Mazak

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FJV-200, FJV-250 SmoothCNC 16.07.3000 S 99J279516E0 Ⓦ

FJV-200, FJV-250

EE

SMOOTH TECHNOLOGY

FJV-200
FJV-250

Mazak

Advanced features of the MAZATROL SmoothC and SmoothG CNC

Fastest CNC in the world—Latest hardware and software for unprecedented speed and precision

Operation control panel layout and process support home screen designed for unsurpassed ease of operation

Fine tuning function—Easily configure machine parameters for different workpiece materials and application requirements

CNC system with the essentials for your programming requirements [MAZATROL SmoothC]

Smooth user graphical interface allows operation similar to your smart phone / tablet for unsurpassed ease of operation [MAZATROL SmoothG]

PC with Windows® 8 embedded OS [MAZATROL SmoothG]

MAZATROL SMOOTH C

MAZATROL SMOOTH G

Standard CNC system varies by market.

No. 40 taper spindle double column machining centers designed for high accuracy and high productivity

Utilizing a basic design concept proven in the field over many years, these machining centers are equipped with a new high speed spindle and advanced CNC system. They are designed to efficiently machine workpieces such as die and molds and aerospace components at high speed with high accuracy.

FJV-250 [MAZATROL SmoothG]
Shown with optional status light

INTELLiGENT MACHiNE®

Innovative support for operators

High accuracy, high productivity double column machining centers

FJV-200, FJV-250

High rigidity No.40 taper spindle

4 spindle specifications are available to meet a wide variety of workpiece material requirements

- 12000 rpm [Standard]
- 12000 rpm High torque [Option]
- 18000 rpm [Option]
- 25000 rpm [Option]

Double column construction

Designed for high accuracy machining over extended periods of operation

Higher Accuracy

Double column machine construction provides high speed and high accuracy performance

The symmetrical machine construction together with advanced technologies, such as integral spindle / motor, ball screw core cooling system, the INTELLIGENT THERMAL SHIELD and many others - provide unsurpassed performance.

High rigidity machine construction

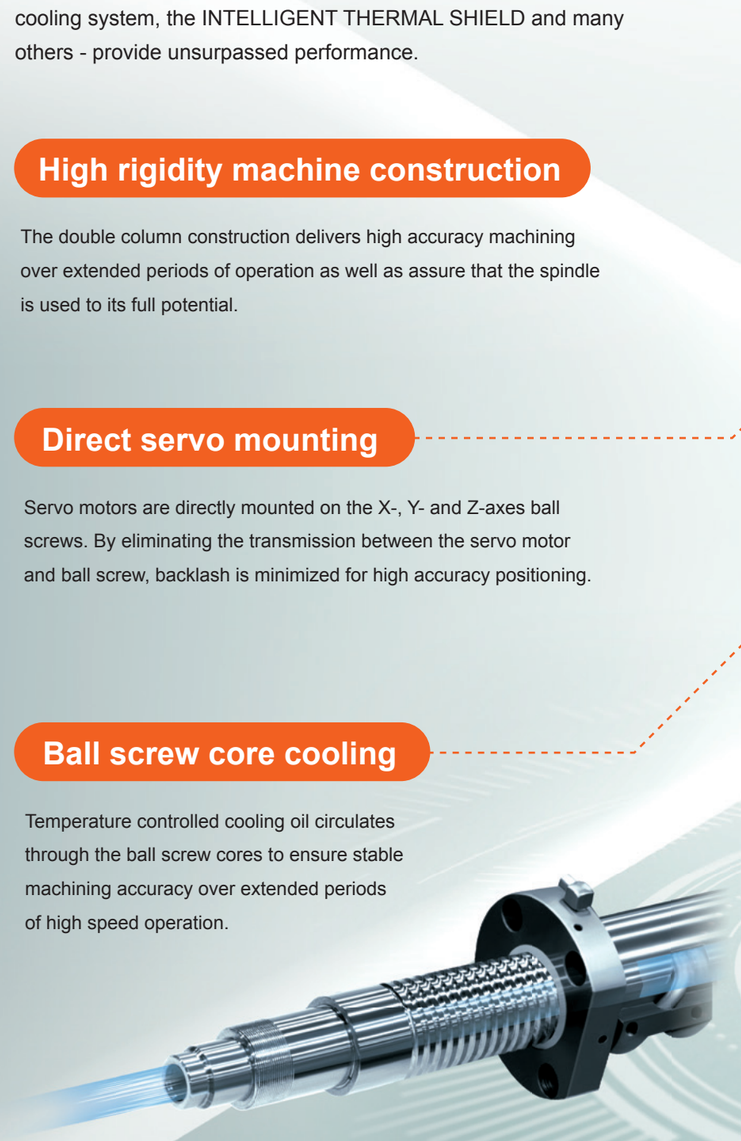
The double column construction delivers high accuracy machining over extended periods of operation as well as assure that the spindle is used to its full potential.

