

Improved Solutions that Maximize Productivity and Reduce Expenses for Machining Aerospace Aluminum Structural Components

Remain Competitive in Today's Tight Environment

The aerospace industry is facing unprecedented challenges, particularly related to the commercial side of the industry. Although the recovery is beginning, production rates are significantly reduced and could continue for a significant amount of time. The pressure will be intense on suppliers to keep their businesses viable while producing much fewer numbers of parts.

Shops which employ modern, productive manufacturing processes will always succeed over those who do not embrace those technologies. Machining centers with state-of-the-art performance provide the technological solutions necessary to allow shops to compete.



A Tight Environment Demands an Optimized Production Solution

In a challenging manufacturing market, it's even more imperative to improve and streamline technologies and processes. Suppliers need to reduce scrap, lower labor costs, and cut unnecessary expenses in order to remain competitive.

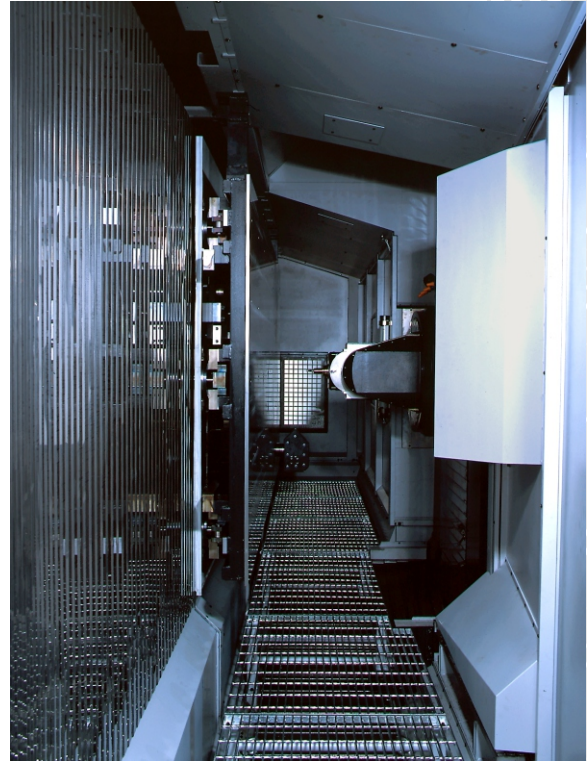
Makino MAG Series of 5-Axis horizontal machining centers (HMCs) are proven machine platforms with expanded capabilities for the optimum processing of complex aluminum structural parts for the aerospace industry. They have proven to be manufacturing industry's top choice with nearly 500 machines installed throughout 25 countries to date. With its speed, power and high-speed motion control enhancements, the MAG series provides aerospace manufacturers with the productivity necessary to exceed customer demands for costs, quality and lead-times

The original MAG series machines have been a staple in the aerospace industry for nearly two decades. Over this time, Makino has continuously improved these products in order to prepare manufacturers for the future by increasing both cutting speed and control capabilities.

When updating the machine, Makino focused on three main design objectives:

- A higher productivity
- Enhanced features and reliability
- Interchangeability

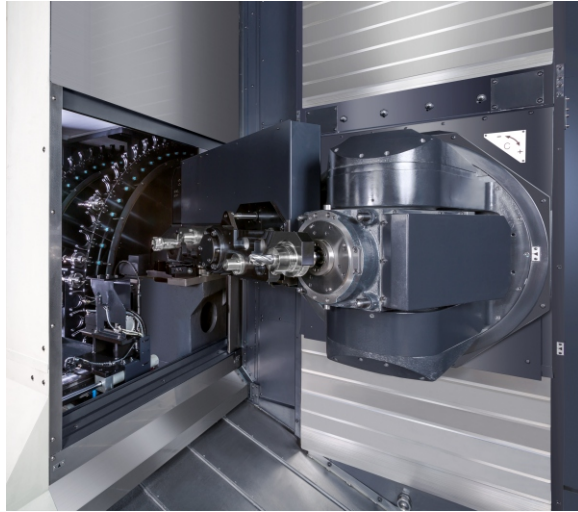
The newest designs deliver on all three objectives with exceptional results, establishing a new standard for aluminum structural aircraft component production.



