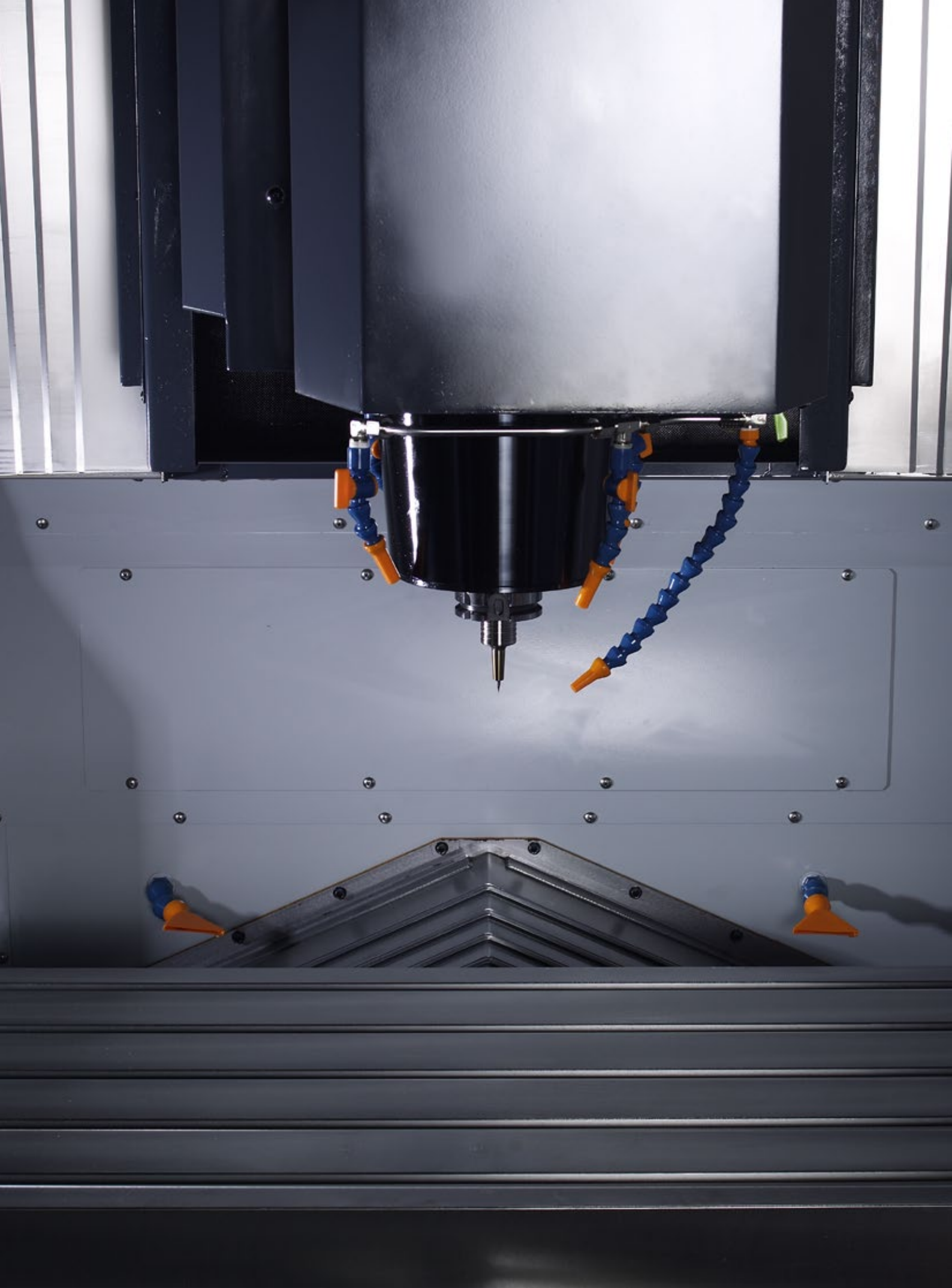


F3 · F5

Vertical Machining Center





“Defining the art of precision mold making”

In the evolution of consumer goods, there is a demand for continuous improvement in aesthetics, styling, cost and performance. It is a tremendous challenge for manufacturers to provide an efficient and competitive mold making solution to automotive, aerospace, 3C & medical industries. Each industry has its own demanding requirements on surface finish, contouring accuracy, and tool life, with the ultimate goal being a lower cost per part with improved quality.

Makino is well-established in bringing this value to these markets through the reliability of our product line, the innovation of the technologies employed in them, and the expertise of our engineering and applications personnel. Makino's F-series vertical machining centers is another example of Makino's ability to bring the finest machining solutions to the marketplace. Three elements make this possible:

- Rigid Machine Construction
- Advance Spindle Technology
- Motion Technology

The F-series combines these advantages with an ergonomic design and an efficient chip evacuation system. This line was designed with the customer and operator in mind. Parts are easily loaded, programs easily run, and high-quality machining finishes are achieved all at a lower cost per part.