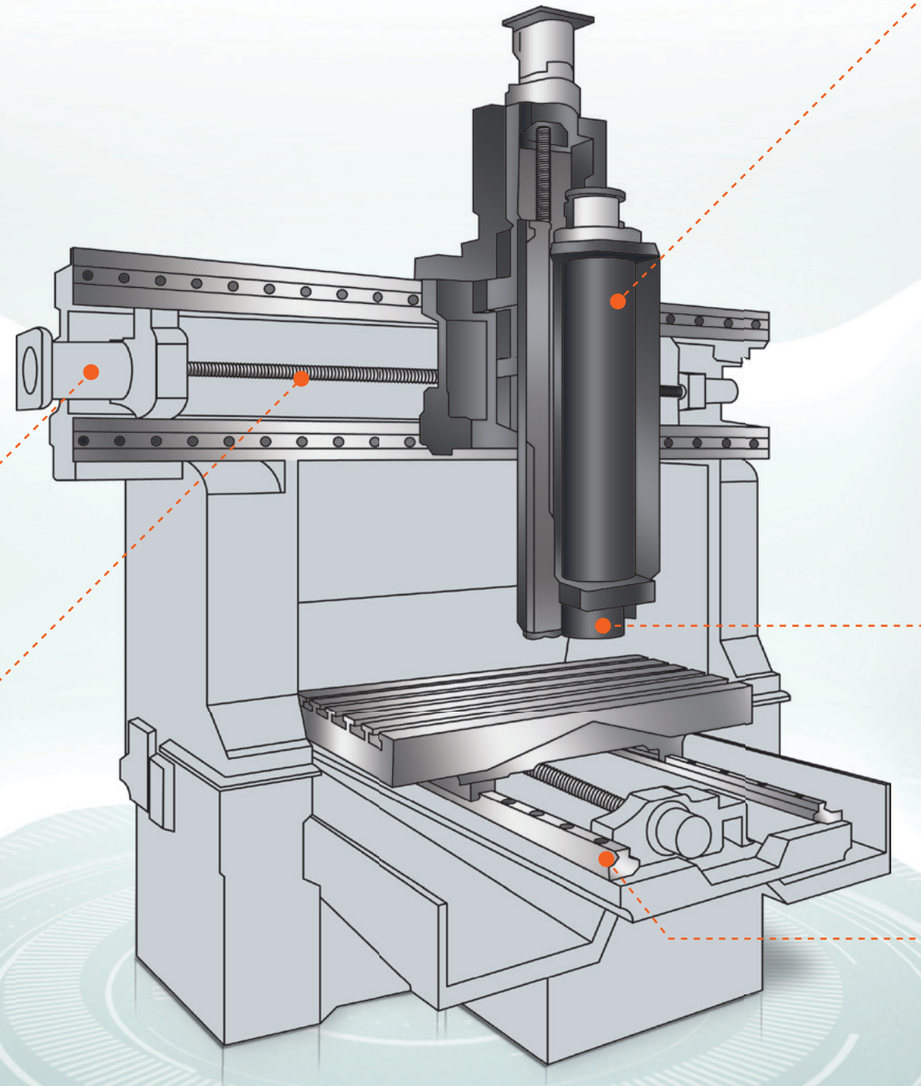
Direct servo mounting

Servo motors are directly mounted on the X-, Y- and Z-axes ball screws. By eliminating the transmission between the servo motor and ball screw, backlash is minimized for high accuracy positioning.

Ball screw core cooling

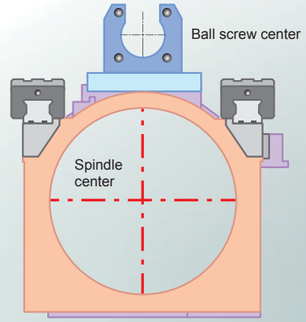
Temperature controlled cooling oil circulates through the ball screw cores to ensure stable machining accuracy over extended periods of high speed operation.





Symmetrical headstock design

The symmetrical headstock design together with the integral spindle / motor minimizes spindle displacement due to heat generated by the spindle operation.



Y-axis direction symmetry

Prevention of temperature change — milling spindle cooling

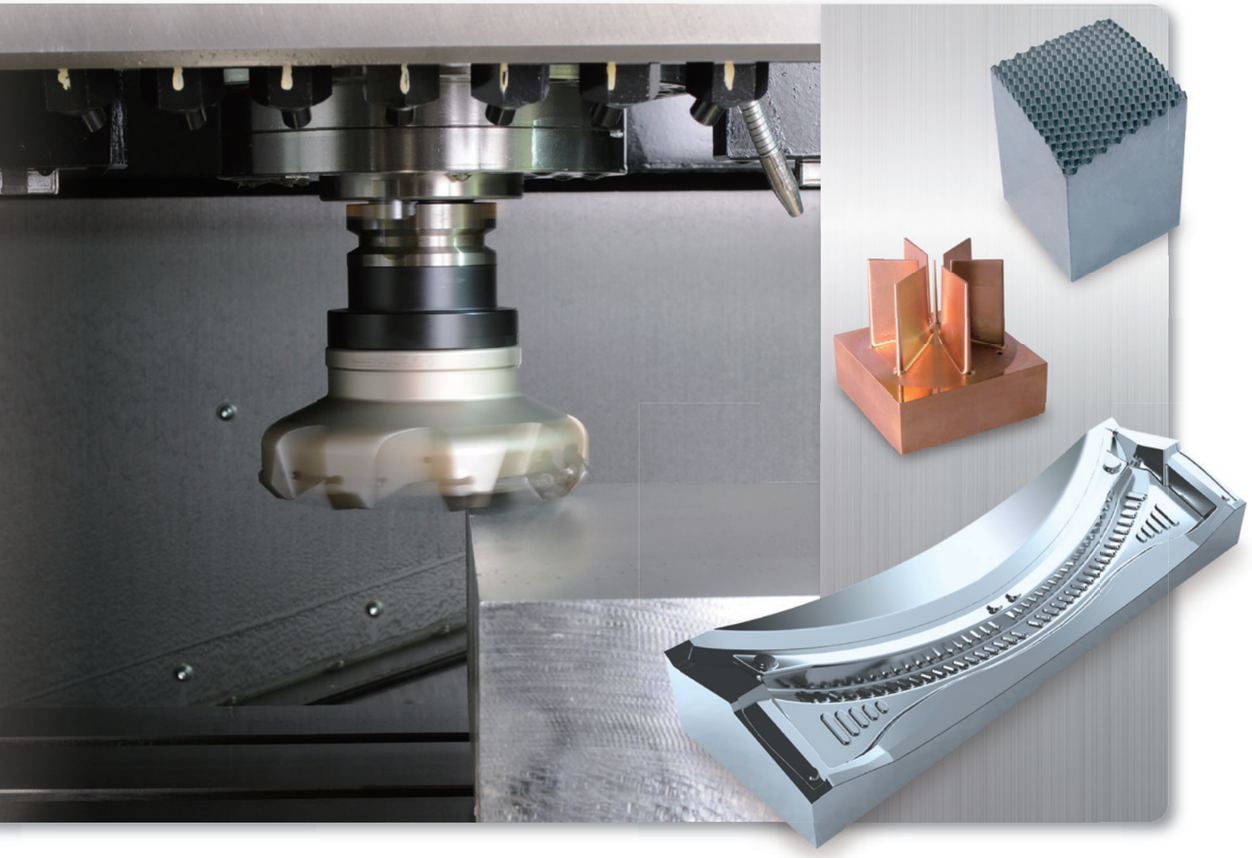
Temperature controlled cooling oil circulates through the milling spindle headstock to prevent heat displacement.

