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COMPETITIVE MOLD MAKER

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INSIDE FEATURES

> FEINTOOL DELIVERS ON SPEED, QUALITY AND PROFITABILITY WITH PRECISION VMCs

> WET: WORLD-LEADING WATER FEATURES MOLDED BY ADVANCED MAKINO EDM TECHNOLOGY

> AUTOMATION OF MILLS AND EDMs RESHAPES SUMMIT TOOLING'S MOLD MAKING

OUT FRONT

ANDRE EY
(248) 232-6203
andre.ey@makino.com
Vice President
Makino Die Mold & EDM Technologies

INCREASING CAPACITY, MITIGATING LABOR SHORTAGES WITH SMART TECHNOLOGY

Being constrained by capacity is a good problem to have, but a problem nonetheless. With OEMs diversifying mold designs and introducing more frequent, on-the-fly engineering changes, mold manufacturers must be more agile than ever. These challenges, combined with a deficit in skilled labor, create the perfect storm for missed growth opportunities.

Manufacturers can seize the day by embracing technology to improve utilization of skilled labor, floor space and machinery—and by better understanding the condition of their process stability.

Traditional approaches rely heavily on the art and expertise of seasoned toolmakers. However, as these veterans have exited the market, so too have their valuable skill sets. To fill the gap, machine and process technologies have adopted various degrees of automation. Die and mold shops that invest in these technologies have maximized machine utilization rates while expanding capacity, improving quality and repeatability, and mitigating the need for additional skilled labor.

Advancements in 5-axis machining provide new levels of efficiency in complex, 3-D molds. Machines such as our new D200Z and V80S 5-axis vertical machining centers feature motion control and proprietary Collision Safe Guard (CSG) technologies for precision toolpath control and crash avoidance along sweeping contours. As a result, the D200Z and V80S are capable of highly reliable 5-axis continuous cutting using multi-flute tools, enabling mold shops to reduce cycle times and increase tool life while achieving precision contours with tight blends and matches.

Today, modern control systems, like Hyper-i for Makino EDM machines, provide operators with a user-friendly and unified control interface across both wire and sinker EDM platforms. On-board interactive maintenance guides, training videos and help buttons shorten the learning curve for new and experienced operators. This not only leads to improved machine efficiency but also helps the next generation of EDM operators produce parts quickly, reliably and efficiently.

One of the fastest-growing strategies for overcoming capacity constraints has been a trend toward automating processes. Whether mold shops are performing hard milling, graphite machining, EDM, small die and mold component production, or large die and mold cores and cavities, automating processes means more than simply adding robotics. It begins first and foremost with an understanding of whether the intended machining process is stable enough for automation. Determining stability entails a detailed analysis of the goals you expect to achieve through automating the process, including the impact on overall shop utilization. It can be as simple as automatically establishing offsets by probing workpieces in the machine, or as complex as deploying a fully automated system with machining, metrology and part storage systems in one cell.

With more than two decades of automation experience, Makino is the leader in the design, development and integration of fully automated systems.

Makino's engineering staff will help you drive what's next in the mold-making industry, raising your competitiveness to the next level by overcoming process challenges and increasing your current equipment, shop floor and labor utilization.

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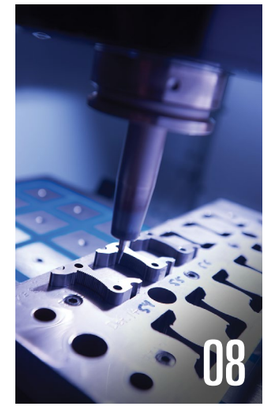

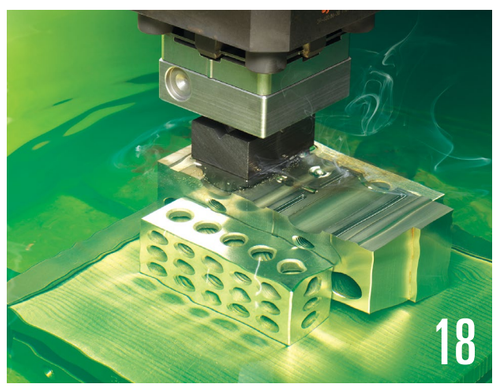

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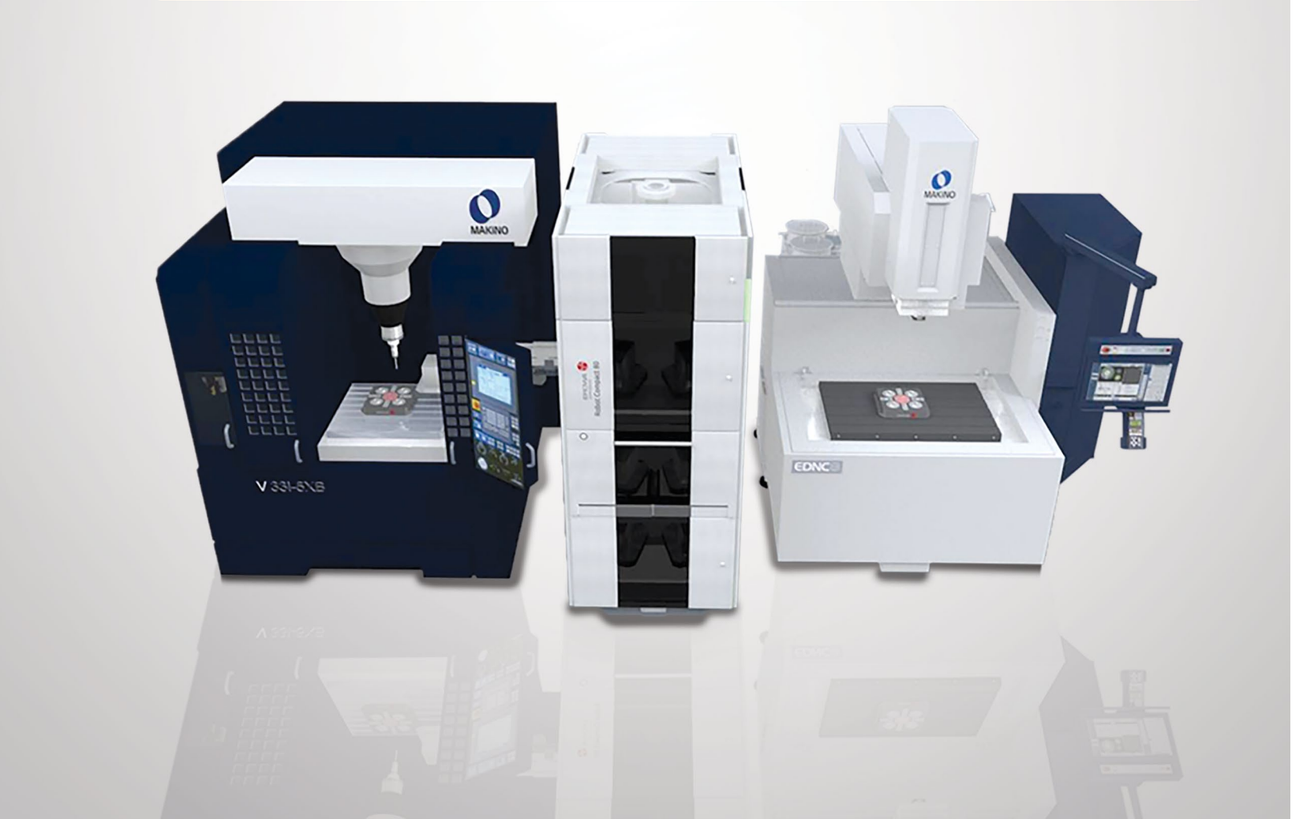
INVEST NOW IN DIE/MOLD AUTOMATION TO MEET GROWING CUSTOMER DEMAND

In today's highly competitive global marketplace, there are two types of die/mold shop owners—those who:

- **Invest in new technology** and automation to create innovative ways to meet customer demands for shorter lead-times, more complex designs and tighter tolerances.
- **Don't invest** and quickly fall behind other North American shops and low-cost, offshore manufacturers.



Business is booming across the aerospace, automotive and white goods industries. Demand for tools to produce their products is expected to outstrip North American capacity for at least another 24 months. Orders for dies and molds are valued at $14 billion this year, said Laurie Harbour, president and CEO of Harbour Results in Southfield, Mich., an industry analyst and manufacturing consultant. In an average year, that estimate would be about $10 billion.

"Now is the time to be thinking about expanding," Harbour said. "Understand that demand for tools is at an unprecedented level right now. Shops are working at more than 100 percent of capacity. They're outsourcing like crazy. They're running 70-hour weeks. And, frankly, a lot of the industry has turned to China as a relief valve because capacity is too tight here."

Only owners of the aforementioned first group of die/mold shops will be positioned to prosper through this period of rapid growth and beyond. They will add the advanced machining centers and manufacturing cells required to make dies and molds for today's products and speed up delivery of more orders. This advancement will enable them to reduce or eliminate the cost advantage many overseas producers enjoy, Harbour said. Significantly, investment in machinery and software improves productivity by increasing utilization and operator efficiency. Likewise, shop owners can create solutions to the severe shortages of skilled labor that exist now and will only worsen as an aging workforce heads toward retirement.

"It's becoming increasingly important to meet some of these capacity demands because customers say to shop owners, 'I need you to make more tools.' The shop owners are saying, 'Hey, we're full.' To meet these demands, small and medium-size die/mold shops have got to be more efficient," Harbour said. "So many owners of these shops are looking at new equipment and new forms of automation. They're looking at new forms of software technology to help them drive efficiency."

SIX TRENDS RESHAPING YOUR BUSINESS

Shaping the demand for greater capacity in today's die/mold market are six key trends that will reward shop owners equipped to take advantage of them:

1. Cars and trucks, household appliances and aircraft continue to become more complex. High-quality tools are required to produce tight tolerances and complex geometries.
2. Manufacturing is now a high-mix, low-volume marketplace. Consumers expect more customization, so more models of products need to be produced.
3. Automotive OEMs sell more trucks than cars. Trucks typically require more tools per vehicle to produce.
4. Customers compress lead-times. What once took 16 to 17 weeks now is expected in 10 weeks, said Wes Stephens, account manager at Industrial Molds in Rockford, Ill. As many as 40 percent of Stephens' customers request that their orders for molds be expedited.
5. The life cycle of products continues to grow shorter. In response, manufacturers more frequently require new tooling to produce their new product designs.
6. Chronic shortages of skilled machinists and people interested in manufacturing jobs will continue. Looming retirement of veteran operators and shop owners compounds this challenge.

These trends are altering the marketplace and, in response, shop owners should think about how they can meet the high demand for tools when at the same time less labor is available.

"There are just not as many toolmakers in North America as people think there are. Therefore, the focus needs to be on automation, on technology like programming software, and how shops can do things easier and faster in the machine without having a whole lot of interface from people, because they don't have a massive group of people they can hire," Harbour said.

"Machine-tool principles have not really evolved in the past 40 years. What has evolved are the levels of accuracy and reliability. This enables today's users to rely less and less on human adjustments and instead rely on the machine performance."

