

Mazak

# VARIAXIS C-600

[ 5-axis vertical machining center ]

Mazak

VARIAXIS C-600

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VARIAXIS C-600 23.08.0 GH 99J292621E1





# VARIAXIS C-600

Manufacturing innovation by 5-axis machining center with AI, digital twin and automation

The innovation of production processes utilizing data and digital technologies is rapidly changing the manufacturing environment.

Mazak's new 5-axis vertical machining center VARIAXIS C-600 is a next generation machine designed to change production processes by incorporating automation, AI and digital twin to support digitalization as well as to enhance machine specifications.

MAZATROL  
*SMOOTH*Ai**



Shown with optional MAZATROL SmoothAi dual monitor

## Ai

- Optimum programming by AI analysis
- High quality and high accuracy machining ensured

## DIGITAL TWIN

- Perform digital setup in an office by utilizing digital twin technology
- Reduce setup time for machine, and improve efficiency for machining of initial product and prototype

## AUTOMATION

- Wide variety of automation equipment available - such as a 2-pallet changer, MPP (MULTI PALLET POOL) , robot and hydraulic / pneumatic fixtures

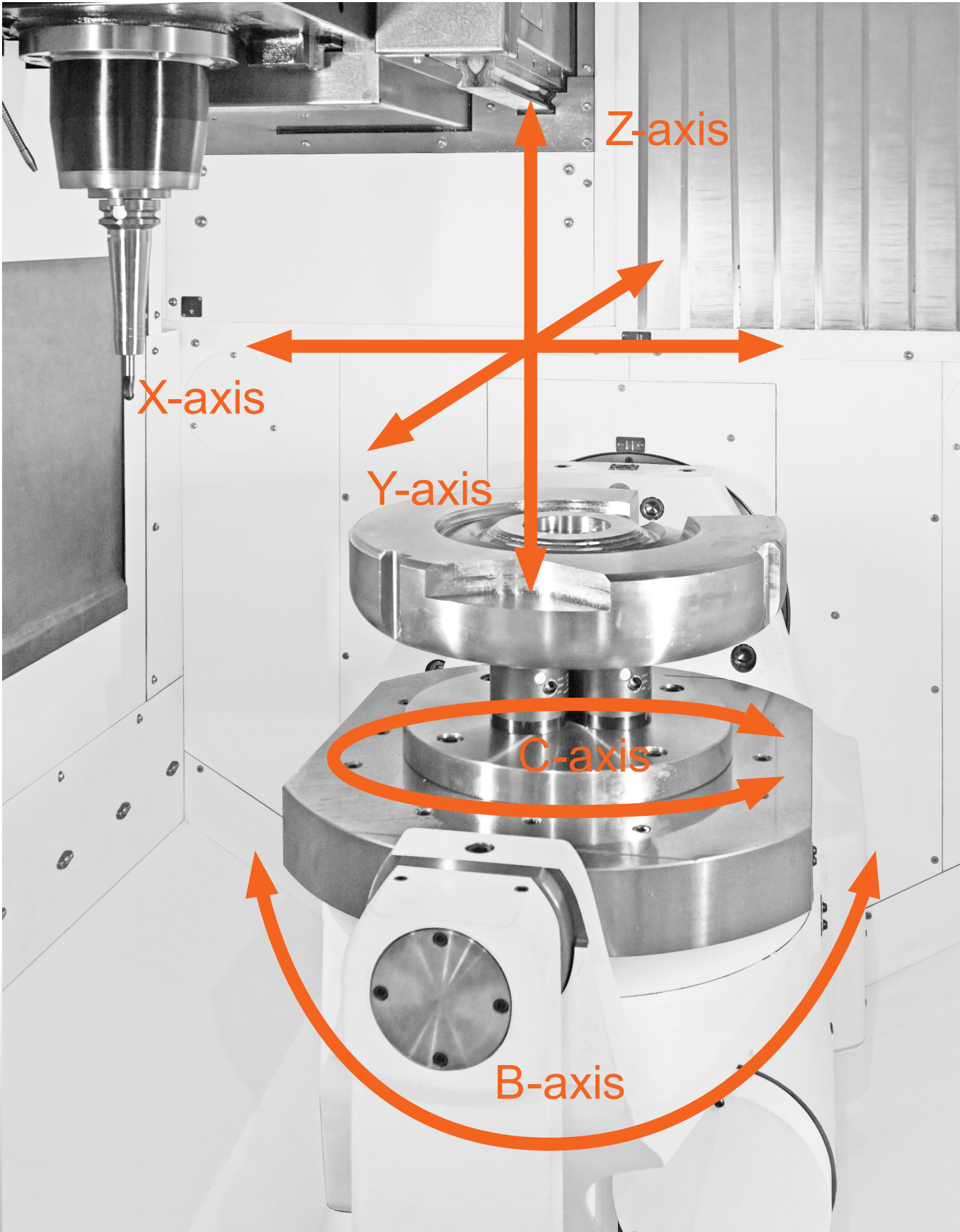


2-pallet changer (option)



Shown with optional equipment





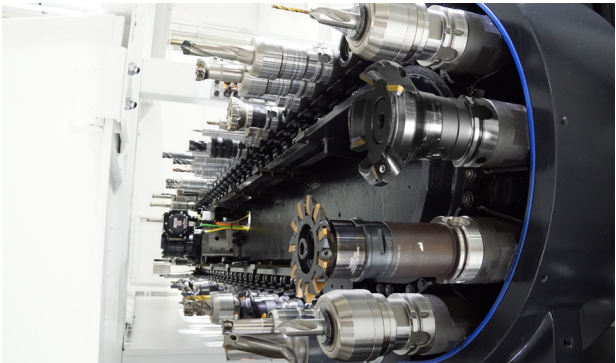
Tool magazine

The standard tool magazine has a storage capacity of 30 tools - 60, 90, 120 tools are optionally available.