Although the MAG series product line covers X-axis travels from one meter to twenty meters, the heart of the product line is the MAG3. The MAG3 products are fully equipped to take on aluminum structural parts up to 4 meters in length (approximately 13 feet), including wing ribs, bulk heads and beam-type components. Its X-, Y- and Z-axis travels 4,000 mm, 1,500 mm, and 1,000 mm (157.5 inches, 59.1 inches, 39.4 inches), respectively. These axes accommodate part sizes up to 4,000 mm by 1,500 mm by 750 mm (157.5 inches by 59.1 inches by 29.5 inches, respectively). The machine's A and C axes are carried by the compact spindle housing/trunnion carrier assembly and provide ± 110 -degree tilting and 360-degree continuous rotation.

Minimized Non-Cut Time, Optimized Metal Removal

Over the life of these products, many key components—including the spindle, coolant system and automatic tool changers—have been updated with enhanced technologies to achieve the current next-generation productivity.



By increasing the spindle power from 120 kW to 130 kW in the updated models, maximum power can be achieved at 26,000 rpm rather than 33,000 rpm with the previous spindle. Cutting feed rates and acceleration rates have also been improved with cutting feed rates nearly doubling from 25.4 m/minute to 50 m/minute and acceleration rates reaching 1G. Together, these enhanced features dramatically improve processing speeds for all aluminum structural type components.

In addition to added power and enhanced feed rates, rapid traverse rates have been improved across all axes: 25 revolutions per minute on the A/C, 62.7 m/minute (2,440 IPM) on the X-axis, and 58 m/minute (2,283 IPM) on the Y- and Z-axis. These faster axial movements, combined with an improved automatic tool changer and automatic pallet changer, reduce non-cutting times in operation for the highest degree of machine utilization. In some test parts, cycle times have been reduced by up to 23 percent compared to the previous models.

To keep up with the larger volume of chips removed by the improved spindle capabilities, the coolant and chip management systems have also been updated for better productivity and maintainability.

The MAG3 family is built with a large-capacity automatic tool changer capable of holding up to 120 tools, reducing the time it takes to change tools by 30 percent. Likewise, an automatic pallet changer eliminates the need to stop machining parts in order to load parts or change setups. Furthermore, the pallet changer features a horizontally oriented work-setting station that allows operators to quickly and easily set workpieces on the pallet, letting gravity be “their friend” just as how they would load a vertical machining center.

Expanded Features for Machine Control

Three key features of the latest generation MAG3s include:

- Makino's new Professional 6 Control
- MPmax real-time process monitoring
- Collision Safe Guard technologies

Makino Professional 6 Control (Pro6)

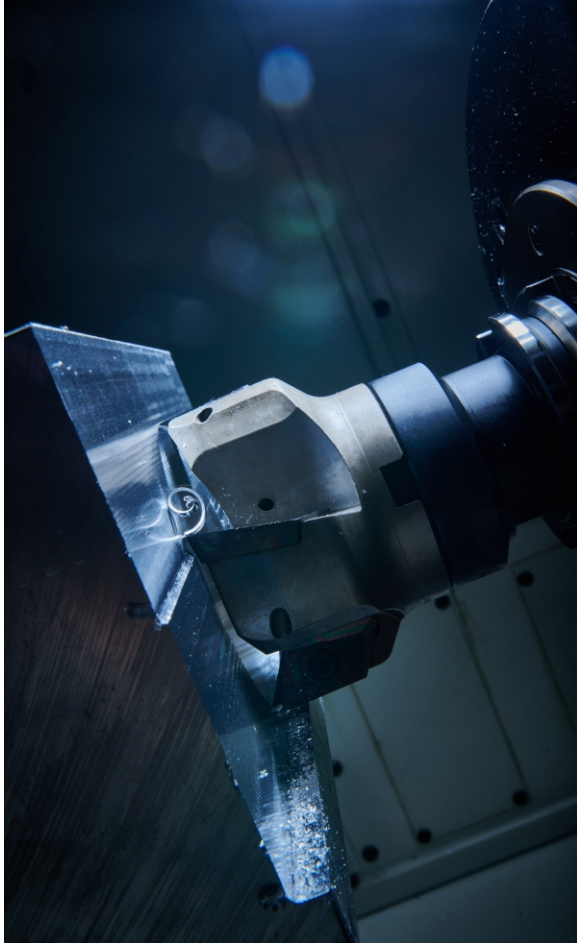


The Makino Pro6 High Performance Control provides the perfect blend of Microsoft Windows 7 OS graphical user interface (GUI), networking and storage capability with the proven stability of Fanuc hardware. It features a highly integrated, embedded control system capable of fast execution of commands, high reliability, flexibility, integration capability and ease of operation.

