

# DIGITAL SOLUTIONS



# Introduction

Mazak SMOOTH TECHNOLOGY continues to merge high technology with manufacturing to revolutionize machine tool performance and overall manufacturing operations. Across the entire part-production landscape, from programming and metal removal to automation and data collection, the all-encompassing, seamless SMOOTH TECHNOLOGY platform adds unmatched speed, accuracy, functionality and ergonomics to virtually every type of metalworking application.

## DIGITAL SOLUTIONS

Under the SMOOTH TECHNOLOGY umbrella, Mazak Digital Solutions propel manufacturing forward and help optimize part production. These solutions include the MTConnect®, Mazak MAZATROL Smooth CNCs, Mazak SmartBox, Mazak SMOOTH Link, and other SMOOTH TECHNOLOGY products for advanced machining, metrology, compensation, monitoring and analytics.

### MTConnect®

All Mazak machine tools come MTConnect capable. Through this open-source, royalty-free manufacturing protocol, users easily connect devices and systems from different suppliers to capture and share information in accessible, non-proprietary formats, including XML.



### SMOOTH TECHNOLOGY

Each of the four core facets of SMOOTH TECHNOLOGY – Machine Design, Engineering Support, CNC Technology and Solutions – has transformed Mazak's machine tools, delivering breakthrough innovations through maximized manufacturing resources. These four fully integrated elements deliver limitless production possibilities. Beyond hardware and software advances, the SMOOTH TECHNOLOGY platform contains the tools that solve manufacturing challenges.



### Mazak Factory Connectivity Solutions

Bring the power of the Industrial Internet of Things (IIoT) to your shop with Mazak's industry-leading factory connectivity solutions. Monitor your machines in real time with your PC or smartphone from anywhere with the power of SMOOTH Link, or leverage your shop's big data to optimize and secure manufacturing processes with the Mazak SmartBox.



# MTConnect

Monitor and harvest real-time manufacturing data from everything on the production floor, including machines, cells, devices and processes. Based on XML and HTTP Internet technology for real-time data sharing, the MTConnect open, royalty-free manufacturing communications protocol fosters greater interoperability among devices and software from varied suppliers. Manufacturers can use that information to enhance their overall productivity and agility, along with their responsiveness to customer and market changes.

## Robust monitoring solution

As a complete communications standard, this plug-and-play networking platform helps factories calculate overall equipment efficiency, monitor all equipment, reduce production losses and identify lean manufacturing strategies.

## Easy implementation

Mazak actively supports MTConnect with more than 200 MTConnect-capable machine models and moderately priced adapters for existing Mazak equipment in the field.

## Mazak iSMART Factory™

Mazak uses every technology it provides to its customers, including the iSMART Factory concept. In 2015, Mazak's Florence, Kentucky, North American Manufacturing Plant became the world's second Mazak iSMART Factory – and an advanced demonstration of what manufacturing connectivity can accomplish.



The MTConnect open communications protocol, along with process support software, monitors and harvests data from all production floor machines, cells, devices and processes. With PCs, smartphones and tablets, management and manufacturing teams access real-time data for improved production efficiency and responsiveness. Customers can achieve these same results in their shops, and Mazak not only makes it possible: It shows customers the way.

# MAZATROL Conversational and EIA/ISO programming

MAZATROL SmoothAi, SmoothX and SmoothG CNCs – integral elements of the SMOOTH TECHNOLOGY platform – combine the world's fastest processing speeds with advanced user-friendly functions, including Mazak's MAZATROL proprietary programming language.

An industry standard since 1981, MAZATROL combines straightforward control with infinite part-production capabilities. Available on all Mazak CNC systems, MAZATROL brings simple-to-use versatility to the production floor and helps new operators get up to speed quickly. For even greater ease, MAZATROL G-codes match those for conventional EIA/ISO CNC machines, so operators can run programs created for other machine brands with little or no editing.

## Simple Q&A programming with powerful results

Through MAZATROL, operators answer natural-language questions about part information, including intended workpiece, type of material, O.D./I.D. dimensions and part lengths, and the Smooth CNC constructs the program for visual verification. The simplicity of conversational MAZATROL allows less-experienced operators to program production work successfully.

## Advanced functionality for quick production responsiveness

MAZATROL Advanced EIA/ISO Functions handle everything from tool data integration to part and tool offset support, spare tool setup, full machine simulation, Quick EIA for graphical toolpath editing and Quick MAZATROL to import 3D CAD data. Shops can move directly from 3D models to production-ready paths in fewer steps, with a proactive view of any problems on an editable screen with full support for toolpath correction.



## MAZATROL conversational programming

MAZATROL interactive programming uses conversational language and automatically determines cutting conditions, M codes and G codes. Even a beginner operator can quickly make programs.

# MAZATROL SmoothG Control

The MAZATROL SmoothG CNC optimizes programming and makes it easy to generate programs for processing complex parts via MAZATROL and EIA/G-code programming languages. The control incorporates a wide variety of advanced programming functions that allow it to offer complete ease of use and ensure high-speed, high-accuracy machining performance.

