Press Release

September 2024
Okuma Corporation

Relentlessly Pursuing "Machines That Do Not Stop", "Productivity Improvements", and "Decarbonization & Energy Efficiency"

Horizontal machining center designed to easily boost productivity, even for beginners, while addressing societal challenges

MA-4000H

Okuma Corporation has developed the MA-4000H, a horizontal machining center that strives to offer **long runs of stable automated operation (machines that do not stop)** along with **productivity improvements**, and **decarbonization and energy efficiency**.

The MA-4000H maximizes production throughput by enhancing operating rates through stable production, reducing both machining and non-machining times, and expanding the range of machinable areas while minimizing space requirements. The machine is evolving and growing as an intelligent machining center that autonomously assesses its own state, achieving decarbonization and energy efficiency while maintaining high accuracy and high productivity.

To meet the growing demand for automation, the MA-4000H has been developed as a **smart machine capable of systematic production without human intervention** and is designed to adapt flexibly to automation. It serves as a **Green-Smart Machine**, supporting solutions to today's increasingly serious social challenges, such as labor shortages, skills transfer issues, decarbonization, and rising energy costs.

- **Machines that do not stop or break down to minimize production losses. Improved productivity with high operating rates through stable production.**
  - **Predictive maintenance is achieved by using AI for machine diagnostics of operational axes and drilling/tapping diagnostics.**
  - **Minimizes production losses associated with chips through an in-machine cover structure that ensures smooth chip removal and the Sludgeless Tank that dramatically extends coolant tank cleaning intervals.**
  - **Increased number of hydraulic and pneumatic supply ports for fixtures that automatically clamp workpieces, achieving a class-leading standard.**
- **Productivity improvement through significantly reduced machining time. Exceptional machining capacity and agile machine movement.**
  - **High-efficiency machining is achieved with a high-rigidity table that significantly boosts machining capability.**
    - **Maximum machining capacity for steel: 483 cm³/min, a 72% increase compared to previous model**
      (Material: S45C, 100 mm diameter milling)
    - **Maximum machining capacity for aluminum: 4,340 cm³/min, a 117% increase compared to previous model**
      (Material: A5052, 25 mm diameter end milling)
  - **Machining time reduced by 12% (actual measurements with sample workpieces).**
    - **Shorter non-machining times. Fastest 90° table indexing time: 0.8 seconds, a 27% reduction compared to previous model**
      (Includes clamp and unclamp times)

◆ **Further evolved Green-Smart Machine balances accuracy stability, improved productivity, decarbonization, and energy efficiency.**

- **Increased machining capacity, which enables shorter actual machining time for parts, and reduced non-machining time accelerate greater decarbonization and energy savings.**
- **40% reduction in power usage by the spindle cooling system** (compared to previous model)

Newly developed automatic control for spindle cooling system even during non-machining time in addition to during machining for achieving energy savings for spindle cooling system operation during machining while maintaining stable high accuracy.

◆ **36% increase in area productivity. Class-leading machining range with a compact footprint.**

- **27% increase in machining range, with a 6% reduction in floor space** (compared to previous model)

The newly developed MA-4000H features advanced AI technology for stable production and high-performance chip discharge, along with exceptional machining capabilities that accommodate a wide range of workpieces, from aluminum to ferrous parts. By delivering high productivity through stable, excellent machining capabilities with a high operating rate, the MA-4000H meets the needs of various markets including automotive (EV), semiconductor manufacturing equipment, industrial robotics, construction machinery, and hydraulic/pneumatic equipment.

Background

In recent years, labor shortages due to a declining working-age population have become increasingly severe. Furthermore, the retirement of skilled workers and a rising turnover rate among younger employees have made it extremely difficult to secure and develop talent with the necessary knowledge and skills as well as the practical experience and expertise. At the same time, the global push toward decarbonization is elevating expectations for companies to disclose their CO_2 emissions from business activities.

Amid this shift, requirements are shifting toward high-mix, low-volume production, with even greater demands for higher quality, lower costs, and quicker turnaround times. In this evolving environment, it is becoming increasingly difficult to rely solely on skills and practical expertise to meet these demands. Production sites now require machine tools that minimize production losses, enable stable operation over long runs, and achieve decarbonization and energy efficiency while maintaining high productivity and high accuracy.

Aim of Development

The newly developed MA-4000H was designed based on the following concepts.

(1) Machines that do not stop or break down to minimize production losses. Improved productivity with high operating rates through stable production.