WHAT'S HOLDING SHOPS BACK

Despite the positive forecasts for manufacturing growth, business expansion at die/mold shops can be limited when owners are reluctant to invest in machinery and technology. Many of them struggled during the recent recession and remain unconvinced the current boom in the automotive, aerospace and appliance markets will last.

"They're risk-averse and aging. Owners who are in their 50s and 60s or older say, 'What's the point' in investing in the business when they don't plan to be around the shop for another 20 years," Harbour said.

At shops already operating over capacity, owners say they do not have time to research new equipment and meet with representatives of machine-tool suppliers. They're too busy working to get existing orders out the door on time.

And always in the background is the influence of low-cost providers around the world. North American shop owners worry about adding the expense of new machinery and technology to their operations when they must go head-to-head with manufacturers in China and other countries with lower cost structures.

"Price competition is really significant," Harbour said. "If companies are sitting here not doing things to make their businesses better, they don't have anything that differentiates them from manufacturers in China. That's why creative and innovative shops are thinking, 'How can we be as efficient as possible here so we don't lose business to low-cost manufacturers?'"

AUTOMATE TO TRANSFORM OPERATIONS

Solutions that prepare die/mold shops to meet more of their customers' demands can be found in investment in advanced mills and electrical discharge machines (EDM) along with automation technologies that load and unload workpieces, pallets and tooling.

Stephens tells the story about his apprenticeship experience in the suburbs of Chicago, where he had originally learned the trade from another mold shop. Prior to 2008, there had been eight local die/mold shops located in that suburban area. Today, due to the recession, unrelenting overseas competition and an aging base of owners who didn't have succession plans, most of those shops have closed. Stephens keenly observed this trend, and took it as a lesson for the future. In 2012, he moved to Rockford to take on a job at Industrial Molds, a designer and builder of molds for thermoplastics, thermoset, die cast and insert precision applications. It was here that Stephens began to see how die/mold shops could not only survive but also thrive in the face of competition.

"The company started automating in 2004. It was an 80-man shop at the time. Now it's a 50-man shop. It's challenging to get new people in, but the automation equipment we invested in enables us to run 24/7, day and night shifts," Stephens said.

Purchasing advanced machine tools and automation systems is only the first step. To optimize that investment, Industrial Molds changed its processes, tooling and fixturing. Engineers and operators focus on getting more spindle time, so measurements and workholding are carefully planned and completed outside of the machines. Similar operations are grouped in manufacturing cells to avoid causing bottlenecks when, for example, mills cutting carbon electrodes run faster than the EDMs, which use electrodes produced by the mills.

"The new equipment is just one piece in the die/mold shop's process, and the owner needs to embrace the idea that this piece of equipment may require him to change his programming techniques, tooling, operator skill and even shop temperature control," said Andre Ey, vice president of die/mold technologies at Makino. "The performance of the equipment may eliminate steps of the current processes and thereby require redeployment of personnel to other operations."

Many of today's most successful die/mold shops are drawing inspiration and techniques from the production machining market to rapidly boost capacity.

THREE STEPS FOR OWNERS

Each die/mold shop is unique, so there's no universal solution to recommend that sets up these businesses for success in dealing with changes imposed on them by the six major trends transforming the market today. However, there are actions each shop owner should consider:

1. Implement basic levels of automation by fully using automatic tool-changers, pallet-changers and advanced control features to optimize utilization, improve cycle times and increase opportunities for unattended operation.
2. Invest in advanced automation systems that organize machines and processes into highly efficient manufacturing cells.
3. Restart or launch an apprenticeship program through local high schools or community/technical colleges to recruit and train machinists to fill specialized mold-making roles.

"Machine-tool principles have not really evolved in the past 40 years. What has evolved are the levels of accuracy and reliability. This enables today's users to rely less and less on human adjustments, and instead rely on the machine performance," Ey said. "The advancements in accuracy and reliability allow for automation and lights-out, unattended manufacturing, therefore increasing utilization."

Advanced machine control technologies make it possible for operators of all skill levels to become more productive and improve quality. Coupled with automation hardware and software, these technologies enable die/mold shops to increase capacity without adding labor. Machinists are freed up to handle tasks at multiple machines, load workpieces and perform maintenance.

Stephens argued that investing in manufacturing technology and workforce development are smart moves, even for older owners who may be considering selling their die/mold shops.

"The business becomes more valuable by increasing its capacity and because you get talent that's interested in newer and better equipment," Stephens said. "Lack of investment means the technology will pass you by and you'll become non-competitive."

HOW TO GET STARTED

Die/mold customers want to be first to market, so they push shops to produce their tools quicker and to deliver them faster. This demand for shorter lead-times—and increased capacity across automotive, aerospace and consumer white goods segments—is expected to remain high for another two years.

Even when demand levels off, shops can expect to remain busy but with order volume "that will be more normal and manageable, and not as painful as it is right now," Harbour said.

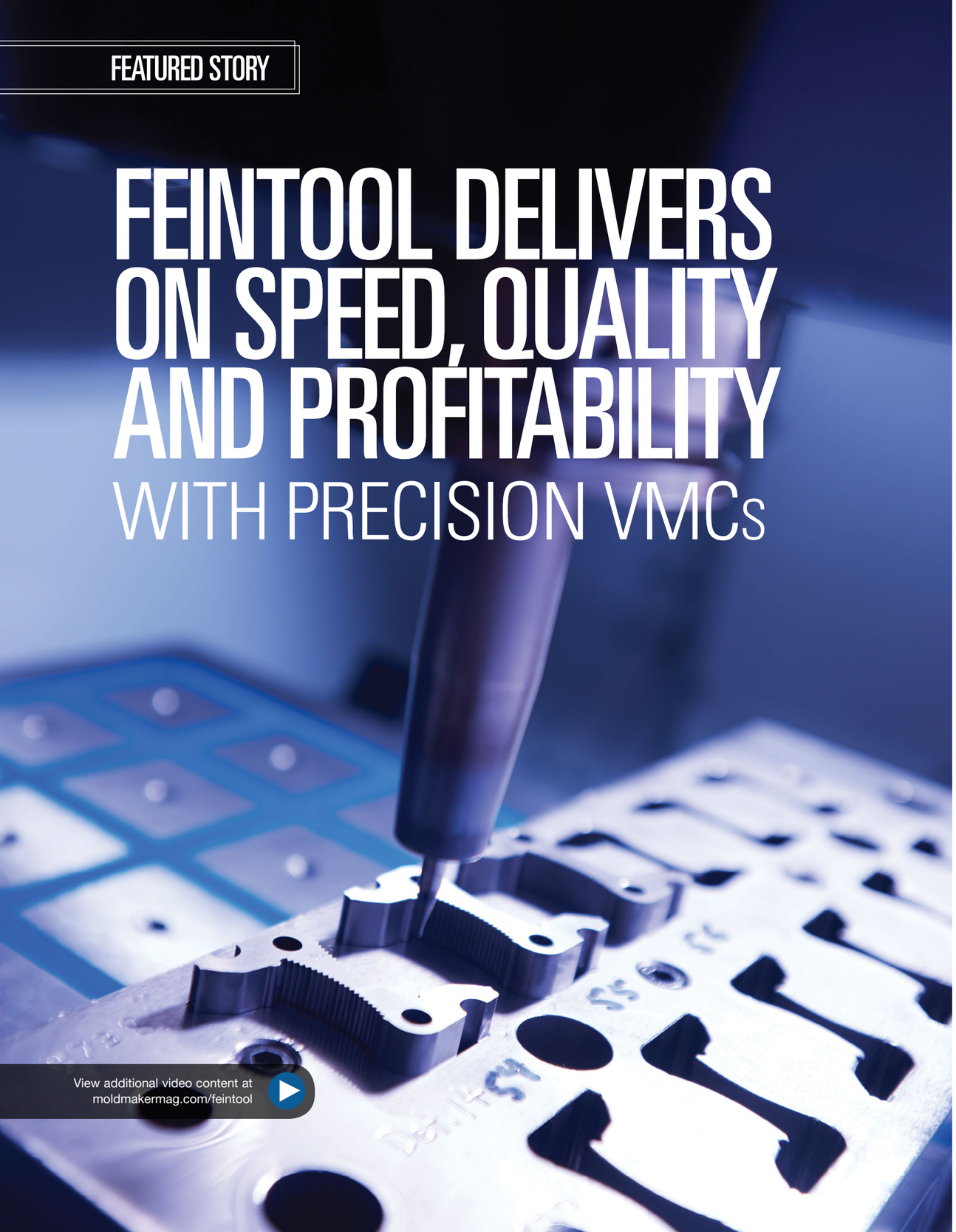
Some shop owners may decide to wait to see what happens to demand before considering whether to invest in new machines and automation. Harbor and Stephens believe that's too late. Opportunities exist to grow now while also preparing the business to continue to meet customer demands with a smaller workforce into the future.

Harbor and Stephens encourage shop owners to visit other companies to see automated die- and mold-making in operation. Ey suggests owners talk with experienced application and engineering services providers to fully understand current processes and customer demands. This analysis will help shop owners choose the most appropriate machine tool and automation options.

"Competing in any market is never a state of equilibrium. Competition requires continuous change," Ey said. "If a shop owner is embracing change, it is not really a matter of pain but a matter of understanding how the impact of new equipment and automation systems can enable the die/mold shop to perform up to its customers' expectations."

FEATURED STORY

FEINTOOL DELIVERS ON SPEED, QUALITY AND PROFITABILITY WITH PRECISION VMCs



"Faster, better, lower cost—pick two." It's a pervasive phrase expressed across a wide range of industries and markets, but is it necessarily true? According to Christoph Trachsler, CEO of Feintool North America, customers don't have to make that choice when it comes to Feintool's fineblanked parts services.

"What matters most at Feintool is reliably delivering precision parts at a competitive cost for our customers," said Trachsler. "Our customers don't have to choose between quality, delivery and cost. We are continuously improving processes, from component and tool design, to system engineering and large-scale component production, to deliver greater results across all criteria. It's how we stay competitive and help our customers succeed."

Feintool is a world leader in the development of fineblanking systems and in the production of pre-finished fineblanked and formed components. The company operates out of facilities in Europe, Japan, China and the United States, with its North American headquarters located in Cincinnati, Ohio. With nearly 60 years of experience in the market, the company has become well known for its fineblanked parts production, fineblanking presses and technical expertise in supporting customers with research and development and prototyping.

The company's fineblanked parts services provide a cost-effective means for companies to acquire high volumes of extremely precise stamped parts. This has made Feintool a premium parts supplier to the global leaders in the automotive and medical industries.

Delivering this level of repeatable precision is no easy feat, though. Due to the intense pressure of the fineblanking process, tooling used within the presses is typically composed of 64 HRc hardened steel. And according to Beat Andres, Feintool's operations manager of tool room and production tooling, identifying a "capable machine for this type of hardmilling" is difficult.