Linear roller guides utilized on the X-, Y- and Z-axes

Linear roller guides on the X-, Y- and Z-axes are utilized by the FJV-200 and FJV-250 in order to provide high accuracy and heavy duty machining.

Higher Productivity

4 different integral spindle / motor specifications available to meet a wide variety of workpiece material machining requirements



Spindle

Integral spindle / motor

Thanks to the integral spindle / motor design, vibration is minimized during high speed operation to ensure exceptional surface finishes and maximum tool life.

Spindle temperature control

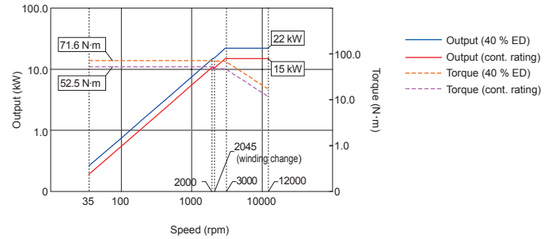
For high accuracy machining, temperature controlled cooling oil is circulated around the spindle bearings and headstock to minimize any thermal change to the spindle.

12000 rpm Standard spindle

For the machining of a wide variety of workpiece materials from steel to nonferrous metals thanks to the maximum torque of 172 N·m from 35 – 1000 rpm.

Max. spindle speed	12000 rpm
Spindle output	AC 22 kW(30 HP) [40 % ED]
Torque	71.6 N·m [40 % ED]
	52.5 N·m [cont. rating]

12000 rpm spindle output / torque diagram

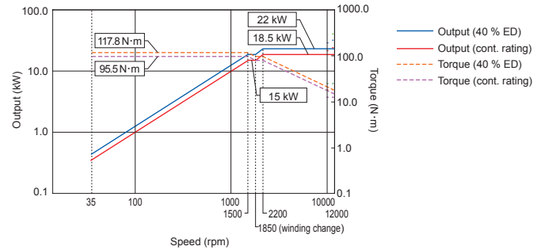


12000 rpm High torque spindle OPTION

No.40 taper spindle with maximum torque of 252 N·m for heavy-duty, rough machining of steel and cast iron.

Max. spindle speed	12000 rpm
Spindle output	AC 22 kW(30 HP) [40 % ED]
Torque	118 N·m [40 % ED]
	95.5 N·m [cont. rating]

12000 rpm High torque spindle output / torque diagram

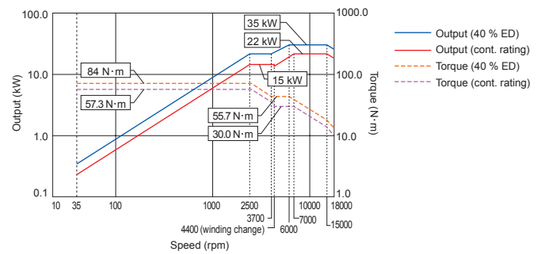


18000 rpm High speed spindle OPTION

High speed No. 40 taper spindle for the machining of aluminum, copper and other similar materials.

Max. spindle speed	18000 rpm
Spindle output	AC 30 kW(40 HP) [50 % ED]
Torque	84.0 N·m [50 % ED]
	57.3 N·m [cont. rating]

18000 rpm High speed spindle output / torque diagram

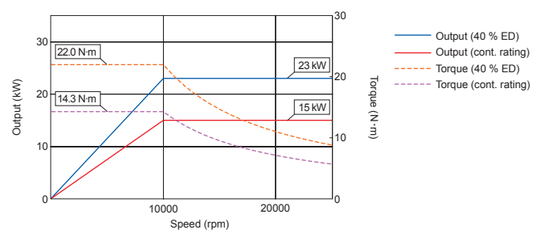


25000 rpm High speed spindle OPTION

This 30 kW high-speed spindle specification uses 2 face contact tool holders and is effective for high speed die machining with small diameter end mills.