- Max. tool length (from tool tip to gauge line) 300 mm
- Tool diameter 80 mm (with adjacent pockets empty 130 mm)
- Max. tool weight 8 kg (120 kg total weight of tools for 30 tool magazine)



30 tool magazine



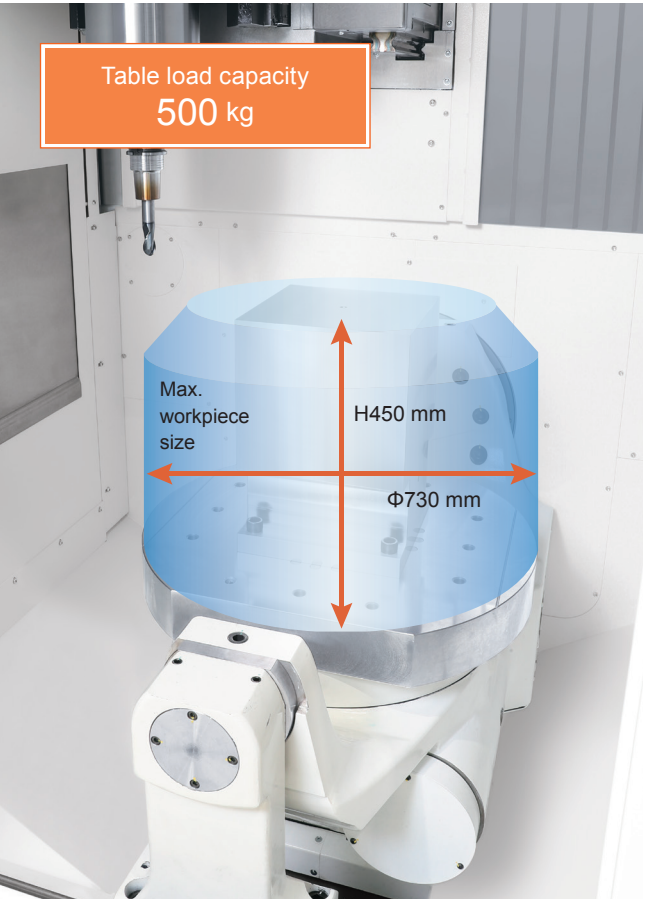
60 tool magazine (option)

High-speed automatic tool changer

Cam-driven double arm automatic tool changer is designed to drastically reduce chip-to-chip time. Chip-to-chip is 4.5 seconds.

High rigidity table

The tilting rotary table is rigidly supported on both ends to ensure high-speed, high-accuracy machining. The B-axis and C-axis both utilize a roller gear cam to eliminate backlash.







Machining example (test results)

15000 min<sup>-1</sup> (rpm) high torque spindle  
Φ80 mm face mill (6 teeth)

Speed : 995 min<sup>-1</sup> (rpm)

Feedrate : 1552 mm/min

Depth of cut : 5.8 mm

Material : C45

Material removal rate : **581 cm<sup>3</sup>/min**

Spindle specifications to meet a wide variety of machining requirements

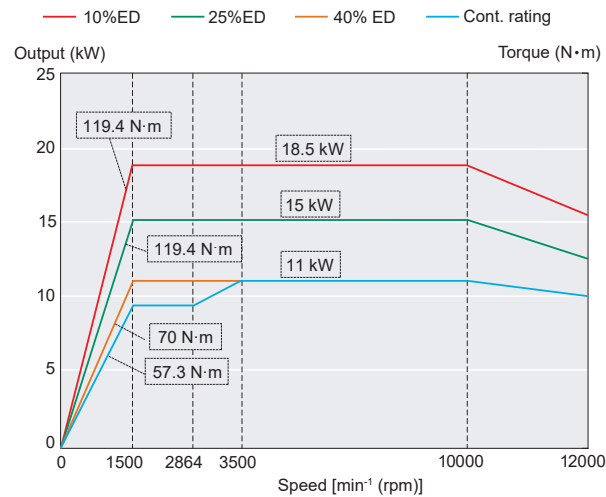
The high rigidity spindle can perform heavy duty machining of steel as well as high speed machining of non-ferrous materials such as aluminum. High speed and high torque specifications are optionally available.

| Speed                | Standard                      | High-torque <b>OPTION</b>     | High-speed <b>OPTION</b>      |                               |
|----------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
|                      | 12000 min <sup>-1</sup> (rpm) | 15000 min <sup>-1</sup> (rpm) | 18000 min <sup>-1</sup> (rpm) | 20000 min <sup>-1</sup> (rpm) |
| Output (40% ED)      | 11 kW (15 HP)                 | 46 kW (62 HP)                 | 30 kW (40 HP)                 | 42 kW (56 HP)                 |
| Max. torque (40% ED) | 70 N·m                        | 200 N·m                       | 105 N·m                       | 161 N·m                       |
| Tool shank           | BT-40 / BBT-40* / HSK-A63*    | BT-40 / BBT-40 / HSK-A63      | BT-40 / BBT-40 / HSK-A63      | BT-40 / BBT-40 / HSK-A63      |