"Many of the tools that we manufacture contain extremely fine, repetitive features, such as small teeth, which require highly repeatable processes within 10 microns of repeatability," said Andres. "For many years, the only option for us to reach this level of precision in hardened steel was to hand finish these features using diamond files. It was a long, arduous and exhaustive process that was not repeatable. Since investing in the Makino V33i vertical machining centers, we've been able to reduce handwork by up to 30 percent, leading to extended tool life, less variability, greater labor efficiency and substantial cost reductions."

> "What matters most at Feintool is reliably delivering precision parts at a competitive cost for our customers."

ENHANCING TOOL QUALITY WITH PRECISION VMCs

Feintool's first investment in high-speed hardmilling occurred in 2008, following a series of collaborative tests developed and conducted alongside the company's Japanese division. The tests were comprised of 3-D models of 64 HRc components featuring fine-tooth features, similar to automotive seat recliner components submitted by many of its customers.

After delivering the test models to several leading machine-tool suppliers, Feintool received its first response just days later from Makino. Company leaders were invited to a private session at Makino's Tokyo headquarters to see the first run of the test performed live on a V33i vertical machining center. The results of the test exceeded Feintool's expectations, achieving the desired tolerances and quality while producing the fastest cycle time among all suppliers evaluated. This success demonstrated a clear return on investment (ROI) for Feintool to invest in high-precision hardmilling capabilities.

Since this initial investment, Feintool's business grew substantially, requiring the company to add a third shift just to keep up with demand. By 2014, customer

As part of the company's continuous-improvement initiative, engineers frequently optimize processes, including increases in annual cutting hours of each machine.

demand had reached Feintool's maximum capacity, which led the company to invest in a second V33i. The tool magazine on the second V33i was increased from 25 tools to 60 tools to support greater capacity and redundant tooling for extended, unattended machining operations. Feintool continued its expansion of hardmilling capabilities with a third V33i in 2015.

Designed for long hours of reliable, unattended hardmilling, the V33i vertical machining center delivers high-speed machining with superb accuracy, efficient chip removal and ease of operation. The machine's standard 20,000-rpm spindle features Makino's unique core-cooling and under-race lubrication system to minimize thermal distortion at high spindle speeds. Additional rigidity is achieved with the integrated construction of the spindle and drive motor, which cuts down on vibration during high-speed operation.

Controlling the impact of machine movement on thermal characteristics reduces temperature impact on the machining process and yields sustainable, long-term, dynamic accuracy. As such, temperature-controlled lubricant is used throughout the machine to minimize thermal growth during cutting. Cooled elements such as core-cooled ballscrews, lubricated ball nuts, a servo motor cooling jacket system and temperature-controlled passageways result in excellent structural temperature control.

"Fineblanking tools require a very fine cutting edge in order to cut the sheet metal accurately during the stamping process, so we oftentimes coat finished chamfers with a TiCN coating to increase the tool's performance," said John Castle, senior supervisor of tool maintenance at Feintool. "When it comes to hand finishing the cutting edge, each toolmaker might have a different method or approach. This increases the likelihood of inaccuracies in the final tool.

"If any inaccuracies are discovered during the stamping process, the tool must be sent back to the tool room to remove the coating, re-radius the cutting edge and add another coat. This adds up to several hours of downtime for our press room. The tool quality coming directly out of the V33i machines has limited the amount of handwork, reducing the likelihood of human error, decreasing lead-times and extending the life of our tools by up to 40 percent more strokes during the stamping process."

"Once we adopted the magnetic work holding and began performing longer runtime setups, we were able to get even more value and returns from our V33i investments," said Castle. "It enabled us to fully take advantage of the machines' rigidity, thermal-control features, broken-tool sensors and expanded tool-changers. Today, we reliably run setups for upwards of 12 hours of continuous cutting with small-diameter endmills, maintaining 10-micron repeatability throughout."

"One of the big benefits to working with Makino is their record of service and support, as well as their close proximity in the Cincinnati area."

MAXIMIZING INVESTMENTS WITH PROCESS OPTIMIZATION

Feintool's success in adopting high-precision hardmilling capabilities has been based on not only its acquisition of new machine technology but also the knowledge and experience of the company's engineers who have become more innovative in their processing techniques. As part of the company's continuous-improvement initiative, engineers recently took aim at maximizing machine utilization rates by increasing annual cutting hours on each V33i from 4,500 hours to 6,000 hours per year.

According to Andres, Feintool engineers "are continuously evaluating new process optimizations to get the most out of machine investments." These optimizations include programming refinements, cutting-tool selection and improved work-holding solutions. One example is the recent adoption of magnetic work holding. When using previous clamping methods, Feintool was limited in the number of tools that it could machine in a single setup. By switching to magnetic work holding, engineers are now able to maximize space within the work envelope to accommodate greater productivity.

Feintool engineers are also active in evaluating cutting tools. The team works closely with tooling suppliers to test new coatings and cutter sizes to achieve the perfect blend of performance and tool life. The rigidity and through-spindle coolant capabilities of the Makino machines have afforded the engineering team greater flexibility in optimizing cutting-tool selection.

"Working with experienced suppliers is essential to the continuous improvement of your processes, cost reduction, and overall service and support," said Andres.

Tools produced at Feintool frequently contain extremely fine, repetitive features, such as small teeth, which require 10 microns of repeatability.

"One of the big benefits to working with Makino is their record of service and support, as well as their close proximity in the Cincinnati area. Our engineering team exchanges frequent dialogue with Makino locally and their engineers in Japan via email. It's a very supportive relationship that continuously helps us meet our goals."

Feintool recently accomplished its objective of maximizing machine utilization. By increasing cutting time on the V33i machines 1,500 hours annually, the company was able to achieve necessary production capacity without investing in a fourth machine.

CUTTING DOWN COSTS AND LEAD-TIMES

In addition to its advancements in hardmilling processes, Feintool has also made significant investments in its preheat-treated machining capabilities through the acquisition of three Makino PS95 vertical machining centers in 2014. Prior to its PS95 investments, Feintool had been outsourcing most of its preheat-treated machining processes. Some preheat-treated machining had been processed in-house on a set of older mills that struggled to handle the forces necessary to perform heavier cutting operations. To reduce lead-times, decrease costs and gain more control over the toolmaking process, Feintool decided to invest in internal machining capabilities.

Feintool tested a variety of machine-tool platforms to gauge their speed and productive capabilities. One process in particular tested each machine's ability to perform heavy drilling in tool steel. While several machines stalled during the heavy drilling portion of the test, the PS95 with its through-spindle coolant capability completed the process without issue and achieved the fastest cycle time among all machines tested.

"The PS95 machines are workhorses that do an exceptional job of heavy cutting, and in a pinch can even support some of our finishing processes in hardened steel," said Andres. "Through these acquisitions, we've been able to eliminate $500,000 each year in outsourcing, enabling us to pay off all three machines in just one year."

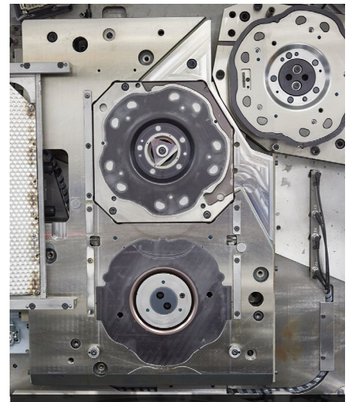
Today, Feintool's preheat-treated machining processes are performed faster and with better quality. This performance has enabled the company to not only reduce lead-times for customers but also expedite prototyping processes to help customers get products into market faster.

SUBSTITUTING PROCESSES FOR SUCCESS

For Feintool, the pursuit of continual improvement isn't simply part of some annual corporate motto; it's a tenet that's essential to the company's long-term competitiveness. As such, leadership and the company's engineering team share a number of aggressive goals to further improve the quality, delivery and cost of its fineblanking parts services.

One of Feintool's short-term goals is evaluating processing enhancements to reduce or eliminate long-runtime machine processes, such as jig grinding and EDM. The company believes that it can save a significant amount of time and investment by replacing these processes with precision milling.

"At this time, there are still many types of processes that just can't be milled; however, the precision of the Makino equipment provides us with an opportunity to minimize the requirements of these processes for shorter lead-times and lower costs," said Andres. "To date, we've been able to reduce sinker EDM processes by approximately 30 percent and wire EDM process by roughly 10 percent. And there's still a lot more opportunity there for further improvement."



Due to the intense pressure of the fineblanking process, tooling used within the presses is typically composed of 64 HRc hardened steel.

Increased tooling output resulting from Feintool's milling investments has also put a strain on the company's existing jig-grinding capacity. Rather than invest in a second jig-grinding machine, the company is currently evaluating ways that it can use the V33i machines for some jig-grinding processes.

"To properly serve a high-volume, high-precision market like automotive, flexible and reliable equipment is essential. To not deliver is not an option," said Trachsler. "Our investments in Makino equipment have supported us in adapting to changes in part complexities, tolerance requirements and delivery times. No matter what challenge comes our way, Feintool is prepared to deliver parts faster, better and at a lower cost than the competition."

VIEW THESE WEBINARS:

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- Unattended Machining Techniques for Die/Mold Applications

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WET: WORLD-LEADING WATER FEATURES

MOLDED BY ADVANCED MAKINO EDM TECHNOLOGY

Visiting WET in Sun Valley, Calif., is not like walking into a typical machine shop. Yes, there are mills, lathes, grinders and EDMs. But they're just one part of the business that designs, manufactures and installs some of the world's most iconic fountains and engaging public displays of water, fire, fog and ice.

The dancing Fountains of Bellagio at the casino resort in Las Vegas? WET.

The 35-acre Dubai Fountain in front of the world's tallest building, the Burj Khalifa? WET.

Luminous, a water wall more than three stories tall illuminated by 5,000 LED lights in the entrance of the W Hotel Guangzhou in China? Again, WET.

To produce these surprising and tightly choreographed experiences, WET holds more than 50 patents for lighting, water flow and compressed air systems that propel water as high as 500 feet. The company employs architects, artists, chemists, model makers, and lighting and sound specialists along with engineers who together create water forms not found in traditional fountains. The Dubai Fountain, for example, contains 6,600 underwater lights that can be seen by astronauts orbiting in space.

WET co-founder and CEO Mark Fuller not only had a vision for the design and experiential aspects of the business, but he also shared a deep appreciation for manufacturing and companies that take pride in building products in America. As such, WET employs its own internal team of manufacturing engineers to help bring these experiences to life. This team continuously strives to improve manufacturing processes to meet increasingly shorter delivery times and lower costs.

"Rapid time to market is absolutely essential when working alongside customers' production schedules, so it is critical that we produce parts as efficiently as possible," said John Borrego, vice president for production. "This is what led us to bring our EDM work in-house, despite having limited experience with modern EDM technologies. Fortunately, we found a simple and user-friendly solution in the Makino EDAF3 and its Hyper-i control, which allowed us to get up to speed quickly, shaving one to two weeks off of our lead-times right away."

Molds previously outsourced used to require six or seven weeks to produce. Today, WET burns its own P20 mold inserts in-house on the EDAF3 in as little as two to five weeks. The company also benefits from faster turnarounds during design and process development, accommodating engineering changes to existing molds in a time frame as short as one week. This level of efficiency has helped the injection molding department produce final lenses, reflectors and enclosures in time for final project installments.