## Features and functions of the MAZATROL SmoothG control include:

- **Virtual Machining** allows operators to simulate part programs prior to initiating cutting.
- **High Gain Feed Forward Control** boosts machining speed and accuracy.
- **SMOOTH Machine Configuration** makes it easy to fine tune for the type of machining with advanced cutting condition select functions. Changes can be made during machining and saved as a custom setting to be used later.
- **Variable Acceleration Control** calculates optimal acceleration for a combination of axes.
- **Seamless Corner Control** reduces vibration and shortens part-machining cycle times through cutter path adjustments made when machining into corners based on a preset radial tolerance.
- **Quick MAZATROL** makes it possible to directly import 3D CAD models into the control and automatically extract coordinates from it to simplify machine programming.
- **Quick EIA** plots toolpaths prior to running programs and checks for any interferences in those paths.



## SmoothG Control Specifications

	MAZATROL	EIA
Number of controlled axes	Simultaneous 2 ~ 4 axes	
Least input increment	0.00001 inch, 0.0001 mm, 0.0001°	
High-speed, high-precision control	Shape error designation, Smooth Corner Control, Rapid traverse overlap, Rotary axis shape compensation	Shape error designation, Smooth Corner Control, Rapid traverse overlap, Rotary axis shape compensation, High-speed machining mode, High-speed smoothing control function
Interpolation	Positioning (Linear interpolation), Positioning (Independent interpolation), Linear interpolation, Circular interpolation, Cylindrical coordinate interpolation, Polar coordinate interpolation, Synchronized milling spindle tapping*	Positioning (Linear interpolation), Positioning (Independent interpolation), Linear interpolation, Circular interpolation, Spiral interpolation, Helical interpolation, Cylindrical coordinate interpolation*, Fine spline interpolation*, NURBS interpolation*, Polar coordinate interpolation*, Synchronized milling spindle tapping*
Feed rate	Rapid traverse, Cutting feed, Cutting feed (per minute), Cutting feed (per revolution), Dwell (specified time, specified number of rotation), Rapid traverse override, Cutting feed override, G0 speed variable control, Feedrate clamp, Variable acceleration/deceleration control	Rapid traverse, Cutting feed, Cutting feed (per minute), Cutting feed (per revolution), Inverse time feed, Dwell (specified time, specified number of rotation), Rapid traverse override, Cutting feed override, G0 speed variable control, Feedrate clamp, Time constant changing for G1, Variable acceleration/deceleration control
Program registration	Max. number of programs: 960, Program storage: 2MB, Program storage expansion: 8MB*, Program storage expansion: 32MB*	
Control display	Display: 19" touch panel, Resolution: SXGA	
Spindle functions	S code output, Spindle speed clamp, Spindle speed override, Spindle speed reaching detection, Multiple position orient, Spindle speed command with decimal digits, Synchronized spindle control, Max. speed control for spindle	
Tool functions	Tool offset pairs: 4000, T code output for tool number, Tool life monitoring (time), Tool life monitoring (number of machined workpieces)	Tool offset pairs: 4000, T code output for tool number, T code output for group number, Tool life monitoring (time), Tool life monitoring (number of machined workpieces)
Miscellaneous functions	M code output, Simultaneous output of multiple M codes	
Tool offset functions	Tool position offset, Tool length offset, Tool diameter/tool nose R offset, Tool wear offset	
Coordinate system	Machine coordinate system, Work coordinate system, Local coordinate system, Additional work coordinates (300 set)	
Machine functions	—	Shaping function*, Dynamic compensation II*
Machine compensation	G0/G1 independent backlash compensation, Pitch error compensation, Volumetric compensation*	
Protection functions	Emergency stop, Interlock, Stroke check before travelling, Retraction function for the vertical axis, Intelligent Safety Shield (manual mode), Intelligent Safety Shield (automatic mode)*, Mazak Voice Advisor	
Automatic operation mode	Memory operation	Memory operation, Tape operation, MDI operation, EtherNet operation*
Automatic operation control	Optional stop, Dry run, Automatic handle control, MDI control, TPS, Restart, Machine lock	Optional block skip, Optional stop, Dry run, Automatic handle control, MDI control, TPS, Restart, Restart 2, Collation stop, Machine lock
Manual measuring functions	Tool length and tip teach, Touch sensor coordinates measurement, Workpiece offset measurement, WPC coordinate measurement, Measurement on machine	Tool length and tip teach, Tool offset teach, Touch sensor coordinates measurement, Workpiece offset measurement, WPC coordinate measurement, Measurement on machine
Automatic measuring functions	WPC coordinate measurement, Auto tool length measurement, Sensor calibration, Tool eye auto tool measurement, Tool breakage detection, External tool breakage detection*	Auto tool length measurement, Sensor calibration, Tool breakage detection, External tool breakage detection*
MDI measurement	Partial auto tool length measurement, Auto tool length measurement, Coordinate measurement	
Interface	PROFIBUS-DP*, EtherNet I/P*, CC-Link*	
Card interface	SD card interface, USB	
EtherNet	10M / 100M / 1Gbps	

\*Option

# MAZATROL SmoothX Control

For highly advanced programming, the MAZATROL SmoothX CNC is the most progressive control available. This powerful control significantly reduces part cycle times, especially in fine-increment programs for full simultaneous 5-axis machining.