Max. spindle speed	25000 rpm
Spindle output	AC 23 kW(30 HP) [40 % ED]
Torque	22 N·m [40 % ED]
	14.3 N·m [cont. rating]

25000 rpm High speed spindle output / torque diagram



Intelligent Machine

INTELLIGENT MACHINE®

Yamazaki Mazak has developed a variety of functions for the improvement of productivity, high accuracy machining and operator support. A variety of unique technologies has been developed that incorporate the expertise of experienced machine operators that realizes unsurpassed productivity and higher accuracy machining.

Advanced Intelligent+ Functions

A variety of Intelligent+ Functions provides incomparable operator support for exceptional ease of operation and the optimum machine efficiency.

Set up

ISS+

Machine Interference Prevention

INTELLIGENT SAFETY SHIELD

MAZATROL SMOOTH G

When an operator manually moves the machine axes for setup, tool measurement or changing inserts, the CNC shows a synchronized 3D model on the display for checking machine interference.
If any machine interference occurs, the machine motion automatically stops. This function for use during automatic operation is optionally available.

MVA+

Verbal Message System

MAZAK VOICE ADVISER

MAZATROL SMOOTH G

Verbal support for machine setup and safe conditions confirmation

Machining

SMC+

Convenient Parameter Setting and Fine Tuning Function

SMOOTH MACHINING CONFIGURATION

Machining time, finished surface smoothness and machining shape can be adjusted for improved productivity

VAC

Variable Acceleration Control Function

VARIABLE ACCELERATION CONTROL

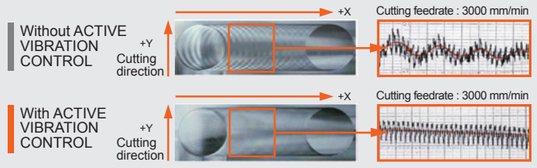
Variable acceleration control is a new function which permits the faster acceleration capability of linear axes to be used whenever possible. The slower acceleration of the rotary axes is not used for all program commands, resulting in faster machining cycle times.

AVC

Minimized Vibration

ACTIVE VIBRATION CONTROL

Machine vibration can be reduced to perform excellent machining accuracy and high-speed machining.



SCC

Seamless Corner Control

SMOOTH CORNER CONTROL

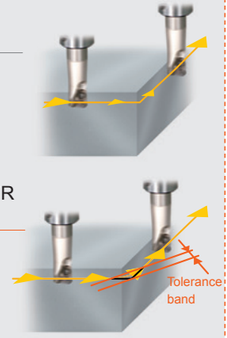
Improved finished surfaces and reduced cycle times by optimized acceleration / deceleration when machining corners.

Other systems

Move to next command position after reaching current command position

SMOOTH CORNER CONTROL

Move to next command position within tolerance band



ITS+

Heat Displacement Control

INTELLIGENT THERMAL SHIELD

The INTELLIGENT THERMAL SHIELD is an automatic compensation system for room temperature changes, which realizes enhanced continuous machining accuracy. MAZAK has performed extensive testing in a variety of environments in a temperature controlled room and has used the results to develop a control system that automatically compensates for temperature changes in the machining area. Changes in the room temperature and compensation data are shown visually.

Temperature and compensation is displayed on screen. Operator can adjust compensation by looking at the data.

Maintenance

IPS+

Comprehensive Spindle Monitoring

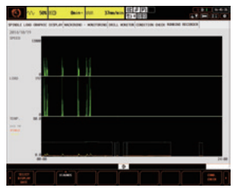
INTELLIGENT PERFORMANCE SPINDLE

MAZATROL SMOOTH G

The INTELLIGENT PERFORMANCE SPINDLE monitors a variety of properties such as temperature with sensors housed in the spindle and provides useful information to the operator. Thanks to this monitoring, production loss due to machine down time can be minimized.

▲ Condition check

Temperature as well as the motor load can be displayed.



▲ Running recorder

Operation status of milling spindle (rpm / motor load) can be recorded for up to one year.

IMS+

Comprehensive Maintenance Monitor

INTELLIGENT MAINTENANCE SUPPORT

Useful information for improved preventative maintenance to prevent unexpected machine downtime.

MAZATROL CNC System

MAZATROL
SMOOTH G

4 axes simultaneous CNC

Fastest CNC in the world

— Latest hardware and software for unprecedented speed and precision

Smooth user graphical user interface

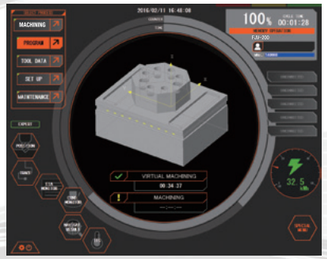
PC with Windows® 8 embedded OS
MAZATROL Smooth graphical user interface for unsurpassed ease of operation
Touch screen operation — operate similar to your smart phone / tablet

Ease of operation

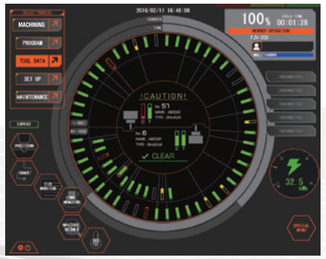
Designed for unsurpassed ease of operation with advanced Intelligent Functions

Process home screens

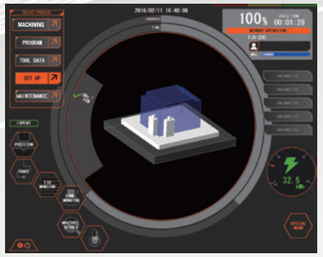
Five different home process screens — each home screen displays the appropriate data in an easy-to-understand manner. Icons can be touched in each process display for additional screen displays.