"Rapid time to market is absolutely essential when working alongside customers' production schedules, so it is critical that we produce parts as efficiently as possible."

WET's novice and experienced EDM operators express appreciation for the Hyper-i control's time-saving support features, such as the E-Tech Doctor process optimization guide.

OUTPACING COMPETITORS WITH ADVANCED TECHNOLOGY

Leaders of WET considered adding plastic injection molding equipment and EDM machining to the company's capabilities for more than two years. Their goals: better control of lead-times, improved part quality and reduced per-part costs.

In 2015 they purchased their first injection machines while outsourcing mold-making. Six months later they were ready to make a decision on EDM to enable WET to bring mold-making in-house. They researched machines from five manufacturers and through that process began to focus on the EDAF3 because of its Hyper-i control, which features a modern, Microsoft Windows 7-based operating system and easy-to-use 24-inch touch-screen interface. Borrego, a veteran of manufacturing at companies building rockets to support the International Space Station, led the company through a cost-benefit analysis of each EDM manufacturer's machines.

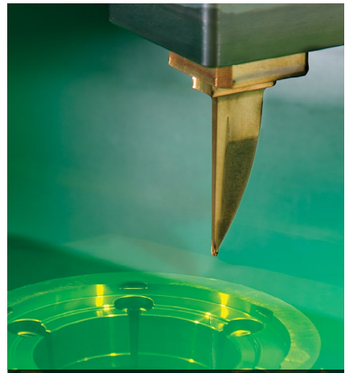
"We didn't want antiquated control technology. We wanted to maintain our technological superiority. We want to be at the forefront of manufacturing and to push ourselves," Borrego said.

Representatives of SST and Makino took Borrego's team to visit some California machine shops with the Hyper-i control installed on their EDM machines. While WET had one operator with some previous sinker EDM experience, he was familiar only with older control systems. The company was essentially starting from scratch, so Borrego pursued EDM systems that would enable WET to quickly and efficiently implement new machining technology and processes.

At the heart of Makino EDM machines is a robust and rigid structure that provides sustained, long-term precision. The EDAF3 offers X-, Y- and Z-axis strokes to accommodate larger workpieces. The dielectric reservoir is built into the base casting of the machine to improve thermal stability and also minimize the machine's footprint, and chilled dielectric fluid is circulated through the Y-axis and Z-axis structures to maintain stable and consistent thermal control over the entire machine. Work-tank access is unrestricted on the EDAF3 with a programmable, three-sided drop-tank system, which simplifies operation and loading and unloading of workpieces.

The EDAF3 is loaded with other Hyper machining technologies that deliver optimum productivity that Chris Syzmel, WET's lead mold maker, said he's just beginning to explore. Makino's proprietary generator and adaptive power control technologies ensure efficient machining while achieving the highest level of accuracy and surface integrity. Dedicated settings such as HyperCut, SuperSpark™ IV and ArcFree empower the operator with practical tools to accomplish a wide variety of work.

But it was Makino's Hyper-i control system and familiar interface that attracted WET.



Equipped with proprietary HyperCut, SuperSpark IV, HQSF and ArcFree technologies, the EDAF3 has improved surface quality to 0.4 Ra, eliminating the need for most secondary polishing.

"We didn't want antiquated control technology. We wanted to maintain our technological superiority. We want to be at the forefront of manufacturing and to push ourselves."

The Hyper-i control contains intelligent, intuitive and interactive functions that are streamlined to assist the operator in every step of the machining process. It also enables easy access and selection of power settings to produce the most accurate results with the fastest possible cycle time. By providing answers to simple prompts, and inputting basic data, even novice operators can generate efficient burn routines. Operators of all experience levels also can benefit from the control's E-Tech Doctor, a software feature that gives guidance for adjusting cutting conditions to create the intended result. E-Tech Doctor offers machine-setting optimization in sinker EDM applications to help reduce cycle times, improve surface finish and enhance form accuracy.

"You don't have to run to a computer or dig up a manual to find answers. The control helps you solve problems at the machine as you are readying your processes. The on-screen tips also help you achieve shorter burn times and better quality with preconfigured settings," Syzmel said.

The Hyper-i interface uses touch-screen functions of tap, drag, swipe, pinch and spread to navigate software features. Gesture control gives the interface a simple and natural feel that is comfortable and efficient. More important, the Hyper-i control enables a basic user to do more with logical and easily utilized functions that equal the productivity and capability of an experienced operator. This ease of use was important to WET to help its operators learn EDM programming. In addition, the control enables WET to run EDM processes overnight and during weekends with an operator remotely logging in to the control to check on a job's status. Unattended burn times reach 10 hours for some of WET's parts, and Syzmel can log in remotely to check on the status of work.

Pickup cycles or a tooling probe are preprogrammed so even novice operators can easily learn to use the system, which includes hyperlinked information and training tools embedded in the machine control. When operators press cycle start, they can be confident the EDAF3 is going to do what they need it to do. The EDAF3 machine utilizes advanced Z-axis jump motion control to create a hydraulic effect that efficiently evacuates and flushes debris from the cut zone, allowing for improved part quality and greater unattended operation by eliminating the need for manually adjusted flush lines.

CUTTING THE COST FROM LOW-VOLUME PARTS

WET's team not only designs water features but also manufactures the valves and nozzles along with electrical fixtures that transform the fountains into entertaining spectacles of light, sound and motion. Some parts are standard with volumes as large as 4,000 pieces and are often used in WET's projects. Other parts are uniquely designed for specific applications. In both cases, there are big opportunities to produce the parts faster and for less cost by bringing the EDM processes in-house, Borrego said.

> "The simple machine interface, customer support and overall knowledge base that Makino has with their technical staff far supersede anyone else on the market."

Producing precision parts is a top requirement for WET, and the company chose the EDAF3 because it's equipped with HQSF™ (High-Quality Surface Finish) capability and a Z-axis stabilizer, another function critical to enabling WET to consistently produce the tolerances and surface quality the company's designers specify. The HQSF technology allows WET to achieve finer surface finishes with less cycle time, and the Z-Stabilizer function brings a core-cooled ballscrew that delivers 1-micron level Z-Depth tolerances even during high-speed jump motions. Since bringing mold-making in-house, WET has improved surface quality to 0.4 Ra, eliminating the need for most secondary polishing operations on lens molds.

"These are optical quality lenses. Light that's several thousand foot-candles is required to make these amazing shows, so the lenses have to be as clear as possible," Borrego said.

When mold work was outsourced, final molded components had cost $3 to $4 each; some cost as much as $12 each. By adding the EDAF3 to make the molds in-house, WET lowered the cost of some parts to $1 each, and the most expensive parts now cost $4 each. As a result, Borrego projects a return on the company's investment in the EDAF3 to be achieved in less than two and a half years.

"From a cost perspective, on every job, we're saving thousands of dollars in outside EDM work," Borrego said.

Now, WET is working on how to shift the materials and processes it uses for valves and nozzles. The company has always cut features into these brass and acrylic parts using commodity vertical mills. Borrego is confident the company can save additional time and money by changing to plastic injection molding of the parts with molds made on the EDAF3.

MAKING WHAT MATTERS: CAPABILITY TO INNOVATE

What's important to WET is manufacturing molds for lighting and water control to a high degree of accuracy to meet a customer's schedule and other requirements.

"Makino has provided us the ability to do that. The simple machine interface, customer support and overall knowledge base that Makino has with their technical staff far supersedes anyone else on the market," Borrego said.

SST and Makino provided technicians who worked alongside WET operators for three days after installation of the EDAF3, teaching them the machine controls and working through programming processes for each application. The detailed, hands-on support enables WET to realize another goal for its investment in a precision sinker EDM machine: adding the capability to invent new ways of creating grand experiences.

"A lot of our molds before were really simple in design because we were limited by CNC machining, and we had to make sacrifices on tolerances. With sinker EDM, our molds are getting more complex, which means we're able to build more beautiful products or more complex geometry—things we hadn't really thought about until we started taking a look at EDM technology," Borrego said. "Now, the capability of the EDAF3 and some of the things that Makino brings to the table allow us to make precision parts that we haven't even thought of yet."

VIEW THESE WEBINARS:

- New Sinker EDM Technologies
- The Hyper-i Control Revolution

>> Go to makino.com/library

FEATURED STORY

AUTOMATION OF MILLS AND EDMs RESHAPES SUMMIT TOOLING'S MOLD MAKING

View additional video content at moldmakermag.com/summit

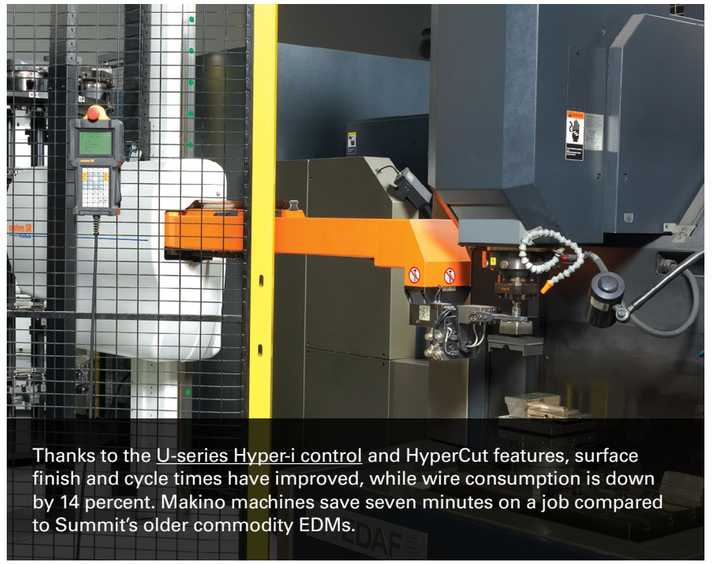
Visitors to Summit Tooling in McHenry, Ill., can expect to see 24/7 unattended machining. That's unusual in mold-making shops but not at Summit, where it's become routine.

Robots load and unload tooling and workpiece fixtures in three manufacturing cells, feeding nine machines, including a graphite mill, vertical mills, and sinker and wire electrical discharge machines (EDMs). As a direct result, production has doubled, with the same number of employees. The first cell paid for itself in six months.

What's not so obvious to visitors is the partnership Summit Tooling President Dan Martin has built with Makino as its supplier of the machine tools and engineering services used to implement these complex automation systems.

Among die/mold shop owners, automation has been viewed as expensive, complicated and better suited for higher-volume production of milled parts. Owners visiting Summit Tooling often tell Martin that their traditional, manual processes with an operator in front of every machine are needed to produce the complex shapes and tight tolerances of prototypes, small orders for unique molds, as well as cavity and component repairs. Martin and his team chose another way.

"The reality is that, had we not automated our mold-making operations, we would not be in business," Martin said. "Automation is hugely instrumental in our profitability and our ability to succeed in the tough times our industry has had during the past several years."