## Features and functions of the MAZATROL SmoothX control include:

- **Variable Acceleration Control** calculates optimal acceleration for a combination of axes.
- **Virtual Machining** allows an operator to perfect part programs prior to initiating cutting.
- **SMOOTH Monitor** provides equipment monitoring and utilization analysis.
- **Quick EIA** plots toolpaths prior to running programs and checks for any interferences in those paths.
- **Quick MAZATROL** allows for the direct importation of 3D CAD models into the CNC and extracts coordinates from the model to simplify machine programming.
- **3D Assist** lets operators import workpiece coordinate data from 3D CAD data to a MAZATROL program without having to input coordinate values to reduce errors and time spent checking programs.
- **EIA/ISO and MAZATROL conversational** programming capabilities.



## SmoothX Control Specifications

	MAZATROL	EIA
Number of controlled axes	Simultaneous 2 ~ 4 axes	Simultaneous 2 ~ 4 axes, Simultaneous 5 axes <sup>1</sup>
Least input increment	0.00001 inch, 0.0001 mm, 0.0001°	
High-speed, high-precision control	Shape error designation, Smooth Corner Control, Rapid traverse overlap, Rotary axis shape compensation	Shape error designation, Smooth Corner Control, Rapid traverse overlap, Rotary axis shape compensation, High-speed machining mode, High-speed smoothing control function, 5-axis spline <sup>1</sup>
Interpolation	Positioning (Linear interpolation), Positioning (Independent interpolation), Linear interpolation, Circular interpolation, Cylindrical coordinate interpolation, Polar coordinate interpolation, Synchronized milling spindle tapping <sup>1</sup>	Positioning (Linear interpolation), Positioning (Independent interpolation), Linear interpolation, Circular interpolation, Spiral interpolation, Helical interpolation, Cylindrical coordinate interpolation <sup>1</sup> , Fine spline interpolation <sup>1</sup> , NURBS interpolation <sup>1</sup> , Polar coordinate interpolation <sup>1</sup> , Synchronized milling spindle tapping <sup>1</sup>
Feed rate	Rapid traverse, Cutting feed, Cutting feed (per minute), Dwell (specified time, specified number of rotation), Rapid Cutting feed (per revolution), Dwell (specified time, specified number of rotation), Rapid traverse override, Cutting feed override, G0 speed variable control, Feed rate clamp, Variable acceleration/deceleration control, Constant control for G0 tilting <sup>1</sup>	Rapid traverse, Cutting feed, Cutting feed (per minute), Cutting feed (per revolution), Inverse time feed, Dwell (specified time, specified number of rotation), Rapid traverse override, Cutting feed override, G0 speed variable control, Feed rate clamp, Time constant changing for G1, Variable acceleration/deceleration control, Constant control for G0 tilting <sup>1</sup>
Program registration	Max. number of programs: 960, Program storage: 2MB, Program storage expansion <sup>1</sup> : 8MB	
Control display	Display: 19" touch panel, Resolution: SXGA	
Spindle functions	S code output, Spindle speed clamp, Spindle speed override, Spindle speed reaching detection, Multiple position orient, Constant surface speed, Spindle speed command with decimal digits, Synchronized spindle control, Max. speed control for spindle	
Tool functions	Tool offset pairs: 4000, T code output for tool number, Tool life monitoring (time)	Tool offset pairs: 4000, T code output for tool number, T code output for group number, Tool life monitoring (time)
Miscellaneous functions	M code output, Simultaneous output of multiple M codes	
Tool offset functions	Tool position offset, Tool length offset, Tool diameter/tool nose R offset, Tool wear offset	Tool position offset, Tool length offset, Tool diameter/tool nose R offset, Tool wear offset
Coordinate system	Machine coordinate system, Work coordinate system, Local coordinate system, Additional work coordinates (300 set)	
Machine functions	—	
Machine compensation	G0/G1 independent backlash compensation, Pitch error compensation, Geometric deviation compensation, Volumetric compensation <sup>1</sup>	
Protection functions	Emergency stop, Interlock, Stroke check before travelling, Retraction function for the vertical axis, Intelligent Safety Shield (manual mode), Intelligent Safety Shield (automatic mode), Mazak Voice Advisor	
Automatic operation mode	Memory operation	Memory operation, Tape operation, MDI operation, EtherNet operation <sup>1</sup>
Automatic operation mode	Optional stop, Dry run, Automatic handle control, MDI control, TPS, Restart, Machine lock	Optional block skip, Optional stop, Dry run, Automatic handle control, MDI control, TPS, Restart, Restart 2, Collation stop, Machine lock
Manual measuring functions	Tool length and tip teach, Touch sensor coordinates measurement, Workpiece offset measurement, WPC coordinate measurement, Measurement on machine	Tool length and tip teach, Tool offset teach, Touch sensor coordinates measurement, Workpiece offset measurement, WPC coordinate measurement, Measurement on machine
Automatic measuring functions	WPC coordinate measurement, Automatic tool length measurement, Sensor calibration, Tool breakage detection, External tool breakage detection <sup>1</sup>	Automatic tool length measurement, Sensor calibration, Tool breakage detection, External tool breakage detection <sup>1</sup>
MDI measurement	Partial auto tool length measurement, Auto tool length measurement, Coordinate measurement	
Interface	PROFIBUS-DP <sup>1</sup> , EtherNet I/P <sup>1</sup> , CC-Link <sup>1</sup> , USB	
Card interface	SD card interface	
EtherNet	10M / 100M / 1Gbps	