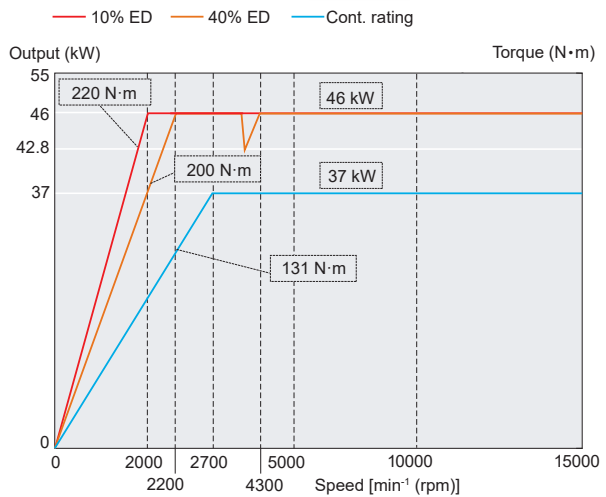
\*Option

Spindle output Torque diagram

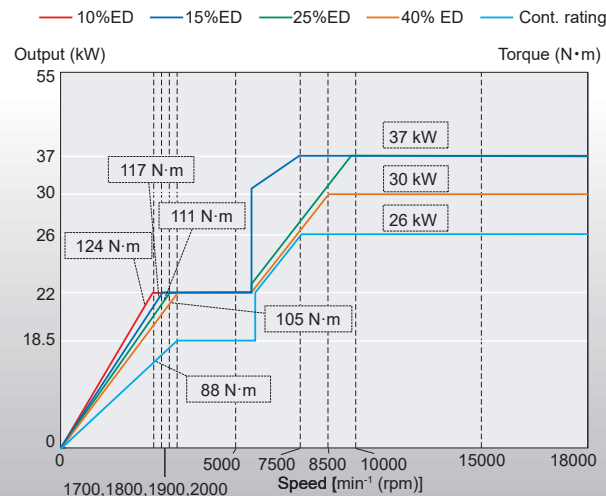
12000 min<sup>-1</sup> (rpm) spindle



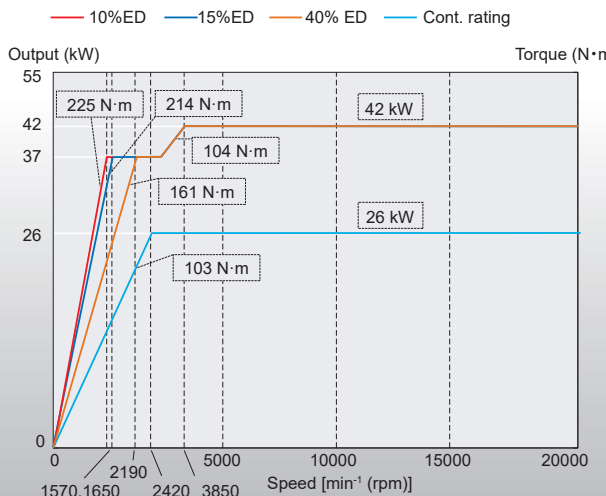
15000 min<sup>-1</sup> (rpm) spindle **OPTION**



18000 min<sup>-1</sup> (rpm) spindle **OPTION**



20000 min<sup>-1</sup> (rpm) spindle **OPTION**

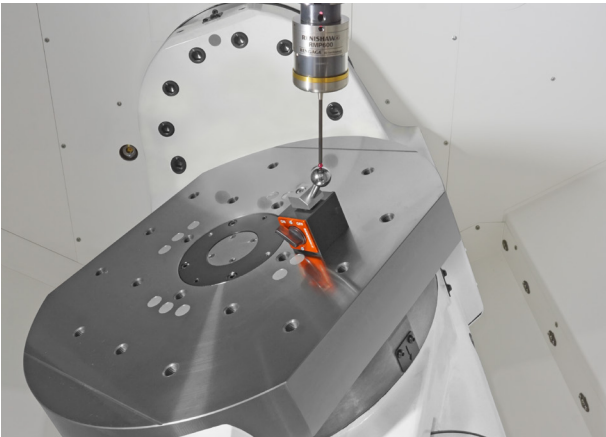




For high accuracy 5-axis machining

High accuracy 5-axis calibration - MAZA-CHECK

Position misalignment and incline of the rotary axes can automatically be measured and compensated for high accuracy 5-axis machining. The center of rotation of both C and B axes can be automatically measured and compensated.

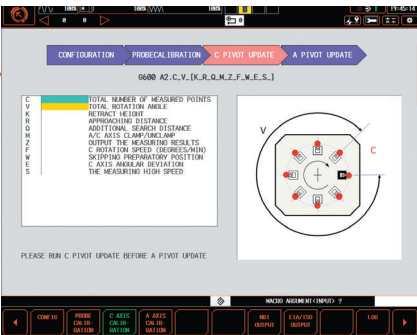


Wireless touch probe RMP600 is optional equipment.

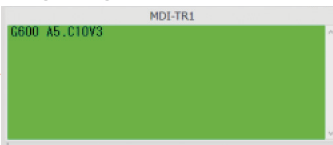
Measurement item selection



Measurement information setting



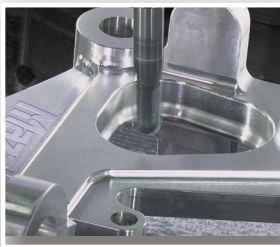
Automatic measurement program generation



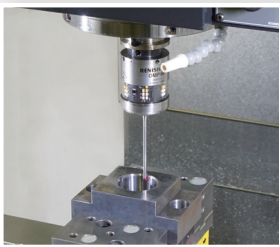
Convenient screen display assists measurement operation.

Ai Thermal Shield

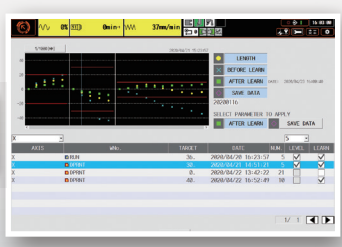
New algorithms automatically determine the amount of compensation to be automatically applied according to changes in the temperature to ensure even higher machining accuracy.



Machining



Workpiece inspection



Simulation

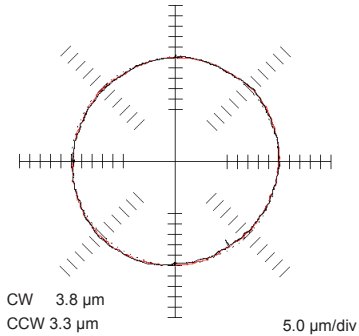
High rigidity construction combined with the MAZATROL SmoothAi ensure high accuracy machining

DBB (test results)

X-Y plane measured results

3.8 μm (CW)  
3.3 μm (CCW)

|          |                |
|----------|----------------|
| Machine  | VARIAXIS C-600 |
| Diameter | 200 mm         |
| Feedrate | 560 mm/min     |



Positioning accuracy and positioning repeatability (test results)

Mazak precision results

|                      |        |         |                           |        |         |
|----------------------|--------|---------|---------------------------|--------|---------|
| Positioning accuracy | X-axis | 1.17 μm | Positioning repeatability | X-axis | 0.99 μm |
|                      | Y-axis | 1.56 μm |                           | Y-axis | 1.52 μm |
|                      | Z-axis | 1.15 μm |                           | Z-axis | 0.68 μm |

Note : The inspection is conducted according to ISO-230 on a recommended foundation with room temperature controlled to 22°C±1°C after the machine has reached operation temperature.

