



F6

Vertical Machining Centre

Redefining Accuracy in Precision Mould Manufacturing

In pursuit of higher accuracy during extended machining cycles, the Makino f6 vertical machining centre is engineered to meet these demands without compromising surface finish or cycle time. With excellent stiffness and rigidity for chatter-free cutting, combined with the agility required for high-speed hard milling, the f6 achieves the precision necessary for tight-tolerance blends and matches – typical of the complex 3D-contoured geometries found in precision die and mould applications.



Stamping die



Die cast die



Forging die



Plastic moulds



Copper electrode



Accurate and consistent

The f6 is designed with three key highlights:

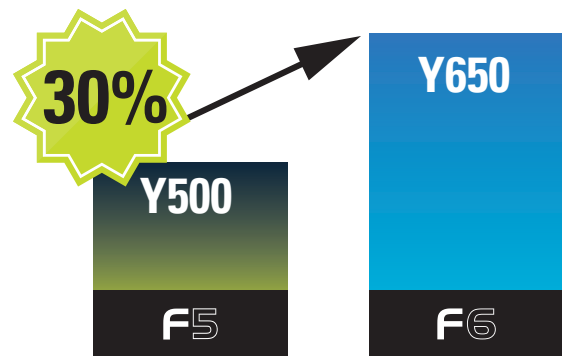
1 Extended machining capability

The f6 3-axis vertical machining centre delivers consistent accuracy during long-duration machining operations. This is achieved through the synergy of superior surface finish, high precision and reduced cycle times – maintained even over prolonged periods of continuous use.



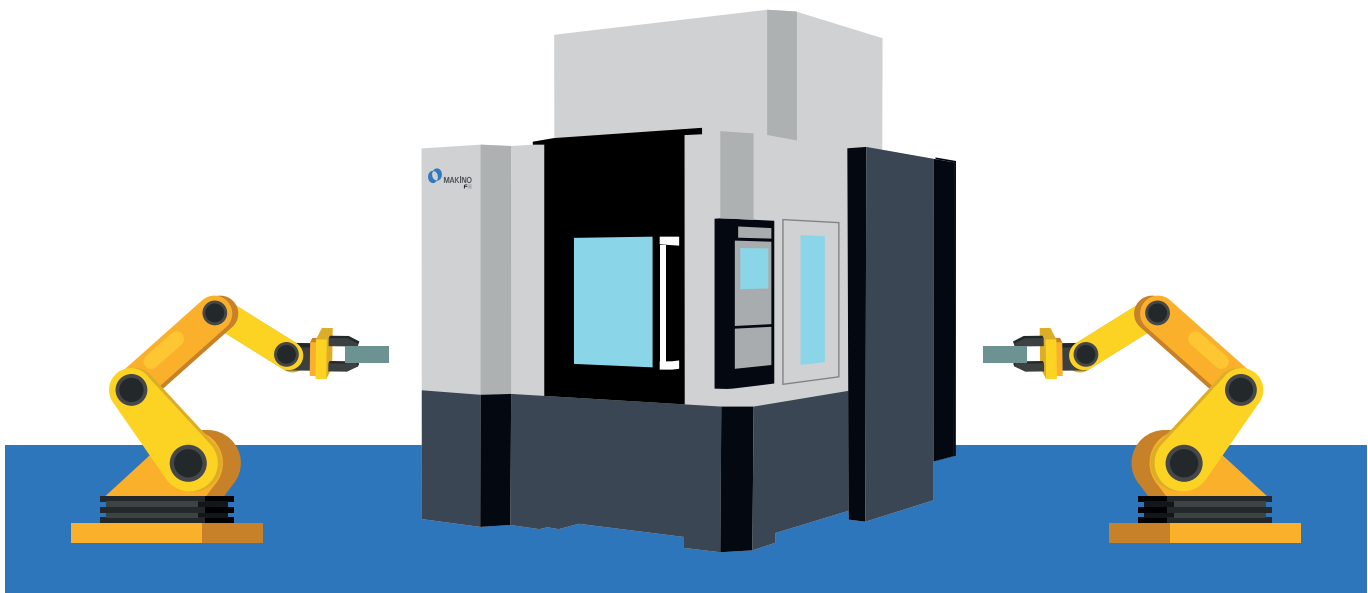
2 Increased Y axis stroke

The extended Y axis stroke of 650 mm accommodates moulds that are increasingly square in shape – a 30% increase compared to the f5 machining centre.



3 Automation-ready design

A larger side door improves operational accessibility and supports automation, in addition to standard front access.



Setting New Standards in High-Performance Machining

The f6 has been designed from the ground up to deliver exceptional speed and precision. Incorporating a proven axis configuration, optimised for die and mould machining and featuring rigid castings with no overhangs, it provides the foundation for a robust and stable cutting platform.