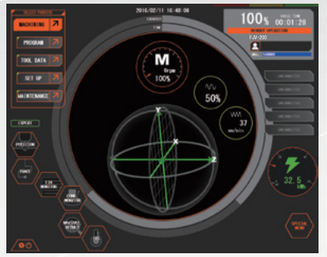
Programming



Tool data



Set up



Machining

Maintenance

Programming screen links tool path, workpiece shape and programming to reduce programming time

QUICK MAZATROL

MAZATROL program, unit list and 3D workpiece shape are linked to each other. After defining a machining unit in a MAZATROL program, the 3D shape is immediately displayed to easily and quickly check for any programming error.

Quickly move to the corresponding section in the MAZATROL program by touching a feature in the 3D model

3D model in the process list is displayed with updated programming in real time

3D ASSIST

Workpiece and coordinates data can be imported from 3D CAD data to a MAZATROL program.
No coordinate value inputs are required.
Can reduce input errors and time for program checking.

CAD model importing

Shape selection

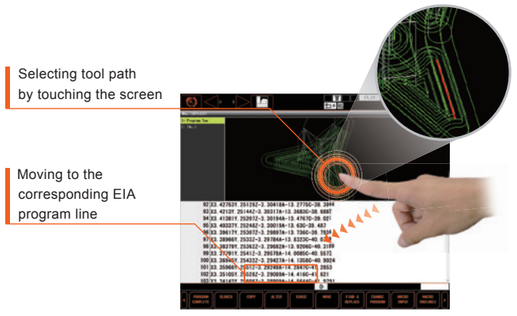
Automatically input to MAZATROL program

QUICK EIA

Program, process list and 3D tool path display are linked to each other. Visible search on touch screen can reduce the time for program checking.

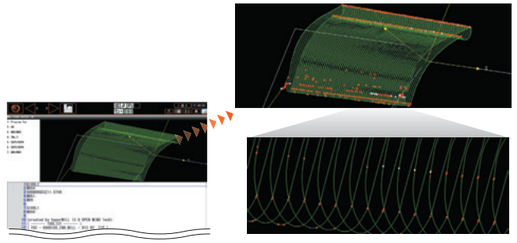
Selecting tool path by touching the screen

Moving to the corresponding EIA program line



VIEW SURF

By analyzing tool path, any predictable failure on the finished surface can be visualized. Program modification can be done before machining to minimize the time for test cutting.



MAZATROL CNC System

MAZATROL
SmoothC

4-axes simultaneous CNC

Fastest CNC in the world

– Latest hardware and software for unprecedented speed and precision
Same servos as MAZATROL SmoothG

Essential functions for increased ease of programming

Ease of operation

Home screen

The home screen displays overall process status in an easy to understand manner

Comprehensive status display on one screen

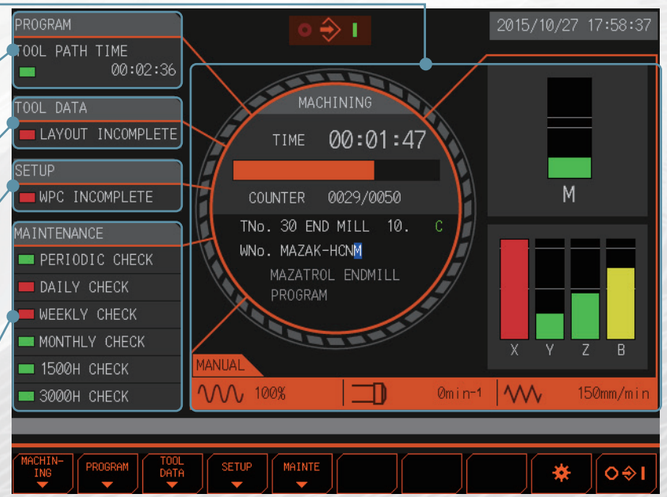
Machining
Displays axes in operation and load on motors.

Programming
Displays the simulation time and machining time

Tool data
Displays status of tool layout.

Set up
Displays status of workpiece coordinate setting.

Maintenance
Overview of the status of items requiring maintenance



Simplified display and key input operation

Following traditional conversational MAZATROL programming, this new system is designed for ease of operation by simplified key operation.

- Menu keys under the display can be pressed to go to other pages for program data input and editing
- Home screen key goes to the home screen from any display
- Compact keypad with unique design for ease of input
- USB interface
  Transfer program and tool data.
  Connect PC keyboard
- SD card slot
  Transfer program and tool data

MAZATROL conversational programming

MAZATROL interactive programming uses conversational language and automatically determines cutting conditions, M codes, and G codes. Even a beginner operator can quickly make programs.

Ergonomics

Designed for ease of operation and maintenance ergonomics

Large window

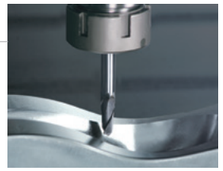
Large front window allows the operator to easily monitor workpiece machining.

Convenient maintenance

All the items that require frequent access, such as hydraulic and pneumatic valves and lubrication inlets, are at the same location to make daily maintenance easier.

Retraction function for Z-axis

The Z-axis retraction automatically pulls up the spindle from the machining surface to prevent workpiece damage in the case of sudden electrical power blackout.

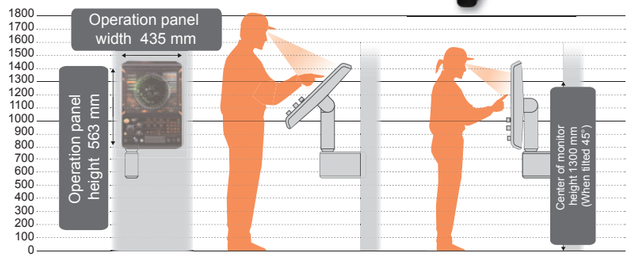


Note) Z-axis retraction will not function properly during a servo amplifier alarm, power supply alarm or if the stored power charge is low due to high axis acceleration.