Continuous inverted boring accuracy (test results)

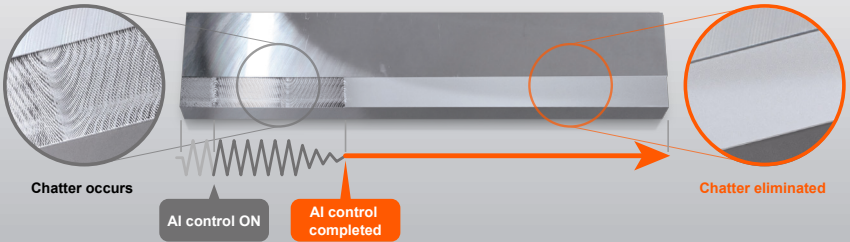
|                    |                         |       |
|--------------------|-------------------------|-------|
| Mazak test results | X-axis deviation (max.) | 3 μm  |
|                    | Y-axis deviation (max.) | 6 μm  |
|                    | Concentricity (max.)    | 19 μm |

Note : The inspection is conducted according to ISO-230 on a recommended foundation with room temperature controlled to 22°C±1°C after the machine has reached operation temperature.

Smooth Ai Spindle



Using AI, milling spindle vibration is detected and machining conditions are automatically changed to produce unsurpassed surface finishes and high productivity. Thanks to AI, adjustments can be easily made in a short time without a skilled operator.

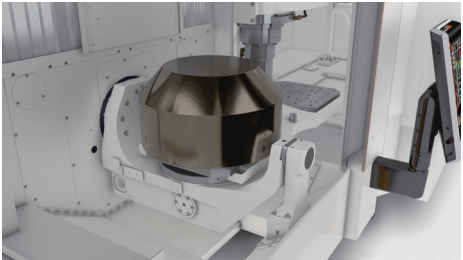




2-pallet changer

OPTION

The next workpiece can be setup during the machining of the current workpiece for higher productivity.



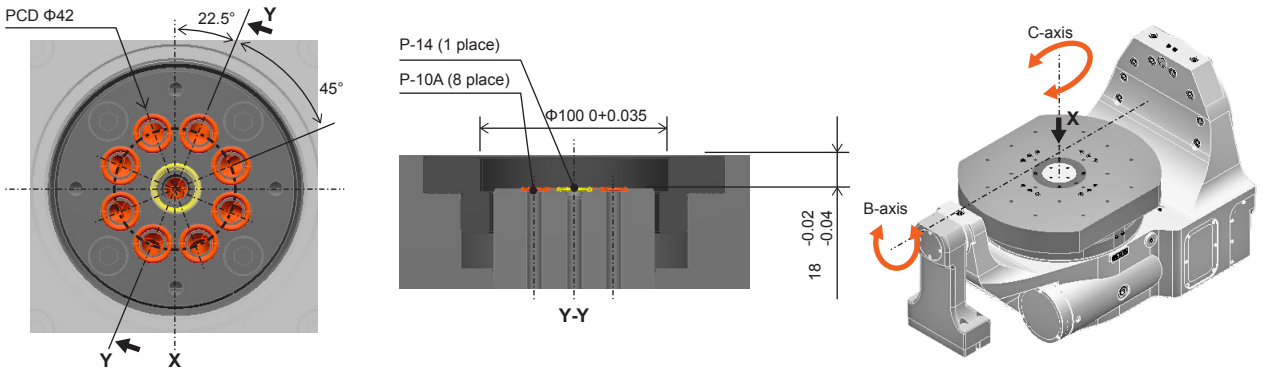
|                     | VARIAXIS C-600<br>(2-pallet changer) |
|---------------------|--------------------------------------|
| Pallet size         | □500 mm                              |
| Max. workpiece size | Φ730 mm × 450 mm                     |
| Max. load           | 500 kg                               |

Preparation for hydraulic and pneumatic fixtures

OPTION

Hydraulic power and pneumatic power are supplied through the pallet for hydraulic fixtures and pneumatic fixtures.  
Maximum number of ports - 9

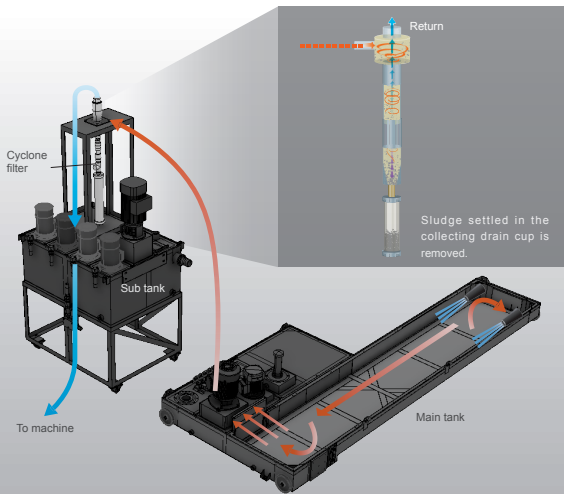
Unit : mm



Clean coolant system

OPTION

Nozzles inside the main tank circulate coolant to prevent the accumulation of chips and sludge. More than 95% of particles larger than 20 μm are removed by separation by the cyclone filter. Thanks to these features, the coolant tank stays clean and the service life of the coolant is extended.



MPP (MULTI PALLET POOL)

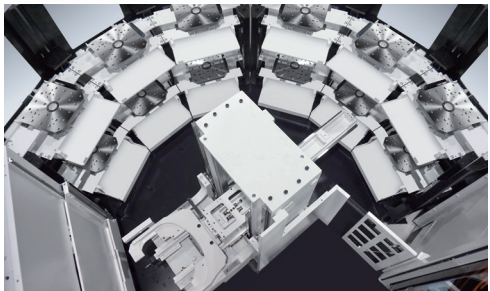
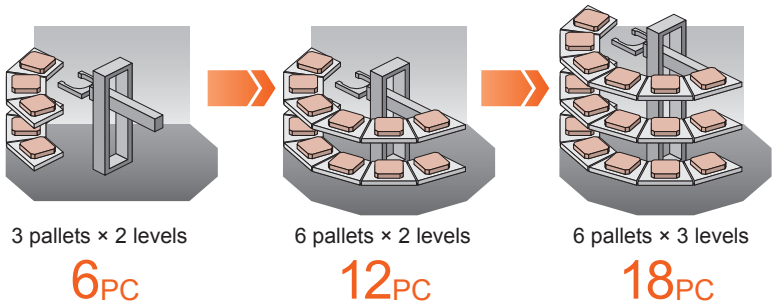
The MPP (MULTI PALLET POOL) is a new system that meets the increasing worldwide demand for automation. It is designed to provide high productivity in the production of a wide variety of parts in small size lots. Operators can access the workpiece from the machine as well as loading station of the MPP.



