Featuring Makino’s traditional operator-friendly design concept of single-position operation.

Never misses the targeted accuracy

Ideal for dies/molds and precision parts requiring high accuracy at the several micron level. The V33i pursues absolute accuracy independent of warmed-up operation and compensation.
Makino’s high-quality spindle is built without compromise for superior dynamic balance.

Spindle imbalance must be removed to suppress deflection and vibration in high-speed operation. After the spindle has been semi-finished, it is checked, which can reduce the error. Naturally, the outer contour must be ground to perfection, but the inner diameter into which the tool clamping mechanism is inserted might remain bent. Makino meticulously finishes the entire length of the inner diameter again to produce a high-quality spindle that features minimal deflection and vibration.

No spindle growth even during long hours of continuous operation at top speed thanks to spindle core cooling, jacket cooling and under race lubrication.

Accuracy in the depth direction of a workpiece can change gradually during long hours of machining. Such variation is mainly caused by spindle thermal growth. To prevent thermal distortion of the spindle, the V33 spindle Makino’s unique spindle core cooling and jacket cooling system to cool the spindle from both the inside and outside. The spindle core cooling system circulates a large volume of temperature-controlled lubricating oil through the center of the spindle to cool it directly from the inside. This helps to inhibit spindle growth by keeping the spindle temperature constant from the low to the high speed range. Lubricating oil is supplied from the rear of the spindle through the motor to the taper holes at the very front. The motor and bearings that generate a lot of heat are effectively cooled from the inside.

With the under race lubrication system, the lubricating oil of the spindle core cooling system is circulated directly below the bearings. Oil is discharged from the nozzle holes toward the bearing inner races and flows through holes in the races to lubricate the bearings directly. Used for jet engines, this advanced lubrication technology prevents any abrasion of an oil film on the sliding surfaces, something that is not allowed even for a moment. It delivers long hours of continuous operation at top speed without any concern about spindle vibration and machine accuracy.

30000 min⁻¹ Spindle

The 30000 min⁻¹ spindle thoroughly reduces deflection and vibration in high-speed operation. It is an ideal spindle for machining that uses many fine tools. Yet, it has sufficient rigidity over a wide range of speeds, including low-speed operation, to enable continuous machining from roughing to finishing with ample performance.

30000 min⁻¹ Spindle

Photograph: HSK-E60

Breakdown of spindle shipments in 2010

Quiet operation indicative of an ideal bearing layout

As shown in the diagram below, the ideal bearing layout is achieved by reducing the distance (L1) between the bearings to obtain a uniform arrangement. This layout effectively suppresses spindle vibration at high speed.

The overall length of the new 30000 min⁻¹ spindle was substantially shortened to reduce the L1 diameter by 20% compared with previous spindles. This markedly reduces spindle vibration for enhanced machined surface quality and longer tool life. The overall spindle weight was also lightened by 20% to reduce tool motion in the XY axis of spindle travel.

Performance characteristics of 30000 min⁻¹ spindle

Previous machine

HSK spindle

The HSK system with two non-circular faces simultaneously couples the taper portion of the shank and the spindles and feeds. The hollow 1/10 taper changes rapidly, while the flange and face fits tightly to the spindle nose.
**40000 min⁻¹ Spindle**

- Taper hole: HSK-E32
- Coolant injection system
- Spindle speed range: 400 – 40000 min⁻¹
- Spindle bearing outer diameter: 84.0 mm
- Output characteristics: 8.4 kW (Cont.)
- Torque characteristics: 2.0 N·m (Cont.)

This spindle delivers practical machining performance in all speed ranges from low to high-speed operation. While facilitating machining with ultra-fine tools at speeds up to 40000 min⁻¹, this spindle also delivers powerful cutting performance in the low-speed ranges which clearly distinguishes it from other high-speed spindles to date.

**Performance characteristics of HSK-E32 spindle**

---

**20000 min⁻¹ Spindle**

- Taper hole: T24 taper No.49, HSK-A63 (optional)
- Coolant injection system
- Spindle speed range: 200 – 20000 min⁻¹
- Spindle bearing outer diameter: DIA. 65 mm
- Output characteristics: 15 / 11 kW (20 min/Cont.)
- Torque characteristics: 45.7 / 31.1 N·m (20 min/Cont.)

The 20000 min⁻¹ spindle available on the V33i delivers 55% more torque than previous spindles, for markedly enhanced face milling and tapping performance. A 20000 min⁻¹ spindle is no longer a high-speed spindle today.

---

**Tool Used:** M20 x 2.5 tap
**Spiral nose:** 250 mm²
**Feedrate:** 625 mm/min
**Workpiece material:** S50C

**Tool Used:** 60 mm dia. face mill & insert/Wi/dia.50 mm Workpiece material: S50C

**Tool Used:** S50C

**Performance characteristics of 20000 min⁻¹ spindle**
Machine construction for maximizing spindle performance

The V30i is distinguished by extremely little ball motion, thanks to its construction without any exchange and the short distance in each axis from the guide to the machining point. The angle guide length of the spindle unit reduces the distance to the machining point from the machine, thereby avoiding any long projection like an elephant’s trunk. As a result, the spindle obtains the same machining performance and machined surface quality regardless of its position.

