6 $\mu\text{m}$ (0.000236")
Concentricity (max.)	19 $\mu\text{m}$ (0.000748")

Note: The inspection was conducted following ISO-230 on a recommended foundation with room temperature controlled to 22°C±1°C after the machine reached operating temperature.

SMOOTH Ai Spindle



AI detects milling spindle vibration and automatically changes machining conditions to realize unsurpassed surface finish and high productivity. Quick, easy AI-based compensation does not require a skilled operator.

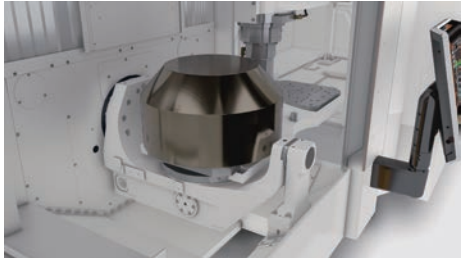




2-Pallet Changer

OPTION

For higher productivity, set up the next workpiece while machining the current workpiece.



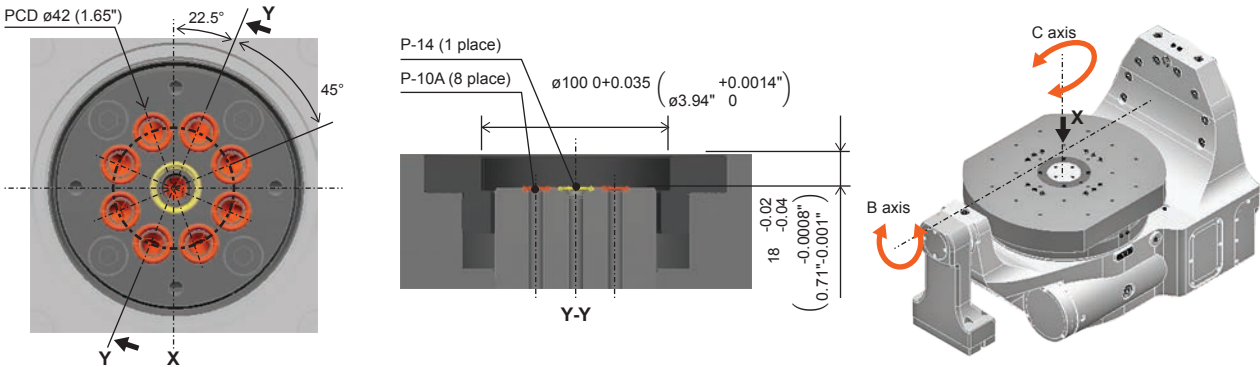
	VARIAxis C-600 (2-pallet changer)
Pallet size	□500 mm (□19.69")
Max. workpiece size	ø730 mm × 450 mm (ø28.74"×17.72")
Max. load	500 kg (1102 lbs)

Preparation for Hydraulic and Pneumatic Fixtures

OPTION

Power is supplied through the pallet for hydraulic and pneumatic fixtures. Maximum number of ports: 9

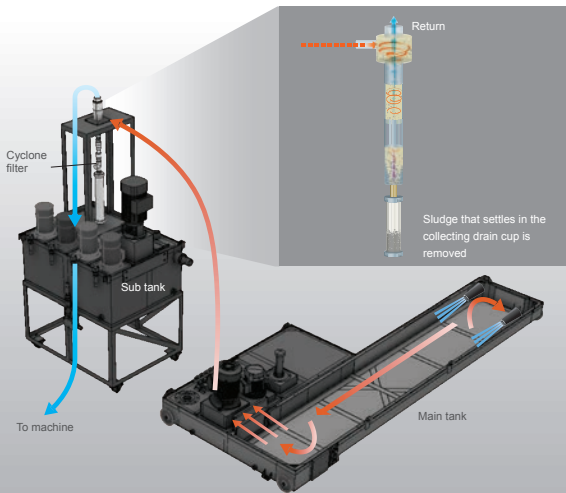
Unit: mm (inch)



Clean Coolant System

OPTION

Nozzles inside the main tank circulate coolant to prevent accumulation of chips and sludge. The cyclone filter removes more than 95% of particles larger than 20 µm (0.000787") through separation. These features keep the coolant tank clean and extend coolant service life.



