NH4000 DCG
High Precision Horizontal Machining Center
Presenting the ideal machining center.

It’s been 50 years since the birth of the machining center. As performance reaches maturity, we at Mori Seiki decided to wipe the slate clean and take a completely fresh look at machine tool design. The result was “Driven at the Center of Gravity,” a method to minimize the vibration of moving parts. The perfect “Driven at the Center of Gravity” system was made possible for the NH4000 DCG by achieving the ideal form of the machining center. It fuses high speed and high quality at a top level. However, the machining center still has room to grow. This is proven by how much of the future is packed into this machine.
Faster in all aspects of operation. A “Driven at the Center of Gravity” machine that delivers excellent acceleration and quality at the same time.

DCG™: Driven at the Center of Gravity

※Figures in inches were converted from metric measurements.
This is the Mori Seiki approach to “Driven at the Center of Gravity”.

The story behind its development and the advantages it can bring you

1: A breakthrough in high-speed, high-precision machining technology after 15 years.

Starting in the mid-1980s, machine after machine was produced for high speed and high precision. The biggest challenges during the first 10 years were size and speed and spindle motors, developing the technology to deal with the resultant heat, designing machines to match fast NC devices, and other areas. The results were quite impressive. However, the past 5 years have seen a loss of direction in the search for technologies to increase speed and precision. Machining time was only slightly reduced by increasing speed, but on the other hand speed had to be sacrificed for higher precision or surface quality.

In comes “Driven at the Center of Gravity” – a technology created by approaching the actual movement dynamics of the machine. Any machine tool engineer worth his salt knows it’s always better to push against the center of gravity. Few engineers thought about why this is so important.

At Mori Seiki, we believe this technology will make possible the most fundamental improvements in machining time, precision, surface quality, and tool life. This principle is common to all machine tools in which the tool and the workpiece move relatively to each other, not just machining centers.

Mori Seiki machines using the “Driven at the Center of Gravity” principle can move as instructed, accurately and with ease.

2: Driven at the Center of Gravity

The “Driven at the Center of Gravity” principle reduces machining time, improves contouring precision, and delivers better surface quality. Everyone knows you have to push something at its center of gravity; otherwise it will spin and become unstable. “So push it at the center” – that, in so many words, is the “Driven at the Center of Gravity” principle. (Fig. 1)

Machine tools use ball screws and linear motors to move tools and workpieces. If they are pushed at their center of gravity, moving them poses no problem, although, sometimes this is not true.

Why? Take, for example, the axis that moves the spindle up and down in a vertical machining center. The center of gravity of the spindle is the center of the spindle itself, but you cannot put a ball screw there.

On the other hand, the center of gravity of the axis which moves the table back and forth in a horizontal machining center is somewhere just above the surface of the table when working with a heavy workpiece. In other words, the table’s center of gravity is inside the workpiece. There is no way you can get a ball screw in there, either.

The solution? At Mori Seiki, we had the idea to enclose the center of gravity with two drive points on either side. The line connecting the middle of two ball screws would have to pass through the center of gravity of the object being moved. (Fig. 2)

[The “Driven at the Center of Gravity” principle]

If the edge of the part is being pushed, balance is lost and vibration is created.

If the center of gravity is pushed, the part moves straight without any vibration.

Machine tools hold objects above the center of gravity, making it impossible to push them at the center of gravity.

However, if the edges on other side of the center of gravity are pushed, the object moves straight.
3: Vibration during axis travel

So what, specifically, are the advantages of the “Driven at the Center of Gravity” innovation? In a word (or two): less vibration. The graph (Fig. 3) compares vibration in our “Driven at the Center of Gravity” machines and standard machines.

① shows the amount of vibration during travel in the NV4000 DCG without the “Driven at the Center of Gravity” principle applied. ② shows the same situation, but with the principle applied. The results are dramatic and clear.

4: What’s so bad about vibration?

This graph (Fig. 4) shows a time-based representation of vibration. Note how the “Driven at the Center of Gravity” machine stops the vibration almost right away, while the ordinary machine continues to vibrate long after.

At the edge of the vibrating machine, a tool and a workpiece are attached. Obviously, the vibration will adversely affect the quality of the machined surface.

Additionally, if the tool enters the workpiece while both are vibrating, the tool tip will wear down. Vibration is the natural enemy of tool life.

There is an even graver problem. When there is vibration, the NC device reacts to it by deviating from the instructions and attempts to correct it by moving the feed motor. This, of course, results in even more vibration in most cases.

Engineers are familiar with this phenomenon, so to counteract it, they adjust the NC device to react with less sensitivity. In other words, they make the NC device ignore minor discrepancies. As a result, operating precision plummets or speed is sacrificed. Therefore, vibration could be called the natural enemy of precision and machining time.

5: Why linear motors?

Linear motors are touted as the end-all be-all when discussing dynamic characteristics of machine tools, supposedly because the ball screw acts as a torsion bar. Is this really the case when compared with the “Driven at the Center of Gravity” principle? The graph (Fig. 5) adds a linear motor to the previous graph (Fig. 3).

① is a non-“Driven at the Center of Gravity” machine with a linear motor and ② is a “Driven at the Center of Gravity” machine with a linear motor. The effects of the linear motor are negligible compared with those of the “Driven at the Center of Gravity” design.

[Minimize residual vibration of the tool tip]
6: Improving machined surface quality

The “Driven at the Center of Gravity” design is said to be effective in improving machined surface quality. Let’s examine this claim. Machining of curved surfaces is a major part of die and mold machining. The curved surface can be looked at as a succession of subtle polygonal lines – the direction of travel changes ever so slightly at each corner along the line. In order to make these changes without losing speed, powerful acceleration is needed, even if the changes in direction are only slight.

At each point where acceleration starts, rotational vibration proportional to the distance between the drive point and the center of gravity occurs. This is particularly noticeable when the machining point descends down the side of a pocket, reaches the bottom, and then suddenly changes direction. The unstable lines in Picture are traces of a sudden change in direction by the machining point in an ordinary machine.

However, the “Driven at the Center of Gravity” technology gets to the heart of the cause of deterioration in the quality of the machined surface.

Another example of this type of sudden change in direction is the cutback during round cutting. This problem occurs when the tool cuts into the workpiece at 0°, 90°, 180°, and 270°. Roundness is very important when replacing boring with contouring using an end-mill that easily makes diameter correction. The “Driven at the Center of Gravity” technology improves roundness, too. (Fig. 6)

7: Reduction of machining time

The “Driven at the Center of Gravity” innovation is very useful for reducing machining time. Machines that are “Driven at the Center of Gravity” produce little vibration at the start of acceleration, which means they can accelerate at full force right from the start. Machines not endowed with this innovative technology, however, must apply accelerating force gradually, for fear of creating too much vibration when starting to accelerate.