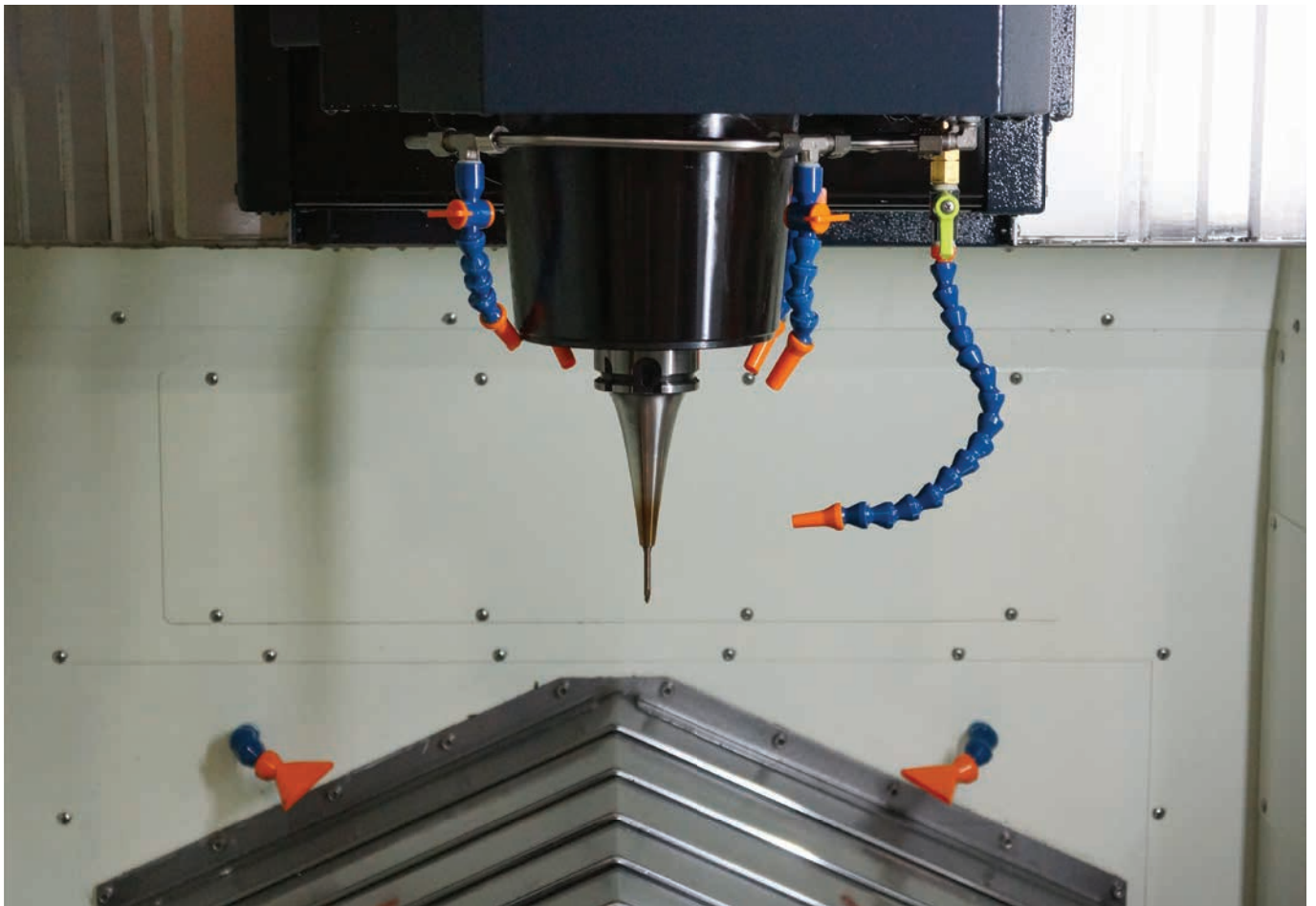
Equipped as standard with fine-pitch ball screws on all axes, the f6 offers superior precision. Temperature-controlled, core-cooled ball screws, ball nuts, and support bearings ensure long-term thermal stability. Together, these features minimise variability during long extended periods of high-accuracy, tight tolerance machining.

The f6 is fitted with a highly productive 20,000 rpm HSK-A63 spindle (optional: 30,000 rpm HSK-F63 spindle) that incorporates Makino's unique core-cooling, under-race and jacket-type spindle temperature control system. This advanced spindle

design enables vibration-free machining at high speeds and is ideally suited for both roughing and finishing operations – completed in a single setup.

The machine comes equipped with the Makino Professional 6 control, delivering the perfect combination of the proven stability of FANUC hardware and the flexibility of the Microsoft Windows Embedded operating system. This provides streamlined operation, on-screen operator guidance and enhanced functionality.

Also featured is Makino's proprietary Super Geometric Intelligence (SGI.5) software – developed specifically for high-feedrate, tight tolerance machining of complex, 3D-contoured surfaces that involve continuous, fine NC data blocks. SGI.5 enables production speeds significantly faster than conventional CNC systems, while consistently maintaining high levels of accuracy.



Rigid Structure

The rigid construction and unique axis configuration deliver exceptional stiffness, rigidity, thermal stability, accuracy and unmatched support across the full travel range of each axis:

X and Z axes on the column

- Constant spindle support distance
- Fully supported maintained throughout travel

Y axis beneath the table

- No “stack-up” of X and Y axes
- No off-centre table loading
- Full support maintained throughout travel

Finite Element Analysis (FEA) of the core components ensures optimal structural rigidity and torsional stiffness, delivering peak performance and consistent results.

Structural rigidity forms the basis of superior cutting performance, providing effective vibration damping and long-term accuracy throughout the machine’s operational life.

