October 2011

GEAR TECHNOLOGY

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The Journal of Gear Manufacturing

Gear Expo 2011

- Map and Booth Listings
- Booth Previews
- Showstopper Ads
- Cincinnati at Night!
- ASM Heat Treat Show Coverage

Technical Articles

- Low-Distortion Heat Treat of Transmission Components
- Results of Test Rig vs. Field Measurements for Wind Gearboxes

Plus

- Addendum: Antique Gear Show

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GEAR TECHNOLOGY
October 2011

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GEAR EXPO/ASM COVERAGE

TECHNICAL ARTICLES

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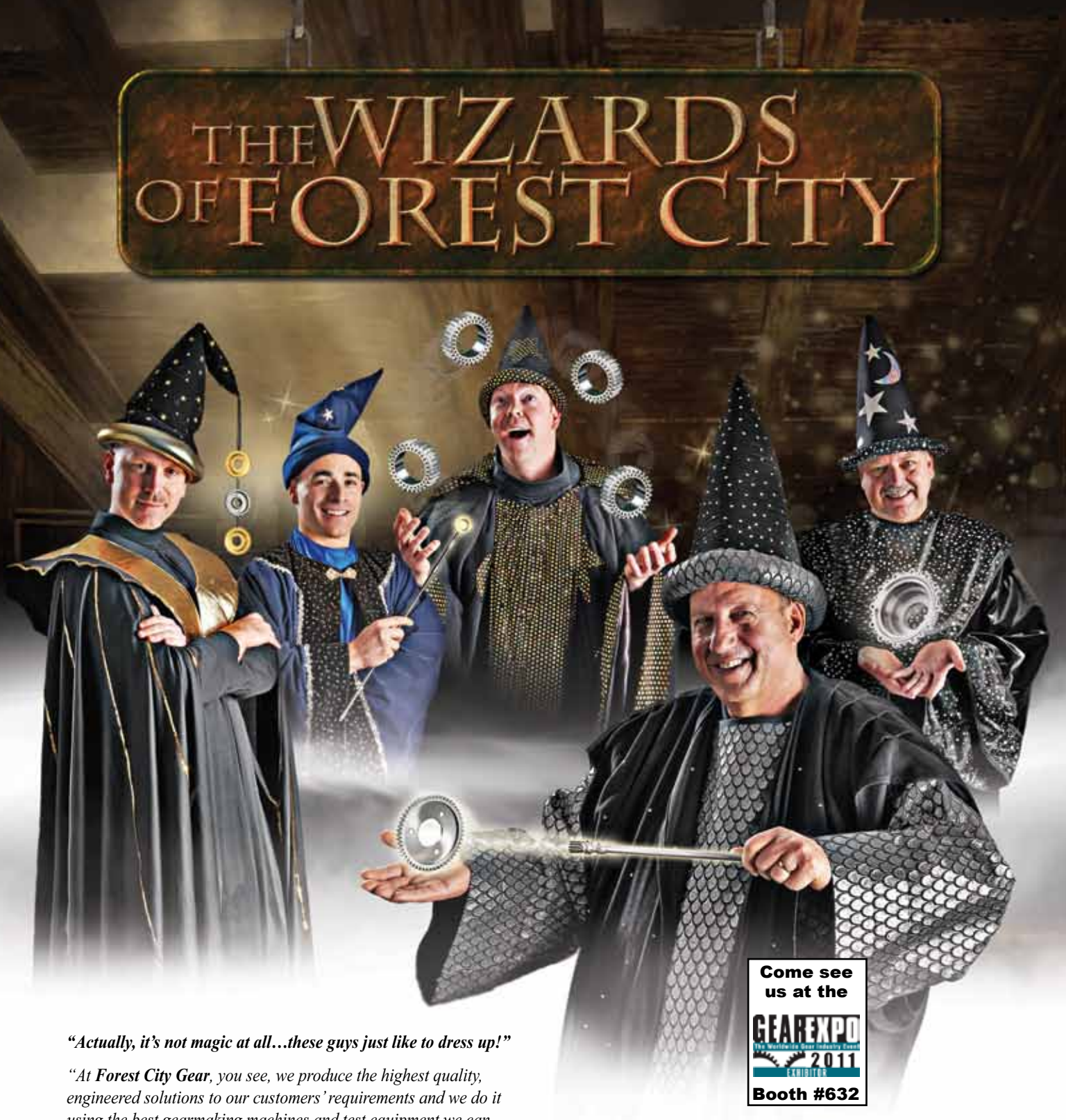