(2) Productivity improvement through significantly reduced machining time.
Exceptional machining capacity and agile machine movement.

(3) Achieving both high accuracy and high productivity, along with decarbonization and energy efficiency, in a way that's easy for beginners to implement

(4) Maximizing one of the largest machining areas in its class within a compact footprint, enhancing area productivity

Features and implementing technology

(1) Machines that do not stop or break down to minimize production losses. Improved productivity with high operating rates through stable production.

・Autonomous assessment of the state of the machining process and machine by the machine itself. AI technology for preventing unexpected production losses.

AI Machine Diagnosis (optional specification) diagnoses abnormalities in operational axes and visualizes the machine status.

AI diagnoses the spindle and feed axes for any potential issues, identifying and pinpointing any detected abnormalities

Stable operation through **AI Machining Diagnostics (Drilling & Tapping)** (optional specification) to prevent sudden tool breakage

AI performs real-time diagnostics of machining state, and if an anomaly is detected during machining, the tool automatically retracts.

This prevents defective workpieces and machine failures caused by sudden tool breakage, significantly reducing downtime needed for recovery.

・Enhanced chip discharge performance combined with decarbonization and energy efficiency

Significantly improves chip discharge performance without the need for large

amounts of cleaning coolant.

By expanding and flattening the angle of the in-machine cover and incorporating a **full-center trough** structure that collects chips across the entire machining area, chip buildup is minimized, and power usage for the coolant pump is reduced.

- **Sludgeless tank** (optional specification) for significantly extending coolant tank cleaning intervals

  By reducing stagnant areas in the tank, residual sludge (such as fine chips) is efficiently and automatically collected. This feature dramatically reduces the time and labor required to clean the tank, which used to rely on manual labor.

  This enables a longer service life for coolant, which becomes waste fluid after use, for contributing to reduced environmental impact.

  Sludge collection rate of 99% (actual data when using cast iron and aluminum workpiece materials)

  No coolant tank cleaning or coolant replacement required for three years (actual results at Okuma facilities)

- Flexible adaptation to increasing demand for automation. Addresses labor shortages and eliminates production losses caused by human error.

  Increased number of hydraulic and pneumatic supply ports for fixtures that automatically clamp workpieces, achieving a class-leading standard:

  Setup station side: **16 ports** (previous model: 4 ports) (optional specification)

  Machining chamber side: **8 ports** (previous model: 4 ports) (optional specification)

  This allows for more independent fixture operation, supporting diverse automation needs such as automatic loading and unloading of multiple workpieces by robots, as well as avoiding tool and fixture interference during fixture operations inside the machining chamber.

(2) Productivity improvement through significantly reduced machining time. Exceptional machining capacity and agile machine movement.
High machining capabilities and high-speed operation to minimize both machining and non-machining times.

High machining capabilities to reduce actual processing time

- Standard spindle for high-efficiency machining of a wide range of workpieces

  Maximum rotation speed: **15,000 min^{-1}**

  Maximum output: **38 kW** (**46% increase** compared to previous model) Maximum torque: **242 N·m** (**48% increase** compared to previous model)

- High machine rigidity enables high-accuracy, high-efficiency machining across entire machining area

  Improves rigidity at elevated positions, addressing a structural challenge of horizontal machining centers.

  Compared to previous model, table bearing moment rigidity has increased by **3.9 times**, and overall machine static rigidity in the Z-axis direction has **improved by 18%.**

High-speed operation to reduce non-machining time

- Rapid traverse acceleration/deceleration: **Improved by up to 32%** (compared to previous model)

  X-axis: **1.0 G**, Y-axis: **1.0 G**, Z-axis: **1.1 G** (at low inertia)

- Agile table indexing for workpieces up to **400 kg**

90° indexing time: **0.94 seconds**, a **15% improvement** compared to previous model (including clamp/unclamp times)

- Standard configuration equipped with electric ATC shutter has reduced tool change time (CTCmin) **by 15%** compared to previous model.

(3) Achieving both high accuracy and high productivity, along with decarbonization and energy efficiency, in a way that's easy for beginners to implement

- **Green-Smart Machine** where the machine autonomously achieves high accuracy and high productivity combined with decarbonization and energy savings
- **Thermo-Friendly Concept**, an intelligent technology that allows machines to autonomously and stably maintain a high level of accuracy

  Because the machine does not require a temperature-controlled room to maintain a constant temperature, factory facility costs and power usage can be significantly reduced.