Key Features:

- Ergonomic operation
- Streamlined process
- Operator assistance
- Program data management
- Convenient data editing
- System/production monitoring functions
- Enhanced safety
- High-speed technology

MPmax



MPmax provides software functions to visualize the performance information from the machines. The functions of MPmax assist in maximizing the utilization of machines, managing tool data, scheduling production and much more.

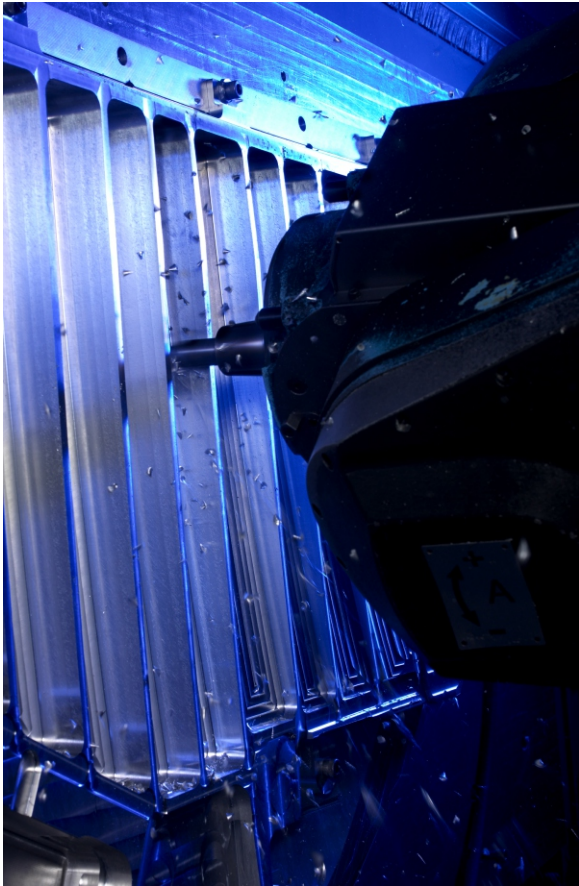
The MPmax functions are:

Power Monitor - Displays instantaneous power draw and maximum power draw (requires machine power monitor option)

- **Shop Monitor** - Real-time display of the connected machine's status
- **Up Time Monitor** - Machine utilization display by bar chart and machine operation status display by Gant chart
- **AST Monitor** - Monitoring, display and analysis of the spindle and the machine axes
- **Machine Camera** - Image display with machine internal camera (requires machine
- **e-Monitor** - Notifies by e-mail when an alarm or machining finish happens
- **Power Monitor** - Displays instantaneous power draw and maximum power draw (requires machine power monitor option)
- **e-SPC** - Automatic collection of on-machine measuring data analyses the data and displays the result by histogram
- **e-Tool** - Manages tooling data for the machines

You can use as many of the MPmax functions as you wish to improve the productivity of the machining operation. MPmax is configurable and distributable to fit a company's needs. cycle time, tool life, part quality and reliability.

Collision Safe Guard



Makino's proprietary Collision Safe Guard technology is a crash avoidance function that runs real-time interference checks to avoid spindle crashes. By combining on-board machine geometry models with workpiece, fixture and tooling data input by the user, CSG can predict and stop the machine prior to collision—protecting investments in the machine, fixture, tooling and workpiece. This state-of-the-art sensing technology safeguards the spindle from damage caused by overload. You can use as many of the MPmax functions as you wish to improve the productivity of the machining operation. MPmax is configurable and distributable to fit a company's needs, cycle time, tool life, part quality and reliability.

Interchangeability and Automation

The original MAG3 family has been a leading machine platform for the aerospace industry for more than a decade and features one of the broadest install bases in the industry. As such, maintaining compatibility and interchangeability with these existing systems was a critical consideration in the development of the next-generation MAG3.

The updated MAG3 can be used with existing pallets, work-setting stations and even pallet changers; making it fully compatible with Makino's highly flexible MMC2 systems. This design enables manufacturers to expand existing MAG3 cells or replace older machines from their MMC2 with no changes to the foundation.



Conclusion

It is not uncommon to achieve productivity improvements of 30% to 40% with the newest machine technologies. Shops with old technology and equipment will not be able to compete with those that have modernized operations. The Makino MAG3 series 5-Axis horizontal machining centers provide the aerospace manufacturing industry with powerful production platforms necessary to competitively machine aluminum structural parts.

