

# motion world

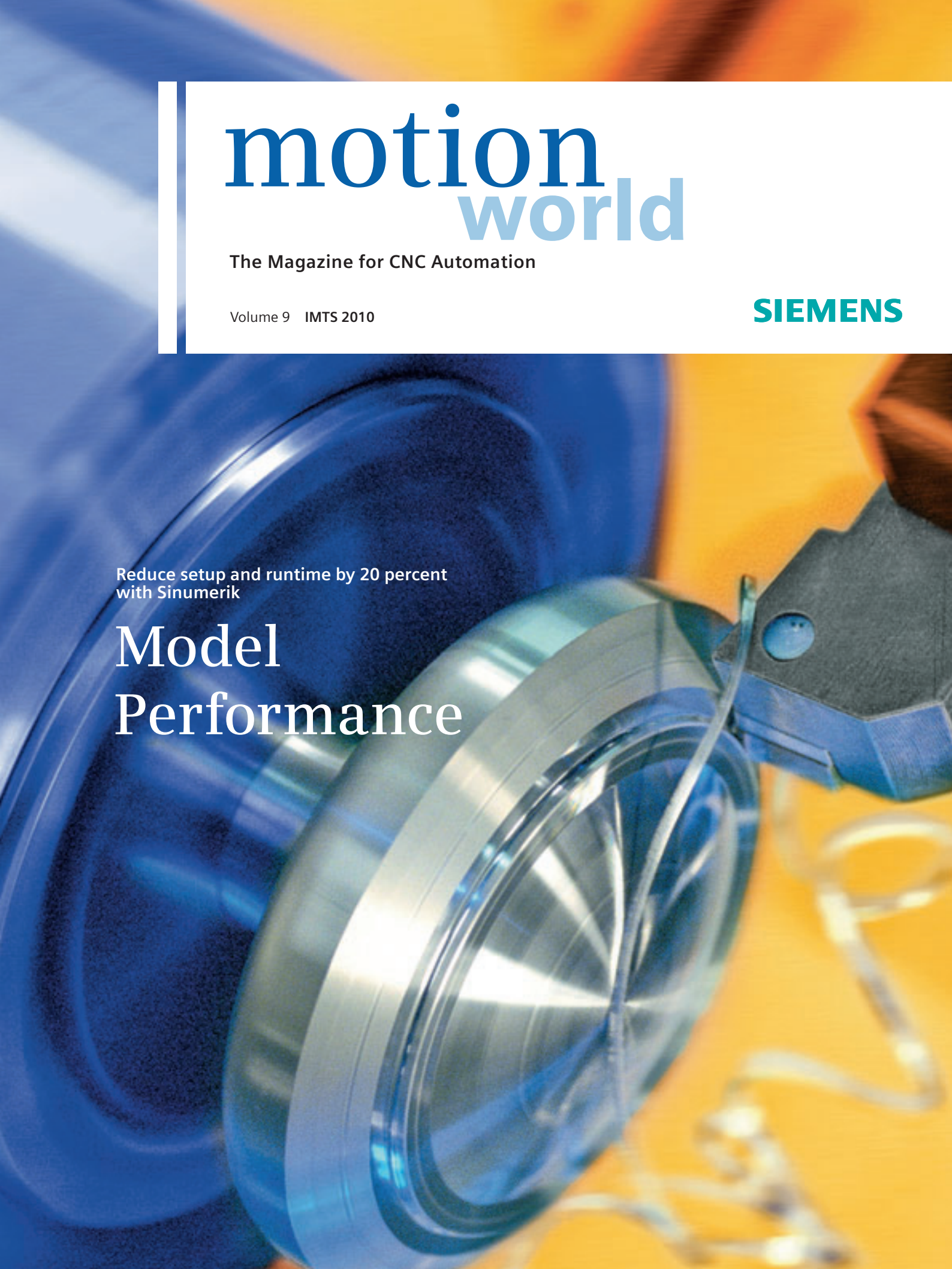
The Magazine for CNC Automation

Volume 9 IMTS 2010

**SIEMENS**

Reduce setup and runtime by 20 percent  
with Sinumerik

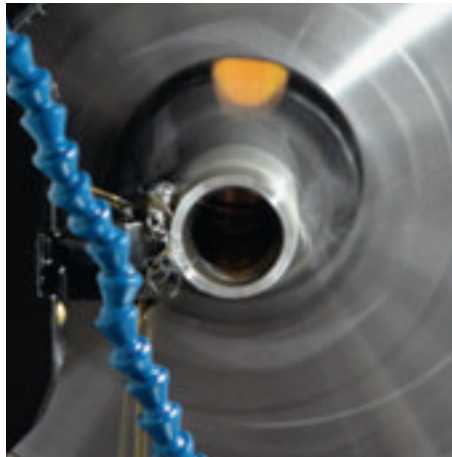
## Model Performance





Medical equipment manufacturer Stryker Corporation benefits from rapid and extremely precise machining processes thanks to Sinumerik

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Continental Machine in Illinois reduced setup and runtimes by 20 percent using Sinumerik-equipped machines

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B.A.R. Engineering & Manufacturing, located in California, uses a Sinumerik CNC to achieve user-friendly five-axis machining

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**Rajas Sukthankar**

Business Segment Manager —  
Machine Tools  
Siemens Industry, Inc.  
Chicago, Illinois

**Dear readers,**

In this challenging economic environment, with its weak domestic demand, a number of U.S. machine tool builders and their end users are focused on exports to Asia, especially China. Globally, China has become the top consumer of machine tools for the mid-range and standard market segment. As a result, leading machine tool builders from the United States and overseas are directly competing against their Asian CNC suppliers in China for the job shop segment.

As a technology leader in the machine tool industry, Siemens is proud to present its latest numerical control, the Sinumerik 828D, at this year's IMTS in Chicago. With the new 828D, we are offering a complete digital CNC package to automate drill-tap centers, turning and milling machines. The global acceptance and success of this control can be attributed to its innovative, easy-to-use tool and workpiece setup routines, and the usability of our Sinumerik 828D CNC package is further enhanced through the ShopMill and ShopTurn user interfaces supporting six global leading languages. With this latest innovation, you no longer need to compete with your Asian CNC supplier. Sinumerik 840D sl, our flagship control, is the most advanced CNC in the world. We have maintained our technology leadership in the American automotive and aerospace markets by leveraging its Open Architecture with US based R&D support. This has allowed us to integrate complex kinematics and error compensation algorithms into the NC kernel to satisfy even the most demanding motion tasks. This special IMTS issue of *motion world* features several stories that show how our customers benefit from using Sinumerik technology.

We are committed to providing you innovative motion control solutions to increase your productivity, regardless of your manufacturing industry. The breadth of Siemens automation and motion solutions are complemented by the integrated CAD/CAM/CNC process chain through Siemens PLM. We enhance the productivity of your new and old machines through Sinumerik Manufacturing Excellence — a complete program of service offerings and software suites. We rely on our Solution Partners to provide you the valuable solutions and services that traditionally fall outside our core competencies. Our Retrofit Solution Partner program gives new life to old iron. We will be happy to present this program to you in our booth at IMTS.