<sup>1</sup> Option

# MAZATROL SmoothAi Control

The next generation of MAZATROL Smooth CNC technology, the MAZATROL SmoothAi control and associated software packages deliver powerful digital enhancements that add efficiency and value throughout the machining process with the power of artificial intelligence (AI), machine learning and advanced data management technology.

## Features and functions of the MAZATROL SmoothAi control include:

- **Solid MAZATROL** utilizes 3D CAD data and AI-enhanced machining process selection to provide optimized MAZATROL programs.
- **SMOOTH Ai Spindle** leverages AI technology to optimize cutting conditions and surface finishes through automatic spindle vibration detection.
- **Ai Thermal Shield** ensures stable machining accuracy through machine-learning-enhanced heat displacement compensation.
- **SMOOTH CAM Ai** gives operators the ability to simulate and analyze data for multiple machines and optimize machining parameters in real time.
- **SMOOTH Robot Cell Controller** simplifies programming and using robots with dedicated management software for high-mix/low-volume production.
- **SMOOTH Project Manager** allows users to synchronize the data associated with machining programs across an entire manufacturing facility, including to virtual machines created with MAZATROL TWINS.
- **SMOOTH Machining Configuration (SMC)** enables real-time process optimization with slider switches that allow operators to vary a wide range of cutting parameters.
- **SMC Plus** serves as an optional software module that assists operators in correcting tool contact points in EIA programs using 3D part models for improved accuracy and part quality.

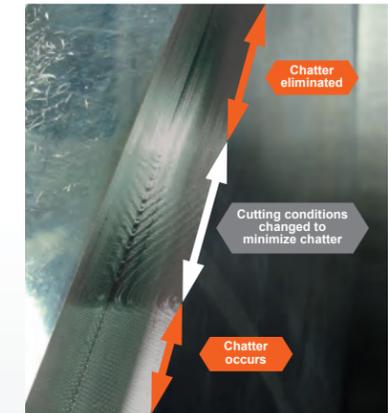


## Solid MAZATROL

This programming powerhouse supplies extremely fast and easy MAZATROL programs using 3D CAD data and AI-enhanced machining process selection. The AI support selects optimal processes for applications, making decisions on the fly that normally require operators with extensive experience and skills. The AI function enables the control to recognize preferences and know-how for customer programming, then automatically adjust the customer cutting process/cutting parameters based on past customer programming experiences.

## SMOOTH Ai Spindle

The next generation of SMOOTH Spindle Analytics, SMOOTH Ai Spindle takes data from adaptive sensors to automatically adjust spindle speed based on machine learning algorithms to increase productivity and produce exceptionally precise surface finishes.



## Ai Thermal Shield

Ai Thermal Shield ensures stable machining accuracy through enhanced heat displacement compensation. New algorithms, powered by AI learning, detect temperature changes, automatically determine the amount of compensation and apply it immediately to enable the highest level of machining accuracy.



Machining



Workpiece inspection



Inspection results



## Software Solutions for Highly Efficient Processes

# MAZATROL TWINS

MAZATROL TWINS creates virtual twins of machines equipped with the MAZATROL SmoothAi CNC, essentially allowing programmers to access virtual machines in their offices. Designed to accurately duplicate the operation of machines on your factory floor, the included software packages can be combined with the power of the MAZATROL SmoothAi control to substantially increase the efficiency of your production.

**SMOOTH Project Manager** conveniently manages the data required to execute machining programs, including tool data, fixtures, system coordination, parameters and workpiece 3D models. In addition, its project data synchronization features can work with SMOOTH CAM Ai and a variety of alternative CAD/CAM software packages to keep data synced between virtual machines and MAZATROL SmoothAi CNC units on the factory floor.