Multi-Pallet Pool (MPP)

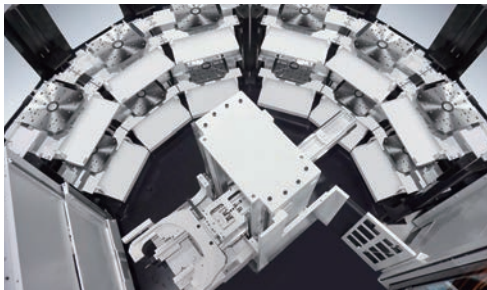
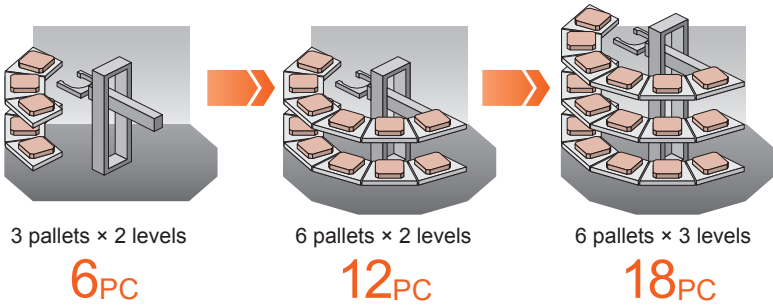
The Multi-Pallet Pool (MPP) system meets the increasing worldwide demand for automation, providing high productivity in machining a wide variety of parts in small lots. Operators can access the workpiece from the machine as well as from the loading station of the MPP.



MPP (18 PC)  
VARIAXIS C-600

Flexible pallet stocker capacity

6, 12 and 18-pallet storage capacities are available after initial installation.



MPP

	VARIAxis C-600
Number of pallets	6/12/18
Pallet size	□500 mm (□19.69")
Max. load (without pallet)	500 kg (1102 lbs)
Max. workpiece size (without pallet)	ø730 mm × H450 mm (ø28.74" × H17.72")

SMOOTH  
MPP

Once the production schedule is input, operations will be performed automatically. Check production results, system utilization and other data on the MAZATROL SmoothAi CNC. On a network (prepared by user), access system data via office PCs, tablets and smartphones.



Designed with environmental considerations

The environment and our impact on natural surroundings have always been important concerns for Yamazaki Mazak. This is demonstrated by the fact that all factories in Japan that produce Mazak machine tools are ISO 14001 certified, an international standard confirming that the operation of our production facilities does not adversely affect air, water or land.

Extended coolant service life

Reduction of lubrication consumption

Reduction of electrical power consumption



Auto-Power Off

When the machine is not operated for a pre-registered period of time, the machine worklights and CNC backlight turn off automatically. They automatically turn on when the motion sensor detects the operator's return.

Chip Conveyor Stop

To reduce electrical power consumption, the chip conveyor automatically stops a predetermined period after machine operation stops. (Chip conveyor is optional equipment.)

Grease Lubrication

Grease lubricates the linear roller guides and ball screws, eliminating tramp oil from the coolant to extend its service life.

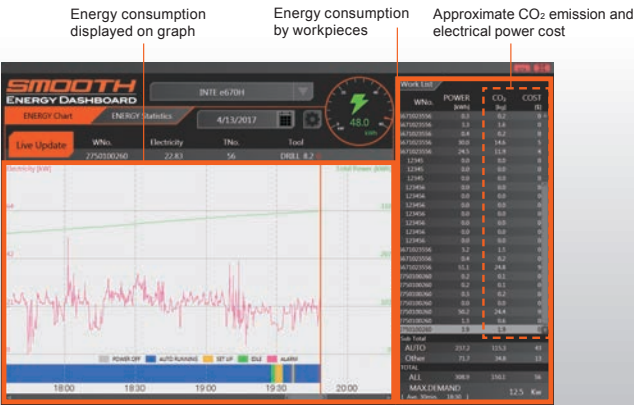
Energy Dashboard

OPTION

The Energy Dashboard provides convenient visual monitoring of energy consumption and analysis.

Process screen display

- Total energy consumption (of workpiece in operation)
- Current energy consumption



Designed for convenient accessibility



Large window

The large front door window enables the operator to monitor workpiece machining easily.



Excellent accessibility

The operator has excellent access to the table from the front of the machine for convenient workpiece loading/unloading and machine setup.



Tool magazine

The tool magazine door is located at the front of the machine for convenient loading and unloading.