Competitive Solutions for Die & Mold



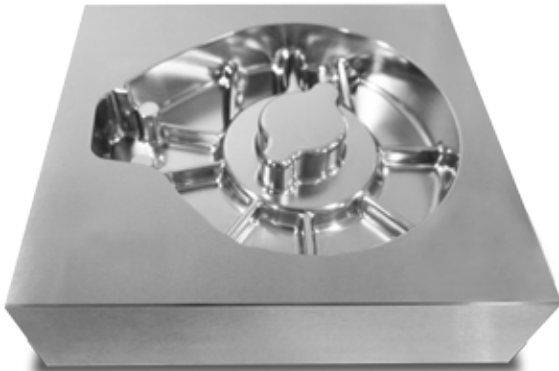
Makino F-series Vertical Machining Centers

The F-series machine delivers positioning accuracies and repeatability in the microns. The spindle assures the capability to address a wide variety of tooling and machining applications, and SGI.4 provides unsurpassed accuracy and speed in tough, challenging, and complex geometries. This platform is an ideal choice for shops looking to get “top-shelf” machining performance and superior machining results at a reasonable investment - a true value proposition.

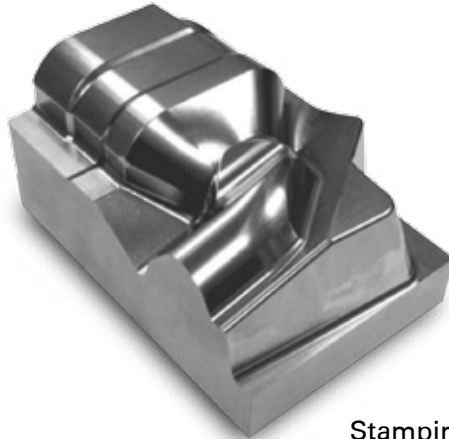
From...

- Plastic, die cast to blow molds
- Stamping to forging
- Prototype to production
- Medical, electronics, aerospace, optical consumer products, to packaging

Superior Surface Finish



Die cast Die



Stamping die



Plastic mold



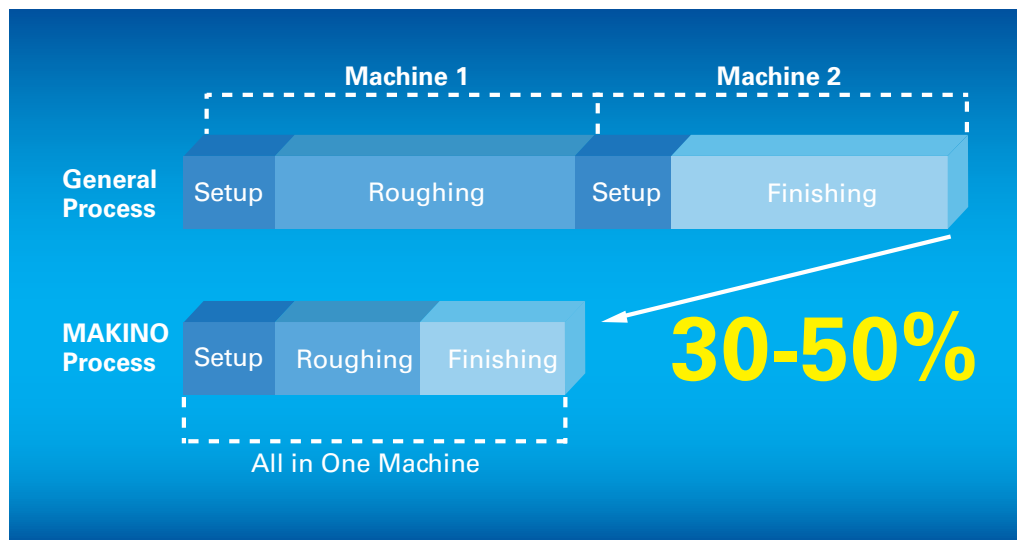
Forging die

High Efficiency Machining

Machining hard materials from rough to finish, increasing productivity and efficiency