MPP (18PC)  
VARIAXIS C-600

Flexible pallet stoker capacity

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

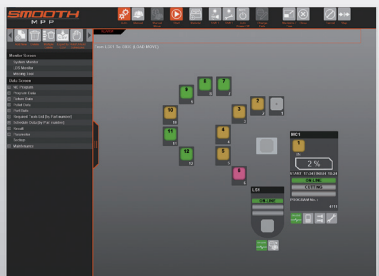


MPP

|                                      | VARIAXIS C-600    |
|--------------------------------------|-------------------|
| Number of pallets                    | 6 / 12 / 18       |
| Pallet size                          | □500 mm           |
| Max. load (without pallet)           | 500 kg            |
| Max. workpiece size (without pallet) | Φ730 mm × H450 mm |

SMOOTH  
M P P

Once the production schedule is input, operation will be performed automatically. Production results, system utilization and other data can be checked on the MAZATROL SmoothAi. If connected to a network (prepared by user), system data are accessible on office PCs, tablets and smart phones.





Designed with environmental considerations

The environment and our impact on natural surroundings have always been important concerns of Yamazaki Mazak. This is shown by the fact that all factories in Japan where Mazak machine tools are produced 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 the CNC backlight are turned off automatically. They are automatically turned on when the motion sensor detects the return of the operator.

Chip conveyor stop

After the passing of a pre-registered period of time after automatic machine operation stops, the chip conveyor automatically stops to reduce electrical power consumption. (Chip conveyor is optional equipment)

Grease lubrication

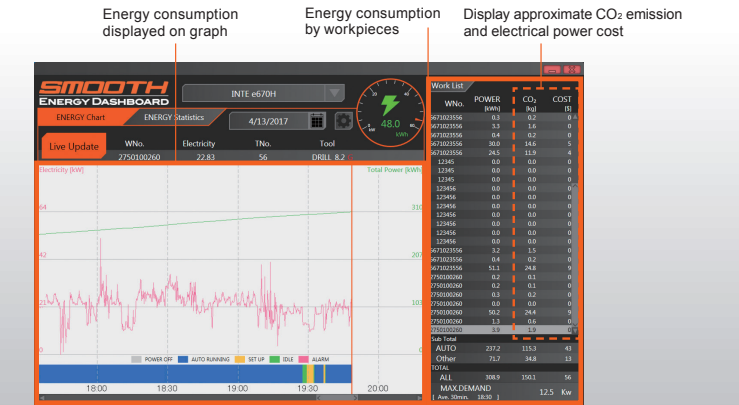
The linear roller guides and ball screws are lubricated by grease which eliminates tramp oil in the coolant resulting in a much longer service life for the coolant.

Energy Dashboard

The Energy Dashboard provides a 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 allows workpiece machining to be easily monitored by the operator.



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 tool loading and unloading.



Innovation for Higher Productivity

# MAZATROL SMOOTH*Ai*

## New MAZATROL SmoothCNC system

Designed to provide unsurpassed productivity through even faster and 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
- Digital twin software that enables real-time sharing and centralized management of various data for increase productivity

■ AI

Increase your productivity with AI technology



■ Digital Twin

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



■ Automation

Advanced automation utilizing robot and software



Shown with optional MAZATROL SmoothAi dual monitor

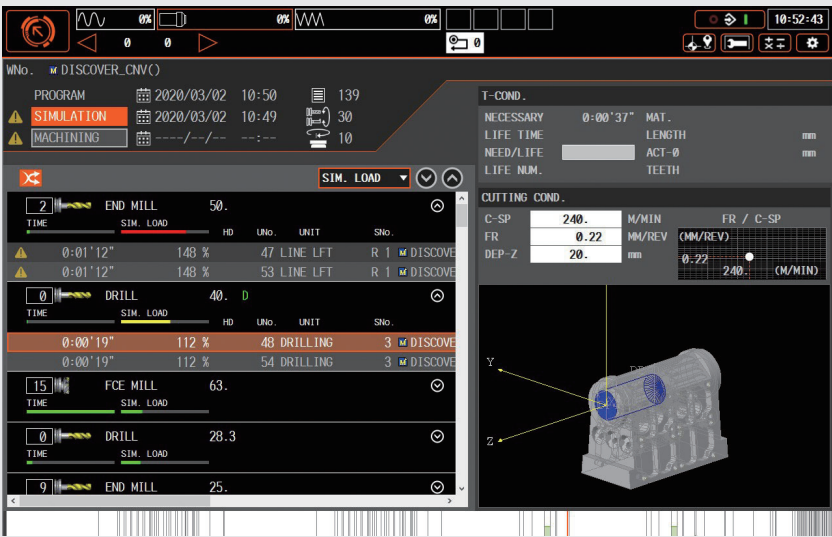


Innovative functions to improve productivity from programming to machining

Simulation, Test cutting (machining analysis, optimization)

Cutting Adviser

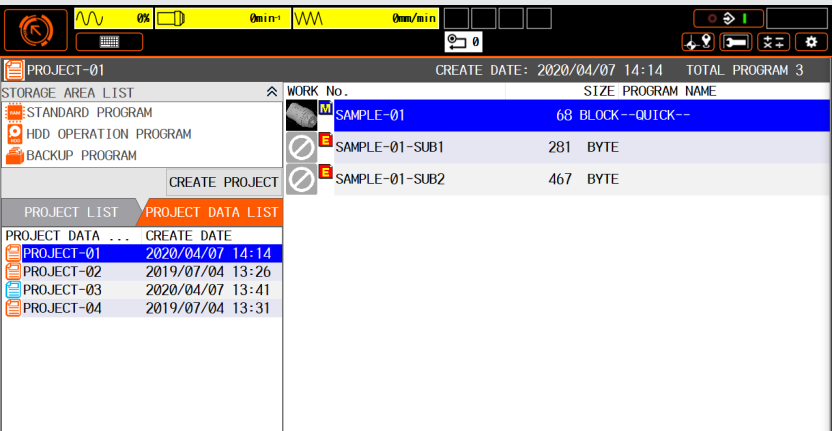
Cutting adviser optimizes machining conditions by machining simulation and visualization of machining process from accumulated machining results.