Innovation for Higher Productivity

# MAZATROL *SMOOTH*Ai

New MAZATROL Smooth CNC system

Designed to provide unsurpassed productivity through even faster, higher-precision control while elevating your production to the next level with AI and digital twin technology

- Touch screen operation – similar to using your smartphone/tablet
- MAZATROL Smooth graphical user interface for unsurpassed ease of operation
- CNC system integrates with your Windows® PC
- Latest hardware and software for unprecedented speed and precision
- Higher machining speed for high-accuracy 5-axis machining
- Fine-tuning function – easy machining parameter setting for various workpieces
- MAZATROL TWINS – software that enables real-time sharing and centralized management of various data for increased productivity

■ Automation

Advanced automation with robot and software



■ AI

Increase your productivity with AI technology



■ Digital Twin

Create a virtual machine on your office PC for efficient setup and improved productivity



Shown with optional MAZATROL SmoothAi dual monitor



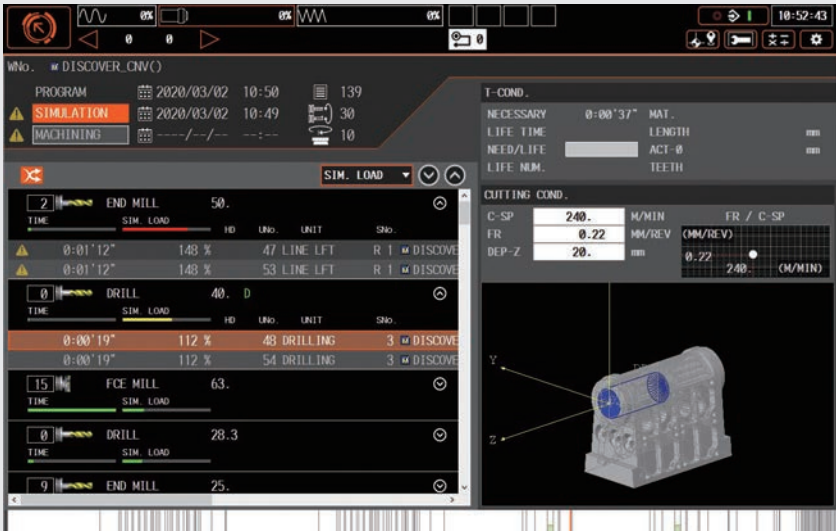
# Innovative Functions for Higher Productivity

Innovative functions improve productivity from programming to machining

## Simulation, Test Cutting (Machining Analysis, Optimization)

### Cutting Adviser

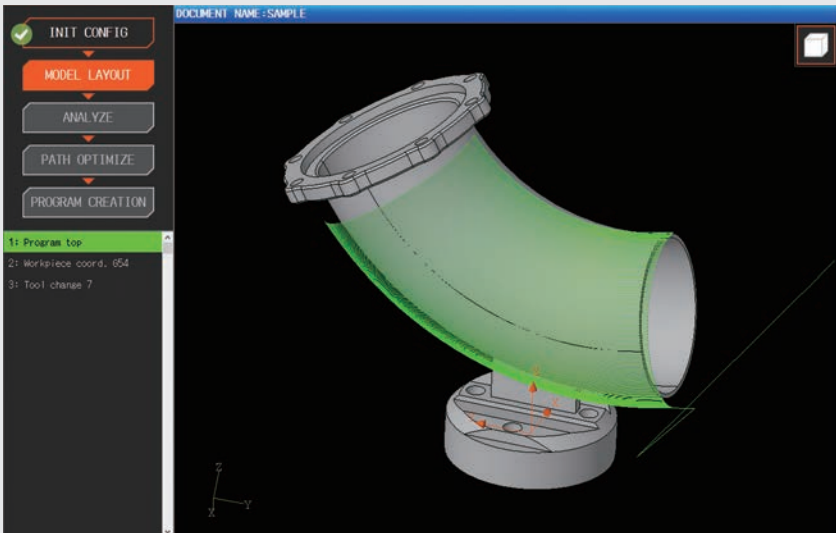
Cutting Adviser optimizes machining conditions through the MAZATROL SmoothAi CNC and optional SMOOTH CAM Ai simulation software.



### SMC PLUS

OPTION

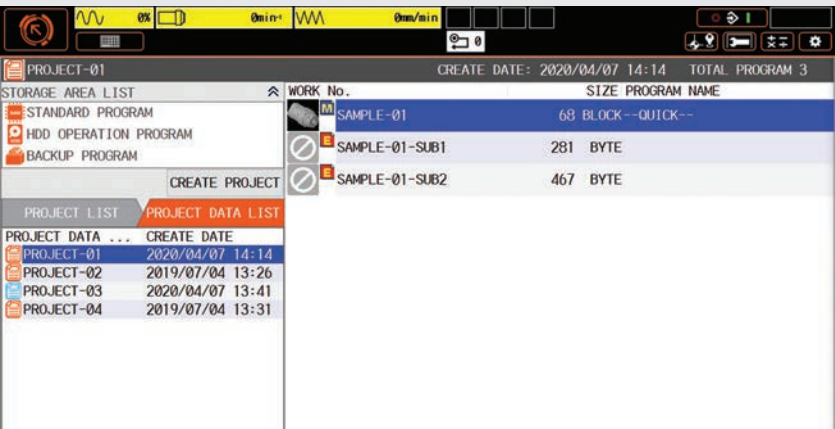
Compare the cutting point of the EIA program with the 3D model to set the correct command point, optimizing the tool path and ensuring high-accuracy finished surfaces.