Thermal Stability

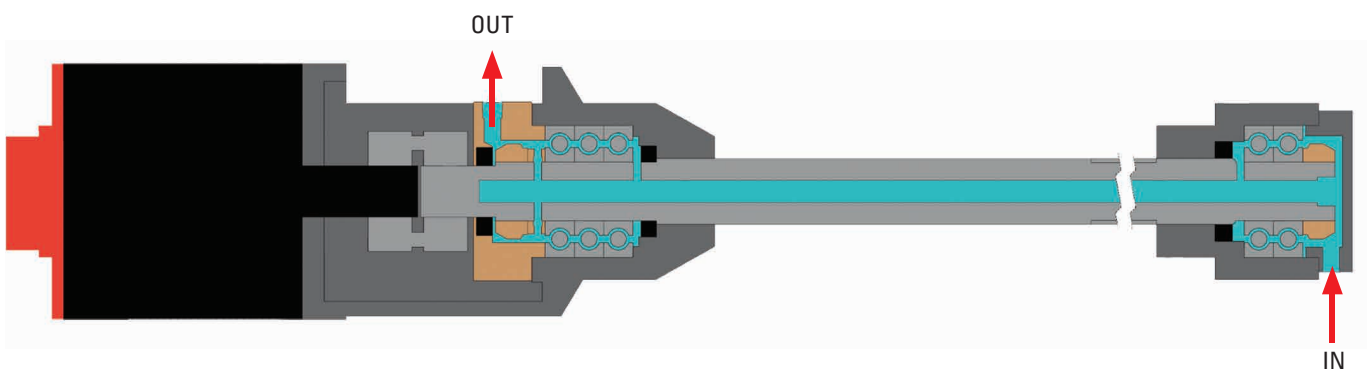
Ball screw core and ball nut cooling

Temperate-controlled cooling oil is circulated through the cores of the ball screws and ball nut to minimise heat generation during high-speed movement.

Additionally, cooling oil is directed to the support bearings, providing the dual benefits of thermal control and extended component lifespan.

Motor flange cooling

Cooling oil circulates through the motor flange to prevent motor heat from transferring to the machine structure, maintaining thermal stability.



Structural cooling

Key structural elements are also cooled to ensure consistent temperature stability across the machine.

High-performance linear motion guideways deliver highly precise, low-friction movement. Pre-tensioned, dual supported, large-diameter ball screws, combined with powerful, direct-coupled, digital servo motors – tuned for peak performance – ensure the rigidity and stiffness required for the most demanding applications.

Fine ball screw motion enables superior precision for blending, matching and complex geometry operations.

Advanced Spindle Technology

Makino's leadership in spindle technology is recognised worldwide. Spindle rigidity, high rotational speed, constant preload, multi-plane balancing, vibration minimisation and thermal growth control are challenges Makino has successfully addressed through years of experience of spindle design, manufacturing and assembly.

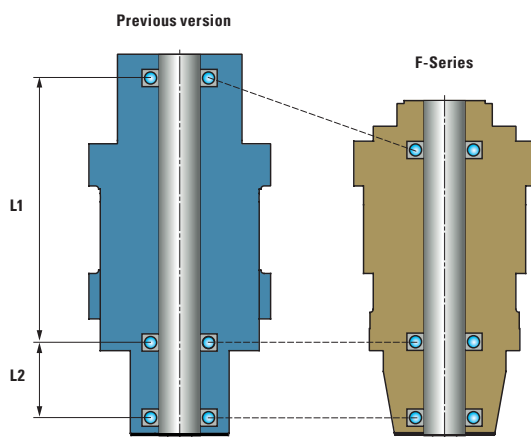
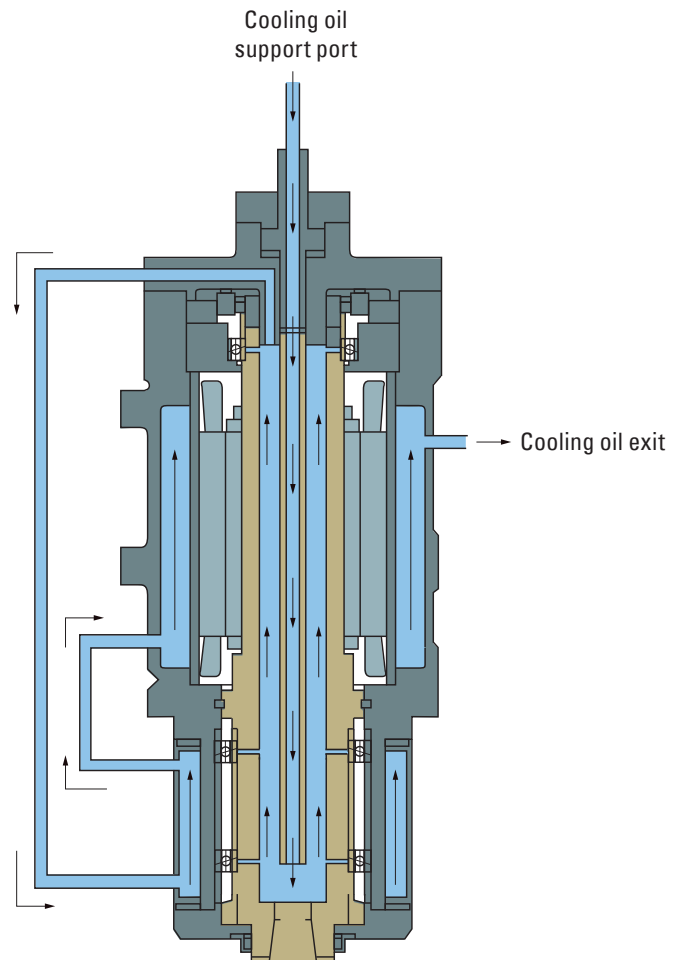
Both the standard 20,000 rpm spindle and the optional 30,000 rpm spindle incorporate Makino's unique technologies:

- Spindle core cooling
- Under-race bearing lubrication
- Closed-loop Oilmatic temperature control

These spindles deliver the characteristics essential for a wide range of high-speed machining applications, particularly in the die and mould sector. The unique, dual-range integral design provides broad capability – from delivering rigidity and stiffness for low-speed roughing operations, to vibration- and chatter-free performance when producing fine features with small tools at high speeds.