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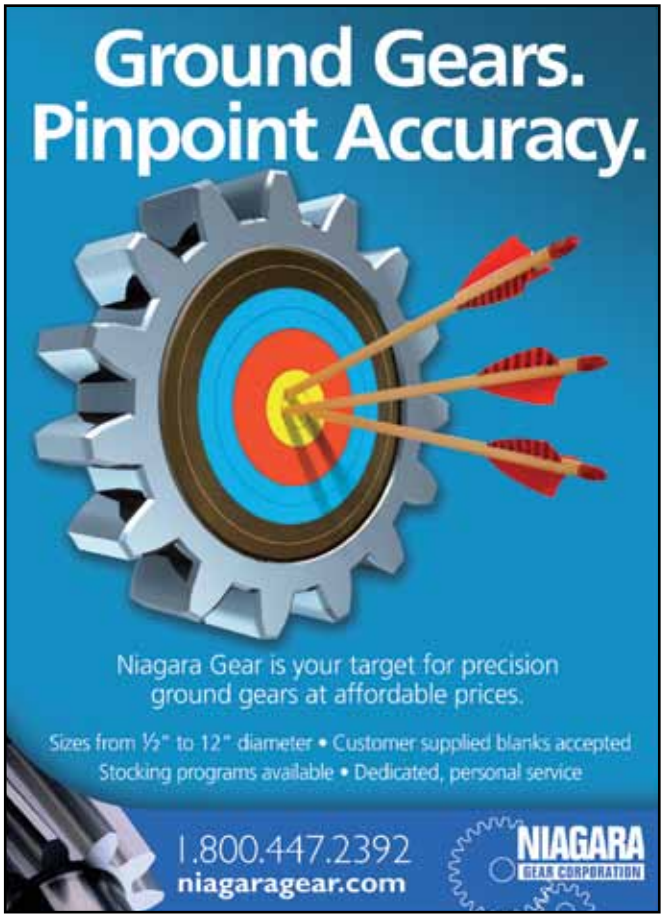

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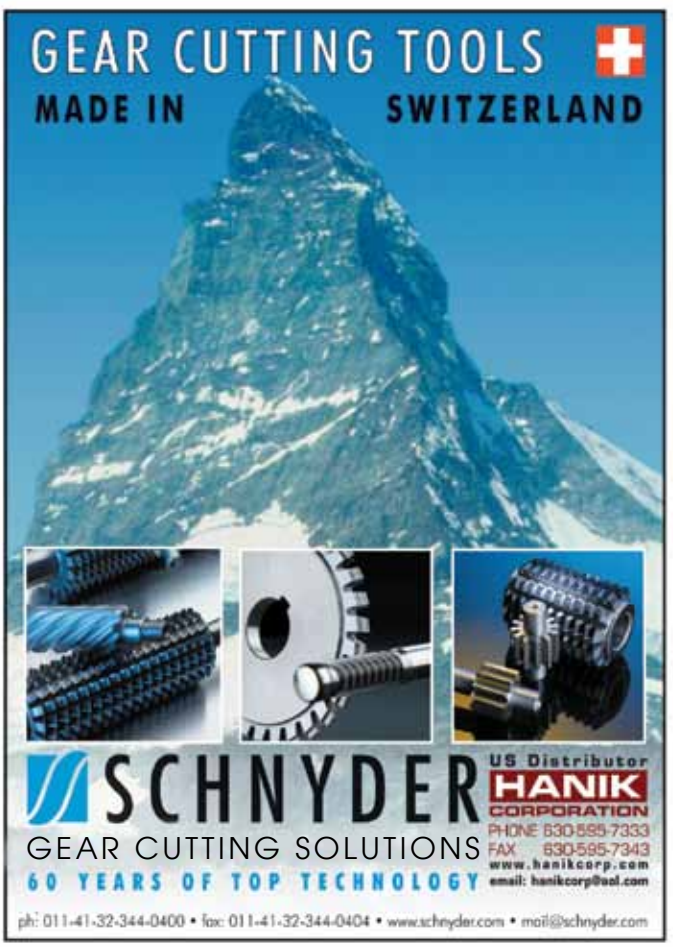

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Randall Publications LLC
1840 Jarvis Avenue
Elk Grove Village, IL 60007

Phone: (847) 437-6604
Fax: (847) 437-6618

EDITORIAL

Publisher & Editor-in-Chief — Michael Goldstein
publisher@geartechnology.com

Managing Editor — William R. Stott
wrs@geartechnology.com

Senior Editor — Jack McGuinn
jmcguinn@geartechnology.com

Associate Editor — Matthew Jaster
mjaster@geartechnology.com

Editorial Consultant — Paul R. Goldstein

Technical Editors — William (Bill) Bradley
Robert Errichello
Octave Labath, P.E.
Joseph Mihelick
Charles D. Schultz, P.E.
Robert E. Smith
Dan Thurman

ART

Art Director — Kathleen O'Hara
kathyohara@geartechnology.com

ADVERTISING

Advertising Sales Manager — Dave Friedman
dave@geartechnology.com

Materials Coordinator — Dorothy Fiandaca
dee@randallpublications.com

CIRCULATION

Circulation Manager — Carol Tratar
subscribe@geartechnology.com

RANDALL STAFF

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Exploring Gear Expo

I'm sure you've noticed that this issue of *Gear Technology* is one of our biggest ever. Like many of you in the gear industry, we've been working at a feverish pace—both because business is good, and because we're getting ready for the gear industry's main event: Gear Expo, taking place November 1–3 in Cincinnati, Ohio.