And on a more personal note, the year 2010 also marks the 50th year of our market-leading CNC, Sinumerik — the brand name synonymous with innovation and technology leadership throughout its history. We want to take this opportunity to thank our OEMs and end-user customers for investing in their future with Siemens. You've made us the global CNC leader! Please join us in celebrating Sinumerik's 50th birthday during IMTS.

See you at the show!





RenShape being machined on the  
DMG milling center

■ Stryker Corporation, Michigan

## Speedy Precision

A global producer of medical equipment finds that Sinumerik enables the rapid creation of highly specialized devices.

Stryker Corporation of Kalamazoo, Michigan, is a global leader in medical devices and equipment, from orthopedic implants to all types of surgical and patient-care devices. Its products are found in medical care facilities around the world.

The Stryker Instruments Division has five facilities — in Kalamazoo, Texas, Puerto Rico, Germany, and Ireland. It produces surgical tools used primarily for

orthopedic, spine, neurological, and ENT (ear, nose, and throat) procedures, plus minimally invasive interventional pain procedures.

### High precision needs

Stryker must often make low quantities of its highly specialized System 6 power tools, which include high-precision handheld devices such as oscillating bone saws. The company uses a variety of sub-

## »System 6 has become a big seller for Stryker, and our ability to ramp up production on the DMG machines with Sinumerik numerical controls has been a big plus.«

Randy Carpenter, senior project engineer for Stryker Instrument's Production Group

strates, including 300- and 400-series stainless steels, 6061 aluminum, and titanium, plus specialty materials such as Inconel, Nitinol, ALG alloys, and others. Assorted thermoplastics such as Delrin, ABS (acrylonitrile butadiene styrene), and Teflon, plus thermoplastic elastomers, are also machined here. Production at Stryker is strictly monitored for compliance to US Food and Drug Administration (FDA) standards.

The Experimental Group in Kalamazoo provides components to Stryker research and development engineers for testing and evaluation, including prototypes. As a result, Stryker maintains a variety of machine tools at its Kalamazoo facility, including

### Sinumerik at Stryker

- ▶ Machining centers and a three-axis vertical milling center with an 8,000 rpm spindle and a 20-position tool changer
- ▶ Sinumerik 840D has helped improve surface finish
- ▶ Stryker is seeing a more than 20 percent reduction in cycle times compared to older machines and controls

three- and five-axis CNC machining centers and electrical discharge machines (EDMs).

### Easy-to-program

Among the newest CNC machines in the Experimental Group is a DMG Model DMC 635 eco, a powerful three-axis vertical milling center with an 8,000-revolution-per-minute spindle and a 20-position tool changer, all run by the Sinumerik 810D CNC with ShopMill software. Supervisor Rich Mitchell explains, "We typically store a few programs on the CNC and keep our backlog of programs on a network drive. We take IGES or PRT 3-D files and can program directly from the digital content, using MasterCAM and now the ShopMill program. The Sinumerik 810D control receives excellent ratings from our operators and has fast become their control of choice." He says the part and tool setup pages are intuitive and incorporate graphic depictions for specific data inputs, thereby reducing the learning curve. "Most of our guys had never used a Siemens control pre-

viously, so it is ironic that this CNC is now their favorite. They literally line up to use it."

Mitchell said that program transfer from the Stryker network back to the CNC is fast and simple. This is advantageous in the Experimental Group, where most jobs are one-offs or very small quantities. Operators write and run multiple programs through each CNC daily, saving time on entering and editing setup data on the machine. The department must produce extremely fast turnarounds, and Mitchell credits the Siemens CNC for facilitating this. "The Sinumerik numerical control has worked quite well for us with a manual touch probe and manual Z-axis presetter for tooling," he says. "As we expand or replace current milling technology in our production, we will most likely transition to a Sinumerik 840D with a Renishaw touch probe and tool presetter to expedite setups."

This machine joins multiple DMG TWIN 65 and TWIN 42 machining centers, each with an upper B-axis to complement the Y-axis and driven tools and create the contours and sophisticated geometries needed. These turning machines have Sinumerik 840D, which enables precise and transferable control of spindle and axis movement variations.

### Reduced cycle times

Randy Carpenter, a senior project engineer for Stryker Instrument's Production Group, says, "We run families of parts. One set of parts is run in 416 and 17-4 (grades of stainless steel) with 38 Rockwell hardness. We're typically running dimensional tolerances down to the ten-thousandths, so it's very precise work. Compared to the older machines and controls, we have tracked our cycle times in relation to our target Cpk's and we are getting better than 20 percent reductions as a result of the DMG machines with Siemens CNC onboard. Plus, we already see the improvements in surface finish, owing to the smoother translations from line to line in the milling and turning programs." Carpenter notes that his production department has achieved considerably higher changeover efficiencies, allowing more jobs to run per shift. ■

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■ Custom Gear & Machine Inc., Illinois

# Expanded Capability

A gear manufacturer uses a Reishauer grinder and Sinumerik control technology to upgrade performance and dramatically reduce cycle time – in one instance from 40 minutes to 6.

Custom Gear & Machine Inc., of Roscoe, Illinois, is a full-service gear manufacturer, producing spur and helical gears to AGMA 8 through 14 standards and up to 30-inch diameters, typically, plus splined shafts to 54 inches in length. Its customers include leading builders of agricultural equipment, construction and off-road vehicles, machine tools, printing presses, food-processing

**»We were making parts within a few days after the installation, and I was completely comfortable with the easy operation of the CNC in less than a month.«**

Daniel Warren

equipment, overhead cranes, material-handling devices, lift equipment, process equipment such as large water pumps, and more.

Founded in 1994, Custom Gear specializes in lot runs from a single piece to 500 and works primarily in steel, including bar grades 4140, 4150, and 8620. The shop also works forgings, as well as cast and ductile iron, brass, bronze, and aluminum, per customer requirements.

## A powerful upgrade

Custom Gear wanted to improve its throughput and overall grinding performance, so it purchased a Reishauer RZ400 with a Sinumerik CNC. Compared to the older Reishauer machine, the new machine increased surface speed from 1,900 to 4,000 revolutions per minute, increased coolant pressure from 30 to 300 pounds per square inch, and had a seven-start grinding wheel rather than a single-start one.

According to Reishauer vice president Dennis Richmond, "Our previous gear grinders at Custom only allowed a 13-inch diameter and our clients were

looking to step up to a 16-inch diameter, plus they were seeking other features we offer. We use the Siemens numerical controls on our machines for a variety of reasons, especially the architecture's ability to allow our engineers to customize the front ends. This simplifies the addition of new part programs and helps operators more easily navigate programming and setup. When data input is completed for the current screen, for example, the operator is prompted to enter data for the next screen and so on, until the program is completed."