This graph (Fig. 7) shows non-“Driven at the Center of Gravity” machines on top and “Driven at the Center of Gravity” machines on bottom. It clearly shows the difference in time to maximum acceleration when starting to accelerate.

8: Gain

Is the “Driven at the Center of Gravity” innovation necessary on all axes? The point of using “Driven at the Center of Gravity” technology is to reduce the amount vibration caused when an axis begins moving. This vibration is caused when the location being pushed and the center of gravity of the object being moved are not the same. If the difference is minor, then this innovative technology is not needed. That’s where gain comes into play, so let’s take a closer look.

Gain is a parameter used to control the accuracy of a machine’s movement. The greater the gain, the more a machine tries to move accurately in accordance with its control instructions. Some machines cannot follow those instructions faithfully, causing a great deal of variation in the movement.

Machine designers know you can set the gain high on a good machine but cannot on a bad machine, so they try to find ways to raise the gain. The size of the gain can vary within the same machine, depending on the axis involved. Some axes can handle high gain, and some cannot. At Mori Seiki, we think this depends on the distance between the center of gravity and the drive point.

Therefore, it is not unreasonable to say there is little need to add ball screws or use careful axis-center drive on axes when distance is short and gain can be set high.
**[Dynamic analysis]**

Real cutting simulation using dynamic analysis.

**[Machine size]**

The NH4000 DCG has the smallest depth and width in its class due to the use of a pocket-type center conveyor. We have also used a space-saving tool magazine that barely increases the area of installation, even if the number of tools is increased.

**[NH4000 DCG Design]**

The X-axis twin drive system has been employed to enable use of a gravity drive. We have achieved a stable machine design using box-in-a-box technology.

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**Size comparison with previous Mori Seiki models**

<table>
<thead>
<tr>
<th>Item</th>
<th>Company</th>
<th>Previous model A</th>
<th>Previous model B</th>
<th>NH4000 DCG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>mm (in.)</td>
<td>2,530 (99.6)</td>
<td>2,905 (114.3)</td>
<td>2,465 (96.9)</td>
</tr>
<tr>
<td>Depth</td>
<td>mm (in.)</td>
<td>3,765 (148.2)</td>
<td>4,357 (171.5)</td>
<td>3,755 (147.8)</td>
</tr>
<tr>
<td>Height</td>
<td>mm (in.)</td>
<td>2,700 (106.3)</td>
<td>2,587 (101.9)</td>
<td>2,610 (102.8)</td>
</tr>
<tr>
<td>Volume</td>
<td>m³ (ft³)</td>
<td>25.72 (908.4)</td>
<td>32.74 (1156.4)</td>
<td>22.54 (796.1)</td>
</tr>
</tbody>
</table>
High speed

High speed that feels even faster than the specs indicate.

In the past, machines have had a limit on how fast spindle acceleration could go, due to vibration caused by the moving parts in the drive system. The NH4000 DCG achieves unprecedented acceleration rates with the “Driven at the Center of Gravity” effect. Non-cutting time can be significantly reduced due to the increased speed of all components.

### Spindle

**Spindle drive motor**

**Standard**
- 18.5/11 kW (24.7/15 HP) \(<10\text{ min/cont}>^1\)
- Max. spindle speed : 14,000 min\(^{-1}\)

**High speed <option>**
- 16.5/15/11 kW (24.7/20/15 HP) \(<10\text{ min/30 min/cont}>\)
- Max. spindle speed : 20,000 min\(^{-1}\)

### Feed

**Max. acceleration**

**X-axis**
- 0.61 G
  \(\{6.0 \text{ m/s}^2 (19.7 \text{ ft/s}^2)\}^*\)
  \([1.13 \text{ G} (11.1 \text{ m/s}^2 \{36.4 \text{ ft/s}^2\})]^*\)

**Y-axis**
- 0.85 G
  \(\{8.3 \text{ m/s}^2 (27.2 \text{ ft/s}^2)\}^*\)
  \([1.19 \text{ G} (11.7 \text{ m/s}^2 \{38.4 \text{ ft/s}^2\})]^*\)

**Z-axis**
- 0.64 G
  \(\{6.3 \text{ m/s}^2 (20.7 \text{ ft/s}^2)\}^*\)
  \([1.06 \text{ G} (10.4 \text{ m/s}^2 \{34.1 \text{ ft/s}^2\})]^*\)
- **Rapid traverse rate**

  **Rapid traverse rate**
  The X-, Y-, and Z-axis have ball bearing linear guides, ensuring high-speed operation.

  *50 m/min (1,968.5 ipm)*
  *

- **ATC**

  **Tool changing time**
  *2.8 sec.*
  (chip-to-chip)
  *

- **Synchronized tapping**

  **Synchronized tapping capability**
  Compared to previous machines, the improved spindle and axis acceleration allows tapping at higher speeds.

- **APC, Table**

  **2-station turn-type APC**
  Changing from the worm gear system used on previous models to a direct drive servo (DDS) has made indexing much faster.

  **Pallet changing time**
  *6 sec.*

  **Table**
  **Minimum table indexing angle**
  *1° [0.001°*1]*

  **Table indexing time**
  *1.3 sec.*
  *

  **Maximum rotational speed of the table**
  *22 min⁻¹*
  
  **Compared against previous model**
  *4.5 times faster*

  **Indexing time**
  *0.85 sec.*

  **Compared against previous model**
  *Reduced by 1/2*

  *1 Max. spindle speed at speed of 6,000 min⁻¹. *2 In actual operation, the spindle may fail to reach the specified speed depending on the distance from the operation start point to the workpiece. *3 For cutting depth=3 × tap diameter=5 mm (0.2 in.)

  *OP: Option* *1 Full 4th axis rotary table. *2 Including clamping and unclamping time. *3 90°
High precision

The ultimate in surface quality thanks to the “Driven at the Center of Gravity” design.

Another advantage of the “Driven at the Center of Gravity” design is the improved surface quality. Using a twin drive on the NH4000 DCG’s X-axis helps control vibration. We are capable of having smoother machined surfaces than ever before.

Sample workpieces

Comparison of tool wear

Minimizing tool tip vibration prevents wear and extends tool life.
**High precision**

**Roundness**
By creating a design that minimizes vibration, we have improved contouring precision and machined surface quality. This is the “Driven at the Center of Gravity” advantage.

**Aluminum**

<table>
<thead>
<tr>
<th>Material &lt;JIS&gt;</th>
<th>A5052</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;outer diameter&gt;</td>
<td>100 mm (4.0 in.)</td>
</tr>
<tr>
<td>Tool</td>
<td>ø 16 mm (ø 0.6 in.)</td>
</tr>
<tr>
<td>End mill</td>
<td>4 blades</td>
</tr>
<tr>
<td>Spindle speed</td>
<td>8,000 min⁻¹</td>
</tr>
<tr>
<td>Feedrate</td>
<td>2,000 mm/min (78.7 lpm)</td>
</tr>
</tbody>
</table>

![Displacement tested under the circumstance when the spindle rotating 14,000 min⁻¹ and the ambient temperature is within the range of 8°C (46.4°F).](image)

Displacement tested under the circumstance when the spindle rotating 14,000 min⁻¹ and the ambient temperature is within the range of 8°C (46.4°F).