**SMOOTH CAM Ai** not only allows for the creation of programs, but it enables users to simulate and analyze data for multiple machines, all from an office desktop. Data is then sent to machines in the factory for fast and accurate machine setups. In addition to enabling users to easily change machining conditions such as speeds, feeds and depths of cut on the fly, SMOOTH CAM Ai's Cutting Adviser function helps users optimize machining parameters, allowing for the precise control of data

related to tools, material removal amount, machining load, machining time, and change of machining data, including cutting speed and depth of cut.

**SMOOTH Machining Configuration (SMC)** enables cycle time, finished surface and machining shape to be adjusted by slider switches for real-time optimization based on material requirements and machining methods, including new options for selecting speed or accuracy as a priority. This is especially effective for complex workpiece contours defined in small program increments, particularly with the software's new ability to adjust rotary axis acceleration turning parameters.

**SMC PLUS**, an optional software module for the MAZATROL SmoothAi CNC, compares tool contact points in EIA programs with a 3D model so users can quickly correct any issues to ensure correct tool paths and high-accuracy finished surfaces.

### Advanced Robot Automation for Unlimited Operations

Whether large or small, shops are eager to make the most of their labor resources and machine capabilities with automation. That's why Mazak has dedicated itself to providing manufacturers around the world with advanced human-machine interface (HMI) functions to reduce automatic operation setup time and increase their productivity and competitiveness.

**SMOOTH Robot Cell Controller (RCC)** is dedicated management software for high-mix/low-volume production environments equipped with robots. Users can easily make a production schedule for extended periods of operation, check production status on an

optional dedicated screen and manage the required tools and fixtures. In addition, the software checks for missing tools or those with short remaining tool life to stop the automatic operation.

The Robot Setup Assist function included with SMOOTH RCC simplifies the process of setting up a robot by automatically generating robot movement programs based on the length of material, diameter and robot hand specifications. This conversational programming method eliminates the need for time-consuming robot teaching sessions.

## Mazak SMOOTH Link

### Mazak SMOOTH Link: The digital tool for production efficiency

Ideal for shops of all sizes, Mazak SMOOTH Link syncs machines with mobile devices to monitor and manage equipment status at any time from a smartphone, tablet or laptop computer. This digital tool works with MAZATROL Smooth CNCs to capture real-time information and transfer data securely to a mobile device via Wi-Fi. Through this technology, a mobile device serves as a Smooth CNC sub-monitor, with access to real-time monitoring as well as cutting-tool and program data for process optimization.

#### Browser-based monitoring and access

SMOOTH Link supports all leading browser software for easy, direct access on standard computer hardware. Permission levels grant full or limited user access to specific functions.

#### Instant status updates and alerts

See machine status at a glance. The SMOOTH Link application screen provides instant monitoring information on the operational status of a machine and its in-production workpiece. This screen and others also present machine in-cycle/alarm signals.

#### Detailed panoramas of machine setups

View in-depth status information about every connected machine with one touch. The SMOOTH Link tool management screen displays all of a machine's tool layouts and data, including lengths, diameters and offsets, as well as the tool types in each of the machine's assigned tool changer pocket numbers/positions. Users with tool data writing authority can rewrite remotely from this application screen.

#### At-a-glance CNC program inventory

See which programs appear on each CNC and review available storage space. The programming application screen shows all EIA programs saved to a machine's CNC and how much data capacity remains.

#### No custom monitoring hardware

Reduce implementation costs with no need for specialized bandwidth or computing technology. SMOOTH Link does not require a server-class PC or a server license, which reduces implementation costs. From a machine's Smooth CNC control or a PC, the product can monitor multiple machines through ordinary commercial wireless connections.



# Mazak SmartBox

## Manufacturing made smarter

This revolutionary launch platform provides an easy, highly secure entry into the Industrial Internet of Things (IIoT). The Mazak SmartBox offers a scalable, end-to-end solution that connects manufacturing equipment – including machines, software and other devices – to a factory network and enables the free flow of information to management systems via MTConnect®.

### Security

The advanced security protection of the Mazak SmartBox gives factory owners and IT departments confidence in the digital integration of their manufacturing operations. It includes a state-of-the-art Cisco® networking platform and Layer 3 Managed Switch, industrialized for the factory environment, to prevent unauthorized access to communications between machines and other networking equipment.



### Analytics

The SmartBox works with any machine, regardless of make, model or age, and enables manufacturers to capture and evaluate data to achieve unprecedented levels of productivity.

Because it operates on a completely open standard, Mazak SmartBox works in conjunction with popular third-party analytical software platforms so users can choose any software that meets their performance levels and operational needs.

### Monitoring

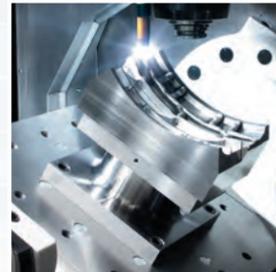
Through standard input/output (I/O) ports, the Mazak SmartBox accepts quick, easy connection of off-the-shelf sensors to gather machine data and monitor conditions. Depending on the application, one Mazak SmartBox can connect several machine tools as well as associated manufacturing equipment.