Sliding guides with excellent vibration damping are used in all axes. The square guides are integrally cast with the bed, hardened, and polished to a precision finish with minimal deflection. Because the guides are not simply bolted on, they have high rigidity and maintain superb accuracy over long periods of use.

Every effort was made to ensure stable quality by using common parts for the feed mechanisms. The ball screws of the X, Y, and Z axes adopt common parts with the same diameters and lengths. All other peripheral parts are the same in all axes.

Y axis travel has been extended to 460 mm, an increase of 50 mm over the previous model. This enables the machining of workpieces one size larger and also allows a wider selection of work, among other benefits.

The mating surfaces of the bed and column and of the spindle head and Z axis slide base are painstakingly hand-scraped to ensure superior squareness between every axis and the spindle.

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Measured</th>
<th>Guaranteed value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Static accuracy</strong></td>
<td><strong>X-Y</strong></td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td><strong>Y-Z</strong></td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td><strong>Z-X</strong></td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Squareness</strong></td>
<td></td>
<td>3.0</td>
</tr>
<tr>
<td><strong>Positioning accuracy</strong></td>
<td></td>
<td>±0.4</td>
</tr>
<tr>
<td></td>
<td><strong>X</strong></td>
<td>±0.3</td>
</tr>
<tr>
<td></td>
<td><strong>Y</strong></td>
<td>±0.2</td>
</tr>
<tr>
<td></td>
<td><strong>Z</strong></td>
<td>±0.1</td>
</tr>
<tr>
<td><strong>Repeatability</strong></td>
<td></td>
<td>±0.1</td>
</tr>
<tr>
<td></td>
<td><strong>X</strong></td>
<td>±0.0</td>
</tr>
<tr>
<td></td>
<td><strong>Y</strong></td>
<td>±0.1</td>
</tr>
<tr>
<td></td>
<td><strong>Z</strong></td>
<td>±0.1</td>
</tr>
<tr>
<td><strong>Spindle swing</strong></td>
<td></td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

- **Roundness:** 0.8 μm (Actual value: 0.8 μm)
- **Table flatness:** 2.1 μm (Actual value)
- **Height to table surface:** 800 mm

<table>
<thead>
<tr>
<th>Axis travel (X/Y/Z)</th>
<th>650 x 450 x 350 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table working area</td>
<td>750 x 450 mm</td>
</tr>
<tr>
<td>Maximum table load</td>
<td>300 kg</td>
</tr>
</tbody>
</table>

The bed & column
Accuracy

High stable machining accuracy over long hours of operation

Improved positioning accuracy in every axis

Machining test details
(1) The sides and bottom surface of test pieces ① are machined.
(2) Test pieces ① to ③ are machined at the same Z-axis height.
(3) Non-cutting operation in XYZ area.
(Spindle speed: 2000 min⁻¹, feedrate: 4000 mm/min, 1 hr)
(4) Then, steps (1) to (3) are repeated nine times, changing the machining position at each level.
Spindle used in machining: 30000 min⁻¹ (Nikken)

Maximum dimensional error of each level relative to the 1st level (actual value)

Surface A: Level difference with reference surface
Surface C: Level difference with reference surface

Pitch accuracy
Machining position error is less than 3μm in continuous machining over a total machining time of 8 hours.
**X-axis guideway cooling**

The X-axis guideway is cooled to prevent heat generation during long hours of high-speed machining. Cooling oil is circulated to the machine temperature is circulated through the saddle to keep the temperature constant. This suppresses thermal growth, especially in the X-axis direction. Positional displacement of the spindle head bar is kept within several microns in every axis even after 12 hours of continuous operation in all axes (patent pending).

**Ball screw core cooling**

Cooling oil is circulated to the machine temperature is circulated through the holes of the ball screws to prevent heat generation during high-speed movement. In addition, cooling oil is also circulated to the bearings supporting the ball screws to prevent pre-pressure from escaping.

**Motor flange cooling**

Cooling oil is circulated through the motor flange to prevent motor heat from being transferred to the machine.

**Prevention of lost motion**

**Guideway backup mechanism provided by lubricating oil circuit**

The X-axis guideway has a hydraulic circuit that pressurizes the guideway by tightly sealing the supplied lubricating oil. This markedly reduces sliding resistance to suppress lost motion. Together with the large-diameter ball screw and high-power head motor, it achieves exceptionally smooth axis motion. The sliding guideway system achieves higher vibration damping than a linear-motion bearing system, while providing response equal to the latter system.

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**GL4 control**

GL4 control moves the tool smoothly and accurately along the commanded path. This control feature works in concert with high-responsiveness servo and high machine rigidity to provide high-accuracy machining with any variation in accuracy even at high speeds.

**Super GL3 control/ Super GL4 control (optional equipment)**

These control features markedly increase the capacity for processing tiny blocks of NC data in 3-D machining jobs. They deliver exacting, error-free shape accuracy and uniform machined surface quality even at high cutting loads.

Super GL3 control is well suited to post-processing machining, including auto parts, while Super GL4 control is ideal for machining dies/molds with minimal need for post-machining polishing.