**Dynamic Thermal Displacement Control**
Minimizes thermal displacement of the spindle.

Processing accuracy is stable and can be maintained even over long periods of use.

**Ball screw cooling**
Ball screw axle coolant which also flows through the support bearings.

![Cooling oil is circulated to counter thermal displacement.](image)

Oil circulation is maintained to counter thermal displacement.

**Pallet clamp system**
A flange contact taper cone with excellent clamping power and high pallet-positioning precision.

**Direct scale feedback**
The absolute positioning optical scale demonstrates unequalled positioning accuracy and can be used for the X, Y, and Z axes.

**Spindle lubrication**
- Oil feed is kept to a minimum to reduce frictional loss.
- Air purge prevents dust infiltration.

**Inverter-type oil cooler**
Cooling oil is circulated to counter thermal displacement.

![Inverter-type oil cooler](image)
Unsurpassed accuracy for any job.

Vibration has been nearly completely eliminated in the NH4000 DCG by achieving zero overhang and attaining our goal of a high-quality stable supply of workpieces. We can provide you with more than satisfactory quality in everything from dies and molds to precision parts.

### Cutting test

<table>
<thead>
<tr>
<th>Face mill Ø 80 mm (Ø 3.1 in.)</th>
<th>Machining rate per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,024 mL/min (62.5 in³/min)</td>
</tr>
<tr>
<td></td>
<td>Spindle speed 12,000 min⁻¹</td>
</tr>
<tr>
<td></td>
<td>Feedrate 16,000 mm/min (629.9 ipm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Face mill Ø 80 mm (Ø 3.1 in.)</th>
<th>Machining rate per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>269 mL/min (16.4 in³/min)</td>
</tr>
<tr>
<td></td>
<td>Spindle speed 1,000 min⁻¹</td>
</tr>
<tr>
<td></td>
<td>Feedrate 2,100 mm/min (82.7 ipm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drill Ø 35 mm (Ø 1.4 in.)</th>
<th>Machining rate per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>44 mL/min (2.7 in³/min)</td>
</tr>
<tr>
<td></td>
<td>Spindle speed 227 min⁻¹</td>
</tr>
<tr>
<td></td>
<td>Feedrate 45 mm/min (1.8 ipm)</td>
</tr>
</tbody>
</table>

### Spindle

**Tool clamp power**

Previous model 7,840 N  NH4000 DCG 12,000 N Compared against previous model Approximately 1.5 times

Using the newly developed collet, clamping power on the tool has been increased. The ability to control vibrations during spindle rotation assures high accuracy processing.

**Flange contact specification**

All Mori Seiki spindles are made in-house to better meet our customer needs. Contact Mori Seiki for more information.

<table>
<thead>
<tr>
<th>BT specification</th>
<th>HSK specification</th>
<th>KM specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air blow</td>
<td>Air blow</td>
<td>Air blow</td>
</tr>
<tr>
<td>Constrained face</td>
<td>Constrained face</td>
<td>Constrained face</td>
</tr>
</tbody>
</table>

* The cutting test results indicated in this catalog are provided as an example. The results indicated in this catalog may not be obtained due to differences in cutting conditions and environmental conditions during measurement.

1 Aluminum  2 Carbon steel  JIS: Japanese Industrial Standard

### Tool clamp power

<table>
<thead>
<tr>
<th>SP</th>
<th>Tool clamp power</th>
<th>Spindle speed</th>
<th>Feedrate</th>
<th>Material &lt;JIS&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP</td>
<td>7,840 N</td>
<td>12,000 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compared against previous model</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Approximately 1.5 times</td>
<td></td>
<td></td>
<td></td>
</tr>
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### Flange contact specification

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</tr>
</tbody>
</table>

Structural rigidity in tools has been raised not only by the spindle taper but by restraining flange, too. This not only lengthens the useful life of a tool, but also allows you to cut with more power and greater machining precision.
Chip disposal
Dramatically improved machine operation capacity.

The other area we worked on to improve operating capacity is chip disposal. The NH4000 DCG, which was built with reliability and chip disposal in mind, is ideal for extended unmanned operation.

Chip conveyor

The NH4000 DCG has the smallest depth in its class with the use of a center conveyor that combines the inside and outside chip conveyors. It also has the merit of allowing the tank to be deepened without creating two steps for chip disposal.

Center conveyor

The chips drop straight down into the conveyor from the machining point.

Chip strategy

Setup station
A chip disposal groove is also included on the setup station.

X-axis

Chips drop straight down into the conveyor from the machining point.

Single cover
A highly reliable design that prevents chip clogging.

Z-axis
Productivity

See a difference in profit when you reduce your non-cutting time.

The NH4000 DCG was designed to reduce your non-cutting time to the limit. Let’s take a look at how much a reduction of non-cutting time can actually affect machining time, production volume, and profits, compared to previous machines.

Data for comparison

<table>
<thead>
<tr>
<th>Option</th>
<th>Max. spindle speed</th>
<th>Rapid traverse rate</th>
<th>Tool changing time (chip-to-chip)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH-400</td>
<td>7,000 [10,000] min⁻¹</td>
<td>X-, Y-, Z-axis: 20 m/min</td>
<td>4.6 sec.</td>
</tr>
<tr>
<td>SH-400</td>
<td>12,000 [20,000] min⁻¹</td>
<td>X-, Y-, Z-axis: 42 [60] m/min (1,653.5 [2,362.2] ipm)</td>
<td>3.7 sec.</td>
</tr>
<tr>
<td>NH4000 DCG</td>
<td>14,000 [20,000] min⁻¹</td>
<td>X-, Y-, Z-axis: 50 m/min (1,968.5 ipm)</td>
<td>2.8 sec.</td>
</tr>
</tbody>
</table>

Manufacturing period:
- MH-400: 1988 year
- SH-400: 1996 year
Comparison with MH-400

Cycle time comparison

<table>
<thead>
<tr>
<th>MH-400</th>
<th>Cycle time 1,989 sec.</th>
<th>NH4000 DCG</th>
<th>Cycle time 1,092 sec.</th>
</tr>
</thead>
</table>

*Reduced by 54.9%*

Comparison of production volume and sales (5 USD/EUR per work)

Running time (one day) : 8 hours x 85% = 3,600 sec x 8 x 0.85 = 24,480 sec.
Number of days operating in 1 year : 21 days x 12 months = 222 days
Production volume per day (pcs./day) : 24,480 sec x Cycle time (sec.)