## Advanced Machining

Mazak's full range of SMOOTH TECHNOLOGY Solutions keeps manufacturing operations on the cutting edge. Through digital technologies and collaborative projects, the Solutions pillar of the SMOOTH TECHNOLOGY platform opens up new avenues for productivity and efficiency in part-processing operations. Our advanced machining solutions offer infinite machining capabilities.



Additive Manufacturing (AM)



Hot Wire (HWD)



Friction Stir Welding (FSW)



Auto Gear (AG)

### HYBRID Multi-Tasking

HYBRID Multi-Tasking innovations create new levels of cost efficiency. These highly productive combinations of additive, subtractive and joining processes can transform manufacturing operations through reduced lead times, improved part accuracy, shortened setup times and streamlined processes, putting an end to WIP.

- **Additive Manufacturing (AM)** uses the heat from one or more lasers to create perfect coatings and build intricate micromachined part features.
- **Hot Wire Deposition (HWD)** uses an arc torch to melt wire directly onto workpieces, creating exceptionally precise sealing coatings as well as near-net-shape part features.
- **Friction Stir Welding (FSW)** uses highly precise levels of frictional heat and forging pressure to create full-penetration, defect-free welded joints with minimal heat-affected zones.
- **The AUTO GEAR (AG)** package integrates powerful machining solutions into the SMOOTH TECHNOLOGY platform to make skiving, milling and hobbing of O.D. spur, spline and helical gears more affordable than ever before.

### SMOOTH Gear Cutting

This SMOOTH TECHNOLOGY solution combines advanced Multi-Tasking machines with Mazak's latest gear-production process developments, which increase accuracy and productivity with Mazak's DONE IN ONE® part processing. SMOOTH Gear Skiving and SMOOTH Gear Hobbing ease mass production with a built-in programming function that uses profile-specific gear cutters. For small-lot production, SMOOTH Gear Milling provides easy machine setups with no need for custom gear software.



### Mazak Oval Turning

The Mazak Oval Turning function enables highly accurate oval machining at high speeds. It allows users to machine quick, precise oval/cam shapes on turning center that incorporate a special oscillating integrated linear motor synchronized with the machine's spindle.



### SMOOTH Engraving

The SMOOTH Engraving function provides an easy, fast and seamless engraving programming for EIA/ISO and conversational MAZATROL part programs.



# Advanced Machining

## Metrology and compensation

Through collaborations with industry leader Renishaw, Mazak continues to raise the bar in the development of metrology and compensation solutions that solve difficult metalworking challenges.

### SMOOTH Set and Inspect



Featured on Mazak machines with MAZATROL SmoothG, SmoothX and SmoothAi controls, SMOOTH Set and Inspect provides an on-machine work measurement and inspection solution with intuitive touch-panel operation. The SMOOTH Set and Inspect software simplifies the programming of tool setting and part probing macros and is ideal for accelerated at-the-machine inspection cycle programming.

### SMOOTH Volumetric Compensation



SMOOTH Volumetric Compensation uses an XM60 laser system to remove 6-DOF (Degrees of Freedom) errors on each machine axis for consistent positioning and high-accuracy machining.

### SMOOTH Tool Management



Available for any MAZATROL Smooth CNC control, Mazak's SMOOTH Tool Data Converter and SMOOTH Tool Management software provide valuable tool-data management to maximize tool life and performance. These intelligent process monitoring solutions ensure preventive maintenance and protect expensive tools.



## Automation systems

Implementing the right type of automation in a manufacturing facility can add significant competitive advantages. That's why Mazak offers the most advanced automation solutions of any machine tool builder in the industry – and integrates solutions directly through MAZATROL Smooth CNCs.

### MPP Series

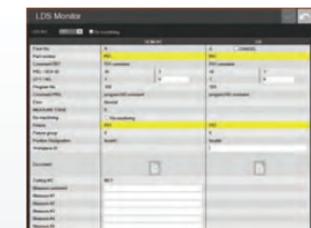
Mazak's MPP (Multi-Pallet Pool) System provides basic automation to increase productivity, especially in floor space too limited for a horizontal pallet stoker. Shops can begin using the MPP system with a few pallets and grow the system as their production needs change, providing a compact, expandable multiple-pallet implementation with the flexibility to accommodate production environments from high-mix/low-volume to high-volume operations.