Surface Finish: Ra 1µm



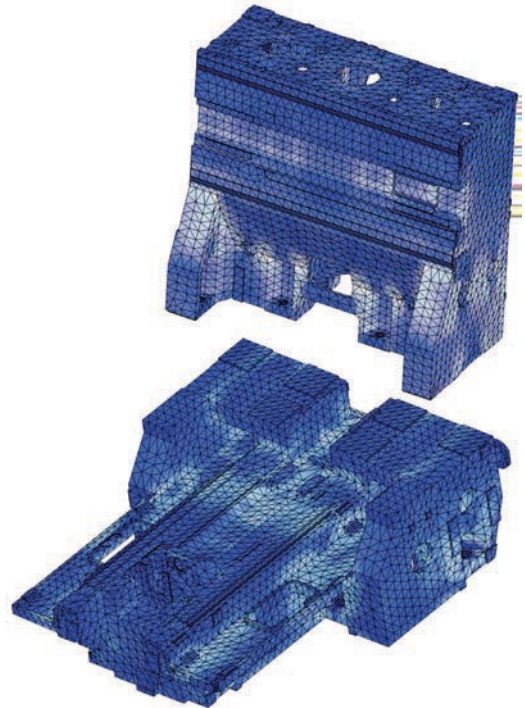
Rigid Structure

Heavy cast iron construction and a unique axis configuration provides outstanding stiffness, rigidity, thermal stability, accuracy and unequaled axis support throughout the full travel of each axis:

- X and Z on the column
 - Constant spindle support distance
 - Fully supported throughout travel
- Y under table
 - No "stack-up" of X and Y
 - No off-center table load condition
 - Fully supported throughout travel

Finite Element Analysis (FEA) of the basic components insure optimized structural rigidity and torsional stiffness for ultimate performance characteristics and consistent results.

This structural rigidity is the foundation for superior cutting performance, provides damping against vibration, and sustained accuracy for the life of the machine.



Most competitive machines feature some variation of a traditional "C-frame" design. Therefore, in most die and mold applications, by virtue of the machine configuration and associated geometry, the machine tool elements significantly overhang their support structure:

- The Z axis is cantilevered from the X axis (Figure 1)
- The X axis is "stacked up" on the Y axis (Figure 2)
- The X axis is overhung from the Y axis (Figure 3)

As a result, cutting forces - combined with these long, unsupported, cantilevered distances create stiffness, rigidity and dynamic distortion issues that produce vibration and chatter. Such instabilities, inertial factors and bending moments during cutting dramatically impact surface finish, final part accuracy, cutting speeds and feeds, achievable depth of cut, cycle time, tool life, and productivity. By virtue of the unique F-series construction, the machine provides a stiffer, more rigid, highly accurate, chatter-free platform for even the most difficult of cuts.

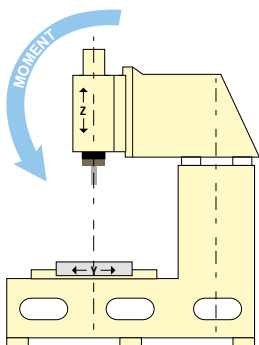


Figure 1

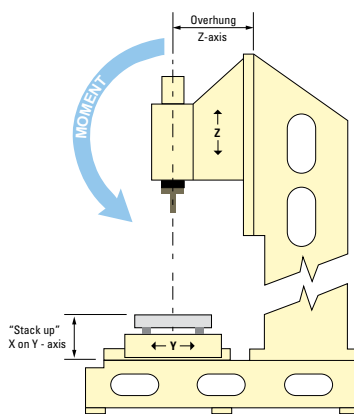


Figure 2

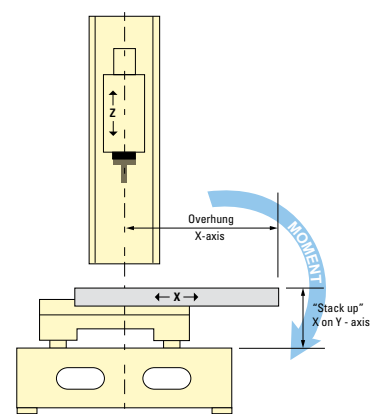


Figure 3

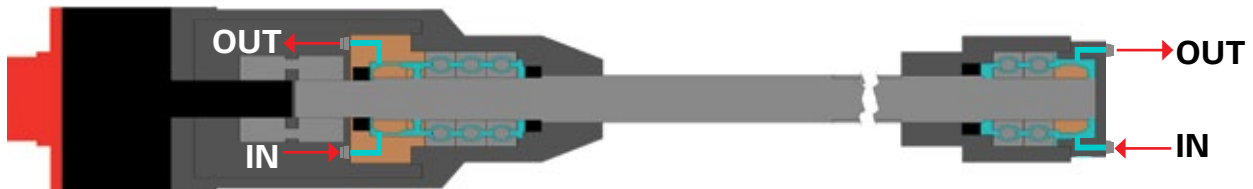
Thermal Stability

High performance linear guideways (utilizing "caged ball" technology) provide extremely precise, anti-friction motion. In addition, pre-tensioned, dual supported, large diameter ballscrews and powerful, direct-coupled, digital servo motors - tuned for peak performance - provide the stiffness and rigidity for the most challenging applications.