Set up

Project function

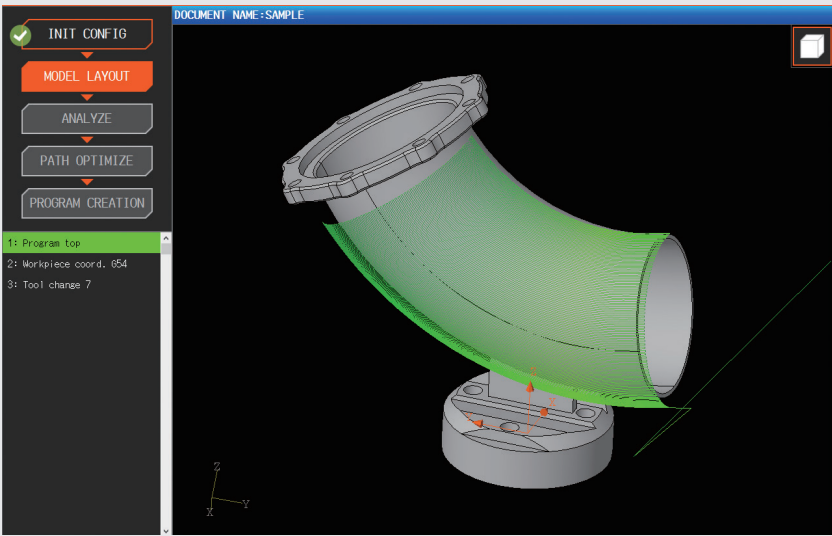
Data required to execute machining is managed as project data. Project data can be exported to the machine, drastically reducing time for inputting data. Additionally, project data of entire factory can be managed with Smooth Project Manager. (optional software)



SMC PLUS

OPTION

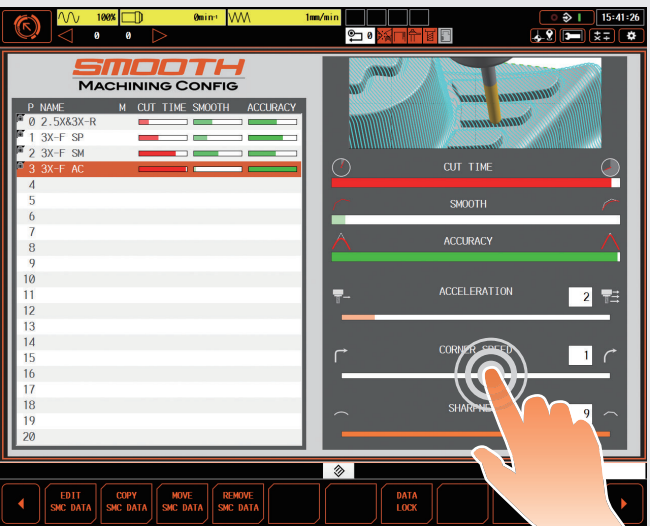
Compares the cutting point of the EIA program with the 3D model so the correct command point can be changed to ensure the correct tool path and high accuracy finished surfaces.



Tuning machining features

SMC (SMOOTH MACHINING CONFIGURATION)

Machining features including cycle time, finished surface and machining shape can be adjusted by slider switches on the display according to material requirements and machining methods. This is especially effective for complex workpiece contours defined in small program increments. Additionally, the rotary axis acceleration tuning parameter can now be adjusted by a slider switch as well as selecting speed priority or accuracy priority for simultaneous 5-axis machining.