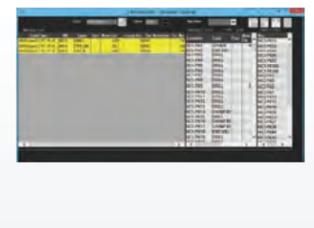
Home screen



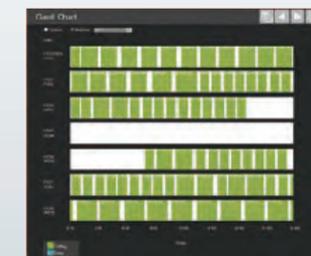
System monitoring screen



Production schedule display



Missing tools display



Gantt chart screen  
(One week of operation results data)



Analysis screen  
(Analysis of machining time and setup time)

### SMOOTH MPP

The software component of Mazak's MPP System automates operations after the input of production schedules. Operators can check production results, system utilization and other data on any MAZATROL SmoothG, SmoothX and SmoothAi controls, or on computers, tablets and smartphones for networked machines. The software displays system and production status visually for convenient operation monitoring. Production schedules, missing tool lists and production results appear onscreen as well, including a wide variety of graphs for convenient analysis of system utilization.

# Mazak Technology Centers

As a key component of Mazak's comprehensive customer support, its network of Technology and Technical Centers strategically located across North America puts component machining demonstrations, experienced applications engineers and training in close proximity to customers. These Technology Centers also provide a channel for customer input to Mazak manufacturing for the development of new machine tool technology.

Technology Centers offer advanced application support, education and training, new technology and manufacturing systems, along with on-site training and technology seminars.

## Advanced application support

- Expert applications engineers help customers optimize part-production processes and create effective manufacturing solutions.
- Mazak-certified cutting tool, workholding and automation partners collaborate to develop optimized turnkey manufacturing solutions.
- Test cuts of customer parts run on the latest, most-advanced machine tools.
- Secure applications development and complete design privacy of each customer's individual manufacturing system.

## Education and training

- Education, training and seminar events in cooperation with Mazak technology partners.
- Free access to the most advanced machine tools.
- Industry focused education - general aerospace, energy, jet engine and construction.



## New technology and manufacturing systems

- The latest, most-advanced manufacturing systems that can optimize the processing of industry-specific components.
- Productivity experts help customers select the best new machine tool technology for their particular businesses.

## On-site training and technology seminars

- Hands-on applications and operator development courses.
- Regularly scheduled market-focused events that provide valuable industry insight.



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8025 Production Drive  
Florence, Kentucky 41042  
(800) 331-9151



**MIDWEST TECHNOLOGY CENTER**  
300 East Commerce Drive  
Schaumburg, Illinois 60173  
(847) 885-8311



**SOUTHWEST TECHNOLOGY CENTER**  
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**SOUTHEAST TECHNOLOGY CENTER**  
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**WESTERN TECHNOLOGY CENTER**  
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# Optimum Plus Service and Support

## Mazak Optimum Plus

To maximize machine tool investments, the [Mazak Optimum Plus](#) program represents a company-wide commitment to provide the best-possible, most-comprehensive support.

The Optimum Plus program encompasses Five Pillars – distinct yet interrelated areas:

- Single-source service
- Technical support – machine and CNC
- Parts support
- Progressive learning
- Spindle and unit rebuild

## Single-source Service

Mazak is a single point of contact for any Mazak-related service need, whether it involves a machine, control, accessory or automation solution. This effective service approach helps customers maintain the highest possible level of productivity.

Benefits of [Mazak's single-source approach](#) include:

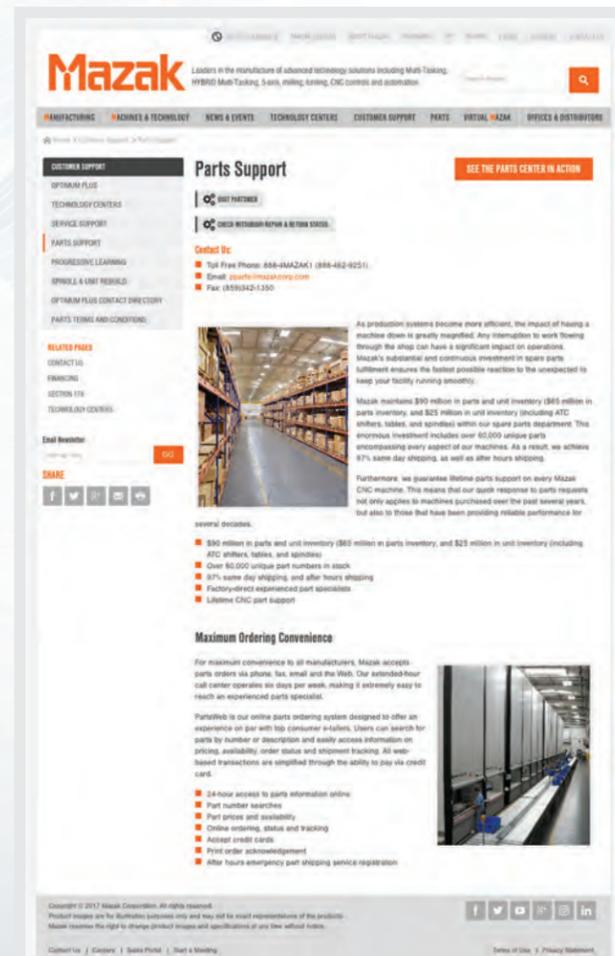
- Free technical phone support and software upgrades for the life of a Mazak machine.
- Software support that provides instantaneous diagnostic services via remote real-time systems.
- Guaranteed phone response to any technical question within one hour via a 24/7 technical phone support system.
- More than 350 factory-trained Mazak service representatives and certified distributor personnel who can be at a customer's site within 24 hours under most circumstances.
- Wide variety of services, including laser calibration to ISO, ANSI and JIS standards; ball bar qualification and analysis; preventive maintenance plans and programs; and vibration analysis and benchmarking.