Thanks to the U-series Hyper-i control and HyperCut features, surface finish and cycle times have improved, while wire consumption is down by 14 percent. Makino machines save seven minutes on a job compared to Summit's older commodity EDMs.

COMPETE BY DELIVERING FASTER

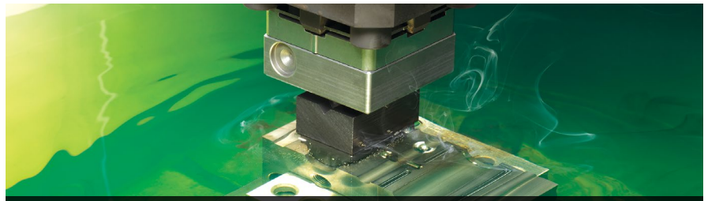
Summit Tooling, founded by Martin and his wife, Michelle, in 1996, designs and manufactures precision prototypes and production molds for a variety of applications including over-molds, two-shot injection molds, insert molds, spin cavity technology, hydraulic core pull technology and thin-wall molds. Customers range from medical, pharmaceutical, consumer packaging, automotive markets and electric utilities.

The company grew from one employee 21 years ago to 30 employees today by investing in the latest machining technologies and continuously adopting processes that enable Summit Tooling to produce the most challenging small to midsize plastic injection molds.

Summit Tooling competes with manufacturers around the world that offer lower labor prices, and the company is also challenged by customer requirements for increasingly complex mold designs with tighter tolerances along with demands for shorter lead-times and reduced costs. To meet customers' needs and remain profitable, Martin said Summit Tooling must reduce labor and consumables costs, speed up delivery and repeatedly produce precise tolerances and complex mold features.

"Customers today are looking for good quality. That's No. 1. If you don't have good quality, you won't be in business. No. 2, the price is a factor. Obviously,

we're dealing with overseas competition and we need to lower our costs. No. 3 is the biggest factor: How fast can I deliver my product to market?" Martin said. "Automation is the only way you can deliver faster. Time is money. We've all heard that saying, but in this instance, even the time that our employees are not here we're still producing parts. That unattended run time is the obvious reason why we can deliver things much, much faster."



The EDAF2 with a fine-hole option enables the machine to change 0.0039-inch-diameter-by-12-inch-long pipe electrodes with its automatic tool changer, completing special automatic dressing routines as small as 0.00024 inches in diameter.

"The first thought for many of our die/mold shop employees was, 'You're trying to eliminate our jobs.' No, we're making your job more efficient so we can push more work through here and make more money with the same number of people. That's the goal."

What matters most to Martin is that the family-owned business stays on the cutting edge of technology to deliver plastic injection molds and mold components faster than its competitors. To accomplish that, Martin began investing in the first of his company's 11 Makino machines in 2008. Shortly thereafter, in 2011, he enlisted the support of Makino's automation and engineering services to integrate the company's first fully automated EDM cell.

The company has doubled its sales while continuing to run one shift and keeping the same number of mold shop employees. To accomplish this, Summit integrated its EDMs and horizontal and vertical machining centers with System 3R material-handling systems that robotically load and unload electrodes and workpiece-holding fixtures. Summit Tooling has also increased productivity by replacing older commodity machines that required operators' continual attention. Machinists can now manage several manufacturing cells simultaneously, as well as take on new roles in the company's growing plastic injection molding operation. Operators set up automated cells and then go operate laser welders and other machines during their shift while the cells run unattended.

Martin researched and met with a variety of mill and EDM suppliers, seeking not just a machine manufacturer but also a partner to play a strategic role in how Summit Tooling would grow. He selected Makino because "they are not just a machine-selling company."

"They want us to succeed with their products," Martin said. "Their partnership has been an essential part of our growth strategy, and without their support, I'm not sure that we'd have had such immediate success."

COMPLETE MORE JOBS WITHOUT INCREASING LABOR

To win new business, Martin chose to update machining capabilities and to automate mold-making processes. Beginning in 2008, Summit Tooling purchased an a61 horizontal machining center and two S33 vertical machining centers from Makino. Martin did not invest in full automation of loading and unloading of tooling, parts and fixtures at this point "because I'm a conservative person, so I tend to move cautiously." Nevertheless, Summit Tooling replaced 12 commodity milling machines with the three new Makino machines because of a host of tool monitoring and control capabilities, all equipped as standard features, that enable users to achieve extended machining hours with no labor costs.

The a61, for example, came with a ring-type 60-tool magazine and has an automatic pallet-changer and two pallets, for a fast pallet-change time of 7 seconds. In addition, it offers a tool-to-tool change time of 0.9 seconds with a chip-to-chip time of 2.5 seconds.

To reduce setups and maximize machine utilization, the S33s came equipped with a 20-position magazine and automatic tool-changer (ATC). The ATC has a quick tool-to-tool exchange time of 1.3 seconds. The S33s and the a61 included Makino's proprietary SGI geometric intelligence servo control to provide exceptionally smooth machined surfaces—even in high-feedrate machining operations. This feature helps achieve the lowest cycle times and smoother blending by controlling toolpaths to create the 3-D shapes of dies, cavities and cores.

"Most machine-tool suppliers will sell you a product and then they're asking you when you want to buy the next machining center. [Makino] is concerned with how efficient you're using the machine you invested in, and are you using the machine to its utmost potential to grow your business."

"We learned that the same volume of work could be done with automated equipment without having a person standing at each machine. Operators can set up the cells and then are available for other operations that still require a hands-on operator, such as surface grinding. We can push more volume of work through there, and the people who would have been operating the older machines can focus on hand operations. The volume of work would go through faster," Martin said.

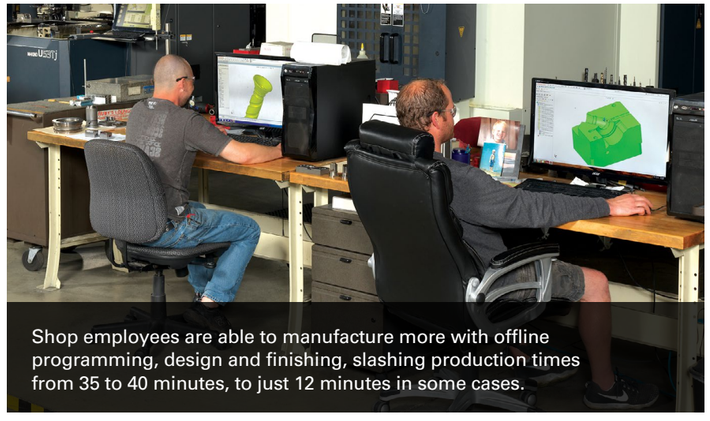
These early steps toward automation involved purchasing machines with advanced controls that support unattended operation with automated tool-changers; the a61 included dual pallets, enabling operators to load workpieces while keeping the spindle running to machine other mold components. How well the machines performed on their own led Martin to consider ways to organize them into manufacturing cells. For the next step, Summit Tooling added to one of its existing commodity EDMs a System 3R material-handling robot recommended by Makino. This freed up the operator to handle other tasks, including micro welding for repairs and tooling alterations, while keeping up with EDM production.

Martin's bigger step toward full automation came in 2011, when he hired Makino to integrate an EDM cell that includes a Makino F3 vertical graphite machining center, with a pressurized system to vacuum out carbon dust for high-speed electrode milling, and two EDAF2 sinker EDMs for production of slides, core pins, cores, cavity details and cavity-forming shapes. A larger System 3R Workmaster system feeds tooling and workpieces to each of the machines.

"When we added the cell, it changed how we do things enormously," Martin said. "Our guys now set up everything, walk out of here and come back the next morning, and everything they programmed is done while we were sleeping. It takes a change in mindset to get used to that thought, especially when we set up the machines and leave on Friday and come back on Monday morning and realize we just ran 72 hours' worth of work through three machines and none of our employees were here."

The company has since added two more automated cells that include:

- A milling cell with a Makino F5 vertical machining center installed in 2013 and the two S33 vertical machining centers purchased in 2008, integrated with a second System 3R Workmaster. This cell replaced nine commodity vertical mills.
- A second EDM cell installed in 2014–2015 combines two U32j and a U53Tj wire EDMs from Makino, loaded and unloaded by a third System 3R Workmaster.



Shop employees are able to manufacture more with offline programming, design and finishing, slashing production times from 35 to 40 minutes, to just 12 minutes in some cases.

The U32j and U53Tj wire EDM machines feature Makino's new Hyper-i control that provides a user-friendly interface between the operator and the machine with a streamlined touch screen. Using familiar technologies found on smartphones and tablets, the Hyper-i control has pinch, swipe and spread functions that give the operator a simple, efficient and natural feel. The simplicity is further enhanced with the integration of on-board digital manuals, intelligent E-Tech Doctor help functions and e-learning training system, which give operators practical support tools to boost machine productivity.

The Hyper-i control includes HyperCut technology that can produce a 3µmRa (16µinRa) surface finish and 1µm (0.00004 inches) straightness with three-pass machining. HyperCut also reduces cycle time. After installation of the first U32j, Summit Tooling tested it against one of its older commodity EDMs by running a job that previously took 12 minutes. A Summit Tooling operator produced the same part, running the same program used on the older machines, in less than five minutes. Wire consumption is down by 14 percent.

"Our previous EDM machines were five to seven years old. We want to stay ahead of the technology curve, so we invested in Makino EDMs because they utilize less wire, give better finishes and enable us to produce parts faster," Martin said.

To provide flexibility in how the automated cells can be configured, one of the reasons that Martin chose the U32j and U53Tj EDMs was their programmable work tank and ergonomic access to the work zone. The automatic rise-and-fall tank simplifies loading and setup of the workpiece while supplying access to robotic loaders from three directions.

Summit Tooling also produces mold components with the a61 HMC and another EDAF2, both operated as stand-alone machines.

MYMAKINO.COM PUTS MACHINE HISTORY, TUTORIALS AT OPERATORS' FINGERTIPS

After working closely during the past nine years with Makino engineers and service technicians to integrate automation into Summit Tooling, company President Dan Martin thought he'd seen all of their surprises.

Then he logged into MyMakino.com for the first time and discovered how much Makino really knew about his die/mold shop's business.

"I was floored by what is in there. I saw all of my machinery listed by serial number, all of the maintenance records and purchase dates. It's more detailed information than we carry in our accounting system," Martin said. "We have 11 machines, and that's a lot to keep up on for maintenance and when it's time to change a filter. My Makino.com helps us keep track of all of that."

Just as important to Martin is the information MyMakino.com provides to his operators and engineers. At their fingertips are operation manuals, tutorials and replacement parts lists. The web portal offers answers to frequently asked questions and other technical advice about cutters.

Martin shared the digital experience with his employees, giving them password access to learn more about the status of the machines they operate and especially the instructional information about machining techniques.

Makino customer service representatives recently visited Summit Tooling and shared their plans for enhancements to MyMakino.com. Among them are preventive maintenance features, for example, that anticipate when a filter needs to be changed and then alerts shop employees and service technicians.