## Operation easy to learn

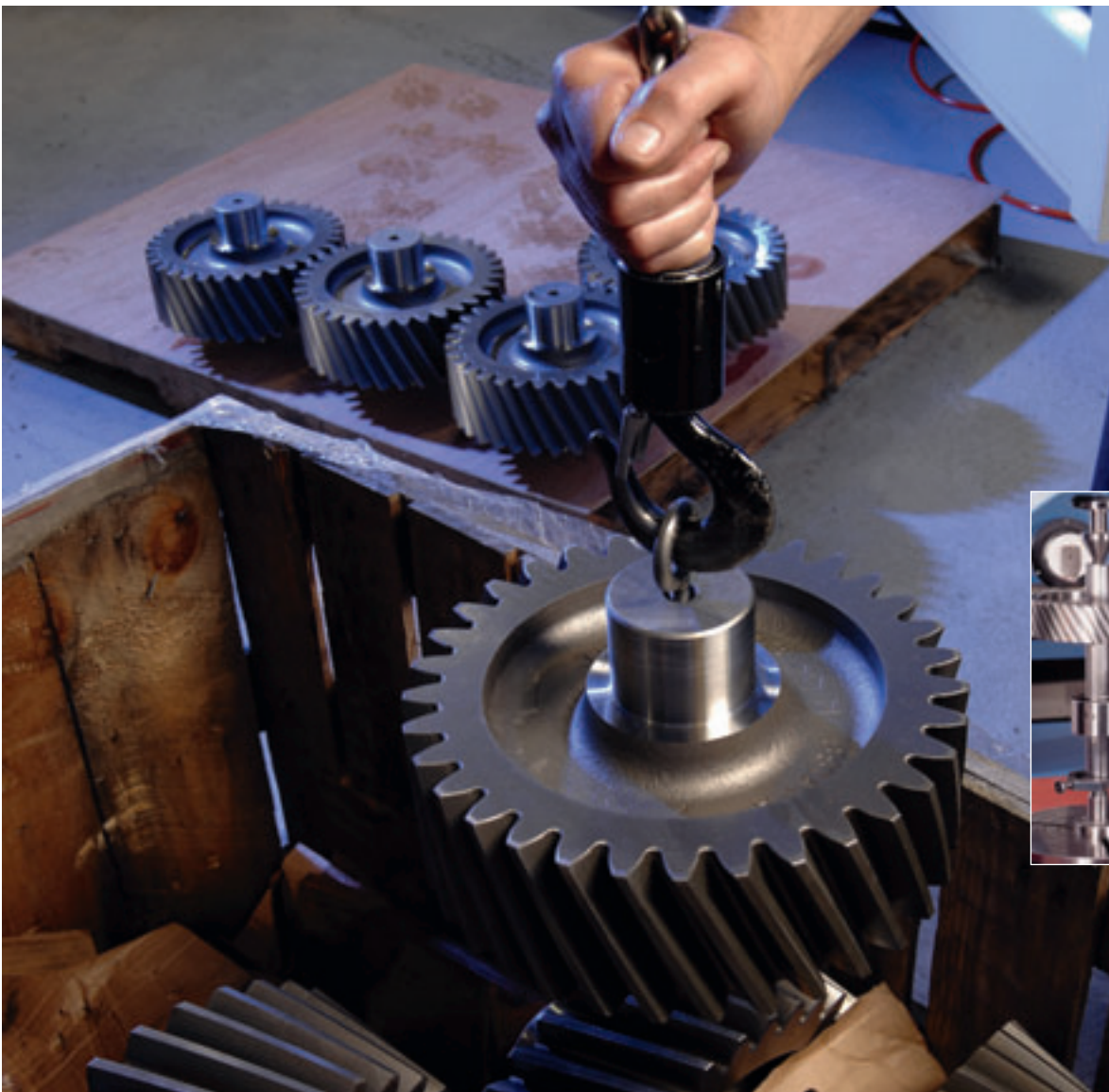
Each Custom Gear machinist is responsible for the setup, running, and maintenance of his or her machine. Machinist Daniel Warren had never run a machine with Sinumerik CNC but says, "I got great training from Reishauer and was up to speed very quickly. We were making parts within a few days after the installation, and I was completely comfortable with the easy operation of the CNC in less than a month." In describing the automatic wheel-dressing sequence, he says the CNC automatically adjusts the settings to compensate for the reduced wheel diameter after dressing, bringing the wheel to the correct point of contact with the subsequent workpieces every time.

Data such as gear configuration, fixture design, and all tool settings are entered into the screens, includ-

## Sinumerik at Custom Gear

- ▶ Custom Gear produces spur and helical gears to AGMA 8 through 14 standards and up to 30" in diameter, plus splined shafts to 54" long, using steel, including bar grades 4140, 4150, and 8620
- ▶ A Sinumerik 840D CNC is installed on a Reishauer RZ400, which goes up to 4,000 rpm with a seven-start grinding wheel and coolant pressure of 300 psi
- ▶ Cycle time was reduced in one instance from 40 minutes to 6, with improved quality





Typical products made by Custom Gear include helical and spur gears up to 30" diameters and splined shafts up to 54" long, plus a variety of large CNC machined parts to complement their gear work

ing pitch, pressure angle, teeth, and dressing steps. Once a new part program is completed, the operator at Custom Gear can begin working through the Reishauer-designed human-machine interface (HMI) setup screens, which also function in the same manner. Reishauer further allows its customers to add their own HMI screens for features onto the Siemens CNC for data acquisition, training aids, and even SPC protocol operations. This enables customers to have a common look across the screens on many machines in their shop. This is especially helpful in work-cell setups, where a single machinist is running multiple machines.

Reishauer also uses other aspects of the Siemens product and service package for added functionality, including Siemens motor and drive packages, in building the control structure on its machines. According to Richmond, this allows seamless integration between all drives and the numerical control unit.

It also makes it easier to integrate ancillary machine devices such as chip conveyors, filtration systems, wheel-dressing stations, and especially the critical

material-handling and part-loading devices frequently built with the machines for customer work-cell setups. Siemens uses the Profibus networking protocol, enabling Reishauer to link various control devices and other machine tools together, greatly reducing the fieldwork integration and wiring time during installations. Reishauer uses Profibus to link the onboard Sinumerik 840D CNC to variable-frequency drives, other drives, electronic gearboxes, and balancing systems for the grinding wheel on its machines.

Mike Rasmann, vice president of operations at Custom Gear, says, "Our investment in the new Reishauer gear grinder has expanded our capability, allowed us to produce more parts for more existing customers, and even opened some new business doors for us. With the added benefit of increased safety on the machine, it was a win-win situation for us all around." ■

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## ■ Continental Machine, Illinois

# Model Performance

**A prototype and short-run production shop whose operators had no prior CNC experience reduced setup and running time by 20 percent using a machine with Sinumerik.**

Josh Johnson, vice president of Continental Machine in Rockford, Illinois, says his prototype and short-run production shop must run lean. There can be no excessive programming, setup, or machining time of any kind or the shop loses.

Continental Machine has a variety of CNC milling, turning, wire EDM (electrical discharge machining), hole popping, and grinding machines, as well as various sheet metal and plastic injection-molding machinery. The shop produces a wide variety of metal and plastic prototypes, including window hardware, bicycle components, automotive parts, chemical processing equipment, medical devices, and food-service equipment.