Spindle temperature control

f-Series machines are the only machines in their class to feature a large-capacity, heat-dissipating spindle chiller – working in harmony with Makino's proprietary technologies. This combination ensures tight thermal control of the spindle, bearings and motor area, minimising thermal growth and its effects on spindle preload. The result is improved spindle stiffness and rigidity, extended tool life, better surface finish and enhanced final part accuracy.



30,000 rpm spindle¹

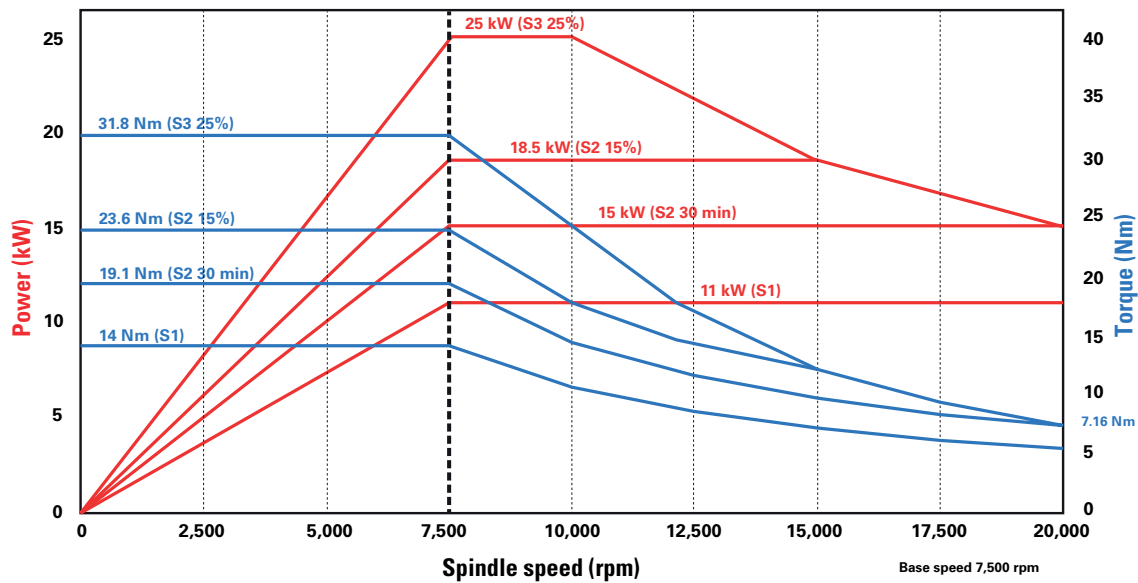
As shown in the diagram, the optimal bearing layout is achieved by reducing the distance (L1) between bearings, creating a more uniform and compact arrangement. This configuration effectively suppresses spindle vibration at high speed.

The overall length of the 30,000 rpm spindle has been reduced to 25% compared to previous version. This markedly reduces spindle vibration for enhanced machined surface quality and longer tool life. The overall spindle weight was also lightened by 30% to reduce lost motion in the X, Y axes of spindle travel.

¹ Option

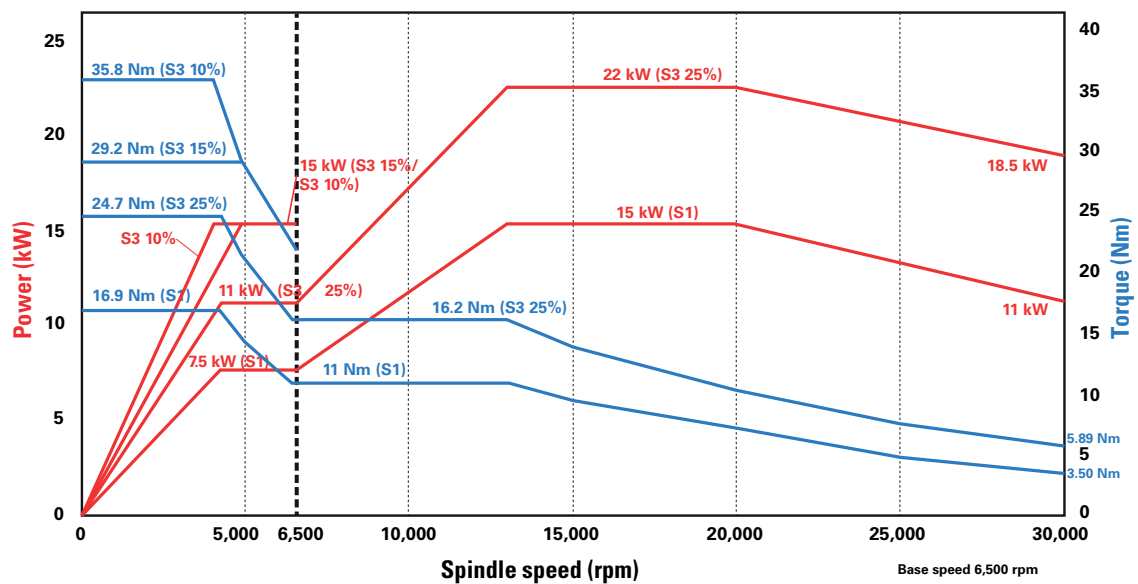
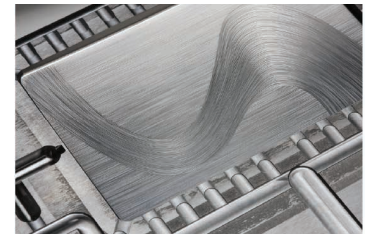
50 - 20,000 rpm spindle

The standard 20,000 rpm HSK-A63 spindle is ideal for high-speed machining and is highly versatile – well-suited for a broad range of medium to small-diameter tools.