5-year sales simulation

MH-400

- 1st year: 15,120 pcs.
- 2nd year: 30,240 pcs.
- 3rd year: 60,480 pcs.
- 4th year: 90,720 pcs.
- 5th year: 120,960 pcs.

NH4000 DCG

- 1st year: 25,120 pcs.
- 2nd year: 50,240 pcs.
- 3rd year: 100,480 pcs.
- 4th year: 150,720 pcs.
- 5th year: 200,960 pcs.

Comparison of production volume and sales

15 pcs. per day 75 USD/EUR per day

Unit: USD/EUR

Comparison with SH-400

Cycle time comparison

<table>
<thead>
<tr>
<th>SH-400</th>
<th>Cycle time 1,059 sec.</th>
<th>NH4000 DCG</th>
<th>Cycle time 897 sec.</th>
</tr>
</thead>
</table>

*Reduced by 15.3%*

Comparison of production volume and sales (5 USD/EUR per work)

Running time (one day) : 8 hours x 85% = 3,600 sec x 8 x 0.85 = 24,480 sec.
Number of days operating in 1 year : 21 days x 12 months = 252 days
Production volume per day (pcs./day) : 24,480 sec x Cycle time (sec.)

5-year sales simulation

SH-400

- 1st year: 5,040 pcs.
- 2nd year: 10,080 pcs.
- 3rd year: 15,120 pcs.
- 4th year: 20,160 pcs.
- 5th year: 25,200 pcs.

NH4000 DCG

- 1st year: 7,560 pcs.
- 2nd year: 15,120 pcs.
- 3rd year: 22,680 pcs.
- 4th year: 30,240 pcs.
- 5th year: 37,800 pcs.

Comparison of production volume and sales

4 pcs. per day 20 USD/EUR per day

Unit: USD/EUR

JIS: Japanese Industrial Standard
Maintenance

Maintenance has been made extremely easy.

MTTR is an index that rates how easy it is to maintain a machine. The NH4000 DCG is extremely easy to maintain, since there are design concepts incorporated throughout the machine to make maintenance easy and quick—important factors in reducing downtime.

Press the detail button on the MAPPS message screen to display detailed information about the alarm. Press the e-mail send button to notify the service center of the contents of the current alarm in an e-mail.

* Network devices and an environment for sending e-mail are required.

MAPPS: Mori Advanced Programming Production System
IT: Information Technology
Spindle unit replacement
Adoption of a cartridge design that even includes the back bearings has significantly reduced spindle replacement time.

Centralized layout of devices
Controls are on the side panel to facilitate maintenance.

Slimmer electrical cabinet
A slim electrical cabinet closes the proximity between you and the insides of the machine during maintenance.

MTTR: Mean Time To Repair

Spindle unit
Changing time
90 min.

300 mm
(11.8 in.)
Including doors

Fewer parts
Coupling type pallet clamp

Number of parts in the table design
Compared against previous model
Less 50%

Previous model
Approx. 60 parts

NH4000 DCG
Flange contact taper cone
Pallet clamp

Approx. 30 parts

Less 50%
Operability

Thorough convenience.

The NH4000 DCG has been designed with the operator in mind, as seen by the labor-saving features throughout the machine.

- Improved convenience

Magazine

Visibility of the magazine has been improved with the addition of a door with a window.

Adjustable operating panel

Swinging the operation panel reduces eye strain and improves operability.

Ceiling tilt

A tilted ceiling prevents coolant from dripping onto the operator.
Eco-friendly design

A variety of functions reduce the environmental burden.

Reducing the strain on the environment has become an important task facing companies today. The NH4000 DCG has been designed with environmentally friendly functions to make this task easier. The new functions focus on reducing lubricant and electricity consumption. This focus fills customer needs at reduced costs.

● Reduced consumption of lubricant

Oil-bath ATC

An oil-bath design has been integrated into the ATC unit. Compared with conventional oil drip designs, the amount of lubricant used is radically less.

Oil-free roller guides

A lubricating oil system for the roller guide is installed on both ends of the block.

Lubricant consumption per hour

Previous model: 24 mL/hour

Approximately 1/15

NH4000 DCG: 1.67 mL/hour

● Reduction in electricity consumption

Automatic machine light function

If the operating panel is not touched for a certain amount of time, the interior light turns off. This saves energy and lengthens the life of the machine lights.

Low speed/low acceleration control function

This function limits the speed and acceleration of the feed axes when manual operations are carried out during setup with the interlocks released. By adding a restriction on acceleration to the speed restriction, an even greater power saving is achieved.

Automatic power-off function

If the keyboard is not touched after a certain amount of time and NC operation is not being performed, power is cut off to the servomotor, the spindle, the coolant pump, and the chip conveyor, thereby saving energy.
**Fixture support**

Proposing the right machining methods for your needs.

At Mori Seiki, it is our goal to offer you “total engineering solutions,” which means looking at fixtures as a vital part of the overall system and providing you with the fixtures and interfaces that fit your needs.

**Auto-coupler fixture interface**

Easily transfer the pallets between the setup station and the work area and avoid external hoses and couplers.

Compressed air is supplied to the setup station. Hydraulic fluid is supplied to both the setup station and the machining table.

- Hydraulic fluid is supplied to the machining table through two ports that diverge from one circuit.

**Check list (for hydraulic/pneumatic fixtures)**

- **Pressure source**
  - □ Hydraulic
  - □ Pneumatic
- **Supplied pressure** ____MPa
- **No. of circuits**
  - Hydraulic×____
  - Pneumatic×____
- **For workpiece holding detection**×____

### Diagrams

- Diagram showing hydraulic and compressed air supplies.
- Diagram showing fixture interfaces and ports.
- Diagram showing workpiece clamp detection air port locations.
- Diagram showing unclamp and clamp ports.
**Auto-coupler**

High pressure can be used with the anti-rising mechanism.

- **Setup station**
  - 8 ports
  - Includes two extra ports.

- **Machining table**
  - 2 ports
  - Hydraulic fluid is supplied to the machining table through two ports that diverge from one circuit.

- **Fixture grip check**

- **Separate hydraulic unit for the auto coupler**

---

**Fixture examples**

The photo shows NH5000.
Automatic operation support

The ideal ultimate solution for your production system.

Long continuous machining, unmanned operation, small-lot, and varied-item production are all different environments the NH4000 DCG’s flexible system can work in to greatly improve productivity.

Work transfer system

Robot

Robots make workpiece loading and unloading more efficient, improving productivity.

Gantry-type loader

This line-ready mass-production system is completely automated, from materials supply to ejection of the final product.
Magazine design which does not increase machine width.

Chain-type

- **40-tool**
- **60-tool**
- **120-tool**
- **180-tool**

Rack-type

Includes a dummy tool.