## Setup

### Project Function

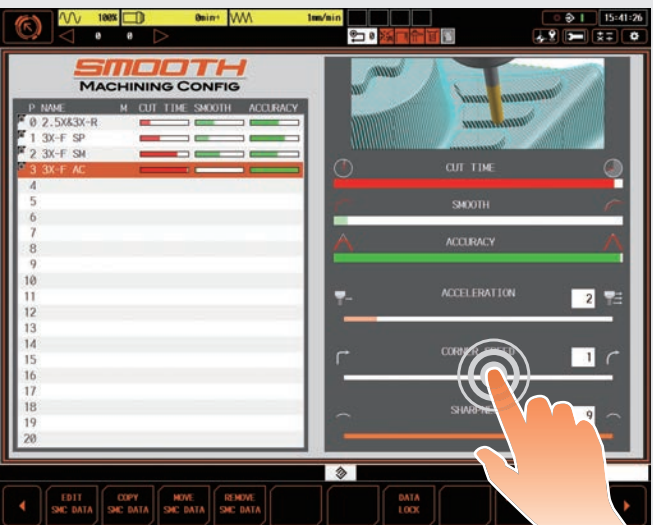
Manage all data required to execute machining as project data, which can be exported to the machine, dramatically reducing data-input time. Additionally, manage project data for an entire factory with SMOOTH Project Manager (optional software).



## Adjust Machining Features

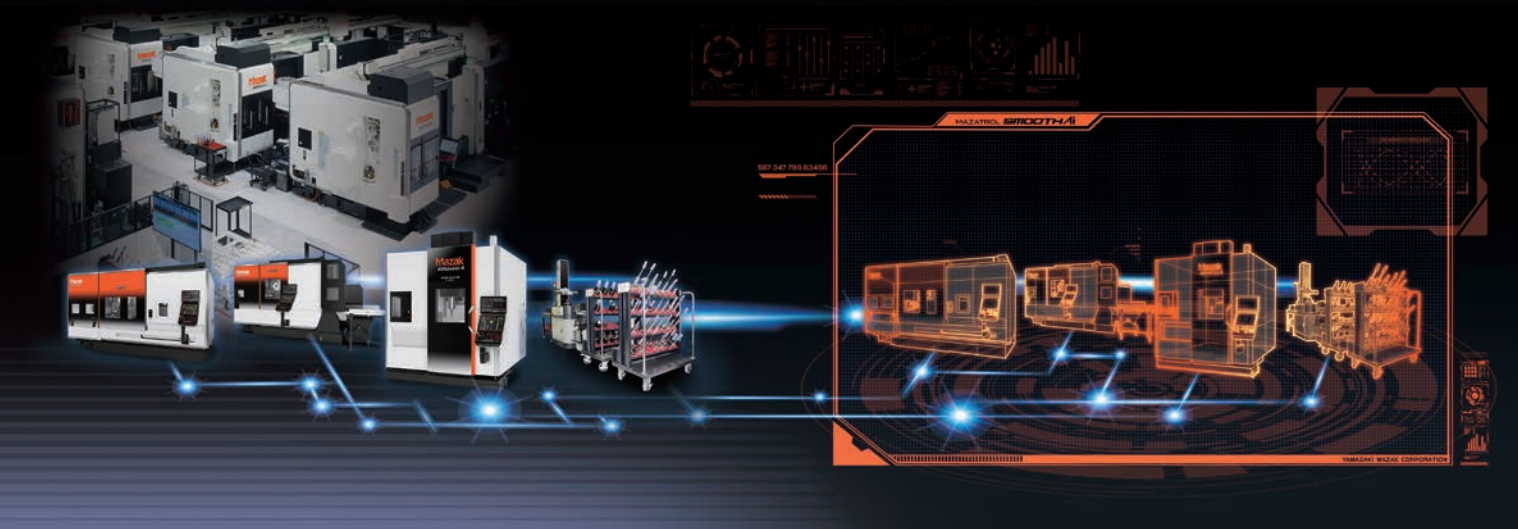
### SMOOTH Machining Configuration (SMC)

Use slider switches on the display to adjust machining features including cycle time, finished surface and machining shape according to material requirements and machining methods. This is especially effective with complex workpiece contours defined in small program increments. Additionally, adjust the rotary axis acceleration tuning parameter with a slider switch, and select speed priority or accuracy priority for simultaneous 5-axis machining.