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**Vertical Machining Center — V331**
Outstanding Operating Ease
Accessibility and Visibility

All machining tasks are done at the front of the machine.

The front splash guard doors open toward both sides to create a wide opening. The coding also opens all the way back for easy loading and unloading of heavy workpieces with a crane. The large opening allows ample light for checking the machining condition and avoids coolant dripping on the operator from above.

The spindle is positioned where the operator can easily check the tool tip by simply extending his arm.
(Table height from the floor: 900 mm)

Foot recesses are provided at the bottom of the machine to allow easier access to the table and spindle.

The tool magazine door is located at the front of the machine so that tools can be changed in a short stop.

A handy chip bucket facilitates chip recovery even during machining.

The swing main control panel can be optimally oriented for the job at hand.
Efficient Chip Removal

Coolant and air systems
- 3-nozzle coolant supply device
  Standard equipment
  Three coolant nozzles and three air blower nozzles are effectively positioned around the spindle.
- Through-spindle air
  Air is supplied from the tool tip and holder.
  Standard specification (not available only with 12,000 rpm spindle).
- Through-spindle coolant (1.5 MPa)
  Coolant is supplied from the tool tip and holder.
  Standard specification only available with the 12,000 rpm spindle with 16K-AAG

MQL device (optional equipment)
This device supplies a fine oil mist to the machining point.

Fully enclosed splash guard
The fully enclosed splash guard keeps the working environment clean by preventing chips and coolant from scattering outside the machine.

Mist collector (optional equipment)
Higher spindle speeds and higher coolant pressures can increase the amount of mist generated. This device recovers mist to prevent it from affecting the shop environment.

- Mist collector interface (optional equipment)
- Connection port for mist collector (optional equipment)
  This port serves as an interface for a user-installed mist collector.
  Some shops unify the mist collectors of various machines for the sake of simplifying maintenance work.

Maintenance
The compressed air unit lubricating oil supply device for sliding surfaces and other units requiring routine maintenance are concentrated on the left side of the machine to minimize the area needed for maintenance work.

Short-type lift-up chip conveyor (optional specification)
Chips generated in continuous machining are reliably evacuated outside the machine.

Chip bucket (optional equipment)

Spiral chip conveyor
(page with the lift-up chip conveyor)
Tool Magazine

Tool changes are executed by two changing arms that access the machining chamber. The ATC system was deliberately adopted to avoid shortening the X-axis ball screws, which would degrade the agility of the V33i. With an ordinary system where the spindle accesses the tool magazine to change tools, the X-axis ball screws must be made longer than the machining travel. To avoid this, tools are changed by having the changing arms enter the machining chamber.

Made of high-precision parts, the ATC unit changes tools smoothly and quickly. The unit has successfully passed a tool-change motion test in which tools were changed more than one million times.

<table>
<thead>
<tr>
<th>Spindle speed</th>
<th>Tool shank</th>
<th>Standard specification</th>
<th>Optional specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>20,000 mm²</td>
<td>BT40 - HSK-A63</td>
<td>15 tools</td>
<td>25-40-60 tools</td>
</tr>
<tr>
<td>30,000 mm²</td>
<td>HSK-E60 - HSK-R30</td>
<td>15 tools</td>
<td>25-40-60 tools</td>
</tr>
<tr>
<td>40,000 mm²</td>
<td>HSK-E32</td>
<td>20 tools</td>
<td>40-120 tools</td>
</tr>
</tbody>
</table>

All tool change tasks are done at the front of the machine. The tool magazine ports are located right near the door to facilitate tool loading in an easy position.

15 tools magazine

20 tools magazine

40 tools magazine

40 tools magazine

60 tools magazine

15 tools magazine

25 tools magazine

Standard specification

Optional specification

Tool Limitation

No. of tool magazine

15

25

40

60

20

40

With automatic tool length measuring device

With automatic tool length measuring device
Monitoring

Hybrid automatic tool length measuring device (optional equipment)

In continuous finish machining jobs using an ATC, tiny tool differences can occur at the seams of machined surfaces due to tool changes. Polishing workpieces to correct such tiny differences is time-consuming. The hybrid automatic tool length measuring device measures the position of the tool tip, with a low-pressure contact probe, and a non-contact sensor measures the position of the spindle nose that is revolving at the speed of the machining operation. This measuring device automatically detects and positions the tool tip with high accuracy for improved surface finishes.

- Tool tip position: Low-pressure contact probe
- Spindle nose position: Non-contact sensor

The tool tip position and spindle nose position are each measured by the optimum method.

Automatic tool length measuring device (optional equipment)

Automatic workpiece measuring device (optional equipment)

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

Rak-rak Touch P&L (optional equipment)

This handy optional feature combines an automatic tool length measuring device (T) and an automatic workpiece measuring device (P). It enables workpieces to be centered and the tool length to be measured during setup work by simple screen inputs alone. This results in shorter setup time and improved accuracy.

Curved shape measuring function (optional equipment)

This optional function enables automatic on-machine measurement of three-dimensional workpiece shapes following machining. By measuring machined workpieces while they are still on the machine, problems can be detected before workpieces are transferred to the next process.
Machine Layout

Selection of two machine layouts matching available shop installation space

- Standard specification
- Layout specification with rear control panel

The control panel is moved to the rear of the machine when it is desired to arrange more machines in a row.