50 - 30,000 rpm spindle¹

The 30,000 rpm HSK-F63 spindle is designed for high-speed machining with small-diameter tools – perfect for ultra-fine detail work such as hair-line machining.



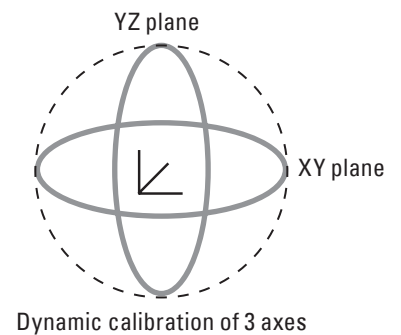
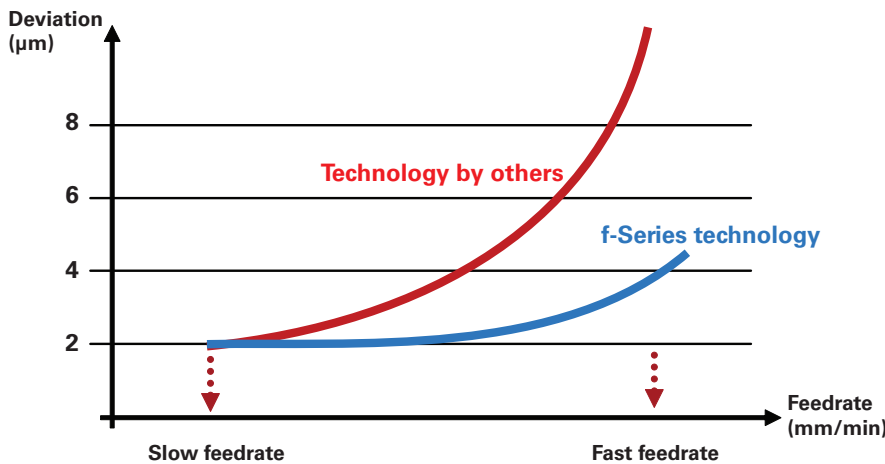
Motion Technology

Super Geometric Intelligence (SGI.5) software is developed specifically for high-feedrate, tight tolerance machining of complex, 3D-contoured shapes involving continuous, small blocks of NC data. It enables faster production speeds than standard CNC systems while maintaining high profile accuracy and improved cycle times.

- Fine motion control even at high feedrates
- The f-Series features advanced acceleration and deceleration control
- High-speed, high-accuracy machining made possible

GI & SGI

- Enhanced cutting point accuracy
- Cutting mode selection
- CMD optimised machine
- Look ahead
- AICC II (Artificial Intelligence Contour Control)



The optimal machining mode for each job can be selected via M-code commands, allowing users to achieve the desired surface quality and shape accuracy. This improves machining efficiency and overall productivity.



High Speed ←————→ High accuracy



Without GI control



With Super GI.5 control

Professional 6 Controller

Combining the proven reliability of FANUC hardware with the flexibility of Microsoft Windows Embedded Standard OS, the cutting-edge Pro6 control system offers:

- **Streamlined operation**
The screen layout aligned with the operator's workflow – from setup to production.
- **Operator assistance**
On-screen guidance, parameter input, code and manual search functions are available exactly when and where needed.
- **Expanded standard functionality**
Additional built-in tools ensure operators are equipped for any task.
- **Enhanced safety**
Includes dual-check safety, 3D graphic viewer, maintenance screens and easy access to machine data.



Easy to see with larger 15 inch LCD

Multi-touch screen to adapt both flick and pinches operations

Full QWERTY keyboard

Simplified operation panel with minimum number of buttons and dials

Portable MPG is standard

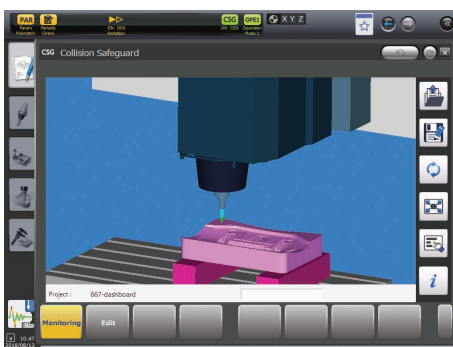
Easy to see 100% position with LED indicator

Five-step workflow for streamlined operation



Crash avoidance:

Collision Safeguard¹



Real-time interference checks run in tandem with the machine to prevent collisions, enhancing safety and reducing downtime.

i-Setup¹



- Quick and easy measuring setup for intuitive operation
- Code-free programming using a dialogue-based screen

¹Option

Efficient Chip Removal

Five-nozzles supply system (standard specification)