  This also greatly reduces the operating time required for warm-up operation and dimensional corrections for further cutting power usage.
- **ECO suite plus** energy-saving system installed as standard

  The energy-saving **ECO Idle Stop** function, based on the Thermo-Friendly Concept, enables the machine to autonomously determine the necessity of cooling during non-machining time, idling the cooling system when not needed to maintain high accuracy while reducing energy usage.

  High-accuracy machining is combined with reductions in CO_2 emissions for providing strong support for factory decarbonization.
- **Further evolution of energy-saving ECO Operation function during machining**

  This function enables the machine to assess spindle heat generation during machining (at spindle speeds of 4,000 min^{-1} or lower) and control the cooling system's stop/start operation accordingly. Furthermore, it controls spindle thermal displacement in response to changes in the cooling state.
- Power usage **reduced by 90%** compared to previous model with the adoption of an intermittently-operating hydraulic unit.

(4) Maximizing one of the largest machining areas in its class within a compact footprint, enhancing area productivity

- Feed axis travel distances (X/Y/Z axes): 560/650/685 mm, Machining area: **0.25 m³** (**27% larger** than previous model)
- Floor space (width × depth): 2,300 × 5,065 mm, Installation area: **11.6 m²** (**6% smaller** than previous model)
- Space-saving enhancements to specifications for handling a wide range of workpieces

  X-axis travel: **560 mm** (same as previous model)

  Y-axis travel: **650 mm** (16% increase compared to previous model)

  Z-axis travel: **685 mm** (10% increase compared to previous model)

  Maximum workpiece dimensions: **630 mm diameter** (5% larger than previous model) × **900 mm height** (same as previous model)

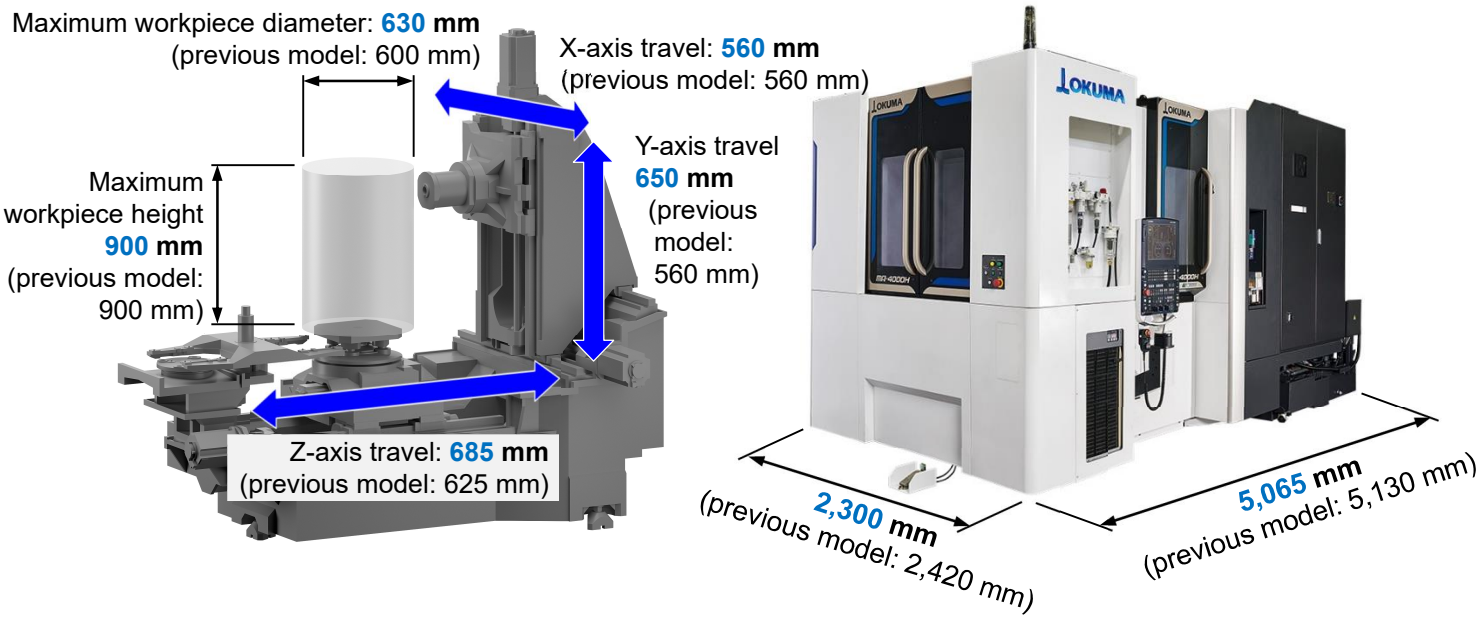
  Maximum tool length: **450 mm** (**50% increase** compared to previous model)