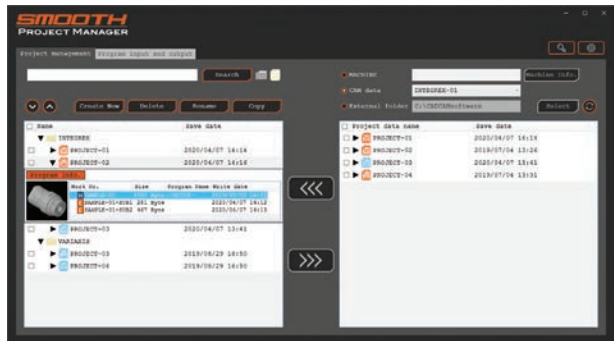
MAZATROL TWINS (software) for High Productivity OPTION

Virtual machines in your office accurately duplicate the operation of machines on your factory floor.  
Substantially increase production efficiency with machines equipped with the MAZATROL SmoothAi CNC.



SMOOTH Project Manager

Manage project data for an entire factory, synchronized between machines in the factory and PCs in the office.



SMOOTH Tool Management

Centrally manage and register tool data and setup for an entire factory to reduce non-cut time.



SMOOTH CAM Ai

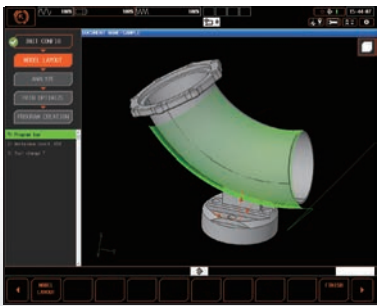
Make and edit programs and perform simulation and analysis for multiple machines. Send data to machines in the factory for fast, accurate setups.

SMOOTH Monitor AX • SMOOTH Link

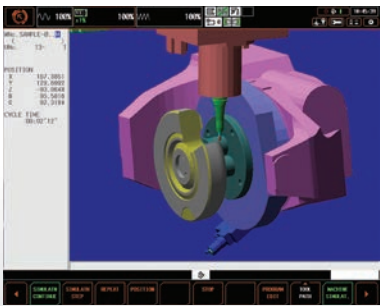
Monitor operational status and analyze accumulated manufacturing data on tablets and smartphones to improve productivity. Operators can view essential information instantly from anywhere.

SMOOTH Scheduler

Use production data to create and display effective machining schedules to monitor production process conveniently.



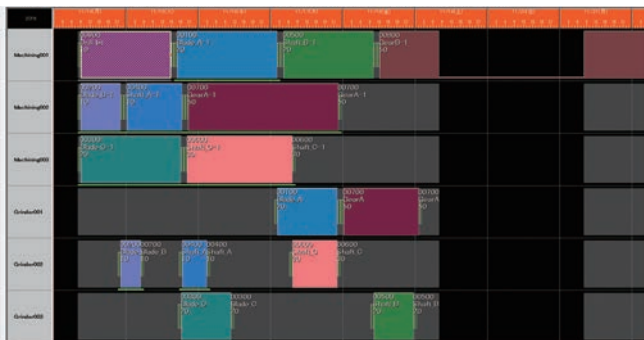
Programming



Fast simulation



Machining analysis·Optimization





Standard Machine Specifications

VARIAXIS C-600		
Stroke	X-axis travel (spindle head left/right)	650 mm (25.59")
	Y-axis travel (spindle head back/forth)	550 mm (21.65")
	Z-axis travel (spindle head up/down)	530 mm (20.87")
	B-axis travel (table tilt)	-30° ~ +120°
	C-axis travel (table rotation)	±360°
Table	Distance from table top to spindle nose	50~580 mm (1.97"~22.83") (table horizontal)
	Size	ø600 mm × width 500 mm (ø23.62" × 19.69")
	Max. workpiece size	ø730 mm × 450 mm (ø28.74" × 17.72")
	Load capacity (evenly distributed)	500 kg (1102 lbs)
	Surface configuration	M16 × P2 (5/8-11 UNC) tap 20
Milling spindle	Max. speed	12000 rpm
	Taper	7/24 taper No. 40
	Bearing I.D.	ø70 mm (2.76")
Feedrate	Rapid traverse rate (X, Y, Z axis)	42 m/min (1654 IPM)
	Rapid traverse rate (B, C axis)	30 rpm
	Simultaneously controlled axes	5-axis
	Min. indexing increment (B, C axis)	0.0001°
Automatic Tool Changer	Tool shank configuration	CAT No. 40
	Tool storage capacity	30 tools
	Max. tool diameter/length (from gauge line)/weight	ø80 mm/300 mm/8 kg (ø3.15"/11.81"/18 lbs)
	Max. tool diameter with adjacent tool pockets empty	ø130 mm (ø5.12")
	Tool selection method	MAZATROL random memory (random pocket assignment)
	Tool change time (chip-to-chip)	4.5 sec.
Motors	Spindle motor [40% ED (30-min. rating)/cont. rating]	11 kW (15 HP)/11 kW (15 HP)
	Electrical power requirement [40% ED (30-min. rating)/cont. rating]	33.02 kVA/33.02 kVA
Coolant	Coolant tank capacity	200 L (52 gal)
Machine size	Height	3039 mm (119.65")
	Width	2350 mm (92.52")
	Length	2962 mm (116.61")
	Weight	10000 kg (22046 lbs)