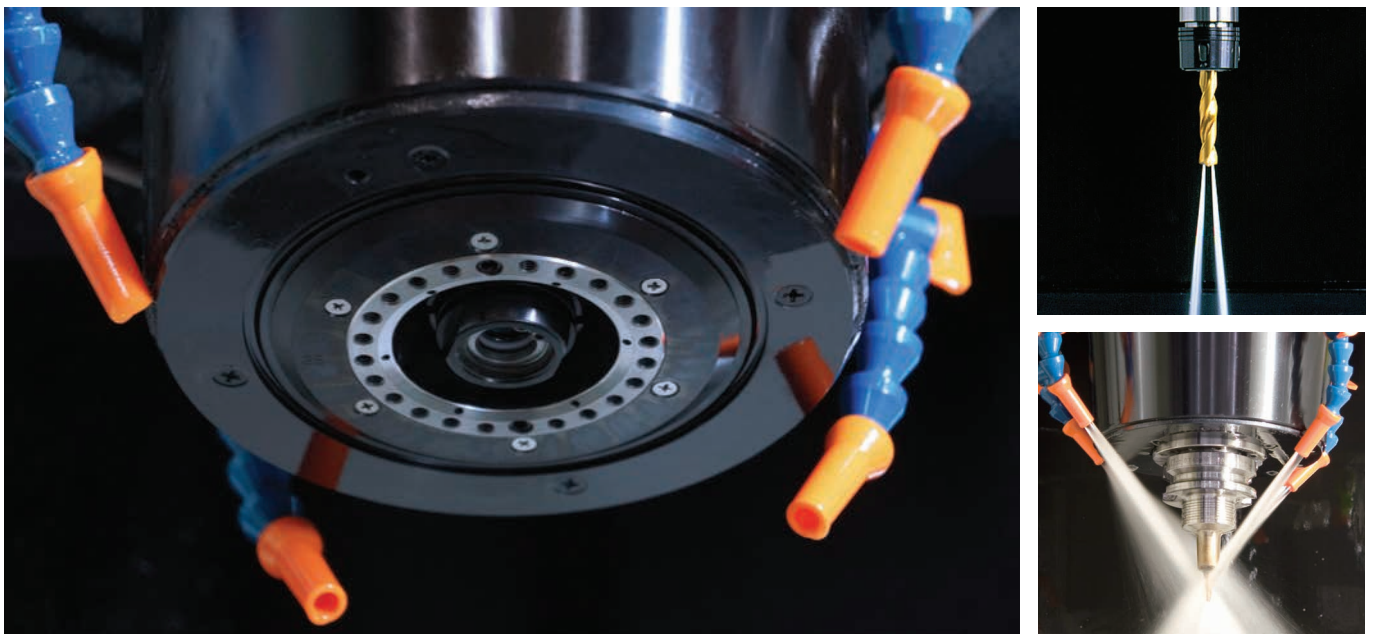
Four coolant nozzles and one air blower nozzle are strategically positioned around the spindle for effective chip evacuation.

Through-spindle air (optional specification)

Air is supplied directly from the tool tip and holder for efficient chip removal during dry machining.

Through-spindle coolant (1.5 MPa and 3.0 MPa) (optional specification, not available with 30,000 rpm spindle)

Coolant is delivered from the tool tip and holder for efficient chip removal during dry machining.



Modern unmanned machining and highly efficient machining processes generate a large volume of chips. As such, a fast, reliable chip evacuation system is essential. An efficient system not only improves machine performance but also allows the operator to focus on core machining tasks, thereby enhancing overall productivity.

To improve chip management, a lift-up chip conveyor is installed as standard specification.

Operation and Maintenance Friendly



Easy operation with precise hand-eye coordination, aided by the 180° swing-type operation panel.



The machine ceiling opens to allow easy handling of large, heavy workpieces and fixtures using an overhead crane.



Convenient ATC magazine access for tool loading/unloading, supported by an unclamp/clamp push button.



Side door access enables easy spindle approach for tool changes.



A centralised maintenance panel groups pneumatic, hydraulic and lubrication points for quick and efficient servicing.

Automation and Production Ready

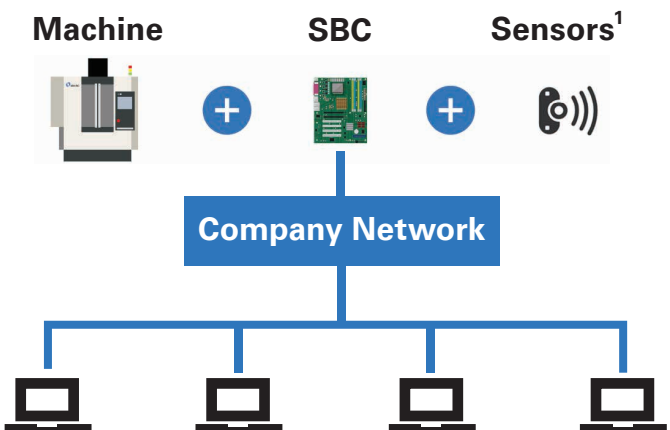
Robot integration enables unattended, continuous operation, significantly improving the efficiency of mould machining processes.



MMS | Machine Monitoring System

The optional Machine Monitoring System (MMS) provides a comprehensive dashboard that monitors machine health and machining processes, helping to ensure consistent performance and high-quality output.

Types of MMS	
Basic	M/C + SBC
Advance	M/C + SBC + Sensors
SBC: Single Board Computer	



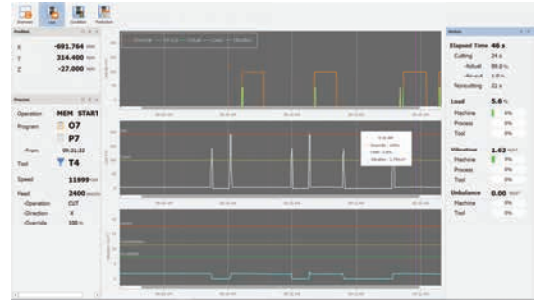
¹Option





Live monitoring

- Real-time machine status and performance data
- Converts machining conditions into digital data for performance optimisation



Condition monitoring

- Transparent monitoring of the spindle, ATC and hydraulic systems
- Reduces downtime through effective alarm management
- Supports predictive maintenance strategies
- Lowers maintenance costs