Fine ballscrew motion provides greater precision for blends, matches and complex geometry applications. Temperature controlled lubrication maintains and controls the thermal stability of the ballscrew bearing mounting area, ensuring stable, long cycle time cutting accuracy.

Lubrication of support bearing of X & Y Axis

- Thermally stabilizes support bearing as it is bathed with oil flow
- Extends life span of the support bearing
- Smoothens axis movement especially during small step machining



Achieving High Precision Accuracy Through Mechanical Means

Parts are accurately manufactured, meticulously adjusted and assembled with exacting precision.

Scrapping is incorporated in the machine assembly in order to achieve better profile accuracy and surface matching which results to mechanical accuracy in order to further enhance and increase the machine performance and increase the machine life at the same time.

Machining accuracy

Squareness	0.005 mm / Full Stroke
Straightness	0.005 mm / Full Stroke

(*Guaranteed values: tolerance at Makino's assembly plant - daily temperature change of $\pm 1^{\circ}\text{C}$)
(*In accordance to JIS B6338 - 1985)



Advanced Spindle Technology

Makino's leadership in spindle technology is renowned throughout the world. Spindle rigidity, higher rpm, constant pre-load, multi-plane balancing, minimizing vibration, and controlling thermal growth are all issues that Makino has solved through years of experience and application of spindle design, manufacture, and assembly.

The optional 20,000 rpm, HSK-A63 spindle incorporates Makino's patented spindle technology:

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

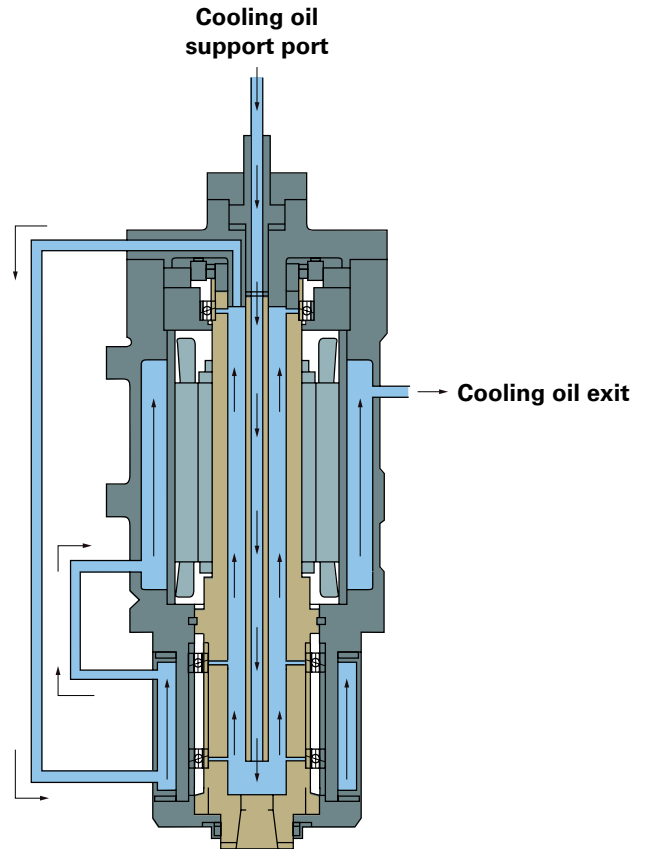
The spindle provides characteristics required in any number of high-speed machining applications typical of the die and mold industry. The two-range, unique integral design provides wide-range capability with stiffness and rigidity at lower ranges (roughing operations) to vibration & chatter-free production of small details and fine features when using small tools at a high rpm.

Spindle Temperature Controller

The F-series machine is the only machine of its class to combine a large capacity, heat dissipating spindle chiller, and the Makino technologies mentioned above. This maintains tight control over the spindle, bearings, and motor area, thus minimizing any spindle thermal growth effects upon spindle pre-load that impacts spindle stiffness and rigidity, tool life, surface finish, and ultimately final part accuracy.

Spindle	BT40	HSK-A63	HSK-F63
12,000 rpm	○	x	x
20,000 rpm	○	△	x
30,000 rpm	x	x	○

Legend
 ○ - standard △ - option x - N/A



HSK spindle (Option)

The HSK shank system with two restrained faces simultaneously couples the taper portion of the shank and the flange end face.