## Technical support – machine and CNC

Comprehensive warranties on every Mazak machine tool component, including a two-year part warranty on CNC control components.

[Technical support](#) for machines and CNCs also includes:

- Additional warranty coverage (available upon request).



The Mazak Optimum Plus program enables customers to maximize the value of their Mazak purchases.

## Parts Support

Mazak's spare parts fulfillment ensures the fastest possible reaction time. The state-of-the-art Mazak North American Parts Center uses the latest AS/RS fully automated warehouse storage system technology and maintains a \$65 million parts inventory.

Benefits of the North American Parts Center include:

- Average 97% same-day parts shipment and after-hours shipping.
- Over 60,000 part numbers in stock.
- Convenient web-based parts ordering.
- Factory-direct experienced part specialists.
- Lifetime CNC parts support.



Fully automated warehouse storage systems ensure the fastest delivery of Mazak spare parts.

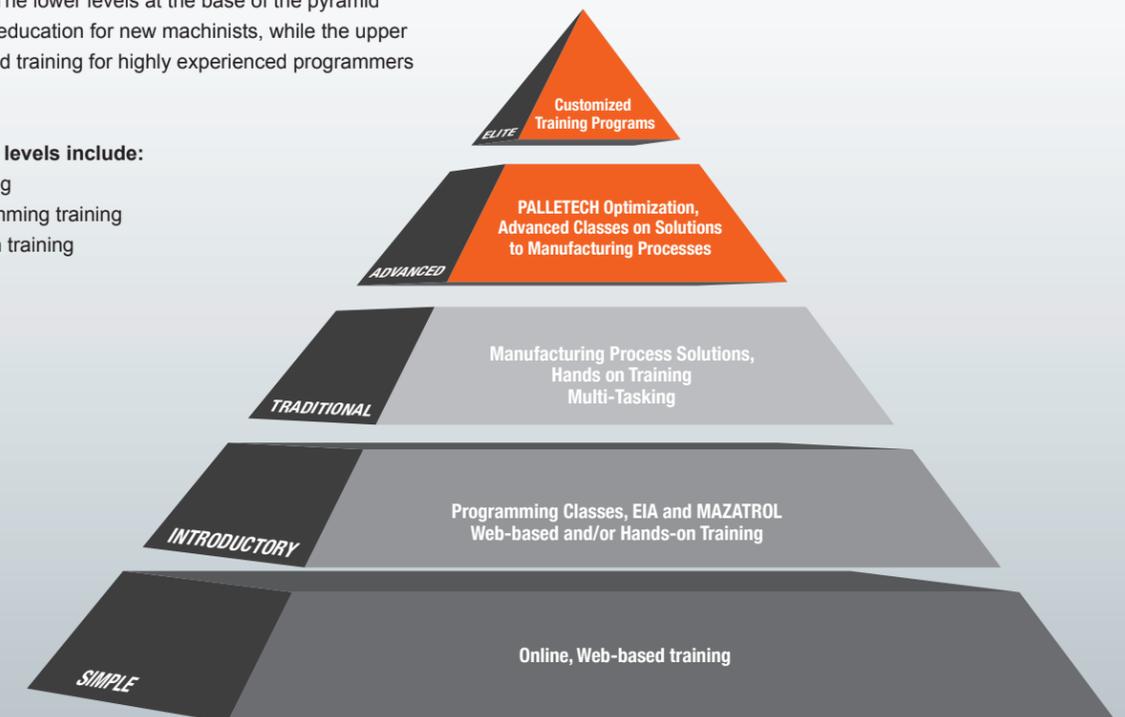
## Progressive Learning

[Mazak's Progressive Learning](#) represents a unique, phased approach to education and training for customers, combining hands-on training, web-based instruction and real-world examples. The program's tiers of offerings – Pyramid of Learning – range from self-paced coursework to highly advanced classes. Every Mazak machine includes three years of programming training at no charge to customers.

[Mazak's Pyramid of Learning](#) is a visual representation of its approach to training. The lower levels at the base of the pyramid represent basic skills education for new machinists, while the upper levels signify advanced training for highly experienced programmers and operators.

Pyramid of Learning levels include:

- Simple online training
- Introductory programming training
- Traditional hands-on training
- Advanced training
- Customized training





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