Adjustable CNC touch panel

MAZATROL SMOOTH G

Operation touch panel can be tilted to the optimum position for any operator's height to ensure ease of operation.



Rotating operation panel

MAZATROL SMOOTH C

The operation panel easily rotates to each operator's preferred position.

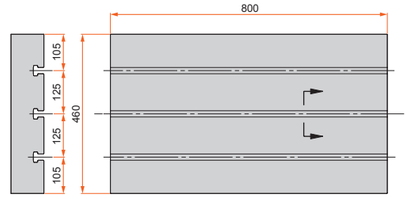
Standard machine Specifications

		FJV-200	FJV-250
Travel	X-axis travel	560 mm	1020 mm
	Y-axis travel	410 mm	510 mm
	Z-axis travel	410 mm	460 mm
	Distance from table top to spindle nose	150 mm ～ 560 mm	200 mm ～ 660 mm
	Effective width between colums	955 mm	1380 mm
Table	Table size	800 mm × 460 mm	1200 mm × 550 mm
	Table load capacity (evenly distributed)	350 kg	1200 kg
	Table top surface	18 mm T-slot × 3 125 mm pitch	18 mm T-slot × 5 100 mm pitch
Spindle	Spindle speed	12000 rpm	
	Ranges	1-Stepless	
	Spindle taper	No.40	
	Spindle bearing ID	Φ80 mm	
	Spindle acceleration time to top speed	1.86 sec	
Feedrate	Rapid traverse rate (X-, Y-, Z-axis)	52000 mm/min	
	Maximum cutting feedrate	52000 mm/min	
Automatic	Tool shank	No.40	
tool changer	Tool magazine capacity	30	
	Max. tool dia./length (from gauge line)/weight	Φ80 mm / 300 mm / 8 kg	
	Max. tool dia. with adjacent pockets empty	Φ125 mm	
	Tool selection method	Random selection, shortest path	
	Tool change time	3.4 sec	3.7 sec
Motors	Spindle motor (30 min. / cont. rating)	22 kW（30 HP）/ 15 kW（20 HP）	
	Flood coolant pump motor (50 /60 Hz)	0.23 kW / 0.37 kW	
Power	Required power capacity (30-minute/ Cont. rating)	45 kVA / 35 kVA	
requirement	Air source	More than 0.5 MPa / 300 L/min	
Machine size	Height	2825.5 mm	2925.5 mm
	Required floor space（MAZATROL SmoothC）	2440 mm × 2380.2 mm	2995 mm × 2475.2 mm
	Required floor space（MAZATROL SmoothG）	2440 mm × 2518.6 mm	2995 mm × 2613.6 mm
	Machine weight	6400 kg	8500 kg
Sound	Equivalent continuous sound pressure level at operator position (dependant on equipment options)	Less than 80 db (A)	

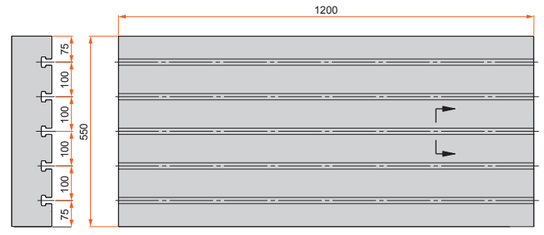
Table Dimensions

Unit : mm

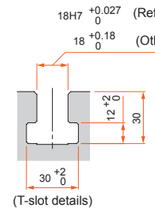
FJV-200



FJV-250



［FJV-200、FJV-250 Common］



MAZATROL SmoothC Specifications

	MAZATROL	EIA
Number of controlled axes	Simultaneous 4 axes	
Least input increment	0.0001 mm, 0.00001 inch, 0.0001 deg	
High speed, high precision control	Shape error desgination, Smooth corner control, Rapid traverse overlap, Rotational-shape correction	Shape error desgination, Smooth corner control, Rapid traverse overlap, Rotational-shape correction, High-speed machining mode, High-speed smoothing control function
Interpolation	Positioning (Linear interpolation), Positioning (Independent interpolation), Linear interpolation, Circular interpolation, Cylindrical coordinate interpolation, Polar coordinate interpolation, Synchronized milling spindle tapping*	Positioning (Linear interpolation), Positioning (Independent interpolation), Linear interpolation, Circular interpolation, Spiral interpolation, Helical interpolation, Cylindrical coordinate interpolation*, Fine spline interpolation*, NURBS interpolation*, Polar coordinate interpolation *, Synchronized milling spindle tapping*
Feedrate	Rapid traverse, Cutting feed, Cutting feed (per minute), Cutting feed (per revolution), Dwell (specified time, specified number of rotation), Rapid traverse override, Cutting feed override, G0 speed variable control, Feedrate clamp, Variable acceleration / deceleration control, Constant control for G0 tilting*	Rapid traverse, Cutting feed, Cutting feed (per minute), Cutting feed (per revolution), Inverse time feed, Dwell (specified time, specified number of rotation), Rapid traverse override, Cutting feed override, G0 speed variable control, Feedrate clamp, Time constant changing for G1, Variable acceleration / deceleration control, Constant control for G0 tilting*
Program registration	Max. number of programs : 960, Program storage : 2 MB, Program storage expansion*: 8 MB, Program storage expansion* : 32 MB	
Control display	Display : 10.4", Resolution : VGA	
Spindle functions	S code output, Spindle speed clamp, Spindle speed override, Spindle speed reaching detection, Multiple position orient, Constant surface speed, Spindle speed command with decimal digits, Synchronized spindle control, Max. speed control for spindle	
Tool functions	Tool offset pairs : 4000, T code output for tool number, Tool life monitoring (time), Tool life monitoring (number of machined workpieces)	Tool offset pairs : 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	–	Hobbing*, Shaping function*, Dynamic compensation Ⅱ*
Machine compensation	G0 / G1 independent backlash compensation, Pitch error compensation	
Protection functions	Emergency stop, Interlock, Stroke check before travelling, Retraction function for the vertical axes	
Automatic operation mode	Memory operation	Memory operation, Tape operation, MDI operation, Ethernet operation*
Automatic operation mode	Optional stop, Dry run, Automatic handle control, MDI control, TPS, Restart, Machine lock	Optional block skip, Optional stop, Dry run, Automatic handle control, MDI control, TPS, Restart, Restart 2, Collation stop, Machine lock
Manual measuring functions	Tool length and tip teach, Touch sensor coordinates measurement, Workpiece offset measurement, WPC coordinate measurement, Measurement on machine	Tool length and tip 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, Touch sensor orientation confirmation, Tool eye auto tool measurement, Tool breakage detection, External tool breakage detection*	Automatic tool length measurement, Touch sensor orientation confirmation, Tool breakage detection, External tool breakage detection*
MDI measurement	Partial auto tool length measurement, Auto tool length measurement, Coordinate measurement	
Interface	PROFIBUS-DP*, Ether Net I/P*, CC-Link*	
Card interface	SD card interface, USB	
EtherNet	10 M / 100 M / 1 Gbps	