HSK-A63 holder
 *Available for 20,000 rpm spindle

HSK-F63 holder
 *Available for 30,000 rpm spindle

1. Improved Heavy-Duty Cutting Performance

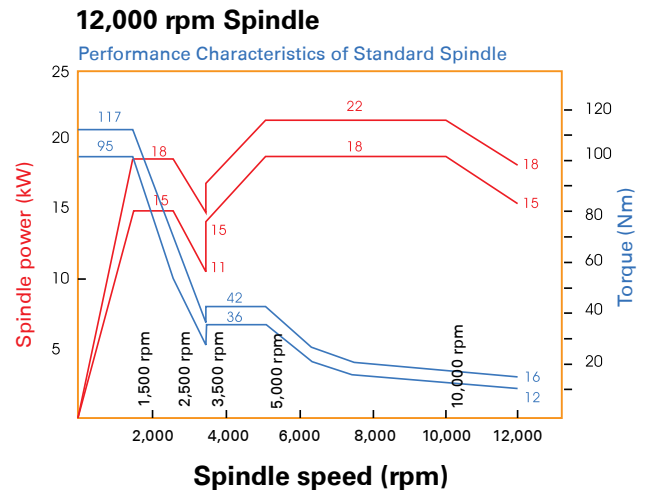
The difference in cutting performance is especially noticeable when machining with longer shank tools.

2. Improved Accuracy

Excellent attachment accuracy is faithfully reproduced for greater machining accuracy. This system firmly secures the tool holder both on face and the shank and provides very high rigidity and improved accuracy. Strongly recommended for high-speed applications.

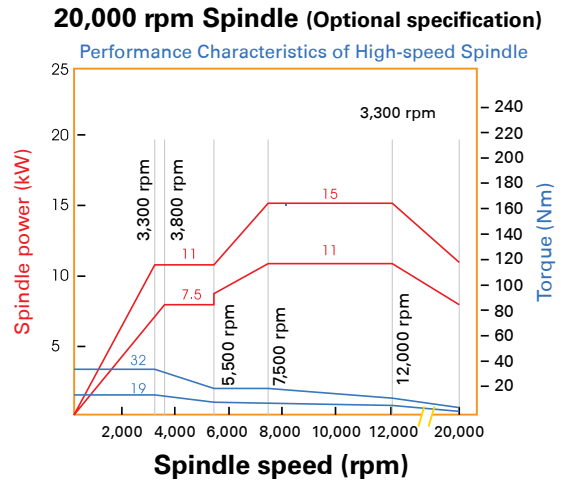
120 ~ 12,000 rpm Spindle

This high-torque spindle provides superior heavy-duty cutting performance for handling a wide range of machining.



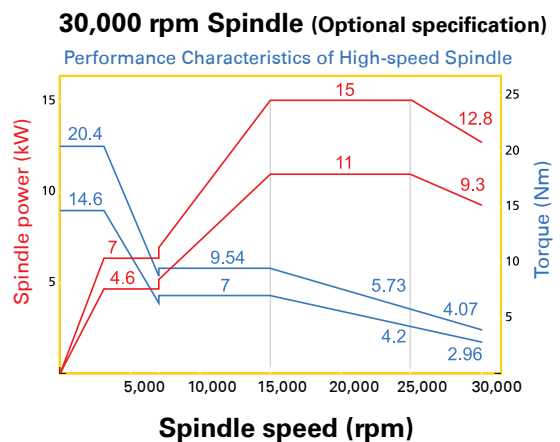
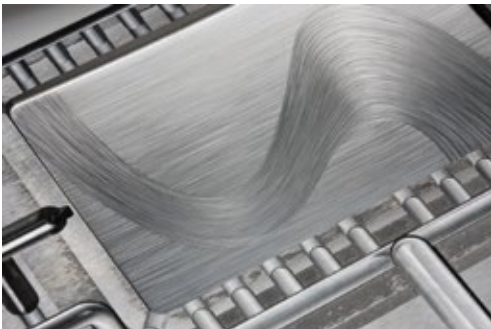
200 ~ 20,000 rpm Spindle

This high-speed spindle is ideal for high-speed machining. Versatile for handling a wide range of medium to small diameter tools.



300 ~ 30,000 rpm Spindle

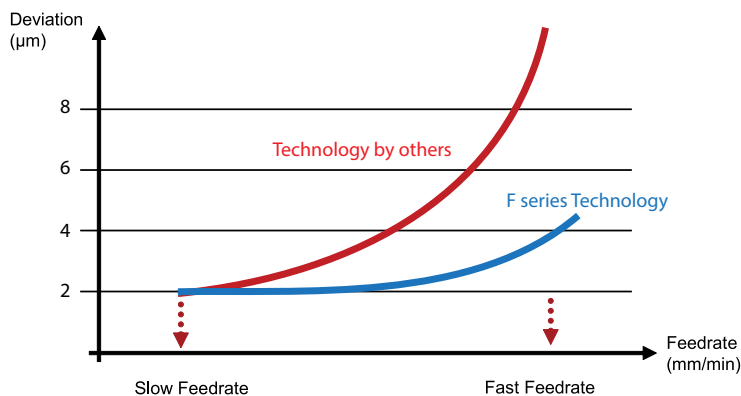
This high-speed spindle is ideal for high-speed machining with small diameter tools, such as hair-line machining.