Standard and Optional Equipment

VARIAXIS C-600		
Table	ø600 mm × 500 mm (ø23.62" × 19.69") tapped table	●
	ø600 mm × 500 mm (ø23.62" × 19.69") T-slot table	○
Machine	Work light	●
	Ai THERMAL SHIELD	●
	12000 rpm spindle	●
	15000 rpm high-torque spindle	○
	18000 rpm spindle	○
	20000 rpm spindle	○
Factory automation	Automatic tool length measurement (RENISHAW PRIMO LTS)	○
	Laser tool measurement system	○
	30-tool magazine	●
	60-tool magazine	○
	90-tool magazine	○
	120-tool magazine	○
	Work measurement printout (printer not included)	○
	Absolute positioning system	●
	Remote manual pulse generator	○
	Front door automatic open/close	○
	Right side door automatic open/close	○
	Automatic power ON/OFF + warm-up operation	●
	Operation end buzzer	○
	Status light (3 colors)	○
	2-pallet changer	○
	Wireless touch probe RMP600	○
	Preparation for hydraulic fixtures	○
Safety equipment	Operator door interlock	●
High accuracy	MAZA-CHECK (software, reference sphere)*1	●
	Ball screw core cooling (X, Y, Z axis)	●
	Scale feedback (X, Y, Z axis)	○
	Scale feedback (B, C axis)	○
Coolant/ Chip disposal	Coolant system	●
	Work air blast	○
	Oil skimmer	○
	Mist collector	○
	Coolant temperature control	○
	Hand held coolant nozzle	○
	Coolant through spindle system 0.5 MPa (73 PSI)	○
	Workpiece washing coolant	○
	High-pressure coolant through spindle 1.5 MPa (218 PSI)	○
	SUPERFLOW coolant system 7.0 MPa (1015 PSI)	○
	Flood coolant 0.45 MPa (65 PSI) 30 L/min (1 ft³/min)	●
	Coolant through spindle pressure switch	○
	Coolant tank with secondary filter	○
	Chip conveyor (hinge) side discharge	○
	Chip conveyor (drum type) side discharge	○
	Chip conveyor (hinge) rear discharge	○
	Chip conveyor (drum type) rear discharge	○
	Chip bucket (swing type)	○
	Chip bucket (fixed type)	○
Tooling	Pull stud bolt	○
Miscellaneous	Manual (CD)	●
	Additional manuals	○
	MAZATROL SmoothAi dual monitor	○

\*1 MAZA-CHECK requires RMP600 wireless touch probe.