Automatic Work Changer

For long hours of continuous unmanned operation

- Automatic work changer variations
- Specifications with an automatic work changer

<table>
<thead>
<tr>
<th>Model</th>
<th>No. of workpieces</th>
<th>Workpiece size accommodated (Art/H/C)</th>
<th>Maximum load (excluding holder)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP648-33S</td>
<td>48</td>
<td>150 x 100 x 100 mm</td>
<td>15 kg</td>
</tr>
<tr>
<td>WP660-33S</td>
<td>60</td>
<td>150 x 75 x 100 mm</td>
<td>15 kg</td>
</tr>
<tr>
<td>WP690-33S</td>
<td>90</td>
<td>150 x 55 x 100 mm</td>
<td>15 kg</td>
</tr>
<tr>
<td>WP648-33M</td>
<td>24</td>
<td>250 x 200 x 150 mm</td>
<td>25 kg</td>
</tr>
<tr>
<td>WP636-33M</td>
<td>36</td>
<td>250 x 125 x 150 mm</td>
<td>25 kg</td>
</tr>
</tbody>
</table>

- Robot shutter (optional specification)
- Loader interface (optional equipment)

The interface is used for retrofitting an automatic work changer or when users install a commercially available automatic loading device.

<table>
<thead>
<tr>
<th>Column specification</th>
<th>Opening width (W) (mm)</th>
<th>Opening height (H) (mm)</th>
<th>Height in table (B) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard column</td>
<td>330</td>
<td>650</td>
<td>800</td>
</tr>
<tr>
<td>High column (low)</td>
<td>530</td>
<td>650</td>
<td>900</td>
</tr>
<tr>
<td>High column (high)</td>
<td>530</td>
<td>650</td>
<td>800</td>
</tr>
</tbody>
</table>

- Large robot shutter (optional specification)

The speed for changing workpieces measures 0.75 x 40°/min, which is high enough to accommodate stock and ARCs that can take a large load to change workpieces.

*Please note for technical use only
Optimally concentrates the machining processes for multi-face machining jobs and intricately shaped parts, including precision die/mold parts, electrodes, optical instruments, medical instruments and semiconductor manufacturing equipment components.

This machine adds a Makino-made tilting rotary table, built for ultimate accuracy, to the V33i Vertical Machining Center. The positioning accuracy obtained in this 3-D space ranks at the top of the world's 5-axis control machining centers. Reduces setup work by allowing multi-face machining in one chucking. The tilting B-axis provides positioning accuracy of ±3.5 sec and repeatability of ±2.2 sec, both guaranteed values. This axis is supported at both ends by a laterally integrated tilting axis base and large-diameter cross rollers. Disk brakes are also adopted at both ends of the tilting axis to provide high rigidity for supporting the table when it is tilted. Supported by roller bearings, the rotating C-axis operates quickly and accurately to provide positioning accuracy of ±3 sec and repeatability of ±1.1 sec, both guaranteed values. The axis feedback system is standard in both the tilting and rotating axes. The machine design minimizes interference between the spindle and the tilting axis base during multi-face machining.

Advantages of graphite electrodes
- Easy machining without high-speed machining
- Outstanding machinability: performs even for (1.5 to 3 times faster than copper electrodes)
- Light weight
- Good thermal conductivity: prevents heat accumulation, allowing high-temperature cutting
- Small thermal expansion: supports high-temperature machining
- High-precision electrode (±0.01 mm accuracy)
- Simple thermal expansion coefficient of copper

Powerful dust collector removes dust in detail to prevent it from escaping. The dust collector generates powerful suction to remove graphite dust quickly and reliably so that it does not accumulate in the machining chamber.

Dust suction port

**Major Specifications**

<table>
<thead>
<tr>
<th></th>
<th>Spindle speed</th>
<th>20000 min⁻¹</th>
<th>30000 min⁻¹ (optional)</th>
<th>40000 min⁻¹ (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis travel (X x Y x Z)</td>
<td>650 x 450 x 350 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Table working area (W x D)</td>
<td>750 x 450 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum table size (W x D x H)</td>
<td>750 x 635 x 350 / 450 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum table load</td>
<td>300 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* There are workpieces shape limitations.
* 1. Z-axis stroke decreases by 50 mm with the 40,000 min⁻¹ spindle.
* Maximum table load decreases when an HRC is used.
Professional 5 provides outstanding ease of operation in machining jobs involving different large-volume programs every time, such as for dies/molds and prototype part machining. Large-volume programs can be easily managed and edited in simple operations, as well as managing tool data. It also features improved maintenance functions.

A wealth of editing functions

Background editing function

Extended editing, fixed program insertion and G & M code insertion

The split screen display shows the foreground program on the left side and the background program on the right side. The foreground program and the background program are easy to recognize because different colors are used.

Data center

This screen shows listings in a tree display. This single screen makes it easy to check, edit, and mutually input/output NC data in the NC memory, internal memory card and network connected host computer.