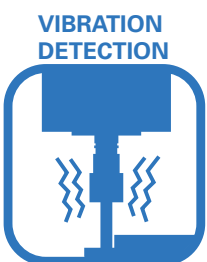
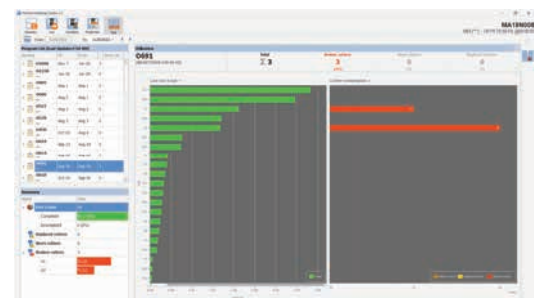
Production monitoring

- Gain insights into machine utilisation, part counts and machining process details
- Analyse the stability and efficiency of operations
- Integrate OEE (Overall Equipment Effectiveness) features for complete performance tracking

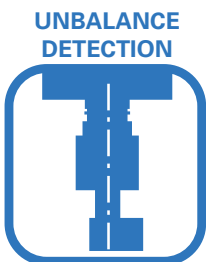


Tool monitoring

- Monitor tool usage by tracking worn and broken tools
- Useful for accurate cost calculation
- Easily monitor and manage tool life



VIBRATION
DETECTION



UNBALANCE
DETECTION



COLLISION
DETECTION

On machine protection

Spindle Active Care, a feature of MMS, protects the spindle from unfavourable, vibration-induced operating conditions.

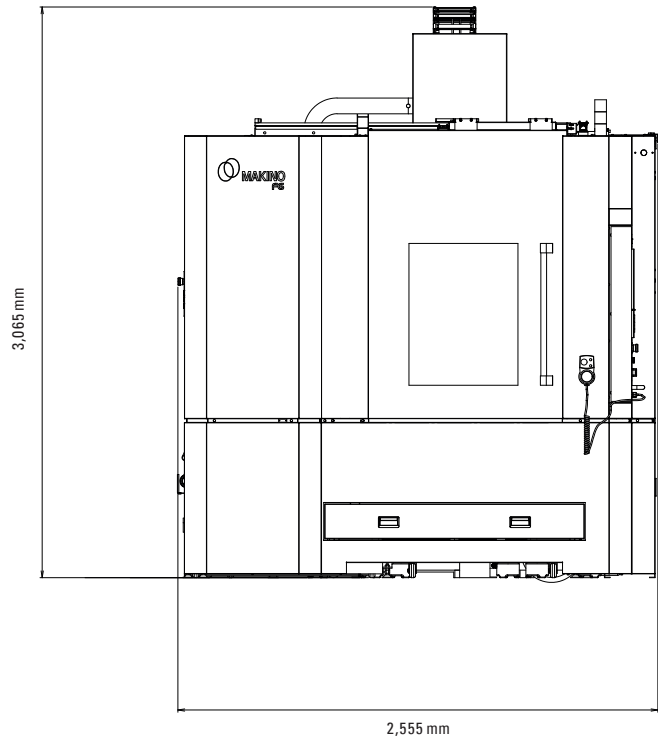
Specifications

	Description	f6
Axis travels	X × Y × Z	900 × 650 × 450 mm
	Distance from table surface to spindle gauge line plane	150 – 600 mm
Table	Working area (Width × Depth)	1,000 × 650 mm
	Maximum workpiece	1,000 × 650 × 450 mm
	Maximum table load (evenly distributed)	1,000 kg
	Surface configuration	6 × T-slots, size 18H8 mm, pitch 100 mm
Spindle	Speed range	50 – 20,000 rpm
	Taper hole	HSK-A63
	Drive motor power (25% ED / cont.)	25 kW / 11 kW
	Drive motor torque (25% ED / cont.)	31.8 N m / 14 N m
	Bearing diameter (inner / outer)	ø 65 mm / ø 100 mm
Feedrate	Rapid traverse	20,000 mm/min
	Cutting feedrate	1 – 20,000 mm/min
Automatic tool changer	Tool storage capacity	30 tools
	Maximum tool diameter (with adjacent pots occupied)	ø 75 mm
	Maximum tool diameter (with adjacent pots empty)	ø 125 mm
	Maximum tool length	300 mm
	Maximum tool weight	8 kg
Coolant tank	Tank capacity	300 L
	Flowrate	80 L/min
Power supply (standard)	Incoming voltage	380 – 440 V, 3 Phase, 50 / 60 Hz
	Installation	52 kVA
Air supply	Pressure	min. 0.5 – 0.8 MPa
	Consumption	400 L/min
Machine accuracy (Tolerance measured at Makino's assembly plant)	Positioning (full stroke without / with scale feedback)	±0.0025 mm / ±0.0015 mm (JIS B 6336); ≤0.010 mm / ≤0.0006 mm (ISO 230.2 - 2006)
	Repeatability (full stroke without / with scale feedback)	±0.0014 mm / ±0.0010 mm (JIS B 6336); <0.006 mm / <0.004 mm (ISO 230.2 - 2006)
Machine	Size (standard specification) Width × Depth × Height	2,555 x 4,375 x 3,065 mm
	Weight	9,800 kg
Floor space	Width x Depth	6,600 x 10,200 mm