Materials used are also wide ranging, including aluminum, CRS (cold-rolled steel), tool steels such as A2 and D2, zinc, brass, copper, bronze, titanium, and a variety of engineered plastics such as glass-filled Delrin.

Recently, the shop purchased a Fryer Easy Turn-21 CNC Combination Lathe, controlled by a Sinumerik 840D sl numerical control. The operators at Continental had limited experience with CNC and none whatsoever with the Siemens protocol.

## Fast ramp-up and quick payoff

Johnson says, "The setup is extremely easy. Teaching the tools and altering the lengths and diameters is kept very simple. After the initial learning curve, which took only a few days, the operators picked up on the conversational programming right away. One of the best features on the machine is that you can still turn the parts by using the electronic handwheel and just one function, such as hogging off material automatically or putting on a tapered thread." He says this feature allows operators to quickly and efficiently prove out part programs.

The result has been at least a 20 percent improvement in the overall cycle time on most part pro-

## Sinumerik 840D sl at Continental

- ▶ Milling of prototypes using a wide range of metals and engineered plastics
- ▶ Fryer Easy Turn-21 CNC Combination Lathe with Sinumerik 840D sl numerical control helps reduce setup and cycle times more than 20 percent

grams. This substantially increases work product output.

## Exclusive use of Sinumerik controls

Sue Ostrander, sales manager at Fryer Machine Systems, says Fryer selected the Sinumerik 840D sl numerical control for all its milling and turning machines, a move the company recently announced to the industry. Fryer manufactures a diverse line of more than 50 models of high-quality CNC machine tools in Patterson, New York, and is well respected for its quality and innovation.

"Moving to the Sinumerik 840D sl platform was the next step in Fryer's ongoing commitment to providing our customers with the most innovative machine tools," Ostrander says. "The Siemens solution allows end users to achieve higher productivity through easy and intuitive features and step-by-step on-screen programming. This enables them to dramatically reduce setup, programming, and tooling times while significantly increasing output."

"The Sinumerik 840D sl modular design allows us to take full advantage of the superior mechanical features in our machines," says Larry Fryer, Fryer president and CEO. "Siemens has been helpful and very thorough in its training and after-sales service. The ShopTurn program now enables us to accurately determine tool path, potential collisions, tool



Close-up of Siemens Sinumerik 840D sl





**»The Sinumerik 840D sl modular design allows us to take full advantage of the superior mechanical features in our machines.«**

Larry Fryer, president and CEO, Fryer Machine Systems

changes, and real-world runtime. This makes operators' jobs much easier, with the added benefit of allowing us to estimate much more accurately than ever." Johnson says the CNC has substantial hard-drive space, allowing most programs to be stored directly on the machine, though the company does maintain a backup system.

"Fryer has always been known for our easy conversational controls, and the move to Siemens has allowed us to greatly enhance this feature," Fryer says. "The 840D sl menu-driven system combines an advanced geometry calculator that displays the part while the operator is programming it. Sophisticated solid-model graphics allow the operator to verify the part program with more clarity than ever before," he says.

**Partnering to meet customer needs**

Fryer is impressed with the automatic tool setup and easy part setup with the Sinumerik CNC. Fryer says auto-run mode is where many operators experience difficulty. Siemens and Fryer Machine Systems together created an electronic-handwheel-run mode that gives the operator a safer way to prove out program execution, both forward and backward, using a standard electronic handwheel. Fryer says, "Siemens provides us with a highly flexible solution that is critical to our ability to meet the specific needs of each customer. Our enhanced capability to offer the same control for both turning and milling gives Fryer machines a unified platform that is very important to customers both in the short term and for long-range expansion. This platform, coupled with Siemens' quality and reliability, is invaluable to us in competing in today's aggressive marketplace." ■



Siemens Sinumerik 840D sl CNC onboard the Fryer Easy Turn combination lathe

OD turning at Continental Machine produces a variety of prototype and production parts

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## ■ Sinumerik 828D

# Open-Road Performance to Job Shops

Sinumerik CNCs offer shopfloor users panel-based, at-the-machine programming and 3-D CAD/CAM capability.



»The five-axis Siemens control has let us do some amazing 3-D work for our customers.«

Jim Quinn, OCC's lead engineer,  
Orange County Choppers, Inc.

According to a recent survey conducted among machine tool professionals, a particular wish was for more open, easier-to-use CNC. Of those surveyed, 81 percent said they wanted faster programming and setups for increased capacity.\*

One control option specially designed for greater simplicity and performance is the new Sinumerik 828D CNC from Siemens. This CNC was introduced to the world at EMO 2009 in Milan, Italy. It was immediately seen as a major new step in CNC for the job shop.

For many years, Siemens has been a leading supplier of five-axis CNCs for aerospace and other high-end machine control applications. With the Sinumerik 840D, Siemens can support almost every application, thanks to the product's open and modular structure and flexibility. With the Sinumerik 828D, Siemens has presented a new CNC that is specifically designed for the requirements of the job shop:

maximum ease of use, and easy commissioning. The new CNC received positive feedback that at its market introduction during EMO indicating that it is right on target for this specific user group.

The new Sinumerik 828D is a panel-based CNC, making it an ideal solution for the demands of milling and turning. It will have a big impact on the capabilities of many smaller shops. In fact, some shops have already discovered the benefits of advanced CNC in working with the Sinumerik 840D. One such company is Orange County Choppers, Inc., a small business that revels in enterprising design and creative freedom.

\* A total of 188 machine tool professionals participated in the survey, which was conducted online in March and April of 2010. The survey was conducted by Centrifuge Brand Marketing, Inc., and sponsored by Siemens Industry, Inc. For a summary of the survey, visit [www.usa.siemens.com/cnc](http://www.usa.siemens.com/cnc).



## »The ability to program the CNC at the machine is an important advantage for Romi.«

Jody Michaels, application and engineering manager, Romi Machine Tools, Ltd.

### Revving up for increased performance

Orange County Choppers, Inc., (OCC) is a small, American, family business that builds custom motorcycles, as featured in the television series American Chopper. Through its television shows, OCC has built a reputation for advanced metal cutting, particularly with creative designs produced by a water-jet machine. The machine is, in fact, a Flow machine controlled by a Siemens Sinumerik 840D CNC.

The Flow machine is programmed by OCC's lead engineer, Jim Quinn. According to Jim, "The five-axis Siemens control has let us do some amazing 3-D work for our customers."

Quinn understands the growing need among American job shops for increased simplicity and performance by way of improved machine tool HMI. As CNC technology goes forward, he anticipates that control interfaces will, by necessity, become more dynamic, and yet easier to use and more adaptable from machine to machine. Knowing how easy the Siemens control is to set up on OCC's five-axis machine, Quinn looks forward to seeing that ease of use on simpler equipment.

### Romi breaks the machine tool mold

Romi Machine Tools, Ltd., was the first machine tool builder to integrate the new Siemens Sinumerik 828D control in the United States. Romi chose the 828D to provide a unique, dual capability for the company's new D800AP vertical milling center.