It allows easy DNC operation from the internal memory card and the network connected host computer. By using the M198 code, programs in the internal memory card and the network connected host computer can be run as subprograms. (There are restrictions on running programs in the internal memory card and network connected host computer as subprograms.)

Handy main menu screen and NC program table screen

This screen shows the number of the tool in the spindle, spindle speed, spindle load and current machining position, among other items. All the information needed for machining, including the program in progress, can be confirmed in this single screen.

Simply touch the desired target program in the table on the screen and the program details are displayed instantly.
Direct-touch screen buttons

**Screen selection/matrix display button**

Simply touching the triangle icon at the lower left displays all the screen selection buttons, making it easy to select the necessary screen.

**Floating function buttons**

Touching the floating button displays the floating function buttons. Frequently used buttons such as those for turning on/off the lights and power supply can be registered and used as floating function buttons.

Centralized management of various types of tools

**Tool data screen and tool monitoring screen**

The necessary tool data can be checked and set via the tool data screen. The screen can be customized to display only the necessary items and not show unneeded ones.

The tool monitor screen displays graphs showing each axis load and the spindle load in real time. The monitoring function for the upper/lower spindle load limits, AC function, tool life monitoring function, and tool change function monitoring function are set from this screen.

Easy-to-understand alarm display screens

**Alarm table screen & alarm details screen**

An image of the alarm location, cause, recovery method, and other details are shown in an easy-to-understand format to facilitate quick machine recovery. In cases where the signal status of a limit or other condition is shown in the alarm details screen, only the signal that caused the alarm is shown, so that there is no confusion about the recovery method.

Machine uptime management

**Machining results screen**

The operating time for each machining process is recorded as a machining result. The results can be rearranged by the program number, program comments, the date machining started, etc. A filter can be applied for quickly checking the results in relation only to a specified condition.

Dependable maintenance support

**Regular inspection screen**

The screen automatically displays items requiring maintenance on the date of the regular inspection. This avoids problems such as carelessly forgetting to perform maintenance for something.
A CAM system developed by Makino on the basis of extensive machining expertise

Machining conditions database

- Contains over 1,000 machining conditions just for a solid ball and mill.
- Accommodates a wide variety of materials, ranging from carbon steels, pre-hardened steels and high hardness steels to aluminum materials.
- Machining conditions are generated for achieving high efficiency with respect to machining time, machining accuracy and tool life while taking into account the deflection and distortion that can occur during machining depending on the diameter and length of the tool used.
- The tool path is automatically generated by a combination of cutting parameters that reflect the specific characteristics of the tool.
- The tool path is automatically generated by the CAD/CAM system, which can handle the process at any time.
- The tool path is automatically generated by the CAD/CAM system, which can handle the process at any time.
- User can also register their own unique machining conditions.

Automation through precisely controlled, not forced, rough machining

The principle of FF Machining is to suppress the temperature rise at the cutting edge while maintaining a constant machining load. The generation of precisely controlled, instead of broad, toolpaths promotes unattended, automated operation.

- The toolpath is specifically generated for continuous cutting with the tool constantly in contact with the workpiece. Naturally, the cutting load is kept at a minimum constant level while the tool is working.
- The toolpath is automatically generated to handle extremely high cutting forces with "virtual entry" where the tool does not start cutting in the actual Athena system.

Pursuit of polishing-free machining

The mission of a CAM system is to solicit the full performance of a machining center so that it produces the best possible machining results.

- Minimizing hand finishing
  A smooth toolpath is generated for machining without manual intervention. In pursuit of realizing true machining, FF-cam generates a toolpath that minimizes approach motions (alongside machining)

- Sharp edges
  Specified edges are finished to sharply defined corners. These functions are especially effective for machining parts for use in specific applications. (Corner corner machining & projection corner machining)

With Tool-path Assist, the desired toolpaths are obtained without returning to the CAD system

The CAM system easily generates toolpaths that the CAD system cannot generate without extending or adding surfaces.

For producing sharp edges

- Without using toolpath assist
- With toolpath assist

Extending the surface of each machining area

- With edge extension function, the machining path is extended by simply selecting the area where you want to extend the path.

One-click Masching covers holes instantly with a single click

Covering holes and grooves not needed for machining has traditionally involved many operations. With Makino’s new One-click Machining function, it can be done in a single operation by merely selecting the area. Even intricate holes and grooves are machined with one click.

Vertical Machining Center - 33/
μDMS5 - μCell Expert

Die/mold machining support system

μDMS5 software manages and performs suitable control processing on the large volumes of data transferred from the CAM system to the machining centers.

The system is installed via dedicated lines to construct an environment for stable and high-speed data communications. Other major features include its flexible agility for accommodating program changes or additions during machining and superior operating ease, thanks to an easy-to-use interface.

Makino’s μCell Expert allows the machining schedule to be changed flexibly to accommodate rush jobs, sequence changes, additions and other changes even while machining is in progress. This capability boosts productivity by improving the uptime rates of machining centers fitted with an automatic work changer.

Program management by Japanese file names

The content of a file can be known from the file name because files can be managed by their Japanese file names within a mixture of hang and kanji. Even large numbers of files can be managed more easily compared with file management by the latter O and numerals.