APC

3-station turn-type APC

Increases productivity because it is the same compact size as the 2-station APC.

- **Built-in 3-station turn-type APC**
  
  Equipped with a tool magazine that can hold up to 120 tools and has a changer option.

Optional coolant gun available.
A one level CPP with outstanding extensibility. Package systems with rapid set up are available.

System chart

- CPP system configuration options example (one level of racks)

**Horizontal specifications**

<table>
<thead>
<tr>
<th></th>
<th>6CPP</th>
<th>8CPP</th>
<th>10CPP</th>
<th>12CPP</th>
<th>2-14CPP*</th>
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</thead>
<tbody>
<tr>
<td>Machine</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Number of pallets (surfaces)</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>Number of racks (rack)</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Setup station (units)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Vertical specifications**

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<th>5CPP</th>
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<th>11CPP</th>
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<tbody>
<tr>
<td>Machine</td>
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<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Number of pallets (surfaces)</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Number of racks (rack)</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Setup station (units)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Contact Mori Seiki for more information.
To meet your needs, we offer a variety of systems with various options including a change in the number of pallets and set up. Increasing the number of levels can save space.

System construction (two levels of racks)

System chart

Example system (layout diagram)
System control

CPP (Carrier Pallet Pool)

LPP (Linear Pallet Pool)

Automation system to maximize efficiency in a flexible production system.

System data creation

Processing

Post-process/Assembly

All processes

- Work number screen
  (setup screens for work data)
- PCMDI menu screen
- Setup station
- Pallet call screen
- Work number (sub-) screen
  (work number setting screen for empty stations and weekly timer)
- Pallet data screen
  (sets whether a pallet is in the machine or not)

- Scheduling
- Management and automatic download of machining programs
- Real time pallet information and system status
- Production and error logging
- Intelligent machine usage balance
- Intranet web reports
- E-mail/pager notification

- Job detail
- Simple settings
  Makes assembly easier
- Pallet registration
- Schedule
- Tracking
  Quick response
- Alarm history
- Machine history and results
- Operating result
  Easy-to-understand graphs are displayed
- Gantt chart
- Intranet web reports
  (option)
- Remote checking
- E-mail/pager notification
  (option)
- E-mail notification

The photo shows NH5000
Coolant

Through-spindle coolant system

The through-spindle coolant system effectively eliminates chips, cooling the machine point, and lengthening the lives of your tools.

High-pressure coolant system

- (1.5 MPa < 217.5 psi) / (3.5 MPa < 507.5 psi) / (6.0 MPa < 870 psi) / (7.0 MPa < 1,015 psi)

* 1 Discharge volume: 30 L/min (7.9 gpm) * 2 Discharge volume: 25 L/min (6.6 gpm)

Coolant gun

Use the high-pressure coolant gun to flush the chips from the machine and fixtures.

Coolant cooling unit

Machining accuracy is stabilized by the coolant cooling unit that controls heat transmission to a workpiece, tool and table. It is especially effective when using oil-soluble coolant. The coolant cooling unit with a heater will be customized.

Shower coolant

Wash away excess chips from the parts and fixture using the directed coolant coming from seventeen nozzles.

Oil skimmer

Oil separator

Oil mist collector

Semi-dry unit

Center

Air-Oil mist

Misting device

Sensor

Contact type sensor (spindle)

Contact type sensor (table mount sensor)

Automates measurement of tools and workpieces using a spindle-mounted sensor and automates setting of tool length using a table mounted sensor.

Sensor

Receiver

When sensor is used

When sensor is stored

Sensor

Receiver

When sensor is used

When sensor is stored

Automates measurement of tools and workpieces using a spindle-mounted sensor and automates setting of tool length using a table mounted sensor.
MAPPS II
for Machining Center

A new high-performance operating system

- **User memory area**
  - Standard **50 MB**
    - Tape memory length equivalent to 127,000 m (416,687 ft)
  - Option **500 MB**
- **3× better CPU performance than previous models, with 8× larger main memory**

- **Equipped with an LCD display that has a very wide angle of view**
  - The NH4000 DCG is equipped with a wide-angle 15-inch TFT LCD display.

- **Equipped with a pointing device.**
  - The pointing device enables accurate and smooth turning during 3-D cutting simulations.

- **Keyboard layout**
  - Easy-to-use keyboard with a perfect balance between operation and compactness.

- **High reliability supporting a stable performance**
  - A Windows® XP embedded-based high-reliability system
  - Meets safety standards in Europe and the US. CE marking and UL approved
  - Waterproofed in conformity with IP65 (IEC60529)
  - Withstands vibrations of 0.98 m/s² (38.6 in./s²)

MAPPS: Mori Advanced Programming Production System  CE marking: a conformance display  CE: Communauté Européenne
UL: Underwriters Laboratories Inc  IP65: Protection from the body and solid objects. Protection from water entry.
The product names indicated in this catalog are all trademarks or registered trademarks of the individual companies.
### 3-D cutting simulation
- It is possible to zoom and to rotate while simulating it. The display of the tool path is possible.

### Vastly improved automatic programming function
- Island shape, open pocket
- Up to 127 islands can be defined.
- Machining time is greatly reduced by the optimized path generation function for open pockets.

### Improved setup
- Programming time is cut by 30% due to the enhanced G-code editing function.
- A function for registering tool names has been added to the tool offset and workpiece offset screens.
- “Undo” function added to recover from mistakes.

### Complex programs can be done with simple instructions
- High speed side milling cycle
- Z feed grooving cycle
- Trochoid cycle

- The high-speed fixed cycle allows you to make complex programs like pocketing, trochoid cycle, helical hole cycle, high speed side milling cycle, Z feeding groove cycle, elliptical milling cycle, spherical milling cycle and more with a few simple instructions.

### An abundance of maintenance functions
- Equipped with handy new functions for maintenance and upkeep.
- Limit switch guidance function
- Regular maintenance function
- Up to 127 islands can be defined.
- Machining time is greatly reduced by the optimized path generation function for open pockets.

### PROGRAMMING

#### CAM system for Machining Center
**VEGA™ Milling Edition**
The easy CAM solution designed to import 3-D solid models and automatically recognize machining shapes.

#### 3-D CAD solid data (Parasolid®)
- Users can convert conversational programs made using VEGA™ Milling Edition into NC programs.
- Cutting conditions can be changed on the MAPPS® control.
- Parasolid® is a brand name and registered trademark belonging to Electronic Data Systems Corporation.