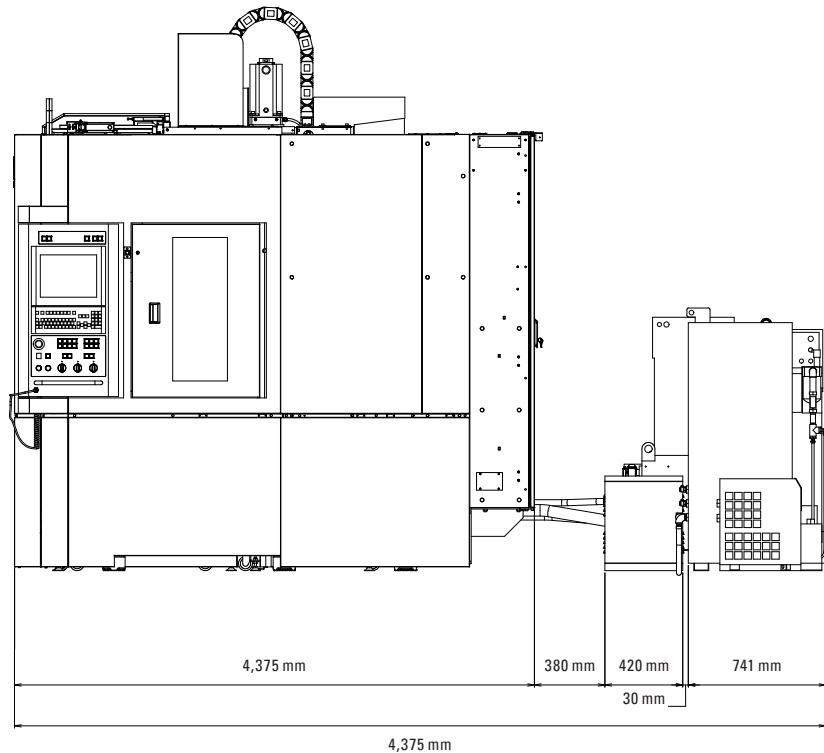
Standard specification

- 20,000 rpm, HSK-A63 spindle
- 30-tool ATC
- Spindle temperature controller
- Axis temperature controller
- Ball screw core cooling
- Ball screw support bearings cooling
- Motor flange cooling
- LED lightning with splash guard
- 3 layer signal light
- Splash guard and ATC door inter-lock with lock
- Automatic air blow
- Centralized auto grease
- Portable manuale pulse generator with the handle enable button
- Rigid tapping
- Professional 6 controller
- Super G1.5 control
- Linear interpolation positioning
- User memory 2 GB + 1 GB
- 1,000 registerable programs
- Tool offset memory type C
- Tool offset 400 pairs
- Custom macro variables, 600 numbers
- Auto power out
- ECO mode functions
- Power fail monitor
- Lift-up chip conveyor (scraper-left discharge)



Optional specifications/ ★ Optional equipment

- 30,000 rpm, HSK-F63 spindle
- 60-tool ATC
- Trough spindle air
- Through spindle coolant (1.5 /3 MPa) on 20,000 rpm spindle
- i-Setup
- ★ 4th axis NC rotary table interface
- ★ 4+1 axis NC tilting rotary table interface
- ★ ATLM (automatic tool length measuring device)
- ★ AWM (automatic workpiece measuring device)
- ★ Chip bucket for lift-up chip conveyor
- ★ Air dryer
- ★ Mist collector
- ★ MTC cabinet door interlock
- ★ Rear coolant tank (tank capacity: 420 L)
- ★ Coolant temperature controller
- ★ Scale feedback 0.05 um (X, Y and Z axes)
- ★ Work wash gun
- ★ Robot interface
- ★ Spindle Active Care
- ★ G1 Smoothing
- ★ Collision Safeguard



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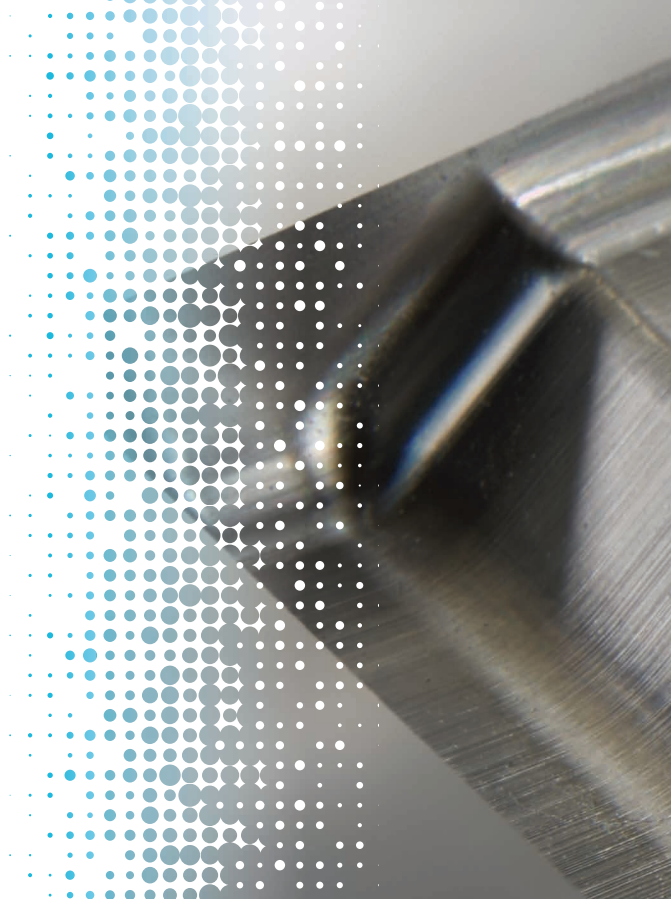
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