Flexible NC program additions and interruptions even during machining

Machining can begin even before all the NC programs have been completed. This reduces machine downtimes and also shortens delivery lead times. This capability is especially effective for NC programs that are divided into multiple parts or those for dies/molds.

Tool data manipulation function (standard) & tool management function

The tool length, diameter and other data on tools in the ATC magazine can be manipulated and selected via the ATC tool data screen. In addition, any data changes are reflected in the data on the machine.

Centralized management of both NC program data and machine data

μDMS5 and μCell Expert also enhance other capabilities besides NC data management. Alarm indications, machining mode, number of the tool in the spindle and other machine conditions can be easily checked on this screen.

Status of the machine, pallet stocker and other conditions can be understood at a glance

The status of the machine, pallet stocker, workplace, work setting station (WSS) and other conditions can all be confirmed via the system monitor screen.

Simple schedule management for each pallet

Schedule changes, addition/deletion of NC programs and other tasks can be done at any time except for the NC program being machined.

Also easy to enter pallet transport instructions

Semi-automatic instructions for transporting pallets between the machine, pallet stocker and WSS are also input simply via a drag & drop operation.
### Machine Specifications

<table>
<thead>
<tr>
<th>Travels</th>
<th>X, Y, Z axes</th>
<th>650 × 450 × 350 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distance from table surface to spindle gauge line plane</td>
<td>150 ～ 500 mm</td>
</tr>
<tr>
<td>Table</td>
<td>Table working area</td>
<td>750 × 450 mm</td>
</tr>
<tr>
<td></td>
<td>Maximum workpiece size (W x D x H)</td>
<td>750 × 635 × 250 mm (with limitation)</td>
</tr>
<tr>
<td></td>
<td>Maximum table load (evenly distributed)</td>
<td>300 kg</td>
</tr>
<tr>
<td></td>
<td>Table surface configuration</td>
<td>T-slots (4 × 18H × 8 mm)</td>
</tr>
<tr>
<td>Spindle</td>
<td>Spindle speed range</td>
<td>200 ～ 20000 min⁻¹</td>
</tr>
<tr>
<td></td>
<td>Spindle drive motor (30 min/cont.)</td>
<td>15 / 11 kW</td>
</tr>
<tr>
<td></td>
<td>Spindle torque (25%ED/cont.)</td>
<td>45.7 / 31.1 N.m</td>
</tr>
<tr>
<td></td>
<td>Spindle taper hole</td>
<td>7/24 No.40 taper</td>
</tr>
<tr>
<td></td>
<td>Spindle inner diameter</td>
<td>Dia. 65 mm</td>
</tr>
<tr>
<td></td>
<td>No. of spindle speed ranges</td>
<td>2 steps with electric changeover</td>
</tr>
<tr>
<td></td>
<td>Cooling / lubrication</td>
<td>Spindle core, Jacket cooling / Under race lubrication</td>
</tr>
<tr>
<td>Feedrates</td>
<td>Rapid traverse</td>
<td>20000 mm/min</td>
</tr>
<tr>
<td></td>
<td>Cutting feed</td>
<td>1 ～ 20000 mm/min</td>
</tr>
<tr>
<td>Automatic tool changer</td>
<td>Type of tool shank</td>
<td>JIS B6339 40T</td>
</tr>
<tr>
<td></td>
<td>Type of retention knob</td>
<td>MAS 403P40T1 type</td>
</tr>
<tr>
<td></td>
<td>Tool storage capacity</td>
<td>15 tools</td>
</tr>
<tr>
<td></td>
<td>Maximum tool diameter</td>
<td>80 mm</td>
</tr>
<tr>
<td></td>
<td>Maximum tool length</td>
<td>250 mm</td>
</tr>
<tr>
<td></td>
<td>Maximum tool weight</td>
<td>7 kg</td>
</tr>
<tr>
<td>Machine size (standard)</td>
<td>Height</td>
<td>2400 mm</td>
</tr>
<tr>
<td></td>
<td>Width x depth</td>
<td>2330 × 2070 mm</td>
</tr>
<tr>
<td></td>
<td>Machine mass (including NC unit)</td>
<td>7700 kg</td>
</tr>
</tbody>
</table>

![Front View](image1.png)

![Floor Plan](image2.png)

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*Dimensions exclude small protrusions*
Standard Specifications

- 20000 min⁻¹ spindle (BT40)
- 15 tools magazine (with 20000 min⁻¹ / 30000 min⁻¹ spindle)
- 20 tools magazine (with 40000 min⁻¹ spindle)
- Spindle temperature controller
- Scale feedback 0.05 micron
- Fully enclosed splash guard
- Splash guard lighting device
- Operator door lock (operation mode)
- ATC door interlock
- Simple chip bucket
- Automatic air blower
- Through-spindle air (unavailable with the 40000 min⁻¹ spindle)
- 3-nozzle coolant supply device
- Portable manual pulse generator with the handle enable button
- Automatic lubrication unit
- Thermal Guard (including bed and column insulation specifications)
- Rigid tap
- GI.4 Control
- Linear interpolation type positioning
- Data center
- Program capacity 80m
- Offset registers 32
- Registerable programs 63
- Tool offset memory type A
- Programmable data input
- Spindle-table interference preventive function
- Standard tool length function
- Automatic power shutoff
- Automatic fire extinguisher interface
- ECO mode functions