"The thing I'm most excited about is that they're going to help me monitor every single piece of equipment that I have on the floor," Martin said. "Makino is helping me make sure we have the pieces, products and items needed for those machines and to make sure they get taken care of before a problem occurs. That's an incredible tool."

Working toward full automation, Summit integrated a System 3R Workmaster into an EDM cell that consisted of an F3 graphite machining center and two EDAF2s to produce slides, core pins, cores, cavity details and cavity-forming shapes.

"Makino is helping me make sure we have the pieces, products and items needed for those machines and to make sure they get taken care of before a problem occurs. That's an incredible tool."

FAST PAYBACK ON AUTOMATION INVESTMENT

Martin said his company realized a full return on its investment of its initial automated manufacturing cell in about six months after installation. That led Summit Tooling to add a second EDAF2 EDM with a fine-hole EDM drilling option to the cell in 2012 to produce high-tolerance small-hole tooling features. The fine-hole machining option makes it possible for the EDAF2 to change 0.0039-inch-diameter-by-12-inch-long pipe electrodes with its ATC. Special automatic dressing routines are also capable of discharge dressing electrodes as small as 0.0035 inches in diameter, which can produce finished hole sizes of 0.004 inches in diameter using the EDAF2 fine-hole option.

"We have two customers that use Nano injection molding for surgical applications. You need a microscope to see the parts. Some are 0.125 inches long, and 0.003 inches in diameter. The fine-hole option allows us to produce holes smaller than 0.012 inches, which is a typical practical limit using traditional hole-popper EDM machines. The difference with the EDAF2 is that the holes it produces are the perfect size and straightness," Martin said.

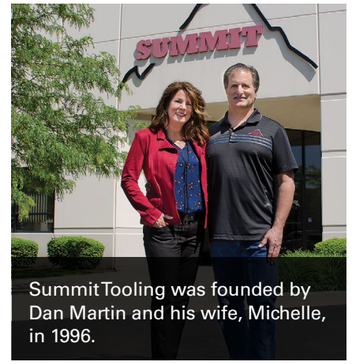
With three machines being loaded and unloaded robotically and running unattended overnight and on weekends, Summit Tooling has dramatically improved delivery times while increasing productivity 30 to 40 percent.

Since 2008, sales have doubled while Summit Tooling has kept its die/mold shop employment steady at 16 operators, programmers and engineers. Operators program and load the three manufacturing cells to run unattended overnight and on weekends to increase productivity and finish orders faster. Reduced labor costs realized by investing in automation and reliable high-performance machines enabled the company to further diversify its services by adding employees to the company's growing plastic injection molding business. Total employment in the company's mold shop and plastic molding divisions has increased from 22 in 2008 to 30 today.

"The first thought for many of our employees was, 'You're trying to eliminate our jobs.' No, we're making your jobs easier and more efficient so we can push more work through here and make more money. That's the goal. It's all about staying competitive and bringing in the revenue to provide good-paying jobs. And there's simply not enough qualified labor to grow otherwise," Martin said.

Next up in Summit Tooling's drive to automate its manufacturing: Martin plans to add a third EDM cell to increase capacity while providing backup to avoid any disruption to delivering molds and components on time to customers.

Martin credits the business growth and increased productivity to his partnership with Makino and SST, which sells Makino machines along with consumables, tooling and fixtures. Both suppliers continue to recommend ways to improve Summit Tooling's manufacturing processes, technology and programming. For one hard-milling operation of a mold component made from grade 420 stainless steel (56 HRC), Summit Tooling previously needed 35 to 40 minutes to make light cuts to finish the part that had already been rough-cut elsewhere. Unsolicited, a Makino applications engineer visited Summit Tooling to demonstrate how the use of a different cutter and programming technique could help optimize productivity. The result: Summit Tooling now produces the entire part from blank stock in less than 12 minutes.



Summit Tooling was founded by Dan Martin and his wife, Michelle, in 1996.

"Most machine-tool suppliers will sell you a product and then they're asking you when you want to buy the next machining center," Martin said. "Makino instead asks, 'How are you doing with the machine you just bought? Can we help you with cutter technology? Can we help you with cutter techniques? Is there a clamping apparatus or another process that you can utilize to speed up production?' They are concerned with how efficient you're using the machine you invested in, and are you using the machine to its utmost potential to grow your business."

VIEW THESE WEBINARS:

- Die/Mold Automation: Achieving 80% Machine Utilization Rates Through Systemic Planning, Scheduling and Management
- Rethinking Processes, Realigning Work Flow Milling and EDM

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MOLD-MAKING IN FULL 5-AXIS WITH

D200Z VERTICAL MACHINING CENTER

Imagine if you could simultaneously achieve faster machining speeds and higher utilization rates in your most complex tool, die and mold, and medical applications. Consider the game-changing impact this would have on your capacity, part costs and bottom line.

The Makino D200Z 5-axis vertical machining center conquers the complexities of multifaceted, contoured 3-D geometries with precision, full 5-axis machining capabilities. From roughing to high-speed finishing, the machine boosts productivity by combining the quickness of machine movements and accuracies with the latest software developments for high-precision, high-speed motion control.

D200Z AT A GLANCE

SIZE (DIAMETER)	300mm
MAXIMUM WORKPIECE SIZE (DIAMETER X HEIGHT)	300 X 210mm
MAXIMUM PAYLOAD	75 kg
AXIS TRAVELS (X, Y, Z)	350mm X 300mm X 250mm
AXIS TRAVELS (B, C)	180° (0° TO +180°) / 360° (continuous rotation)

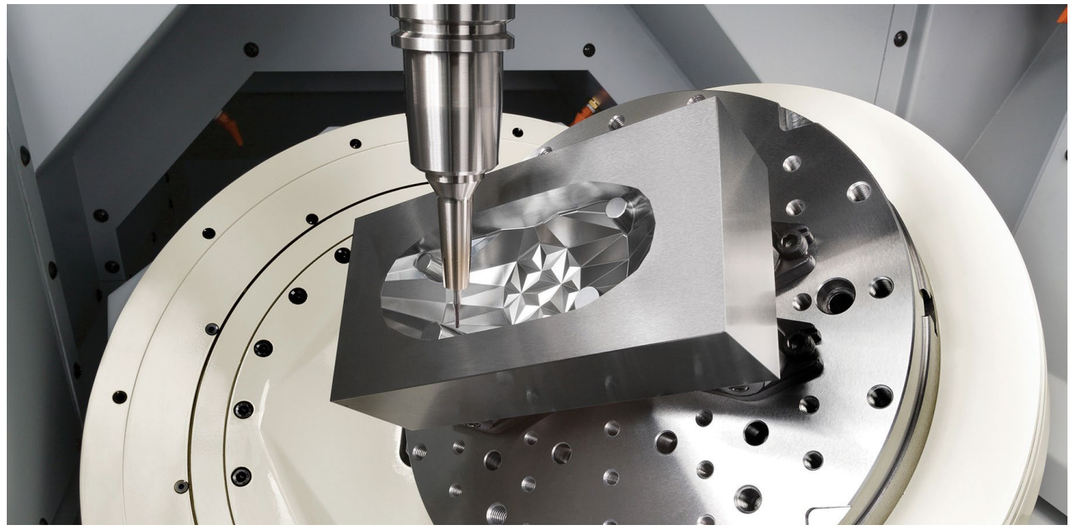
COMPREHENSIVE CONTROLS, EASY-TO-USE INTERFACE

Complementing the robust mechanical features and capabilities of the D200Z machine design is the powerful, yet intuitive, Makino Professional 6 (Pro6) control. With streamlined screen layouts, operator assistance features and new machine functions, Pro6 delivers a seamless interface for operators to maximize productivity.

Included within the Pro6 control is Makino's proprietary, next-generation Super Geometric Intelligence (SGI.5) software—developed specifically for high-feedrate, tight-tolerance machining of complex 3-D contoured shapes involving continuous tiny blocks of NC data. With SGI.5 enabled, mold makers can expect precision accuracy and fine finishes while simultaneously reducing cycle time by 20 to 60 percent, depending on the specific geometry of the application.

A Makino proprietary data center offers easy, flexible program and data management, and enhanced networking capability. The data center is the single source for all files on the machine and network, able to run directly from memory, internal/external card, full direct numerical control (DNC) or from a network.

Also featured on the D200Z is Makino's proprietary Collision Safe Guard technology—a 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, Collision Safe Guard is able to predict and stop the machine prior to collision, protecting investments in the machines, fixture, tooling and workpiece.



"With many mold manufacturers strained for capacity and challenged to keep pace with new design changes, all while minimizing costs, the need for high-performance 5-axis machining has never been more critical," said William Howard, vertical product line manager at Makino. "The speed and precision of the D200Z deliver a unique foundation for responsive, high-speed cutting and outstanding surface finishes that reduce or eliminate handwork. Its 30,000-rpm spindle and integral direct-drive table provide quick, precise, full 5-axis machining. All of this capability is tied together with Makino's proprietary SGI.5 motion control software for the highest degree of accuracy and quality in the blends and matches of intricate surfaces and 3-D accuracy requirements typical of today's die, mold, medical and intricate-geometry components."

The robust speed and precision of the D200Z have been strategically designed into a compact unit (1500mm wide by 2220mm deep) for efficient use of floor space. The main body of the machine incorporates all machine elements and peripheral equipment, including both the standard 20-tool capacity automatic tool-changer (ATC) and the optional 40-tool ATC. This design enables mold shops to expand capability without loss of floor space. Additionally, the D200Z has adopted a compact housing for the B and C axes that features a unique, lightweight tilting structure with 180 degrees of tilt capability at 100 rpm and 150 rpm, respectively. Direct-drive motors for both axes yield agile, accurate, high-speed, responsive angular and rotational operation.

To enhance overall process stability, the D200Z is designed with a rigid base construction and several thermal-control technologies. The machine's 30,000-rpm HSK-E50 spindle is designed with a high-tech spindle core and jacket cooling system to tightly control thermal growth, deflection and vibration during high-speed machining operations. Together, these features enable mold makers to extend tool life and achieve exceptional surface finishes even in applications requiring fine tool blends and matches.

An integrated pallet chuck reinforces the stiffness and rigidity of the machine tool, all while ensuring efficient workpiece changeover speed and full usage of work zone and workload capacities. Additionally, this design has a common pallet interface that can be readily integrated into a variety of automated cells and systems prevalent in today's tool, die and mold, and medical shop environments.

The D200Z can also be configured with a graphite machining package to deliver high-speed, exceptionally accurate and very productive 5-axis production of graphite electrodes.

LEARN MORE

See the full 5-axis machining capabilities of the D200Z.

>> makino.com/D200Z

TRANSFORM YOUR SHOP

WITH PRONETCONNEX INDUSTRIAL INTERNET OF THINGS INTERFACE

Makino's new ProNetConneX offers manufacturers a built-in, instant on-ramp to the Industrial Internet of Things (IIoT), with secure connectivity to today's leading business management systems via the MTConnect standard.

ProNetConneX provides the data and connectivity necessary for intelligent factories to rapidly respond to fluctuating market demands. As a machine interface, ProNetConneX connects and collects machine data in the MTConnect data standard format within a shop's network for use to improve productivity and efficiency.