Machine Dimensions

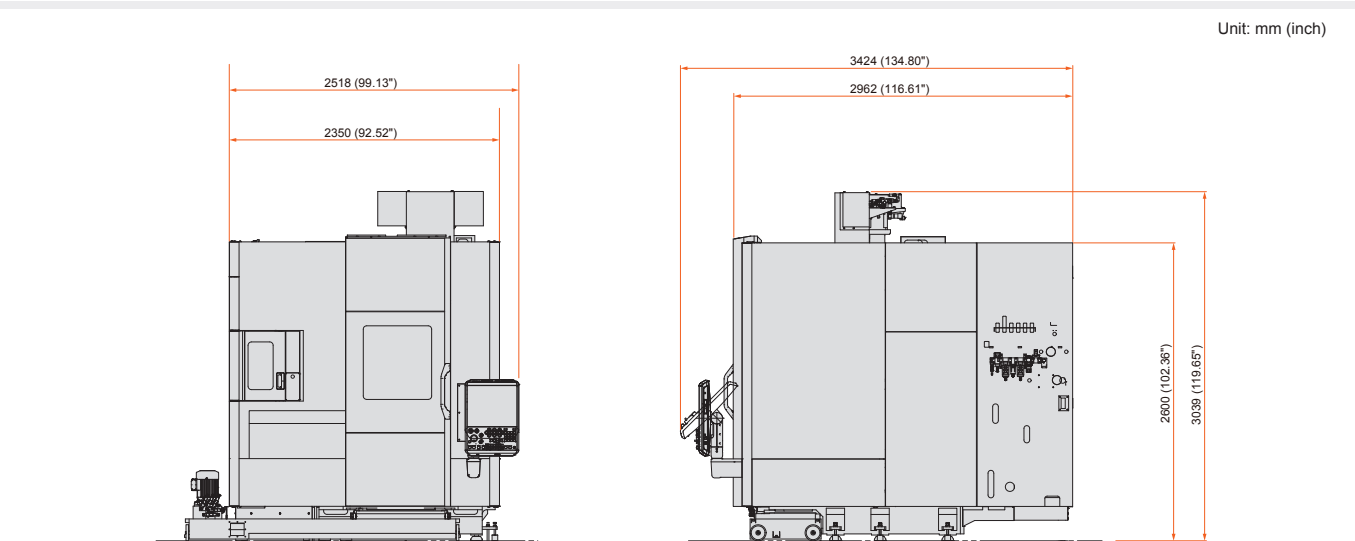
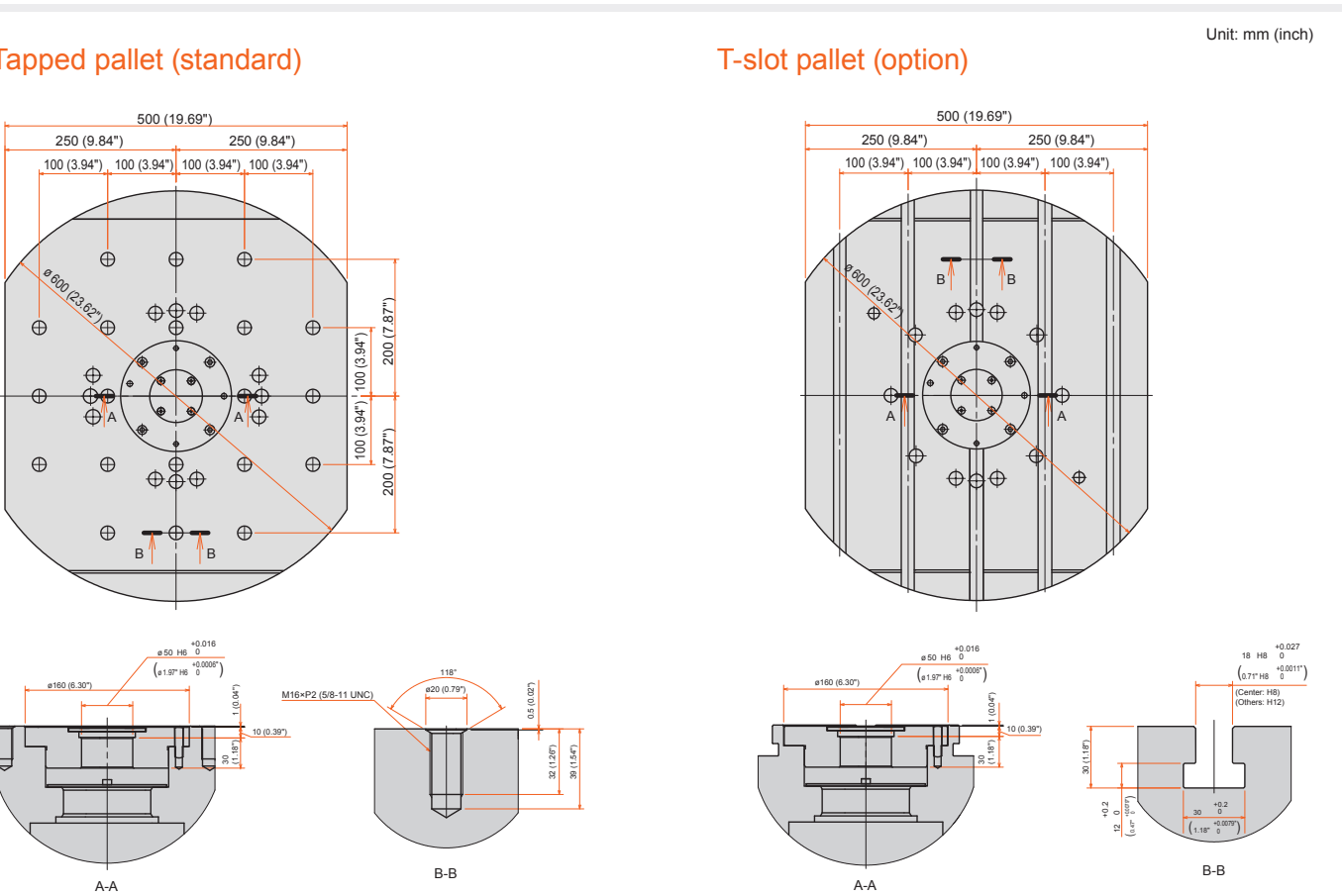