According to Jody Michaels, application and engineering manager for Romi, the company had a reputation for building a very stable, strong machine. However, the available controls were







## »Such an accelerated learning curve is certainly unusual.«

Jim Hokenson, CNC instructor at Moraine Park

► difficult to integrate for typical mold-type job shops. The Siemens 828D control with the D800AP vertical milling center opens up new markets for Romi. Programming simple jobs can be done at the machine using the control's graphical interface, without the need for G-codes. More complex programs, including all kinds of legacy brand G-code programs, can also be uploaded from CAD/CAM via USB, Compact Flash (CF) card or network.

Michaels says, "We had observed that a common problem for job shops was work getting backlogged at the programming stage. The ability to program the CNC at the machine is an important advantage

for Romi." With Sinumerik 828D, many standard jobs for the D800AP vertical milling center can be easily programmed at the machine, saving time waiting for a programmer and making the operation much more efficient. The CNC's graphical interface allows the operator to see the actions to be performed and to feel confident about cutting correctly.

### A lesson in next-generation CNC

The first of Romi's new D800AP vertical milling centers to be installed in North America was purchased by Moraine Park, a technical college in West Bend, Wisconsin. The arrival of the D800AP at Moraine Park was a lesson in fast learning. Although

### Sinumerik 828D highlights

- Panel-based CNC
- 10.4" color TFT display
- Full QWERTY CNC keyboard
- Maintenance-free (no battery, hard disk or fan)
- Vertical and horizontal variants
- USB, Compact Flash (CF), and Ethernet on the front panel
- Powerful CNC functions
- Intelligent path control Advanced Surface
- 80-bit NANO<sup>IP</sup> floating-point accuracy
- Simplified tool and workpiece management
- Easy-to-set-up and use
- ShopMill and ShopTurn graphical programming
- Animated elements (interactive help)

»With the 828D,  
Siemens has given us  
two controls in one.«

Larry Fryer, president and founder of  
Fryer Machine Systems



the Sinumerik 828D CNC was completely new to the college's students, this did not hold them back. They were cutting parts and using the CNC within one day. According to Jim Hokenson, CNC instructor at Moraine Park, "Until the arrival of the 828D, students had only become familiar with the prevailing job shop CNC platforms being taught. Such an accelerated learning curve is certainly unusual."

Hokenson finds the Sinumerik 828D ideal because of its improved HMI and the ability to support all job shop challenges, from standard short-run projects to more complex 3-D CAD/CAM jobs. An innovation of the 828D highlighted by Hokenson is its Easy Message, a process-monitoring system that uses text messaging (SMS) to advise the operator of process data, such as workpiece counts or tool wear alarms.

#### Fryer keeps CNC on the front burner

Fryer Machine Systems is a U.S. machine tool builder that serves the performance needs of both aerospace and job shop customers. Though the company currently uses a customized Siemens Sinumerik 840D CNC platform on its machines, it anticipates migrating to the new 828D.

Larry Fryer, president and founder of the company, explains, "With the 828D, Siemens has given us two controls in one. We have the new HMI, which is

intuitive and conversational, and at the same time, we have a G-code-capable control that can import G-code programs or allow G-code programming on the machine. The ability to import and run G-code from other machines cuts down the need to retrain people."

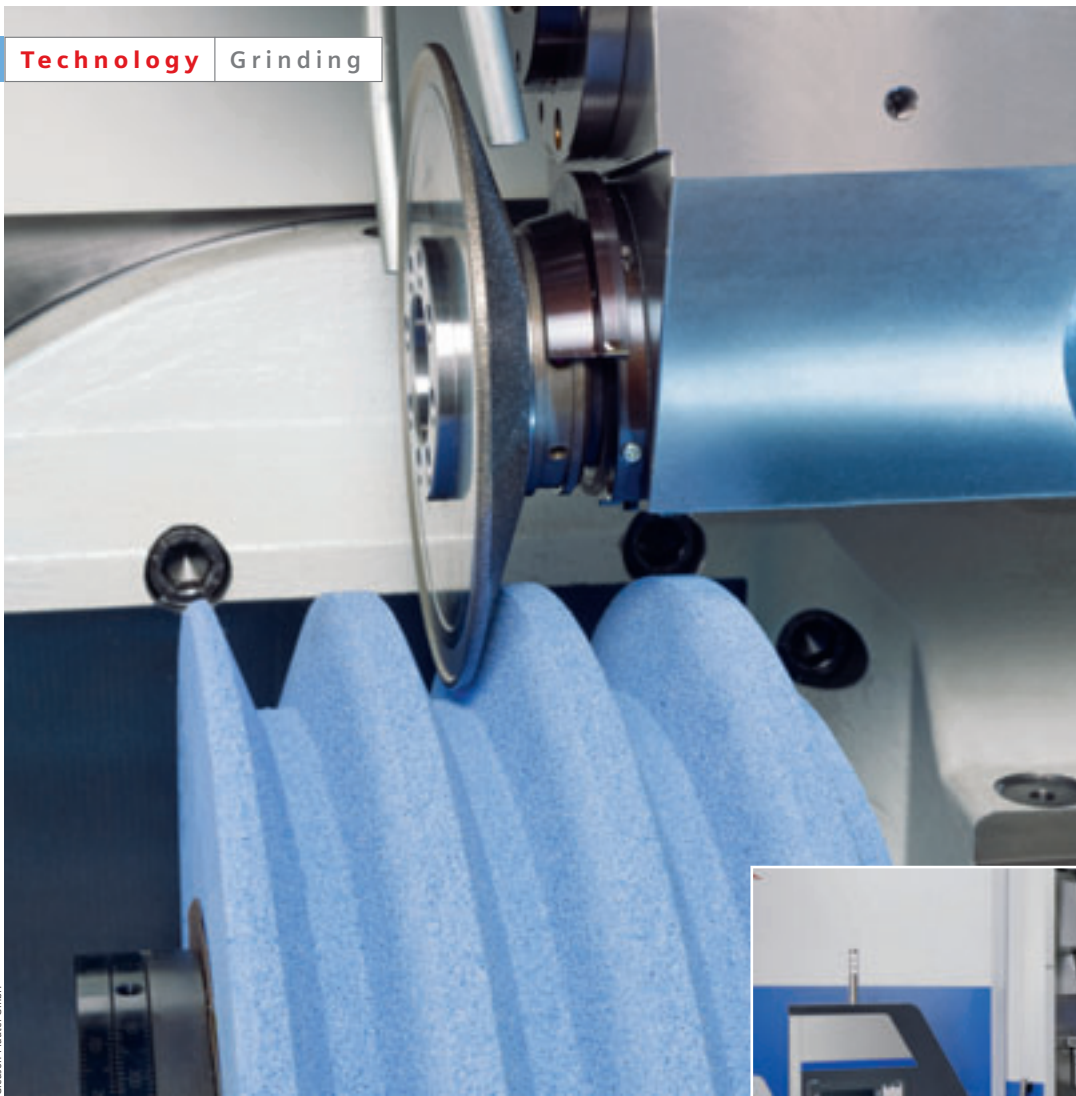
Of the software, Fryer notes that 828D's better graphics display shows the part to be manufactured more clearly and consistently. It also better integrates milling and turning operations in one product.