* : option

MAZATROL SmoothG Specifications

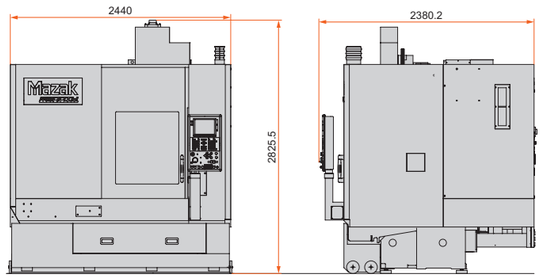
	MAZATROL	EIA
Number of controlled axes	Simultaneous 4 axes	
Least input increment	0.0001 mm, 0.00001 inch, 0.0001 deg	
High speed, high precision control	Shape error desgination, Smooth corner control, Rapid traverse overlap, Rotational-shape correction	Shape error desgination, Smooth corner control, Rapid traverse overlap, Rotational-shape correction, High-speed machining mode, High-speed smoothing control function
Interpolation	Positioning (Linear interpolation), Positioning (Independent interpolation), Linear interpolation, Circular interpolation, Cylindrical coordinate interpolation, Polar coordinate interpolation, Synchronized milling spindle tapping*	Positioning (Linear interpolation), Positioning (Independent interpolation), Linear interpolation, Circular interpolation, Spiral interpolation, Helical interpolation, Cylindrical coordinate interpolation*, Fine spline interpolation*,NURBS interpolation*, Polar coordinate interpolation *, Synchronized milling spindle tapping*
Feedrate	Rapid traverse, Cutting feed, Cutting feed (per minute), Cutting feed (per revolution), Dwell (specified time, specified number of rotation), Rapid traverse override, Cutting feed override, G0 speed variable control, Feedrate clamp, Variable acceleration / deceleration control, Constant control for G0 tilting*	Rapid traverse, Cutting feed, Cutting feed (per minute), Cutting feed (per revolution), Inverse time feed, Dwell (specified time, specified number of rotation), Rapid traverse override, Cutting feed override, G0 speed variable control, Feedrate clamp, Time constant changing for G1, Variable acceleration / deceleration control, Constant control for G0 tilting*
Program registration	Max. number of programs : 960, Program storage : 2 MB, Program storage expansion*: 8 MB, Program storage expansion* : 32 MB	
Control display	Display : 19" touch panel, Resolution : SXGA	
Spindle functions	S code output, Spindle speed clamp, Spindle speed override, Spindle speed reaching detection, Multiple position orient, Constant surface speed, Spindle speed command with decimal digits, Synchronized spindle control, Max. speed control for spindle	
Tool functions	Tool offset pairs : 4000, T code output for tool number, Tool life monitoring (time), Tool life monitoring (number of machined workpieces)	Tool offset pairs : 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	–	Hobbing*, Shaping function*, Dynamic compensation Ⅱ*
Machine compensation	G0 / G1 independent backlash compensation, Pitch error compensation	
Protection functions	Emergency stop, Interlock, Stroke check before travelling, Retraction function for the vertical axes INTELLIGENT SAFETY SHIELD (manual mode), INTELLIGENT SAFETY SHIELD (automatic mode)*, MAZAK VOICE ADVISER	
Automatic operation mode	Memory operation	Memory operation, Tape operation, MDI operation, Ethernet operation*
Automatic operation mode	Optional stop, Dry run, Automatic handle control, MDI control, TPS, Restart, Machine lock	Optional block skip, Optional stop, Dry run, Automatic handle control, MDI control, TPS, Restart, Restart 2, Collation stop, Machine lock
Manual measuring functions	Tool length and tip teach, Touch sensor coordinates measurement, Workpiece offset measurement, WPC coordinate measurement, Measurement on machine	Tool length and tip 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, Touch sensor orientation confirmation, Tool eye auto tool measurement, Tool breakage detection, External tool breakage detection*	Automatic tool length measurement, Touch sensor orientation confirmation, Tool breakage detection, External tool breakage detection*
MDI measurement	Partial auto tool length measurement, Auto tool length measurement, Coordinate measurement	
Interface	PROFIBUS-DP*, Ether Net I/P*, CC-Link*	
Card interface	SD card interface, USB	
EtherNet	10 M / 100 M / 1 Gbps	