#### Machining simulation

#### 3-D CAD solid data import

#### Conversational automatic programming

#### On-line programming

#### Reduce programming time

#### Save costs
### Installation drawing  \( \text{mm (in.)} \)

#### Axis direction after bringing in the APC

- **Auto-coupler**
  - Fixtue clamp 11
    - Fixtue-side port: a hole \# 9 (Ø 0.35) or smaller
  - Fixtue unclamp 1
    - Fixtue-side port: a hole \# 9 (Ø 0.35) or smaller

- **Workpiece clamp detection**
  - Air supply port: \(<1330 (52.4) \text{ from the floor}>\)
  - Power cable port: \(<1600 (63.0) \text{ from the floor}>\)
  - Scraper-type chip conveyor
  - Through-spindle coolant unit

- **Pallet dimension**  \( \text{mm (in.)} \)

<table>
<thead>
<tr>
<th>Pallet</th>
<th>( P_1 )</th>
<th>( P_2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td>inch</td>
<td>3 ( \frac{1}{4} )</td>
<td>6 ( \frac{1}{4} )</td>
</tr>
</tbody>
</table>

Pallet dimensions are for reference only.
Contact a Mori Seiki Technical Center for engineering drawings.
**Drawing**

**Axis travel diagram mm (in.)**

- Max. size workpiece:
  - X-axis travel: 280 (11.0)
  - Y-axis travel: 100 (3.9)
- Max. workpiece height: 900 (35.4)
- Touch sensor (table) attachment position: 80 (3.1)

**2-pallet turn type APC**

- Interference area
  - Max. size workpiece: 480 (18.9)
  - Pallet turning diameter: 210 (8.3)
- Max. tool length: 560 (22.0)
- Sensor cover
  - A1350 (53.1)
- Y-axis protector
  - A630 (24.8)

**Tool restriction mm (in.)**

- With adjacent tool
- Without adjacent tool

<table>
<thead>
<tr>
<th>Tool restriction</th>
<th>MAS</th>
<th>CAT</th>
<th>DIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. tool length mm (in.)</td>
<td>400 (15.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. tool dia. mm (in.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard dimension A mm (in.)</td>
<td>32 (1.3)</td>
<td>34.925 (1.35)</td>
<td>35 (1.4)</td>
</tr>
<tr>
<td>Standard dimension B mm (in.)</td>
<td>63 (2.5)</td>
<td>44.45 (1.8)</td>
<td>50 (2.0)</td>
</tr>
<tr>
<td>Max. tool mass kg (lb.)</td>
<td></td>
<td></td>
<td>8 (17.6)</td>
</tr>
<tr>
<td>Max. moment &lt;from spindle gauge line&gt; N·m (ft·lbf)</td>
<td>7.84</td>
<td>5.78</td>
<td></td>
</tr>
</tbody>
</table>

*Including a dummy tool.*

The values for dimensions indicate the touch sensor measurement position.

ATC is not available for the maximum tool size when the largest workpiece is attached.
**Package Plan**

**STEP 1** First select the specification.

<table>
<thead>
<tr>
<th>Plan A</th>
<th>Regular parts machining specification</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan B</td>
<td>Ultra high precision specification</td>
<td>Direct scale feedback (X-/Y-/Z-axis) + Dynamic thermal displacement control (Z-axis)</td>
</tr>
</tbody>
</table>

**STEP 2** Next select the package.

<table>
<thead>
<tr>
<th>Package</th>
<th>Table</th>
<th>Tool storage capacity</th>
<th>Chip conveyor</th>
<th>Through-spindle coolant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PACKAGE 1</td>
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<td>PACKAGE 2</td>
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<td>PACKAGE 16</td>
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<td>PACKAGE 18</td>
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<td>PACKAGE 31</td>
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<td>PACKAGE 32</td>
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<td></td>
</tr>
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</table>

* Including a dummy tool.
### Standard & optional features

#### Spindle

<table>
<thead>
<tr>
<th>Feature</th>
<th>Standard</th>
<th>Options</th>
<th>Please contact Mori Seiki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. spindle speed</td>
<td>14,000 min⁻¹</td>
<td>20,000 min⁻¹</td>
<td></td>
</tr>
<tr>
<td>&lt;18.5/11 kW (24.7/15 HP)</td>
<td>●</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Inverter-controlled oil cooler</td>
<td>○</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Flange contact specification</td>
<td>BT40, HSK A63, KM6350</td>
<td>○</td>
<td>●</td>
</tr>
</tbody>
</table>

#### Chip disposal

- **Tool tip air blow system** ●
- **Chip conveyer (single construction)** ○
- **Chip bucket** ○
- **Coolant gun** ○
- **Oil mist collector** ○

#### Tool magazine

- **Tool storage capacity**
  - 40-tool <chain-type> ○
  - 60-tool <chain-type> ○
  - 120-tool <chain-type> ○
  - 180-tool <rack-type> ○

#### ATC

- **Type of tool shank**
  - BT40 ○
  - DIN40 ○
  - CAT40 ○
  - HSK A63 ○
  - KM6350 ○

- **Type of retention knob**
  - MORI SEIKI 90° type ○
  - 45° ○
  - 60° ○
  - DIN ○
  - HSK A63 ○
  - Special <center> ○

#### Table/Pallet

- **Pallet**
  - Tap <metric, inch> ●
  - T-slot ○

- **1st indexing table** ●

- **Full 4th axis rotary table** ○

- **Auto-coupler for fixture clamp**
  - Two hydraulic circuits+two clamp circuits ○
  - One hydraulic circuit+one clamp circuit ○

- **Angle plate**
  - One-sided ○
  - Two-sided ○
  - Four-sided ○

- **Sub-table**
  - Without tap ○
  - T-slot ○

#### APC

- **2-station turn-type APC** ●
- **3-station turn-type APC** ○
- **CPP (carrier pallet pool)** horizontal, vertical ○
- **LPP (linear pallet pool)** ○

#### Coolant

- **Coolant system** ●
- **Shower coolant** ○

- **Through-spindle coolant system**
  - <1.5 MPa (217.5 psi)** ○
  - 3.5 MPa (507.5 psi)** ○
  - 6.0 MPa (870 psi)** ○

- **Through-spindle coolant system** ○

- **Oil-hole drill coolant system** ○

- **Oil skimmer** ○

- **Oil shot system** ○

- **Oil mist system** ○

- **Coolant cooling unit** ○

- **Coolant cooling unit <through-spindle coolant>** ○

- **Coolant flow switch <through-spindle coolant>** ○

- **Coolant float switch** ○

- **Semi-dry unit** ○

#### Measurement

- **Contact type sensor (probe sensor)**
  - Optical type
    - Automatic alignment ○
    - Automatic measurement ○
  - Inductive type
    - Automatic alignment ○
    - Automatic measurement ○

- **Contact type sensor <table mount sensor>**
  - Automatic tool length measurement ○
  - Automatic tool breakage detection ○

- **Contact type sensor <magazine>**
  - Automatic tool breakage system ○

#### Operation support device/function

- **Automatic power off system** ●
- **Weekly timer** ○
- **Work counter** ○
- **Total counter** ○
- **Automatic door** ○
- **Manual pulse generator** Handy type ○
- **Automatic indexing setup station** ○
- **Multi counter** ○
- **External M-code** 2, 5, 10 ○
- **Improved accuracy**
  - X-axis ○
  - Y-axis ○
  - Z-axis ○