Optional Specifications (⋆) / & Equipment (★)

- 20000 min⁻¹ spindle (HSK-A63)
- 30000 min⁻¹ spindle (HSK-E50/HSK-F63)
- 40000 min⁻¹ spindle (HSK-E32)
- Built-in hale function (unavailable with the 40000 min⁻¹ spindle)
- 25 tools magazine (BT40 / HSK-A63 / HSK-F63 / HSK-E50)
- 60 tools magazine (HSK-E32)
- 120 tools magazine
- High column Z min = 350 mm specification (Z-axis minimum of 300 mm with 40000 min⁻¹ spindle)
- High column Z min = 250 mm specification (Z-axis minimum of 200 mm with 40000 min⁻¹ spindle)

Automatic work changer
- WPS 48-33S (Work storage capacity 48-piece)
- WPS 60-33S (Work storage capacity 60-piece)
- WPS 90-33S (Work storage capacity 90-piece)
- WPS 24-33M (Work storage capacity 24-piece)
- WPS 36-33M (Work storage capacity 36-piece)

- Robot shutter
- Loader interface (Layout with rear control panel required)
- Pallet changer (Requires the High column specification)
- Through-spindle coolant, 1.5 MPa (Including flow switch) (Through-spindle coolant is available only with the 20000 min⁻¹ HSK-A63 spindle.)
- Workpiece washing gun
- Lift-up chip conveyor (with filter function)
- Short-type lift-up chip conveyor
- Coolant temperature controller

★ Nozzle coolant flow switch
★ Mist collector
★ Joint mount for mist collector
★ Mist collector interface
★ Oil skimmer
★ MQL unit
★ ATC door lock
★ Operator door lock & ATC door lock (with power shutoff)
★ Portable manual pulse generator (with tool position display and the handle enable button)
★ Automatic workpiece measuring device
★ Ring gauge for Automatic workpiece measuring device
★ Automatic tool length measuring device (MARPOSS)
★ Automatic tool length measuring device (Low contact pressure)
★ Non-contact tool length measuring device
★ Hybrid automatic tool length measuring device
   (Optional specification available with the 30000 min⁻¹ spindle : HSK-E50 and 40000 min⁻¹ spindle : HSK-E32.)
   (Unavailable with the pallet changer.)
★ Air dryer
★ Super GI.3 Control
★ Super GI.4 Control
★ Run hour meter
★ Warm-up timer
★ Signal light (3 layer)
★ Leakage breaker
★ Layout with rear control panel
★ Special customer- specified machine colors

*The machine's specification can comply with CE regulation. Please contact your Makino sales representative for details.
25 tools magazine specification

40 tools magazine specification

60 tools magazine specification
### Professional 5 Specifications

#### Control axes
- Simultaneous 3 axes
- Simultaneous 4 axes
- Simultaneous 5 axes

#### Programmed functions
- Programming unit: 0.0001 mm
- Programmable maximum: 29 digits (±99999.9999)
- Absolute/incremental programming (G90/G91)
- Decimal point/Pocket calculator style programming
- Automatic ISO/EIA recognition
- Inch/metric selection (G20/G21)

#### Interpolations
- Positioning (G00) (Linear interpolation positioning)
- Linear (G01)
- Cylindrical interpolation (G02, G03)
- Linear (G01) (Cylindrical + 2 axis linear)
- Involutes (G02, G03)
- Polar coordinate (G12.1, G13.1)
- Inverse_Circular_overview
- Automatic corner override (G52)
- Inverse time feed

#### Feeds
- 5-digit F
- 10-digit Dwell (G04)
- Rapid traverse override
- Feedrate override (0 - 200%)
- Feedrate override cancel (M99/M08)
- One-digit F code feed (F1 - F9)
- Automatic corner override (G52)
- Inverse time feed

#### Program storage and editing
- Part program storage: 80 m
- Additional: 160 m, 320 m, 640 m, 1280 m, 2560 m, 5120 m, 10240 m, 20480 m
- (Quantity including standard)
- Registered program number: 63
- Additional: 125, 250, 500, 1000, 2000, 4000
- Editing
- Program search
- Sequence search
- Address word search
- Voluntary program name (32 digits)

#### Display
- 12.1 type color LCD
- Clock function
- Manual Data Input
- Operation history display
- Run hour and parts quantity display
- Machining time stamp function

#### I/O - Device
- RS232C interface
- HSSB Connection kit
  - for μCell Expert or μDMS5

#### S/T/M function
- S functions direct commanding: Spindle function 55-digit
- T functions: Tool Function T4-digit
- T functions: Tool Function T8-digit
- M functions

#### Tool offsets
- Length compensation (G43, G44 / G49)
- Radius compensation (G41, G42 / G40)
- Tool offset pairs: 32
- Additional: 64, 99, 200, 400, 499, 999
- Type A memory
- Type B memory
- Type C memory
- 3 Dimensional tool compensation

#### Coordinate control
- Manual reference position return
- Automatic reference position return (G28)
- 3rd/4th reference position return (G29)
- Reference position check (G27)
- Retrieve position (G29)
- Establish coordinate (G92)