Digital connectivity and integration are bringing manufacturing operations out from behind the curtains and into enterprise planning, scheduling and product life-cycle systems. Makino introduced ProNetConneX to provide simple and secure transmission of machine information across connected devices on the factory floor. Secure connectivity is achieved through Cisco's Connected Machines Solution with accessibility to today's leading software management systems via the MTConnect standard.

With machine monitoring and connectivity, ProNetConneX is able to integrate machine data within enterprise resource planning (ERP) systems in ways that enable business leaders to make better-informed decisions and control their manufacturing operations in real time.

INTEGRATED IN ADVANCED MACHINE CONTROLS

ProNetConneX facilitates the free flow of machine data for intelligent factories with software built into Makino's machining centers. Capabilities are highlighted below:

- Real-time data collection and accessibility
- Machine health monitoring
- Cloud data collection either locally or via the internet
- Secure local network and cloud-based systems connectivity
- MTConnect v1.3 compliancy

Unlike other IIoT machine interfaces, ProNetConneX is fully integrated into Makino's latest machine controls. Additional machine sensors can be installed within machines and added to ProNetConneX to expand data-collection capabilities based on each shop's unique manufacturing needs.

COMPATIBILITY AND CONNECTIVITY VIA CISCO AND MTCONNECT

Makino engineers helped to develop MTConnect as the industry standard for communication between machines and devices on the factory floor. Compatibility with the latest MTConnect standards enables ProNetConneX to connect with a company's choice of business management systems.

ProNetConneX easily integrates with solutions from Memex, Scytec, Lemoine, Freedom eLog, Forcam and many other leading providers. For example, using ProNetConneX, machine data can be supplied to Forcam for part production monitoring, control and interfacing to MRP/ERP systems.

Data security and cloud services are enabled in cooperation with information technology (IT) leader Cisco. Developed to support industrial fog computing environments, Cisco's Connected Machines Solution enables rapid and repeatable machine connectivity for real-time data monitoring and management. ProNetConneX uses a Cisco Industrial Ethernet (IE) 4000 Series switch to stand up to the most abrasive environments and protect equipment and internal networks from security threats. This system provides a familiar platform for IT technicians to quickly and easily navigate network security settings.

MAXIMIZE PRODUCTIVITY WITH MPMAX

Also compatible with ProNetConneX is Makino MPmax, a real-time machine process monitoring and data management solution. Developed to support manufacturers in optimizing machine processes, MPmax includes spindle load, speed and vibration monitoring analysis tools and capabilities not available in any other software platform.

When combined, ProNetConneX and MPmax enable manufacturers to optimize the efficiency of their manufacturing operations and get the most out of machining investments.

To monitor critical processes across a variety of machine platforms, MPmax has data-management capabilities to track the following key machine performance indicators:

- Status monitoring
- Utilization monitoring
- Alarm analysis
- Spindle and axis monitoring
- Tool data management
- Probe data analysis
- Camera monitoring (optional)
- Power-consumption monitoring (optional)

LEARN MORE

Discover Makino's ProNetConneX and other IIoT solutions in Makino's webinar, "Onboarding to the Industrial Internet of Things."

>> makino.com/webinar-iiot

SGI.5 DELIVERS UNMATCHED SPEED, HIGH FEEDS AND TIGHT ACCURACIES FOR COMPLEX APPLICATIONS

Super Geometric Intelligence 5 (SGI.5), the latest evolution of Makino's advanced motion control, enhances the performance of machining centers in complex contoured, 3-D tool, die and mold applications.

The proprietary software and motion control/servo technology shortens machining time and excels at high feedrates and higher spindle speeds, resulting in greater productivity.

SGI.5 facilitates previously unachievable levels of accuracy and unprecedented reductions in cycle time. It's available as a standard feature on the latest Makino horizontal and vertical machining centers. Depending upon the specific geometry of an application, SGI.5 can provide 20 to 60 percent faster cycle times while maintaining accuracy and surface finishes.

RUN FASTER AND MORE ACCURATELY

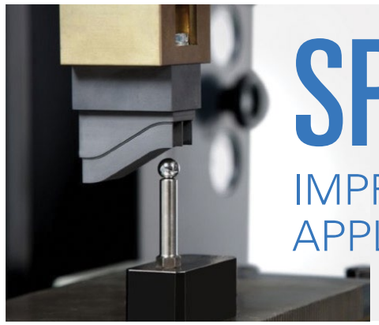
Faster and more accurate production begins with the outstanding kinematics of Makino machining centers and the superior performance and tuning of the machine drive systems. SGI.5 combines these strengths with the latest advancements in servo drive technologies. The results on either vertical or horizontal machining centers: SGI.5 produces unmatched speed, high feeds and tight accuracies when executing NC programs with micro-blocks whose traverse movement value is 1mm or less.

In high-performance milling applications featuring complex 3-D, curved surfaces, the software and servo controls move the tool accurately and smoothly. On-the-fly, three-dimensional compensation enables the machine to precisely track programmed toolpaths on intricate mold contours, feature blends and matches — even at five times or more the feedrates of conventional large machines.

To meet demands for critical surface qualities, operators of Makino machines can engage SGI.5 to produce better surface finishes with minimal cutter deviation transitioning from one cutter path to another, oftentimes within a 3µm step between machined surfaces. SGI.5 also enables operators to improve the accuracy of small-feature details in molds for medical components and automotive lenses. These technologies combine to virtually eliminate, or significantly reduce, final handwork of complex contoured surfaces. This reduction in handwork enables manufacturers to shrink lead-times and redeploy staff to other processes, further increasing overall productivity and slashing costs.

As a result, SGI.5 delivers the following benefits:

- Improved productivity with higher feedrates
- Tighter tolerances in complex geometric features
- Significantly reduced cycle times
- Increased profitability



SPEED UP SETUP,

IMPROVE ACCURACY OF ALL EDM APPLICATIONS WITH PROBING

By Brian Pfluger, EDM Product Line Manager at Makino

Manufacturers and shops of all sizes use probing technologies to reduce part setup time and validate accuracy for a wide variety of applications for wire, sinker and drilling electrical discharge machining (EDM).

Probing is an automatic machine cycle that establishes workpiece or electrode alignment data within the machine. In a recent webinar, I introduced the different standard and optional methods, discussed the advantages and disadvantages of the various probing technologies, and offered recommendations on how probing could improve EDM processes.

In traditional milling, in-machine probing entails the use of a coordinate measuring machine (CMM)-style touch device, but this does not hold true for EDM. Instead, EDM machines can probe and establish location data using electrical touch sensing with an electrode (or the working tool), and most EDMs offer options for traditional CMM-style touch probe systems, too. Workpiece data can be determined for location and feature size as well as the electrode size. The data can be used to establish a work coordinate system (WCS) value, or origin point, from which all work is based. In addition, this data can be used to calculate 2-D and 3-D offset values.

RELY ON WIRE TO PROBE BEFORE BURNING

For wire EDM applications, the wire itself can be used as a probe to establish workpiece locations and feature size, including workpiece rotation conditions. In order to establish reliable pickup accuracy using the wire, the workpiece must be clean and free of debris and burrs, and the wire itself must be clean and of high quality. Premium hard brass wire will generally provide the best pickup accuracy, as the special coatings used on most high-speed coated/stratified wires degrade pickup accuracy.

Most of the probing cycles to pickup locations can be incorporated into a program's NC G-Code to automate production applications. On the Makino Hyper-i control, 12 probing cycles are preset, making them quickly available in the control's main menu. To simplify setup operations, each probing cycle includes convenient how-to directions for the operator from the Hyper-i control's touch screen. The measurements from each pickup cycle can be recorded and exported out of the control in a Microsoft Excel format for statistical process tracking purposes.

Makino also offers a touch-probe option, which employs a high-accuracy Renishaw MP250 probe head. The probe is manually loaded and unloaded on the same centerline as the wire, enabling the probe to reach all areas within the machine stroke. All measurements captured by the probe system calculate an offset value within the machine based upon a calibration process between the probe and wire center line.

IN SINKER EDM, RELY ON SPINDLE AND TABLE BALLS

Just like on a wire EDM, the actual electrode on a sinker EDM can be used to probe the workpiece location and dimensions. However, this method may not produce precise measurements, because the larger surface area of the electrodes makes them prone to inaccuracies caused by any debris between the workpiece and electrode in the work tank.

Use of a spindle ball tool holder is highly recommended for workpiece setup probing. The smaller contact area of the spindle ball makes this method faster and more precise. A table ball within the work tank is also recommended to probe the electrodes.

Sinker machines establish offset and location data between the workpiece and electrode through a correlation measure cycle between the spindle ball and table ball. The spindle ball is used on the Z-axis to establish workpiece locations as well as workpiece and feature sizes. The table ball measures electrode offsets and locations within the machine. Makino's Hyper-i control can record and export this data for statistical process tracking, and provides helpful videos and tutorial information on the operation and function of each pickup cycle to aid the operator in applying these timesaving features.

HOW TO IMPROVE EDM DRILLING PROBING ACCURACY

EDM drilling machines can use the same spindle ball and table ball tooling and preset pickup cycles as a sinker EDM to establish workpiece locations.

A spindle ball probe is recommended for establishing workpiece locations and alignments because using the actual small-diameter electrode tube is unreliable due to movement and bending of the electrode the farther it is extended away from the die guide. The spindle ball tool holder can be a rigid probe or touch-probe system that is loaded and unloaded by the machine's automatic tool-changer (ATC).

The table ball setup for EDM drilling uses a half-ball diameter for faster, more accurate electrode tube pickups. This configuration minimizes the distance the small-diameter electrode is extended from the die guide and also allows for easier Z-depth and electrode length alignment.

PROS AND CONS OF EDM PROBING

PROS	CONS
Capture 2-D and 3-D workpiece data in some applications.	Most in-machine probing capabilities are limited to capturing single data points and do not support 3-D scanning that full-blown CMMs provide.
Reduce setup time in many applications by probing in the work tank.	The time required for in-machine probing is time the machine is not adding any value to the part. Integrated offline CMMs should be considered for high-volume production applications.
Improve and validate accuracy of workpiece location and dimension measurements.	Debris in the work tank or on an electrode and poor workpiece condition can result in inaccurate probing measurements.
Deliver regular correlation with master inspection device or calibrated standard.	On-machine part inspection is one method to validate quality before removing the workpiece from the machine. This does not eliminate the need for final part inspection per ISO standards, but this machine data can be used as part of the overall quality standard system.
Record and track data for statistical process control.	

SUMMARY OF EDM-PROBING TECHNOLOGIES

By watching the full webinar, you'll gain a deeper understanding of the different probing capabilities for wire, sinker and drilling EDM applications.

In-machine probing offers many attractive advantages for manufacturers of all sizes by reducing setup time and providing more precise measurements of workpiece location and dimensions. I recommend using probing, especially when an EDM comes equipped with controls such as Makino's Hyper-i, which provides preset cycles to simplify the probing and workpiece setup process.