Table Dimensions



MAZATROL SmoothAi Specifications

	MAZATROL	EIA
Number of controlled axes	Simultaneous 2 ~ 4 axes	Simultaneous 5 axes
Minimum input increment	0.0001 mm, 0.00001 inch, 0.0001 deg	
High-speed, high-precision control	Shape compensation, SMOOTH Corner Control, Rapid traverse overlap, Rotary axis shape compensation	Shape compensation, SMOOTH Corner Control, Rapid traverse overlap, Rotary axis shape compensation, High-speed machining mode, High-speed smoothing control, 5-axis spline*, Path error suppression control*, Tool path optimization*
Interpolation	Positioning (interpolation), Positioning (non-interpolation), Linear interpolation, Circular interpolation, Cylindrical interpolation, Polar coordinate interpolation, Synchronous tapping*	Positioning (interpolation), Positioning (non-interpolation), Linear interpolation, Circular interpolation, Spiral interpolation, Helical interpolation, Cylindrical interpolation*, Involute interpolation*, Fine spline interpolation*, NURBS interpolation*, Polar coordinate interpolation*, Synchronous tapping*
Feedrate	Rapid traverse, Cutting feed, Cutting feed (per minute), Cutting feed (per revolution), Dwell (time/rotation), Rapid traverse override, Cutting feed override, G0 speed variable control, Feedrate limitation, Variable acceleration control, G0 slope constant*	Rapid traverse, Cutting feed, Cutting feed (per minute), Cutting feed (per revolution), Inverse time feed, Dwell (time/rotation), Rapid traverse override, Cutting feed override, G0 speed variable control, Feedrate limitation, Time constant changing for G1, Variable acceleration control, G0 slope constant*
Program registration	Number of programs: 256 (Standard)/960 (Max.), Program memory: 2MB, Program memory expansion: 8MB*, Program memory expansion: 32MB*	
Control display	Display: 19" touch panel, Resolution: SXGA	
Spindle functions	S code output, Spindle speed limitation, Spindle speed override, Spindle speed reaching detection, Multiple position orient, Constant surface speed, Spindle speed command with decimal digits, Synchronized spindle control, Spindle speed range setting	
Tool functions	Number of tool offset: 4000, T code output for tool number, Tool life monitoring (time), Tool life monitoring (number of machined workpieces)	Number of tool offset: 4000, T code output for tool number, T code output for group number, Tool life monitoring (time), Tool life monitoring (number of machined workpieces)
Miscellaneous functions	M code output, Simultaneous output of multiple M codes	
Tool offset functions	Tool position offset, Tool length offset, Tool diameter/tool nose R offset, Tool wear offset	
Coordinate system	Machine coordinate system, Work coordinate system, Local coordinate system, Additional work coordinates (300 set)	
Machine functions	—	Rotary axis prefilter, Tilted working plane, Hobbing II*, Shaping function*, Dynamic compensation II*, Tool center point control*, Tool radius compensation for 5-axis machining*, Workpiece positioning error compensation*
Machine compensation	Backlash compensation, Pitch error compensation, Geometric deviation compensation, Thermal shield, Volumetric compensation*	
Protection functions	Emergency stop, Interlock, Pre-move stroke check, SAFETY SHIELD (manual mode), SAFETY SHIELD (automatic mode), VOICE ADVISER	
Automatic operation mode	Memory operation	Memory operation, Tape operation, MDI operation, EtherNet operation*
Automatic operation control	Optional stop, Dry run, Manual handle interruption, MDI interruption, TPS, Restart, Machine lock	Optional block skip, Optional stop, Dry run, Manual handle interruption, MDI interruption, TPS, Restart, Restart 2, Collation stop, Machine lock
Manual measuring functions	Tool length teach, Touch sensor coordinates measurement, Workpiece offset measurement, WPC coordinate measurement, Measurement on machine	Tool length teach, Tool offset teach, Touch sensor coordinates measurement, Workpiece offset measurement, WPC coordinate measurement, Measurement on machine
Automatic measuring functions	WPC coordinate measurement, Automatic tool length measurement, Sensor calibration, Tool breakage detection, External tool breakage detection*	Automatic tool length measurement, Sensor calibration, Tool breakage detection, External tool breakage detection*
MDI measurement	Semi automatic tool length measurement, Full automatic tool length measurement, Coordinate measurement	
Interface	PROFIBUS-DP*, EtherNet/IP*, CC-Link*	
Card interface	SD card interface, USB	
EtherNet	10M/100M/1Gbps	

\*Option





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[www.mazak.com](http://www.mazak.com)

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