#### Machine tool freedom

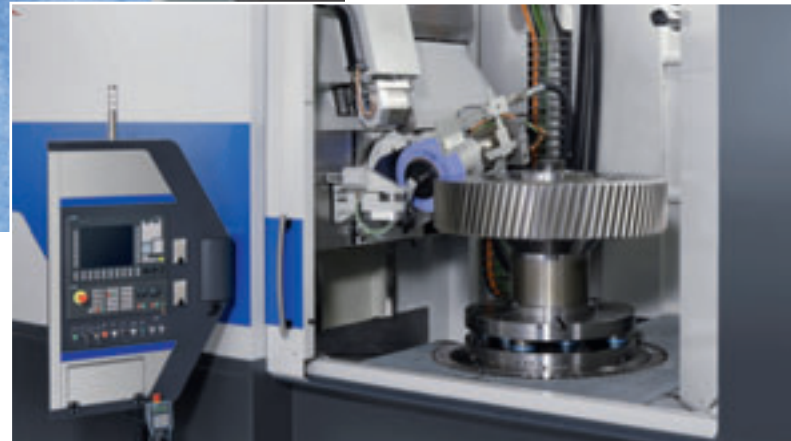
As job shop owners and managers set out to evaluate their machine tool purchase options in the months to come, the majority will pay careful attention to the controls that will drive their new investments. The job shops that expect more from their CNC will find that Sinumerik 828D can take them wherever they want to go. ■

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The world's first gear grinding machine with tool changer enables the use of dedicated tools for both efficient rough machining and achieving maximum surface quality during the finishing process



■ Gleason-Pfauter GmbH, Germany

## A New Paradigm

With its new Titan machine series, Gleason-Pfauter enters a new era in toothed gear grinding: An automatic tool changer, together with efficient CNC and the corresponding drives, enables large, better-quality gear teeth to be used, thus ensuring a better surface finish with faster grinding.



**T**o date, profile grinding is the only technology used to produce the high-precision gear teeth that are required for heavy-duty large gears. As a result of the demand for high quality, this is a very time-consuming process. Gleason-Pfauter Maschinenfabrik of Ludwigsburg, Germany, specializes in gear cutting machines.

As a response to the growing demand from wind-energy plant manufacturers for large planetary gears with a diameter of up to six meters, Gleason-Pfauter has pushed grinding technology not only in the direction of maximum precision, but also toward increased productivity. The innovative development of the tried-and-tested process continued apace until it reached its limit such that the complete processing of a toothed gear or gear rim blank involved one grinding wheel, which must remove the rough machining allowance, as well as achieve high-precision finishing. The specification of the grinding wheel, therefore, has to balance the two targets of achieving a high removal rate and the required surface finish.

### From the rough machining disc to the optimized grinding wheel

"During the development of our latest Titan range of equipment, we managed to combine the very high standards of tried-and-tested profile grinding technology with the principle of tool changing and a number of additional innovations," explains Antoine Türich.

The majority of the rough machining allowance is now removed with a special rough machining disc. For the finishing of the workpiece, the process is switched to a grinding wheel optimized for precision and surface quality. This approach has several benefits: It drastically reduces the time required for rough machining and lessens the risk of overheating when grinding. A greater gear teeth precision and a higher surface finish quality can be achieved as dedicated fine-grain grinding media can be employed for the finishing.

### Efficient generation grinding up to module 14

The Titan tool changer enables both using profile grinding discs that are specially adapted to the specific processing phase and combining threaded wheel and profile grinding on one machine. For gear teeth sizes up to module 14, this technology offers benefits even when compared to rough machining with profile discs: Since the machine is continuously in use and works without motion inversion during threaded wheel grinding, the method is very fast.

"For the smoothing process, the Titan not only changes the tool, but also switches to high-precision profile grinding technology," explains Antoine Türich. This works so well that Gleason-Pfauter has given this method a trademark name: "PowerGrind."

### Simple operation thanks to optimized automation

The basis of the successful and reliable implementation of these numerous innovations is quality-oriented, state-of-the-art mechanical engineering combined with the Sinumerik 840D. This CNC meets the specific Titan requirements in terms of system performance and reliability. It guarantees the indispensable precision of the axis guides for the gear teeth, which can withstand extreme pressure during grinding. This must be made available for the alternative or supplementary grinding technologies by means of a speed that is significantly greater than offered by traditional grinding machines. Siemens motors and drives are also used. Their control response facilitates extremely rigid drives, a stringent requirement of high-precision guiding.

The machine's user interface should be designed in such a way that users can employ, operate and use this innovative machine with confidence. The interface also has to automatically generate and optimize the part programs individually for each gear rim based on the results of integrated centering.

For this purpose, Gleason-Pfauter has made full use of the Sinumerik 840D's openness and implemented a customized user interface that is technology-oriented and extremely user-friendly. The company has also integrated its own mathematical models into CNC for tool and workpiece guidance. Combined with the Sinumerik, the Gleason-Pfauter dialog program enables easy handling of demanding manufacturing processes.

### The technology of the future

Gear manufacturers not only have expectations for high-quality large gear teeth that can withstand extreme pressure, but they also demand reliable manufacturing processes that have been truly mastered and have proven to offer long-term stability. Michael Vranic, the marketing director at Gleason-Pfauter responsible for the machines built in Ludwigsburg points out: "Many users are particularly taken with the two-phase profile grinding process that can now be used with Titan, your tool changer, and our user interface built into the Sinumerik CNC. But the Titan can do much more than this, particularly with workpieces with larger teeth. This is what makes it a future-proof investment. Once you have seen our PowerGrind in operation, you will be as certain as we are that this is the technology that will stand the test of time!" ■

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■ B.A.R. Engineering & Manufacturing, California

# Sophisticated Yet Simple

An aerospace machine shop uses a Sinumerik controller to achieve user-friendly five-axis machining with a fraction of the setups.

Asher Sharoni is the president of B.A.R. Engineering & Manufacturing Inc., an aerospace machine shop in Cerritos, California. This fast-growing shop has won a Boeing Certified Preferred Supplier Award, has excellent ratings on the Boeing Commercial Airline Group's ISBA, has become AS9100 and ISO9001:2000 certified, and is certified to produce nuclear-grade products. The shop is also working to initiate a Six Sigma program with Boeing.

The shop sells to numerous suppliers of Boeing and other aircraft builders, as well as to the military sector. Among its products are hydraulic manifolds, profiles, structures, and turned parts up to 120 inches in length, made from various alloys of steel, including 300M and 9000S, as well as aluminum, titanium, platinum, magnesium, Inconel, and more.

## Staying competitive

Despite these successes, Sharoni notes, "We knew we had our limitations and we needed to differentiate ourselves from the pack." The shop decided to step into the five-axis machine tool world.

"In these economic times, we knew we were taking a risk in making that investment, but we carefully researched the available options and decided this was the best move for our shop," he says.