LEARN MORE

Find out about Makino's EDM-probing technologies that reduce setup time for a wide range of applications from traditional die/mold parts to aerospace and gas turbine blade and vane details.

>> makino.com/webinar-EDM-Probing

IMPROVE WIRE EDM PROFITABILITY BY USING COATED WIRE

By Brian Pfluger, EDM Product Line Manager at Makino

Special exterior coating on wire for electrical discharge machining (EDM) enhances the wire's capability of handling higher machining power without breaking. Let's take a look at the most common types of coated wire and compare their enhanced performance capabilities to standard brass wire.

Here's my take on the advantages and disadvantages of coated wire—plus how to justify the cost of coated wire operations.

WHAT IS A COATED OR STRATIFIED WIRE?

Coated wire has a special outer layer that enhances EDM performance.

Coated wire contains either a copper or brass core. There are different types of coated wire, and while their coatings all involve a high-zinc-content brass alloy, the enriched zinc layer thickness and how this layer is applied to the wire varies by coated wire type as well as the wire's intended application.

The special outer coating helps to preserve the inner core of the wire. The outer layer vaporizes more quickly than the inner core due to the higher zinc content, protecting the integrity of the inner core and minimizing wire breaks. It is through this protection that additional electrical power can be applied to improve machining speeds without seeing an increase in wire breaks when compared to standard brass wire.

WHAT ARE THE TYPES OF COATED WIRE?

Each type of coated wire is designed to provide specific machining performance improvements over standard brass wire at varying price points. The three most common coated wires used today are explained below:

- **Type-A** wire provides a minimal machining speed increase over brass wire, but it works more reliably with automatic wire threading (AWT) systems. Many EDM manufacturers recommend Type A to achieve the highest part quality and surface finish, especially on carbide materials. Type A, which as a distinctive, bright and shiny silver color that contains a single-layer of 110 percent zinc coating, keeps the rollers and components of the machine's wire drive system clean for reliable operation.

- **Type-D** wire increases roughing speeds by as much as 20 percent (or more), making it ideal for tall workpieces or poor flushing applications, while providing the same level of surface finish and accuracy capability as standard brass wire. The coating on Type D contains a modified zinc-enriched outer coating to cut faster than Type A. The distinctive dark brown color of Type D wire results from an outer layer of 50/50 split of copper and zinc.

- **Gamma-Phase** wire can achieve cutting speeds 30 percent faster than standard brass wire. Gamma Phase is an excellent choice to improve cycle times for both good and poor flushing applications. Gamma-Phase wire sometimes exhibits excessive flaking or produces a powdery residue on the EDM rollers due to the dull gray or gray-gold coating's relatively soft state. The AWT reliability of Gamma-Phase wire is slightly lower than that of standard brass wire.

HOW DO YOU JUSTIFY THE HIGHER COSTS OF COATED WIRE?

While the cost of coated wire is typically one-and-a-half to two times the cost of standard brass wire, coated wire provides a 20 to 30 percent increase in cycle times during roughing operations. That trade-off makes coated wire ideal for higher part volumes.

Many shops take a myopic approach to evaluating the use of coated wire by following a thought process of "if coated wire costs twice as much, but doesn't cut twice as fast, then it's not worth using." Although coated wire is more expensive, its higher productivity provides a greater billable shop rate, and almost always provides higher operational profit.

The business case for coated wire can be found in the additional billable machine time that is gained. Profit can be increased by as much as 19 percent. See an example in Figure 1.

The additional cost of using coated wire also can be justified by examining the manufacturing cost per part. The focus here is on the faster machining speed, as the same amount of work or number of parts is being machined in this calculation. The use of coated wire in this case, even with its higher purchase price, yields about a 20 percent lower manufacturing cost per part. See an example in Figure 2.

Whether you prefer the hourly shop rate or the per-part cost calculation, the bottom line is coated wire provides greater profit.

SHOULD YOU USE COATED WIRE?

If your workload is low, or you're considering fine-skimming operations, use standard brass wire for its economy. However, if your workload is high or you're considering roughing operations, use coated wire. The three coating types support greater machining speeds with fewer wire breaks. The potential to improve cycle times by as much as 30 percent will almost always offset the additional cost of coated wire.

LEARN MORE

Find out about the latest developments and applications for coated EDM wires. Multiple types of coated wires will be covered, along with their performance differences to standard brass wire.

>> makino.com/webinar-EDM-Wire

ADDITIONAL PROFIT BY IMPROVING CYCLE TIMES

	WIRE PRICE	OUTPUT	SHOP RATE	TOTAL PROFIT
BRASS WIRE (40 HOURS)	$6 PER LB. ($240)	100%	$60/HR. X 40 ($2,400)	$2,160
COATED WIRE (40 HOURS)	$11 PER LB. ($440)	125% (+10 HRS)	$60/HR. X 50 ($3,000)	$2,560 (+19%)

Figure 1

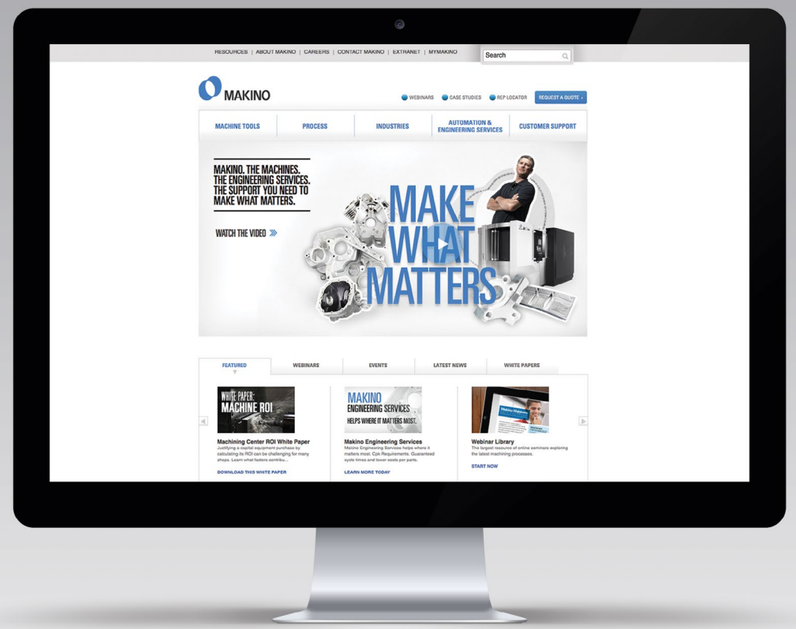
ADDITIONAL PROFIT BY REDUCING PER-PART COST

	WIRE PRICE	SHOP RATE	BILLABLE HOURS	WIRE COSTS	TOTALS
BRASS WIRE PART COSTS	$6 PER LB.	$60/HR.	2,080 HRS.	$12,480	$137,280
COATED WIRE PART COSTS	$11 PER LB.	$60/HR.	1,560 HRS. (25% FASTER)	$17,160	$110,760 $26,520/-19%

Figure 2

PROS AND CONS OF COATED EDM WIRE

PROS	CONS
Coated wire can achieve cutting speeds 20 to 30 percent faster than standard brass wire, thus increasing productivity.	Some coated wire can cause EDM machines to be less reliable.
The potential for wire breaks is significantly reduced when using coated wire.	Certain types of coated wire may degrade the reliability of an AWT system due to its different memory characteristics and tendency to flake or leave a powdery residue on components of the wire drive system, which can increase maintenance requirements.
Operational profit can be increased when using coated wire.	More machine maintenance is required when using coated wire.
Less wire will be consumed per part.	The purchase price per pound for coated wire is higher than standard brass wire.



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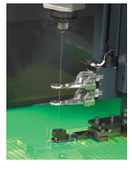

White Paper: Selecting the Appropriate EDM Technology for Hole-Drilling Applications

Read this white paper and more at **makino.com/whitepapers**

Video: Precision Machinery Drives Rapid Growth at Innovation Mold & Design

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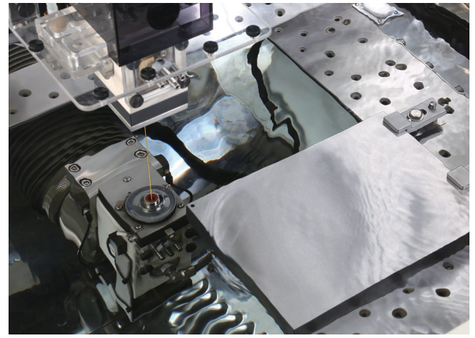
RECOMMENDED CLEANING SOLUTIONS FOR MAINTAINING WIRE EDMs



In this question-and-answer session with Brian Pfluger, EDM product line manager at Makino, we revisit a question we're frequently asked: What are the best ways to clean wire electrical discharge machines (EDMs)? Here's Brian's advice:

- Regular maintenance and cleaning are key to achieving reliable and repeatable results.
- As a general rule, try to use the most mild but effective cleaning chemical.
- All cleaning chemicals should be used sparingly within the machine.
- Apply the cleaning chemical to a shop rag rather than spraying it directly in the machine, which can cause contamination to the water, damage other machine components and overconsume the cleaner.

Q: What are the best cleaners to maintain my wire EDM machine?

A: We recommended a general all-purpose cleaner/degreaser (such as Simple Green).

When more aggressive cleaners are required, use an acid cleaner designed for EDM, such as HYP-R2S, previously known as K200, which is a phosphoric acid-based chemical. The concentration level of the EDM acid cleaner is specifically designed for the cleaning application without being too aggressive.

Q: What other cleaners can be used?

A: Here's our full list of cleaning chemicals to consider:

- HYP-R2S (K200) (aggressive)
- EDM cleaners (aggressive)
- Denatured alcohol or acetone
- General cleaners (Simple Green, 409, citrus-based surface cleaners)

Q: What safety precautions should be followed when using EDM acid cleaners?

A: **Proper safety is a must, and gloves and eye protection should be worn.** Be sure to read and follow the chemical's directions, as many cleaners come in highly concentrated form and require dilution with water.

Depending on the type of chemicals used, care should be taken when cleaning. Allowing cleaners to soak on some surfaces for too long may etch, bleach or damage surfaces.

Avoid getting cleaners on attachment points where power cables connect to the heads. Cleaners can act like a corrosive agent and degrade the power cables.

Wash and rinse all cleaned surfaces with water to neutralize any remaining chemicals.

Q: What chemicals should not be used?

A: It is important to use and apply the **proper chemicals to your cleaning tasks.** Commercial toilet bowl cleaners have no business being used on a wire EDM machine. These cleaners have too high of a concentration level for EDM cleaning needs, and sterilization is not an EDM requirement.

Q: How often should wire EDM machines be cleaned?

A: **Cleaning at regularly scheduled intervals** (weekly is recommended) helps prevent the buildup of heavy debris that can require additional cleaning time and the use of stronger cleaners. Most machines also include a wash-down hose to help keep the work tank clean and debris buildup to a minimum.

LEARN MORE:
Keep up on the latest tips, trends and industry discussions around electrical discharge machining by following the EDMmatters blog.

>> edmmatters.com