#### Coordinate control
- Establish machine coordinate (G53)
- Select work coordinate (G54 - G59)
- Establish local coordinate (G52)
- Floating reference position return (G30.1)
- Work coordinate system preset (G92.1)
- Addition of workpiece coordinate system pair (+48 pair)
- Addition of workpiece coordinate system pair (+300 pair)

#### 5-axis function
- 3-dimensional manual feed
- Three-dimensional circular interpolation
- Three-dimensional coordinate conversion
- Rotary table dynamic fixture offset
- Tool center point control *
- 3-dimensional cutter compensation *
- Tilted working plane command

#### Operating conveniences
- High-speed Smooth TCP
  - Workpiece setting function
  - (including tilted working plane command with guidance)
- VP control

#### Programming conveniences
- FS-15M format
- Radius designation (12 digits)
- Canned cycle
- Sub program call (10 folds nested)
- Exact stop check (G09)
- Exact stop check mode (G61)
- Tapping mode (G63)
- Cutting mode (G64)
- Rigid tapping
- Programmable data input (G10)
- Chamfering and rounding
- Programmable mirror image (G51.1/G50.1)
- Scaling (G51/G50)
- Coordinate rotation (G68/G69)
- Figure copying (G72.1/G72.2)
- Polar coordinate command (G15/G16)
- Normal direction control
- Custom macro: common variables 100
- Additional custom macro common variables 600
- Shopping function *
- Mold package *

#### Error compensations
- Pitch
- Backlash
- Single direction positioning (G60)

#### Maintenance / Safety
- Emergency stop
- Stored stroke limit
- Stored stroke limit 2
- Self-diagnostics
- ECO mode functions
- ECO mode of air consumption volume
- Power consumption monitoring
- Interlock
- Spindle-table interference preventive function
- Standard tool length
- Help function

(1) Number of registerable programs restricted according to each program size.
(2) Palettes changer specification, Automatic work changer specification, and V23A are not available.
(3) Super G13 or G14 control is necessary.
(4) When selecting this function, please contact us.
(5) Including F-one-digit automatic corner override, programmable mirror image, scaling, coordinate rotation and figure copying.
# Professional 5 Specifications

## Machine Control

<table>
<thead>
<tr>
<th>High speed, High precision</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>G1.4 control</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Super G1.3 control</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Super G1.4 control</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Nano-smoothing function</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I/O</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data center (Standard memory: 4 MB)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>File management function (NC programs, various data files)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>DNC simple schedule function (Multiple main programs executable)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Data center memory extension function A (Total 360 MB)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Data center memory extension function B (Total 800 MB)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Twist-pair cable (10 m, 20 m, 30 m, 40 m, 50 m)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>8 port HUB</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Special user I/O interface</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Automatic fire extinguisher interface</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Loader interface (for WPS)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Macro variable file output function</strong></td>
<td></td>
</tr>
</tbody>
</table>

| Program Editing |  |
|------------------|  |
| **Program preview function** |  |
| **Cut, past and replace function (Equivalent to FANUC "Extended tape editing")** |  |
| **Background edit function (Equivalent to FANUC "Background edit function")** |  |
| **2-program simultaneous edit function** |  |
| **G code insert function** |  |
| **M code insert function** |  |
| **Fixed-program insert function** |  |
| **Final MDI program insert function** |  |
| **Coordinate value insert function (Equivalent to FANUC "Playback function")** |  |
| **Other program insert function** |  |

| Monitor |  |
|---------|  |
| **Spindle load display** |  |
| **Spindle load monitoring function (SL)** |  |
| **Tool life monitoring function (TL)** |  |
| **Adaptive control function (AC)** |  |
| **Direct spare tool selection function** |  |
| **Parts count function (Equivalent to FANUC "Run hour and parts quantity")** |  |
| **Machining record function (Equivalent to FANUC "Machining time stamp function")** |  |

| One touch |  |
|-----------|  |
| **Registered tool automatic selection/changing function** |  |
| **All axis automatic return to reference point** |  |
| **Automatic work setting position** |  |
| **Z axis retraction** |  |
| **Automatic Z-axis retract and restart function** |  |

| Guidance |  |
|----------|  |
| **Self-diagnosis and instruction display** |  |
| **Number & position of LS & SOL display for alarm** |  |
| **Alarm History function (Machine side & NC side)** |  |
| **Automatic display for regular maintenance advice** |  |
| **User create function for regular maintenance** |  |

| Software |  |
|----------|  |
| **FF-PATH** (Custom macro (common variables: 100) and helical interpolation is required) |  |
| **External setting type orientation** |  |
| **Coordinate calculation setting function by rotation angle** |  |
| **3D shape measuring function A** |  |

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**Note:**

| (43) | However, if the run hour and parts quantity are got by using the FANUC FOCAS Library, FANUC "Run hour & Parts quantity display” option is required.  |

| (44) | However, if the machine time is got by using the FANUC FOCAS Library, FANUC "Machining time stamp function" option is required.  |

*The specifications in this catalogue may be changed without prior notice to incorporate improvements resulting from ongoing R&D programs.*