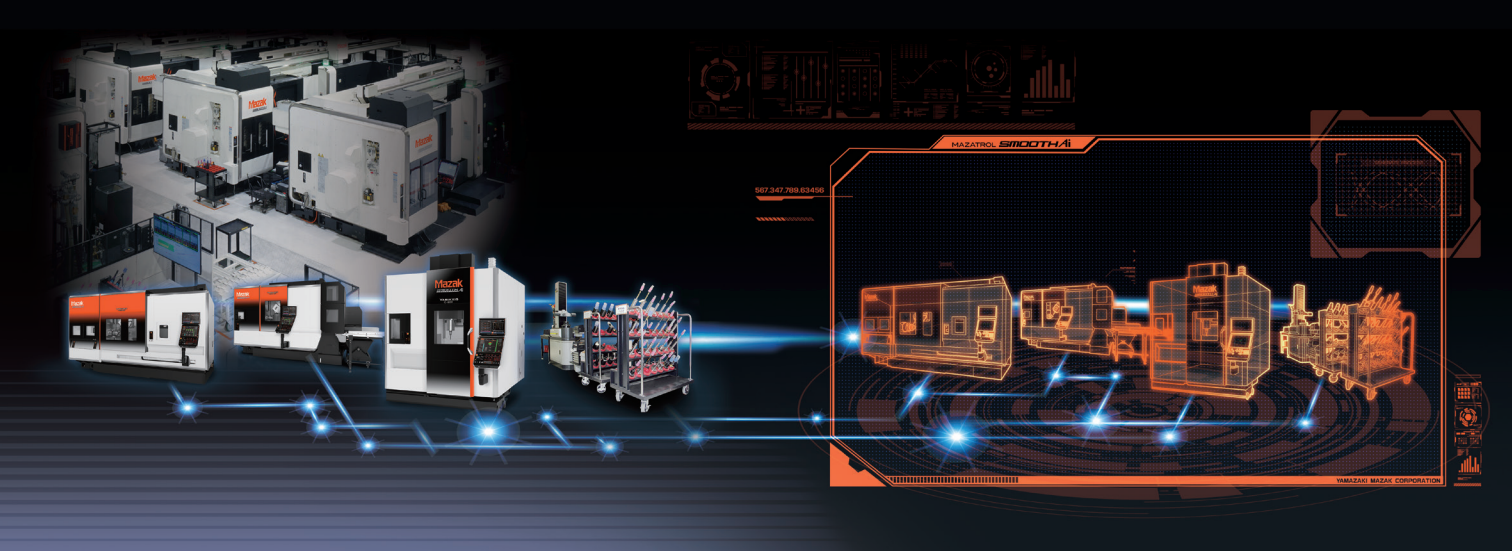




Digital twin software for high productivity

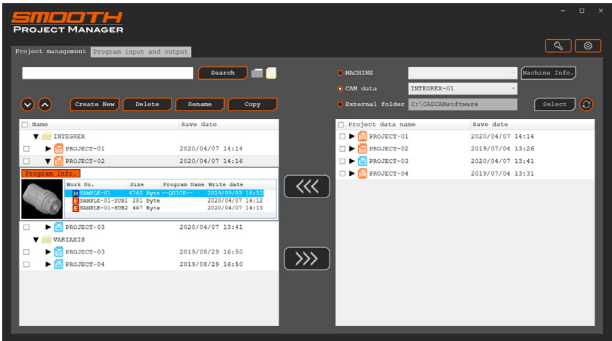
OPTION

Virtual machines in your office accurately duplicate the operation of machines on your factory floor. Available software can be used together with machines equipped with the MAZATROL SmoothAi CNC to substantially increase the efficiency of your production.



Smooth Project Manager

Smooth Project Manager is used to manage the project data of the entire factory. The data can be synchronized between the machine in the factory and the PC in the office.



Smooth Tool Management

The Smooth Tool Management software manages data of the large number of tools in use by a factory. By centrally managing tools and registering tool data as well as tool setup, machine non-cutting time can be reduced.



MAZATROL DX / Smooth CAM Ai

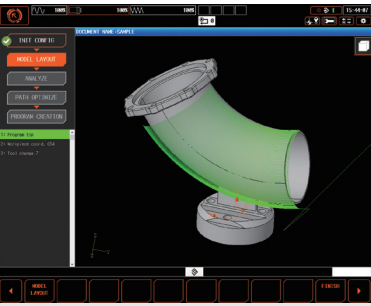
Programs can be made and edited, as well as performing simulation and analysis on the MAZATROL DX / Smooth CAM Ai for multiple machines. This data is sent to machines in the factory for fast and accurate machine setups.

Smooth Monitor AX・Smooth Link

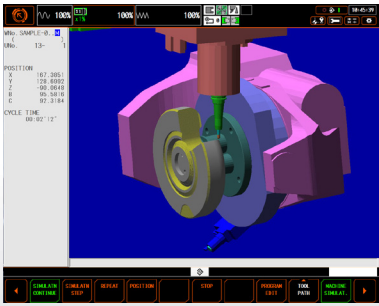
Smooth Monitor AX is software to monitor operational status and analyze accumulated manufacturing data for factory productivity improvement. Smooth Link is software to view operational status and machining programs on tablets and smartphones, so the operator can instantly view necessary information while monitoring away from the monitor.

Smooth Scheduler

Smooth Scheduler is software to create effective machining schedules utilizing production data. Schedules are displayed for convenient monitoring of production progress.



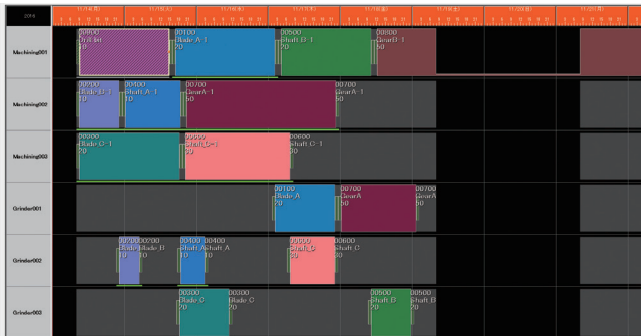
Programming



Fast simulation



Machining analysis・Optimization





Standard Machine Specifications

| VARIAXIS C-600         |                                                        |                                                   |
|------------------------|--------------------------------------------------------|---------------------------------------------------|
| Stroke                 | X-axis travel (spindle head left / right)              | 650 mm                                            |
|                        | Y-axis travel (spindle head back / forth)              | 550 mm                                            |
|                        | Z-axis travel (spindle head up / down)                 | 530 mm                                            |
|                        | B-axis travel (table tilt)                             | -30° ~ +120°                                      |
|                        | C-axis travel (table rotation)                         | ±360°                                             |
|                        |                                                        |                                                   |
| Table                  | Distance from table top to spindle nose                | 50 ~ 580 mm (table horizontal)                    |
|                        | Table size                                             | Φ600 mm × Width 500 mm                            |
|                        | Max. workpiece size                                    | Φ730 mm × 450 mm                                  |
|                        | Table load capacity (evenly distributed)               | 500 kg                                            |
|                        | Table surface configuration                            | M16 × P2 tap 20                                   |
|                        |                                                        |                                                   |
| Milling Spindle        | Max. spindle speed                                     | 12000 min <sup>-1</sup> (rpm)                     |
|                        | Spindle taper                                          | 7 / 24 taper No.40                                |
|                        | Spindle bearing I.D.                                   | Φ70 mm                                            |
| Feedrate               | Rapid traverse rate (X-, Y-, Z-axis)                   | 42 m/min                                          |
|                        | Rapid traverse rate (B-, C-axis)                       | 30 min <sup>-1</sup> (rpm)                        |
|                        | Simultaneously controlled axes                         | 5-axis                                            |
|                        | Min. indexing increment (B-, C-axis)                   | 0.0001°                                           |
| Automatic tool changer | Tool shank configuration                               | MAS BT-40                                         |
|                        | Tool storage capacity                                  | 30 tools                                          |
|                        | Max. tool diameter / length (from gauge line) / weight | Φ80 mm / 300 mm / 8 kg                            |
|                        | Max. tool diameter with adjacent tool pockets empty    | Φ130 mm                                           |
|                        | Tool selection method                                  | MAZATROL random memory (random pocket assignment) |
|                        | Tool change time (chip-to-chip)                        | 4.5 sec.                                          |
|                        |                                                        |                                                   |
| Motors                 | Spindle motor (40% ED / cont. rating)                  | 11 kW (15 HP) / 11 kW (15 HP)                     |
|                        | Electrical power requirement (40% ED / cont. rating)   | 33.02 kVA / 33.02 kVA                             |
|                        | Air supply                                             | 100 L/min                                         |
| Coolant                | Coolant tank capacity                                  | 200 L                                             |
| Machine size           | Height                                                 | 3039 mm                                           |
|                        | Width                                                  | 2350 mm                                           |
|                        | Length                                                 | 2962 mm                                           |
|                        | Machine weight                                         | 10000 kg                                          |