Expanded and flattened in-machine cover slope
Full-center trough structure for chip collection across the entire machining area

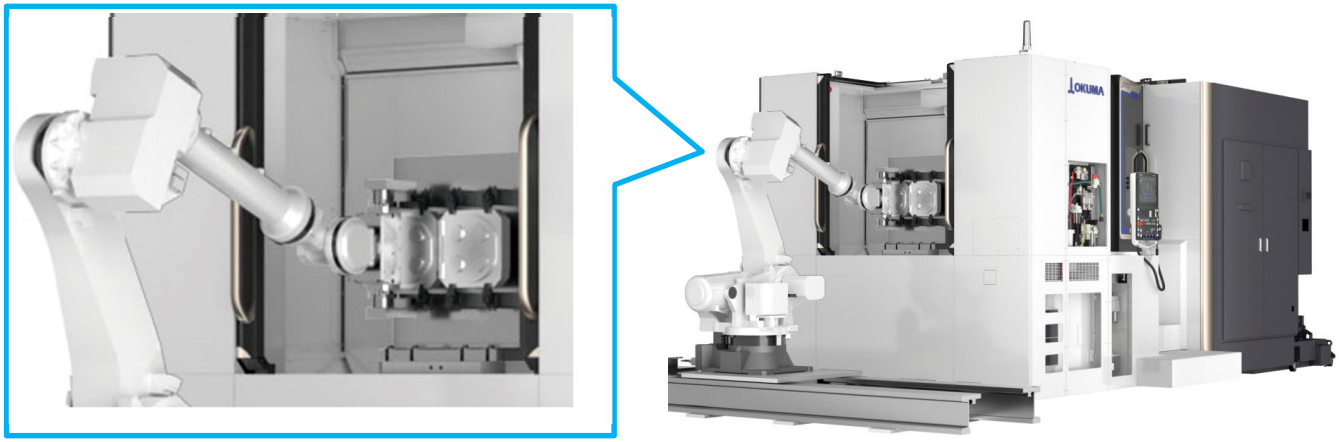
Expanded slope and full-center trough structure for the in-machine cover

Flat machining chamber

Class-leading machining range with a compact footprint



Automatic loading and unloading of multiple workpieces by robot



Product Specifications

* The numbers in parentheses ( ) indicate the values for optional specifications.

Item		MA-4000H
Travel	X-axis travel (Column left/right)	560 mm
	Y-axis travel (Spindle head up/down)	650 mm
	Z-axis travel (Table forward/backward)	685 mm
Distance from pallet top surface to spindle center		80 to 730 mm
Distance from pallet center to spindle nose surface		85 to 770 mm
Pallet	Pallet size	400 × 400 mm
	Max. workpiece dimensions	630 mm dia. × 900 mm
	Max. load capacity	400 kg
Spindle	Max. speed	Standard: 15,000 min^{-1} [High power spindle: 12,000 min^{-1}] [High-speed spindle for aluminum machining: 20,000 min^{-1}]
	Maximum output	Standard: 38/18.5 kW (40% ED/continuous) [High-power spindle: 38/26 kW (40% ED/continuous)] [High-speed spindle for aluminum machining: 43/22 kW (15%ED/continuous)]
	Maximum torque	Standard: 242/148 N·m (20% ED/continuous) [High-power spindle: 302/148 N·m (10% ED/continuous)] [High-speed spindle for aluminum machining: 137/54 N·m (10%ED/continuous):
	Tapered bore	7/24 taper No.40 [HSK-A63]
Feed rate	Rapid traverse	X-axis: 60 m/min, Y-axis: 60 m/min, Z-axis: 60 m/min
ATC	Tool magazine capacity	48 tools [64 tools] (models with disk magazine specification) [140, 180, 220, 260, 300, and 340 tools] (models with matrix magazine specification)
	Max. tool diameter	170 mm (with adjacent tool: 90 mm)
	Max. tool length	450 mm
	Max. tool weight	12 kg
Machine size	Machine height	2,750 mm
	Required floor size (width x depth)	2,300 × 5,065 mm (Models with hinge type + scraper type (with drum filter) out-machine chip discharge specification)
	Machine weight	11,000 kg (excluding workpiece and tool weights)