* : option

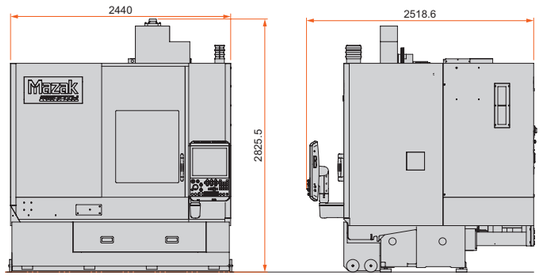
Machine Dimensions

Unit : mm

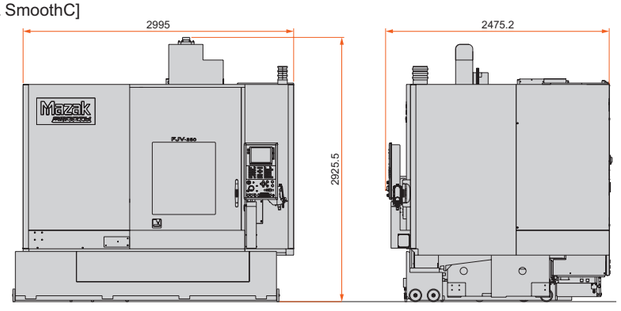
FJV-200 [MAZATROL SmoothC]



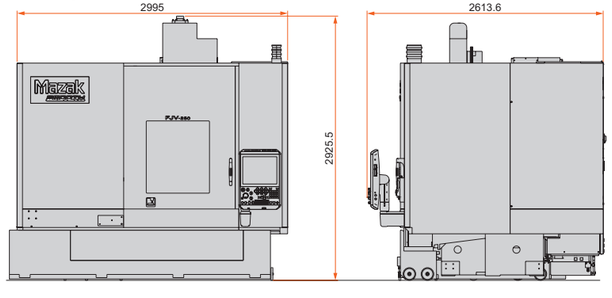
FJV-200 [MAZATROL SmoothG]



FJV-250 [MAZATROL SmoothC]



FJV-250 [MAZATROL SmoothG]



Standard and Optional Equipment

● : Standard ○ : Option

		FJV-200		FJV-250	
		MAZATROL SmoothC	MAZATROL SmoothG	MAZATROL SmoothC	MAZATROL SmoothG
Machine	Sub table	○	○	○	○
	Work light	●	●	●	●
	Additional work light	○	○	○	○
	Top cover	●	●	●	●
	Additional top cover	○	○	○	○
	Status light (3 colors)	○	○	○	○
	Status light (1 color)	○	○	○	○
	Additional axis	○	○	○	○
Spindle	12000 rpm (#40)	●	●	●	●
	12000 rpm High torque (#40 / BBT / HSK)	○	○	○	○
	18000 rpm (#40 / BBT / HSK)	○	○	○	○
	25000 rpm (BBT / HSK)	○	○	○	○
Tool magazine	30-tool magazine	●	●	●	●
	40-tool magazine	○	○	○	○
	60-tool magazine	○	○	○	○
Set up	Absolute position detection (not available with scale feedback)	●	●	●	●
	Automatic tool length measurement & tool breakage detection	○	○	○	○
	Laser tool measurement	○	○	○	○
	Automatic front door (with 2 hand switches)	○	○	○	○
	Tool ID magazine operation panel	○	○	○	○
	Pull stud with tool ID	○	○	○	○
	Mazak monitoring system B (optical) OMP60	○	○	○	○
	Preparation for Mazak monitoring system B / OMP60	○	○	○	○
	Manual pulse generator	○	○	○	○
Factory automation	Automatic power of	●	●	●	●
	Automatic power ON / OFF + warm-up operation	○	●	○	●
	Machining end buzzer	○	○	○	○
High accuracy	Ball screw core cooling (X-, Y-, Z-axes)	●	●	●	●
	Coolant temperature control	○	○	○	○
	Scale feedback (X-, Y-, Z-axes)	○	○	○	○
Coolant	Coolant system	●	●	●	●
	Work air blast	○	○	○	○
	Oil skimmer	○	○	○	○
	Oil mist coolant	○	○	○	○
	Hand-held coolant nozzle	○	○	○	○
	Flood coolant 4.5 kg/cm², 30 L/min	○	○	○	○
	Air through spindle (can operate while spindle rotating)	○	○	○	○
	Coolant through spindle (5 kgf/cm²)	○	○	○	○
	Niagara coolant	○	○	○	○
	Niagara coolant & cover coolant	○	○	○	○
	High pressure coolant through spindle (15 kgf/cm²)	○	○	○	○
	High pressure coolant through spindle (70 kgf/cm²)	○	○	○	○
	Mist collector	○	○	○	○
	Preparation for mist collector	○	○	○	○
	Cover coolant	○	○	○	○
Chip disposal	Chip conveyor (side discharge / CONSEP)	○	○	○	○
	Chip conveyor (side discharge / hinge)	○	○	○	○
	Chip bucket (rotary)	○	○	○	○
	Chip bucket (fixed)	○	○	○	○
Safety equipment	Operator door interlock	●	●	●	●
Others	Manuals	●	●	●	●
	Additional manuals	○	○	○	○