Standard and Optional Equipment

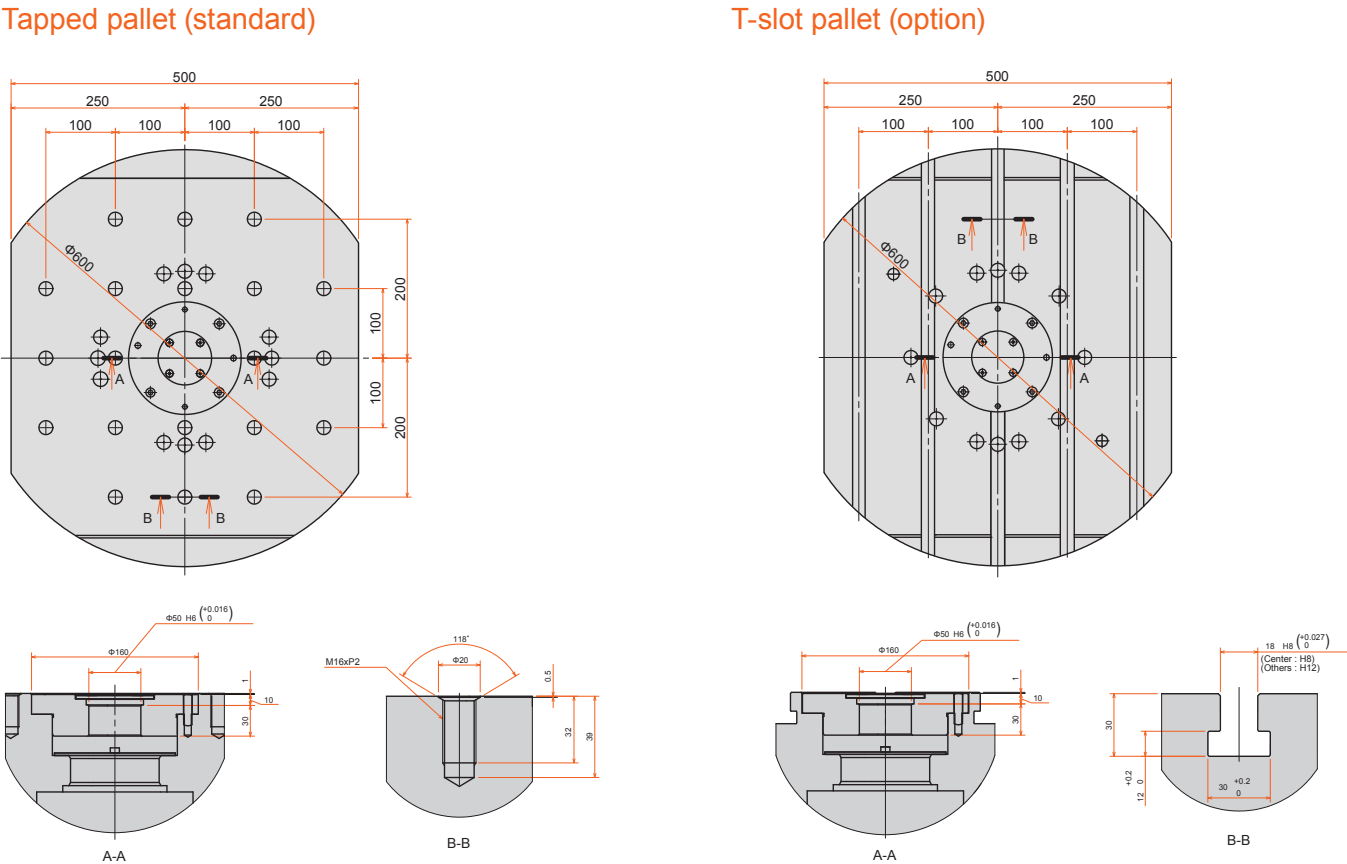
| VARIAXIS C-600            |                                                                         |   |
|---------------------------|-------------------------------------------------------------------------|---|
| ● : Standard   ○ : Option |                                                                         |   |
| Table                     | Φ600 mm × 500 mm tapped table                                           | ● |
|                           | Φ600 mm × 500 mm T-slot table                                           | ○ |
| Machine                   | Work light                                                              | ● |
|                           | Ai THERMAL SHIELD                                                       | ● |
|                           | 12000 min <sup>-1</sup> (rpm)                                           | ● |
|                           | 15000 min <sup>-1</sup> (rpm) high torque spindle                       | ○ |
|                           | 18000 min <sup>-1</sup> (rpm)                                           | ○ |
|                           | 20000 min <sup>-1</sup> (rpm)                                           | ○ |
|                           |                                                                         |   |
| 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)* <sup>1</sup>                   | ● |
|                           | 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 (5 kgf/cm <sup>2</sup> )         | ○ |
|                           | Workpiece washing coolant                                               | ○ |
|                           | High pressure coolant through spindle 1.5 MPa (15 kgf/cm <sup>2</sup> ) | ○ |
|                           | SUPERFLOW coolant system 7.0 MPa (70 kgf/cm <sup>2</sup> )              | ○ |
|                           | Flood coolant 0.45 MPa (4.5 kgf/cm <sup>2</sup> ) 30 L/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                                                          | ○ |
| Others                    | Manual (CD)                                                             | ● |
|                           | Additional manuals                                                      | ○ |
|                           | MAZATROL SmoothAi dual monitor                                          | ○ |

\*<sup>1</sup> MAZA-CHECK requires RMP600 wireless touch probe.



## 22

Unit : mm



\*Option