#### Safety features

- **Full cover** ●
- **Door interlock system <incl. mechanical lock>** Front door ○
  - Setup station door ○
- **Door interlock system** Electrical cabinet door ○
- **Low air pressure detecting switch** ○
- **Low hydraulic pressure detecting switch** ○
- **Danger sensing device interface** ○
- **Earth leakage breaker** ○

#### Others

- **Built-in worklight** ●
- **Leveling block** ○
- **Hand tools** ○
- **Signal tower** 3 steps ○

- 1 10 min/cont
- 2 10 min/30 min/cont
- 3 High-pressure coolant system is attached.
- 4 Discharge volume: 30 L/min (7.9 gpm)
- 5 Discharge volume: 25 L/min (6.6 gpm)
- 6 Special retention knobs are required.
- 7 Oil-hole drill holder available as an option.
- 8 Recommended when oil-based coolant is used or during unmanned operation.

The details given above and the specifications are subject to change without notice. Specifications, accessories, safety device, and function are available upon request. Some options are not available in particular regions. For details contact Mori Seiki.
**NC unit specifications (MSX-501)**

### Standard

#### Controlled axes
- X, Y, Z, B
- Simultaneously controllable axes: Positioning/linear interpolation/circular interpolation (3/3/2)

#### Programmable methods
- Least input increment: 0.001 mm (0.0001 in.)
- Least command increment: 0.001 mm (0.0001 in.)
- Max. command value: ±9,999,999 mm (9,999,999 in.)
- Absolute/Incremental programming: G00/G01
- Decimal point programming
- Inch/metric conversion: G20/G21
- Tape code: EIA RS244/ISO 840 code automatic discrimination

### Interpolation
- Positioning: G00
- Linear interpolation: G01
- Circular interpolation: G02/G03
- Helical interpolation
- Linear acceleration/deceleration before cutting feed interpolation

### Feed
- Cutting feedrate: 0 – 50,000 mm/min (0.01 – 1,968.5 ipm)**
- Override: G02/G03
- Pulse handle feed: Manual pulse generator: 1 unit × 1, ×10, ×100 (per pulse)
- Automatic acceleration/deceleration: Linear type (rapid traverse)/Exponential function type (cutting feed)
- Rapid traverse rate override: F0 (forward feed stop), 25/100%
- Feedrate override: 0 – 150% (10% increments)
- Feedrate override cancel: M42/M49
- Spindle orientation
- Manual jog feed: 0 – 1,260 mm/min (0 – 50.0 ipm) <15 steps>
- Feed per minute

### Program storage and editing
- Part program storage: 320 m (1,050 ft) <4 kB> = 10 m (33 ft) in tape length>
- Part program edit: Deletion, Insertion, and Alteration
- Search function: Sequence number search, Program number search, Address search
- Number of stored programs: 125 programs
- Program number/program name: 4 digits/48 characters

### Operation and display
- Operation panel: Display section: 15-inch TFT color LCD
- I/O Functions and units
- I/O interface: RS-232-C-PCMCIA (Type I, II)
- Tape operation with RS-232-C**

### STM functions
- Spindle speed function (S function): 5-digit S code
- Spindle speed override: 50 – 120% (10% increments)
- Tool function (T function): 8-digit T code**
- Miscellaneous function (M function): 4-digit M code
- High speed M/S/T/SB interface

### Tool offset
- Tool length offset: G43, G44, G49
- Cutter radius offset C: G40 – G42
- Number of tool offsets: 64 sets
- Tool offset data memory: C (3-digit code, geometry and wear offset data)
- Offset amount program input: G10

### Coordinate system
- Manual zero return
- Automatic zero return: G28
- Unit zero return**: G30
- Zero return check: G27
- Return from zero point: G29
- Automatic coordinate system setting
- Coordinate system setting: G92
- Work coordinate system selection: G54 – G59
- Local coordinate system setting: G52/G53

### Operation support functions
- Single block
- Optional stop
- Optional block skip
- Dry run
- Machine lock
- Auxiliary function lock

### Operation support functions
- Mirror image
- Manual absolute: PC parameter
- Z-axis neglect
- Running time display/No. of parts display
- Expanded tape editing
- Background editing
- Load meter display
- Clock function: Screen display
- Tool length measurement
- Load monitoring function C: Exceeding adaptive control function

### Programming function support
- Circular arc radius command
- canned cycle: G73, G74, G76, G80 → G89, G98, G99
- Sub-program: Up to 4 nestings
- Custom macro B
- Exact step check: G99
- Exact step check mode: G61/G64
- F15 format
- Synchronized tapping
- NC statement output**: Conversational automatic programming function
- Look-ahead control function
- Conversational automatic programming

### Mechanical accuracy compensation
- Backlash compensation: ±9.999 pulses
- Pitch error compensation
- Uni-directional positioning
- Follow-up
- Rapid traverse/cutting feed backlash compensation

### Machine control support functions
- Axes interlock: By external input: option
- Automatic support functions
- Stored stroke limit 1: 8
- Self-diagnosis: Includes alarm display, I/O signal diagnosis and ladder diagram
- Door interlock
- Alarm history display: NC and PC alarm
- Software damper: Abnormal tool detection

### Option
- Additional part program storage capacity (in total): 64/1,280/2,560 m (2,100/4,200/8,400 ft)
- Additional number of stored programs (in total): 2,048/4,096/1,000 programs
- Additional number of tool offsets: Additional number of tool offsets in total:** 99/200/400/499/999 sets
- Programming resolution multiplied by 1/100
- Least input increment 0.0001 mm <0.00001 in.>
- Least command increment 0.0001 mm <0.00001 in.>
- Hypothetical axis interpolation
- Polar coordinate interpolation: NUMERS interpolation
- Smooth interpolation
- Cylindrical interpolation: Exponential function interpolation
- Involute interpolation
- Bell-shaped acceleration/deceleration after cutting feed interpolation
- Whirlpool interpolation
- High-speed skip: 1-f1 feed (F1 – F9) Inverse time feed: Feed per revolution
- Remote buffer (DNC)**
- High-speed remote buffer (A: Binary input, B: NC statement input)**
- Data server (ATA card): Constant surface speed control: Tool position offset (G45 – G48)
- 3-D tool offset: 3-D coordinate conversion
- Additional number of work coordinate systems: 48 sets, 300 sets
- Floating zero return: Handle feed interruption: Program restart: Sequence number collation and stop
- Addition of optional block skip functions (B072 to B079) Machine time stamp function
- Tool escape and return: Arbitrary angle, chamfer, corner R designation: Interpolation type custom macro
- Programmable mirror image: Automatic corner override: Playback
- Additional custom macro common variables (in total): (600 variables)
- Scaling
- Coordinate system rotation: Polar coordinate command: Multiple M commands in a block
- AI contour control: AI nano contour control: AI high precision contour control
- AI nano/high precision contour control: Small diameter deep hole drilling cycle: High-speed skip**
- Tool life management: Additional number of tool life management functions: In total: 512 sets
- Stored stroke limit 2: Rotary table dynamic fixture offset