## Five-axis milling for smaller projects

Sharoni found that most five-axis milling machines were used for large structures, were too big to fit into his shop, and were expensive. He then discovered the DMU50 from DMG America. "Most of our milled parts are smaller and shorter runs, in the range of 10 to 15 inches high and 24 inches long. We were doing everything on three- and four-axis machines. They were good ... but we knew we were missing out on many jobs," Sharoni says.



In the DMU50, this shop found a smaller footprint, an affordable price, lower power consumption, and user-friendly controls. "All our operators were accustomed to the basic control," Sharoni says, "and they thought the CNC on this machine, a Sinumerik 840D, would be too complicated, but they found the exact opposite was true. The control is powerful yet very user-friendly. We were able to train our operators for both our day and night shifts in a short time, which really surprised us, since our operators had never run a Siemens control before."

## Reductions in setup and cycle time

One job was a hydraulic manifold. Quantities were too low to make casting or forging cost-effective. On a four-axis machine, the aluminum block needed a complex set of machining convolutions, each with a separate setup, owing to the number of internal



### Sinumerik at B.A.R.

- ▶ B.A.R.'s milled parts are usually 10–15 inches high and 24 inches long, and made from alloys of steel
- ▶ B.A.R. used Sinumerik to completely machine a complicated part that had previously been created through sand casting
- ▶ On one part, cycle time was reduced more than 60 percent, and required setups went from 23 to 4



By adding a rotary table, a six-axis cutting theater was achieved

holes on compound angles. In fact, 23 setups were needed, resulting in a slow cycle and considerable scrap. There were 11 setups just for internal holes. Foundation plates and custom blocks slowed the cycle further. The job was precarious, tedious, and time-consuming.

On the DMU50, the job was hogged out on the outside, with all holes machined without separate setups. The part was made in just four setups, reducing machining time by two thirds and the scrap significantly. "We went from walking to running overnight," Sharoni says.

On another job, out of a 30-piece order, only 18 pieces were delivered and the others were scrapped. When Sharoni informed the customer of the acquisition of the DMU50 and its capabilities, the customer

## »We went from walking to running overnight.«

Asher Sharoni  
President of B.A.R. Engineering & Manufacturing Inc,  
Cerritos, California

increased the order by 20 more. Runtime dropped from 20 hours to 4 hours. "We went from a type-writer to a PC on this job," says Sharoni. The DMU50 produces parts 95 percent finished in most cases.

In another occasion, a customer had a sand-casting part that was difficult to machine because of casting variations. The part was machined in two days, to the amazement of the customer, who is now seriously considering a complete hogout.

### Premium functionality and service

By adding a rotary table to the DMU50, a six-axis cutting theater can be achieved. With a 16-position tool changer, most jobs can be accommodated, though Sharoni notes that he is already planning to purchase another five-axis machine with a larger tool changer.

The shop also plans to add a simultaneous five-axis machine that could make blades and impellers. Virtually any drawing or e-file format can be accommodated, and the ShopMill program onboard the Sinumerik CNC can simulate the actual cutting path in trackable sequences to determine the cycle time, prevent tool collisions, and allow faster, more accurate quoting.

"The machine control actually modifies the part program when needed," Sharoni says, "and that is a real asset to us, as we learn more about five-axis work on each shift." In addition to the machine tool and CNC technology, Sharoni cited the superior service from DMG and Siemens as key influencers in his decision to buy again from them. ■

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■ Coast Composites Inc., California

# A Precise Marriage

Coast Composites, working with the Siemens Aerospace Center of Competence, uses advanced software and a Sinumerik CNC to make composite molds for the very largest aircraft.

Airplanes were first made of wood and fabric, then metal. We are now in the third phase of aircraft evolution, with many metal parts being replaced by plastic composites. Lightweight composites were used initially in noncritical applications. With advances in technology, composites are now widely used in aircraft to build the fuselage, wings, tail fin, and control surfaces. The composite parts are made by hand layup of carbon fiber, machine-applied reinforced carbon-fiber tape, resin-infusion processing, or filament winding. All these techniques require a template or mold that accurately defines the shape of the component. Manufacturing these tools is a challenge because they are made of complex three-dimensional shapes, and for a large aircraft the molds can be the size of an articulated truck.

The standard material used to make large molds is Invar, a high-nickel iron alloy. Invar is chosen because it has a low coefficient of thermal expansion. But even with Invar the change in dimensions due to temperature fluctuations becomes a problem with very large molds. To avoid thermal problems during manufacture, many companies work in completely air-conditioned environments. However, one company, Coast Composites Inc., working with Siemens, has developed a manufacturing process that can be run without air-conditioning yet achieves possibly the highest standard of machining accuracy in the aerospace industry.

At its main facility in Irvine, California, Coast Composites has large long-bed CNC gantry mills that can machine structures from solid blocks up to 22.9 meters long, 6.7 meters wide, and 2.1 meters high to an accuracy of  $\pm 0.075$  millimeters. This unprecedented level of accuracy is achieved by using complex numerical controls with thermal compensation, real-time inspection and data analysis, and laser tracking.



Coast Composites is a vertically-integrated supplier of Invar tooling, as well as mandrels and resin transfer molds used for composite layup in the manufacture of very large aerospace structures

# »The Coast manufacturing process, with temperature compensation and the Siemens Volumetric Compensation System ... might be the highest standard of machining accuracy in the aerospace industry.«

Jerry Anthony, Coast Composites Founder and Director of Best Practices

## Volumetric Compensation System

In its largest CNC mill in Irvine, Coast runs a German-built Handtmann five-axis machine using twin Sinumerik 840D numerical controls with Siemens' Volumetric Compensation System (VCS). Siemens VCS takes account of all the machine's axes of motion, such as pitch, yaw, and roll, to precisely adjust the orientation of the tool tip to the workpiece. This ensures that the cutting tool is always correctly positioned no matter how complex the shape being cut. The VCS offers a high level of cutting accuracy, but this accuracy is taken to a new level by marrying VCS with an innovative temperature compensation system developed by Coast.

## Temperature compensation

The very large molds for aircraft parts require long machining runs, during which time the ambient temperature may change. Also the act of machining the workpiece creates heat. The temperature compensation system developed by Coast Composites works intimately with the Siemens VCS. It takes account of changes in the temperature of both the workpiece and the machine tool. The system adjusts the go-to points, cutting profiles, and acceleration/deceleration mapping in real time as machining proceeds, with temperatures and other parameters being continuously measured.

## The marriage of temperature and volumetric compensation systems (VCS)

Siemens VCS compensates for 21 error factors of machine axes, including pitch, yaw, and roll. Coast enhanced this process by combining its own temperature compensation system with the VCS inside the CNC to take account of the thermal expansion rates for the material being run as well as that of the machine itself. The machine movement is adjusted in real time, producing a smoother finish on the part surface and a very high degree of machining accuracy.

## Real-time inspection

Coast Composites uses the power of the Sinumerik 840D CNC to run real-time inspections and data analysis during machining. The in-process inspection system essentially turns each of their machine tools into its own CMM (coordinate measuring machine). The machine tool inspection interface software was written by Siemens CNC engineers in Elk Grove Village, Illinois.