Motion Technology

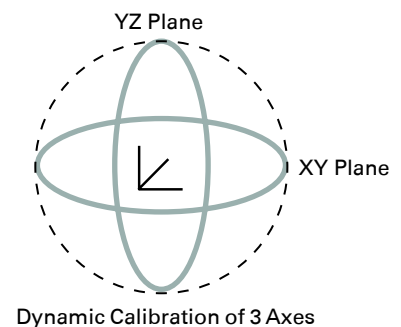
Super Geometric Intelligence (SGI.4) software - developed specifically for high feedrate, tight tolerance machining of complex, 3D-contoured shapes involving continuous tiny blocks of NC data. It ensures production rates faster than standard CNC systems while maintaining high accuracy. SGI.4 helps provide the lowest cycle time and cost.

- Fine Motion Control Even At High Feedrate
- F series Provides advanced acceleration and deceleration control technology
- High-Speed & High-Accuracy machining made possible



G.I. & S.G.I.

- Enhanced cutting point accuracy
- Cutting mode selection
- CMD optimized machine
- Look ahead
- HPCC (High Precision Contour Control)

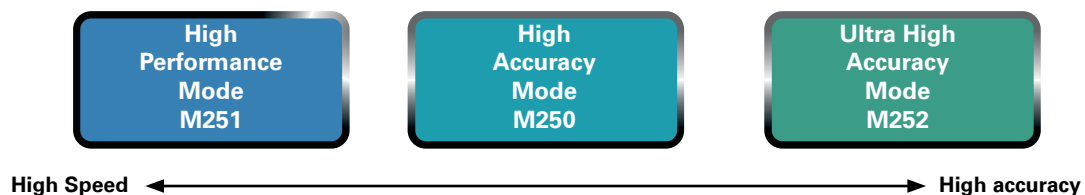


Direction (X-Y)	CW		CCW	
Diameter, mm	20	20	20	20
Feedrate, mm/min	200	8,000	200	8,000
Roundness, µm	1.1	4.8	1.4	4.8

Direction (Y-Z)	CW		CCW	
Diameter, mm	20	20	20	20
Feedrate, mm/min	200	8,000	200	8,000
Roundness, µm	1.9	5.7	1.6	5.4

(*Guaranteed values: tolerance at Makino's assembly plant - daily temperature change of $\pm 1^{\circ}\text{C}$)
 (*In accordance to JIS B6338 - 1985)

The machining mode that optimally matches the machining job can be selected with M code commands.



Without GI control



With Super GI.4 control

Pro 5 Controller

F series utilizes the Makino Professional 5 Control which affords the perfect blend of a Windows CE graphical user interface (GUI), touch-screen selection that provides instant access to information literally at your fingertip, user-friendly, efficient PC-like capability for data management and editing, and the networking and storage capability of a Makino proprietary data center.

Key Features

- Data Center – Single screen to check, edit and manually read/write NC data
- Tool Data Screen – Spindle load, tool life and tool data management
- Machine uptime management – The operating time for each machining process is recorded as a machining result
- Alarm Display – Easy to understand alarm display screen for quick machine recovery



Tool Data



Spindle Load & Tool Life



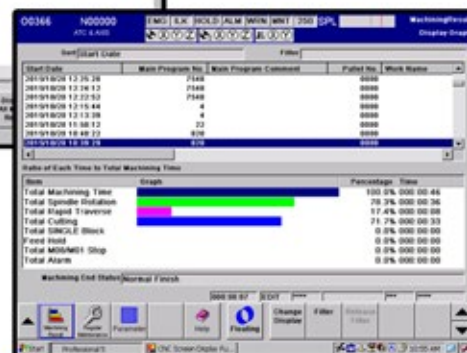
Preventive Maintenance



ATC Recovery



Machine Uptime Management



Efficient Chip Removal

5 nozzles supply device (standard specification)

- 4 coolant nozzles and 1 air blower nozzle are effectively positioned around the spindle.

Through-spindle air (optional specification)

- Air is supplied from the tool tip and holder.