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1. For look-ahead control. 5,000 mm/min (196.9 ipm) in non-look-ahead control.
2. Maximum feedrate will vary depending on cutting conditions.
3. 3 Convex adaptative contorl programming, Tool file: 4-digit
4. Used with ATC/APC.
5. Output to NC memory is possible. Output to an external device is not possible.
6. The number selectable tool offsets on the tool storage capacity.
7. Max. command value: ±9,999,999 mm (±9,999,999 in.)
8. B Standard for the machine equipped with sensor.
### Machine specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>NH4000 DCG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Travel</strong></td>
<td></td>
</tr>
<tr>
<td>X-axis travel &lt;longitudinal movement of saddle&gt; mm (in.)</td>
<td>560 (22.0)</td>
</tr>
<tr>
<td>Y-axis travel &lt;vertical movement of spindle head&gt; mm (in.)</td>
<td>560 (22.0)</td>
</tr>
<tr>
<td>Z-axis travel &lt;cross movement of table&gt; mm (in.)</td>
<td>630 (24.8)</td>
</tr>
<tr>
<td>Distance from pallet surface to spindle center mm (in.)</td>
<td>80—640 (3.1—25.1)</td>
</tr>
<tr>
<td>Distance from table center to spindle gauge plane mm (in.)</td>
<td>100—730 (3.9—28.7)</td>
</tr>
<tr>
<td><strong>Table</strong></td>
<td></td>
</tr>
<tr>
<td>Pallet working surface mm (in.)</td>
<td>400×400 (15.7×15.7)</td>
</tr>
<tr>
<td>Pallet loading capacity kg (lb.)</td>
<td>400 (880) [300 (660)]**</td>
</tr>
<tr>
<td>Max. workpiece swing diameter mm (in.)</td>
<td>Ø 630 (24.8) [Ø 560 (22.0)]**</td>
</tr>
<tr>
<td>Max. workpiece height mm (in.)</td>
<td>900 (35.4) [800 (31.5)]**</td>
</tr>
<tr>
<td>Pallet surface configuration</td>
<td>M16 (1/2-13 UNC) Tap: 24 Holes, Pitch 80 mm (3½ in.)</td>
</tr>
<tr>
<td>Table indexing time** s</td>
<td>1.3** [0.5]** (90')</td>
</tr>
<tr>
<td><strong>Spindle</strong></td>
<td></td>
</tr>
<tr>
<td>Max. spindle speed** min⁻¹</td>
<td>14,000 [20,000]</td>
</tr>
<tr>
<td><strong>Feedrate</strong></td>
<td></td>
</tr>
<tr>
<td>Rapid traverse rate mm/min (ipm)</td>
<td>50,000 (1,968.5)</td>
</tr>
<tr>
<td>Jog feedrate mm/min (ipm)</td>
<td>0→1,260 (0→50.0) &lt;15 steps&gt;</td>
</tr>
<tr>
<td><strong>ATC</strong></td>
<td></td>
</tr>
<tr>
<td>Type of tool shank</td>
<td>BT40 [CAT40]</td>
</tr>
<tr>
<td>Type of retention knob</td>
<td>MORI SEIKI 90° type</td>
</tr>
<tr>
<td>Tool storage capacity**</td>
<td>Chain-type: 40 [60] [120] Rack-type: [180]</td>
</tr>
<tr>
<td>Max. tool diameter &lt;without adjacent tools&gt; mm (in.)</td>
<td>Ø 70 (Ø 2.7); Ø 140 (Ø 5.5)&gt;</td>
</tr>
<tr>
<td>Max. tool length mm (in.)</td>
<td>400 (15.7)</td>
</tr>
<tr>
<td>Max. tool mass kg (lb.)</td>
<td>8 (17.6)</td>
</tr>
<tr>
<td>Max. tool mass moment &lt;from spindle gauge line&gt; N·m (ft·lb)</td>
<td>7.84 (5.78)</td>
</tr>
<tr>
<td>Method of tool selection</td>
<td>Fixed address, shorter route access</td>
</tr>
<tr>
<td>Tool changing time &lt;tool-to-tool&gt; s</td>
<td>0.9</td>
</tr>
<tr>
<td>Tool changing time &lt;chip-to-chip&gt; s</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>APC</strong></td>
<td></td>
</tr>
<tr>
<td>Number of pallets</td>
<td>2 [3**]</td>
</tr>
<tr>
<td>Method of pallet change</td>
<td>Turn-type</td>
</tr>
<tr>
<td>Pallet changing time s</td>
<td>6</td>
</tr>
<tr>
<td><strong>Motor</strong></td>
<td></td>
</tr>
<tr>
<td>Spindle drive motor &lt;10 min/cont&gt; kW (HP)</td>
<td>18.5/11 (24.7/15)** [18.5/15/11 (24.7/20/15)]***</td>
</tr>
<tr>
<td>Feed motor &lt;X/Y/Z/B&gt; kW (HP)</td>
<td>1.6×2/4×4/1.2 (2.1×2/5/3.6/3.1)</td>
</tr>
<tr>
<td><strong>Power source</strong></td>
<td></td>
</tr>
<tr>
<td>Electrical power supply kVA</td>
<td>35.2</td>
</tr>
<tr>
<td><strong>Tank capacity</strong></td>
<td></td>
</tr>
<tr>
<td>Coolant tank capacity L (gal.)</td>
<td>535 (141.2)</td>
</tr>
<tr>
<td><strong>Machine size</strong></td>
<td></td>
</tr>
<tr>
<td>Machine height &lt;from floor&gt; mm (in.)</td>
<td>2,610 (102.8)</td>
</tr>
<tr>
<td>Floor space mm (in.)</td>
<td>2,300×3,755 (90.6×147.8)</td>
</tr>
<tr>
<td>Mass of machine kg (lb.)</td>
<td>9,600 (21,120)</td>
</tr>
</tbody>
</table>

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**Option:**
- *1* 3-station turn-type APC specification.
- *2* Including clamping and unclamping time.
- *3* 1˚ indexing.
- *4* Full 4th axis rotary table.
- *5* Depending on restrictions imposed by the workpiece clamping device, fixture and tool used, it may not be possible to rotate at the maximum spindle speed.
- *6* Including a dummy tool.
- *7* High-speed winding side.
- *8* 20,000 min⁻¹
- *9* 10 min/30 min/cont
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