For final checking, Coast uses laser tracking in tandem with Valisys inspection software. This provides independent confirmation that the VCS and temperature compensation system have done their work.

## Application engineering

Coast has extensive experience in producing molds and templates for aircraft composites, having been one of the earliest players in the field. The temperature compensation system was developed by Coast over a period of several years, but the company could not have achieved this success alone. For the massive Handtmann five-axis gantry mill, application engineering and training assistance are provided to Coast Composites by the machine tool builder's local representative, BD Technology, and by personnel from the Siemens Aerospace Center of Competence. ■



Coast Composites operates a complete metal fabricating shop, including metal bending and welding, in its Santa Ana plant. GTAW/GMAW welding is performed here

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■ **Southeastern Institute of Manufacturing and Technology, South Carolina**

# Welcome to the New Machine

Sinumerik CNC technology's Ease-of-use and quality production enable an educational facility in the southeastern United States to become a prestigious machine tool training facility for local industries.

A unique facility opened recently on a new 146-acre campus adjacent to Florence-Darlington Technical College in Florence, South Carolina, to provide local industry with advanced machine tool training. The Southeastern Institute of Manufacturing and Technology (SiMT) offers engineering, CAD/CAM, rapid prototyping, and 3-D virtual reality services, as well as leading-edge manufacturing workforce development and business process training. Housed within SiMT is the Advanced Manufacturing Center (AMC), which represents a state-of-the-art concept in machine tool systems training for the southeastern United States.

SiMT has engaged in a partnership with Siemens, which supplies the Sinumerik CNC technology, to work with educational providers at the center to

## **Manufacturing and Operator Advantages with Sinumerik Controllers:**

- ▶ Reduced costs
- ▶ Optimized quality
- ▶ Less development and downtime
- ▶ New service potential

bring training closer to the job shops and end-user machining departments of local business enterprises.

### **A new learning method**

An array of machine tool and support technologies, comprising electrical discharge machining (EDM), water-jet machining, multiaxis machining centers, CNC mill/turn equipment, grinders, and the latest versions of CAD/CAM design software and postprocessing modules are offered at the center. Additionally, fully equipped and staffed training labs and



Training labs and classrooms enable students, designers, and shop personnel to utilize the latest CAD/CAM software as well as HMI simulators for CNC machining

classrooms with human-machine interface (HMI) stations enable both design and operations personnel to learn current programming and machine control protocols using the operator panel simulators.

At the heart of the AMC is its 18,000-square-foot manufacturing arena, which enables operators to learn a variety of inspection equipment and machining techniques, plus the programming and control skills necessary to run today's sophisticated CNC machine tools. It is in this area where the partnership with the German machine builder EMCO and Siemens is most evident. More than 20 EMCO machining centers with Sinumerik CNCs onboard are available for training and comparative machining strategy analysis by companies looking to improve their throughput, time to first part, or even part-handling techniques. In addition, 25 workstations for



**»Our clients are working with the newest equipment and software modules on the market. This gives them a great benefit once they return to their shops or, in the case of start-ups, begin their operations.«**

Jack Roach, Director of SiMT



3-D/Virtual Reality Center, one of only six interactive digital centers in the world, where product development imaging can be utilized for sales presentations, trade shows, training, and enhanced engineering

offline programming are on hand in the AMC, utilizing WinNC, a control-specific software developed by EMCO, to allow simultaneous training on various control systems. As a result, students or operators can learn the particulars of various control programs on the same Siemens simulator, making them flexible and productive employees when they enter or return to the shop environment.

### Designed for ease of use

The Sinumerik controller is the ideal CNC for shop-floor manufacturing, as it combines flexibility with high productivity. Even small series can be manufactured quickly and profitably. And getting started with CNC technology from Sinumerik without DIN standards programming knowledge requires very little effort, as it is dialog-oriented and uses graphics for easy comprehension. And because individual parts or small series are frequently manufactured

on the shopfloor, the short switchover times offered by Sinumerik are particularly advantageous.

### A beneficial collaboration

Under the leadership of Jack Roach, director of SiMT, the partnership with EMCO and Siemens has resulted in a highly advanced concept that not only achieves machine tool training for operators but also provides a unique opportunity for product and production systems development. "Our clients are working with the newest equipment and software modules on the market," he says. "This gives them a great benefit once they return to their shops or, in the case of start-ups, begin their operations." ■

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## ■ Training

# SinuTrain Goes “Operate”

The SinuTrain training system enables straightforward Sinumerik operation and CNC programming based upon the real Sinumerik CNC kernel — on a PC.



Sinumerik Operate offers new and powerful functions for operating and programming

The Sinumerik CNC family covers the complete range of machine tools, from sophisticated high-level factory automation to individual turning or milling machines. Last September, at EMO 2009, Siemens introduced Sinumerik Operate, a new HMI integrating the control and programming interfaces for HMI-Advanced, ShopMill, and ShopTurn into a single unified programming environment. The same interface is used for high-level programming of multiple-axis systems and for step-by-step programming of simpler machines. The clearly structured layout with context-based functions and self-explanatory icons enables faster and more intuitive handling by machine operators and quicker familiarization with new machines.

## Bringing Sinumerik to the PC

Sinumerik Operate is now fully supported by SinuTrain, Siemens' practice-oriented, integrated solution for CNC training. SinuTrain provides a complete training and system simulation package and runs on a PC with no additional hardware required.

SinuTrain provides an on-screen control that looks and behaves exactly like that of the target machine. This is possible because SinuTrain is based on the

## SinuTrain for Sinumerik Operate

- ▶ Straightforward Sinumerik operation and CNC programming on a PC
- ▶ Suitable for all globally established CNC programming methods
- ▶ Maximum machine “feeling” with integrated software machine control panel
- ▶ Optimal machine adaptation for maximum CNC-program compatibility
- ▶ Multitude of operator languages available
- ▶ Intelligent software license management for all needs and budgets

real Sinumerik CNC kernel. The software enables the student to become familiar with machine details such as control, working range, and tool changing. The student can learn to work proficiently with the coordinate system and then go on to generate machining plans. A machining program can be safely simulated, with the on-screen display reflecting exactly what would occur as the job proceeds.

## More than a training tool

In addition to being a CNC-identical offline training tool that enables easy and risk-free learning, SinuTrain based upon Sinumerik Operate can also be used for offline CNC programming. This contributes to higher productivity and more efficient resource utilization. Plus, SinuTrain can be used to compile professional CNC presentations for both training and sales purposes. Student and instructor workstations can also be networked with real machine tools so the student's efforts can be tested by cutting real metal after the programs have been fully debugged offline. ■

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# CNC4you

## The SINUMERIK CNC user community



[www.usa.siemens.com/cnc4you](http://www.usa.siemens.com/cnc4you)

Do you want to learn new tips-and-tricks for SINUMERIK?

Are you interested in reading about other Siemens customers and how they keep their productivity in motion with SINUMERIK CNC?

Well, look no further — point your browser to our user community website where you'll find:

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