Through-spindle coolant (1.5 MPa and 3.0 MPa) (optional specification)

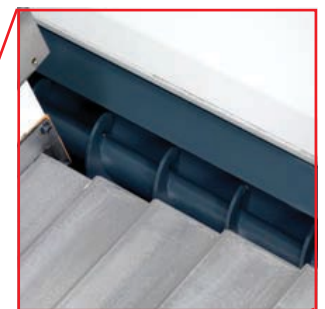
- Coolant is supplied from the inside of the holder through the tool tip.



Unmanned machining application and highly efficient machining processes generate high volume of chips. Therefore, a quick, good and reliable machine chip evacuation system is required. In F series, optional two spiral type chip conveyors is used in transporting chips from the machining zone to the rear of the machine. This efficient system will enable operator to focus on the machining tasks and hence improve his work efficiency.



Chip Tray is located at the front of the machine and can be emptied even during machining



Spiral Conveyor

An optional Rear Tank is equipped with 2 x spiral conveyors to evacuate chips to the rear side of the machine

An optional lift up chip conveyor can be installed along with the rear tank to further improve the chip management of the machine.

Ease of Operation



The chip and splashguard doors, as well as the machine ceiling, open together to facilitate easy handling of large, heavy workpieces that require an overhead crane. Combined with the movement of the table, and the convenient table loading height, the F-series machines significantly reduces part exchange load times and operator fatigue.

The machine control is on a pivot that provides 90° of swing. This assures the operator will always have easy access to the control during set-up, program prove-out, operation, and even manual tool loading through the front of the machine.



An integral ATC shutter separates the machine workzone from the tool magazine, assuring the chips and coolant from the machining area do not migrate into the tool magazine.

The tool changer door provides ready access for easy loading and unloading of tooling to the machine magazine. An ATC control panel is located adjacent to the tool changer door to assist the operator in manual operation of the tool magazine and double gripper for tool replenishment and maintenance.

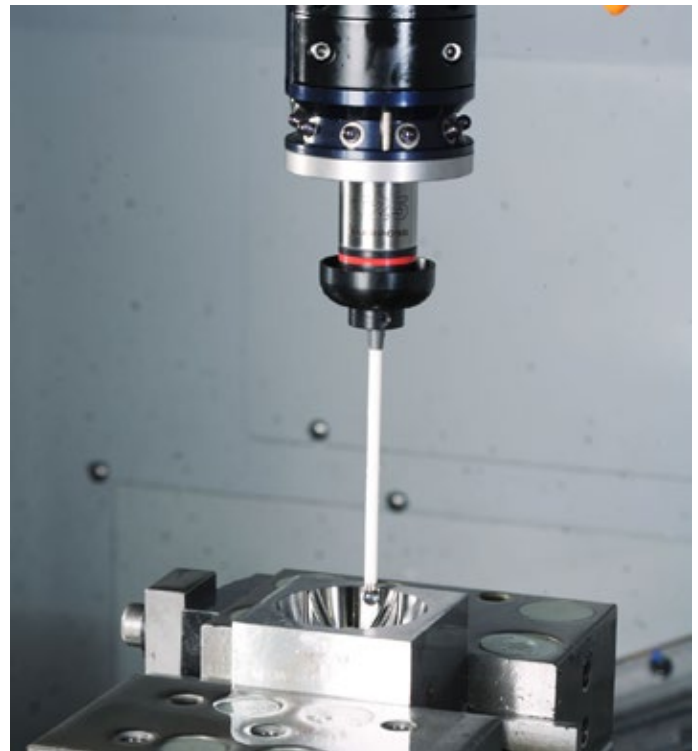


Measurement Systems



Automatic tool length measuring device (contact)*

This device measures the length of small diameter tools with diameter more than 0.5 mm. An air blower is attached to remove chips and coolant before the measurement so as to ensure that the tool length is measured accurately.



Automatic workpiece measuring device*

This device can be programmed to measure workpieces automatically before, during and after machining.



Non-contact tool measuring device (laser type)*

This device measures the length & diameter of small tools.

***Optional Equipment**

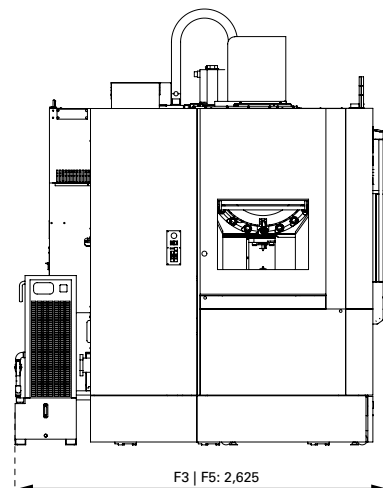
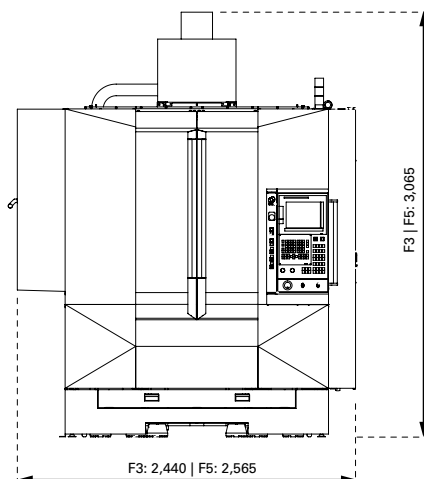
Machine Specifications			F3	F5
Travels	X x Y x Z axes	mm	650 x 500 x 450	900 x 500 x 450
	Distance from table surface to spindle gauge line plane	mm	150 ~ 600	
Table	Table working area (WxD)	mm	850 x 500	1,000 x 500
	Maximum table load (Evenly distributed)	kg	800	1,000
	Table surface configuration		5 x T-slots, size 18H8 mm, pitch 100 mm	
Spindle	Spindle speed range	rpm	120 ~ 12,000	
	Spindle taper hole		7/24 taper No. 40	
	Spindle drive motor power (15 min. / cont.)	kW	22 / 18	
	Spindle drive motor torque (15 min. / cont.)	Nm	117 / 95	
	Spindle bearing diameter (inner/outer)	mm	Ø70 / Ø100	
Feedrates	Rapid traverse	mm/min	20,000	
	Cutting feed	mm/min	1 - 20,000	
Automatic tool changer	Tool shank type		MAS 403 BT40 (JIS B6339 40T)	
	Tool storage capacity		20 tools	
	Maximum tool diameter (with adjacent pots occupied)	mm	Ø 114	
	Maximum tool diameter (with adjacent pots empty)	mm	Ø 120	
	Maximum tool length	mm	300	
	Maximum tool weight	kg	8	
Coolant tank	Tank capacity	L	160	
	Flowrate	L/min	80	
Air supply	Pressure	MPa	Min 0.5 ~ 0.8	
	Consumption	L/min	400	
Power supply (Standard)	Main electrical power capacity	kVA	40 (AC 200V, 3P)	
Machine accuracy (Tolerance measure at Makino's assembly plant)	Positioning (Full stroke without / with scale feedback)	mm	JIS Standards: ±0.0025 / ±0.0015 ISO 230.2 (1997) : ≤0.010 / ≤0.006	
	Repeatability (Full stroke without / with scale feedback)	mm	JIS Standards: ±0.0014 / ±0.0010 ISO 230.2 (1997) : <0.006 / <0.004	
Machine size (Standard)	Height (H)	mm	3,065	
	Floor space (W x D)	mm	2,440 x 2,625	2,565 x 2,625
	Weight	kg	7,300	7,500

Standard Specifications

- 12,000 rpm spindle
- 20-tool ATC
- Automatic Air Blower
- Complete set of manuals
- Data Center A - 160MB
- Fixed Manual Pulse Generator (MPG)
- Fluorescent lighting within splash guard
- Helical Interpolation
- Makino Professional 5 controller
- Manual centralized lubrication system
- Nozzle coolant (4 nozzles)
- Number of registerable programs: 120
- Part program storage memory: 160 m
- Rigid tapping
- Splash guard door lock
- Super G1.4 control

Optional Specifications (◦) & Equipment (▲)

- 30-tool ATC
- HSK-A63 Spindle (for 20,000 rpm spindle)
- HSK-F63 Spindle (for 30,000 rpm spindle)
- Through spindle air
- Through spindle coolant (1.5/3.0 MPa)
 - ▲ 4th axis NC rotary table interface
 - ▲ Air dryer
 - ▲ ATLM (Automatic Tool Length Measuring Device)
 - ▲ Auto power out
 - ▲ AWM (Automatic Workpiece Measuring Device)
 - ▲ Lift-up Chip Conveyor
 - ▲ Chip bucket for lift-up chip conveyor
- ▲ Mist collector
- ▲ MTC cabinet door interlock
- ▲ Portable manual pulse generator
- ▲ Power failure monitoring (3 axes)
- ▲ Rear coolant tank
- ▲ Scale feedback (X, Y, Z axes)
- ▲ Work wash gun





<http://www.makino.com.sg>

*The specifications in this catalog may be changed without prior notice to incorporate improvements resulting from ongoing R&D programs.
*The machines displayed in this catalog are fitted with optional equipment.
*The accuracy and output of machine may vary according to conditions of working environment.
*This product, including technical data and software, may be subjected to the Singapore Foreign Exchange and Foreign Trade Law.
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