While putting the finishing touches on this issue, we're also packing up and getting ready for the show. We'll be there, in booth #1337. As we've done the past several shows, we'll be transforming our booth space into the Cafe de Gears, serving free cappuccino, espresso or latte to attendees and exhibitors. Whether you are a current subscriber or want to become one, whether you've advertised for years or just want to enquire about getting started, we welcome you to our booth and hope you'll take the opportunity to come relax and have a nice chat.

At the show, we'd also like to tell you about our new publication, *Gear Technology India*, which will be launched officially in January 2012 and distributed at the IPTEX 2012 show in Mumbai (February 9–12). A description of the new magazine and its focus, along with our editorial calendar and advertising rates, are all available in the media kit located at *www.geartechnologyindia.com*. We and our partner—Virgo Publications—are extremely excited about this new publication, designed specifically to serve the Indian market. We're looking for contributors and advertisers, so if you're interested, please stop by our booth or the Virgo booth (#1204) to learn more.

In order to help prepare you for the show, we've put together some 56 pages of Gear Expo-related content and advertising, beginning on page 24 of this issue. The map and listings will help you get your bearings at the show. More importantly, our booth previews (beginning on p.43) and the special Showstopper advertising section (beginning on p. 61) should give you a good feel for what to expect at this year's event.

For those who are lucky enough to be attending this year, we've also included an article on what to see and do—and where to eat and drink—in Cincinnati (p. 58).

Once again, Gear Expo has teamed up with the ASM Heat Treating Society Conference and Exhibition, and the ASM show will take place November 1–2 in the same hall, right next to Gear Expo. For those of you with an interest in heat treating, we've also included the ASM map and listings, booth previews and Showstopper ads. ASM coverage begins on page 68.

You can find even more great Gear Expo information online in the article archives at *geartechnology.com* and *powertransmission.com*. The September 2011 issue of *Gear Technology* included a show overview, a description of AGMA's Fall Technical Meeting, some additional Showstopper ads, and interviews with exhibitors. The October 2011 issue of *Power Transmission Engineering* explored Gear Expo from a gear buyer's perspective, listing all of the gear manufacturers and suppliers who will be exhibiting, and featuring booth previews from a number of them.

As always, there is a lot to be learned at Gear Expo. I've often said it's the greatest concentration of gear knowledge, experience and technology all under one roof. If gears are your business, there's much to be gained by going, and much to be missed by staying home.

Come to Gear Expo and see for yourself. We look forward to seeing you there.

Michael Goldstein,
Publisher & Editor-in-Chief

LMT Fette Introduces SpeedCore

TECHNOLOGY ALLOWS FOR MORE EFFICIENT AND FLEXIBLE HOBBING

In today's gear manufacturing environment, flexibility and efficiency are key factors in modern machine tool technology. Productivity improvements, including state-of-the-art gear cutting machine tools, allow higher cutting speeds by up to 30 percent. While most of the machines are already designed to utilize carbide hobs and work under dry conditions, the newly developed material SpeedCore by LMT Fette, is now at the stage to accelerate the machining conditions dramatically—for the benefit of the customer.

"The core of the new SpeedCore material is made out of carbon-free iron, cobalt and Molybdenum," says LMT Tool Systems' Thomas Falk. "This new composition as well as the powder metallurgy manufacturing method allows an increase in high temperature hardness of the material compared to the traditional PM-HSS materials. The hardness of this material is generated by special nanostructures, which are in an intermetallic state."

Higher cutting speeds increase the mechanical and thermal loads of the hob. While HSS materials are limited to a range of cutting speeds due to their limited high temperature hardness, SpeedCore hobs are manufactured out of this new cutting material, which overcomes the barriers of high temperature hardness while at the same time offering sufficient toughness. "With hobs using the new SpeedCore material, the cutting speed increases, the customer gains significantly more parts in less time and the machine tools will be utilized more efficiently," Falk adds. "Nearly no additional investment is necessary to increase the productivity, just the new SpeedCore material."

LMT Fette has tested the capability with the support of the Technical University of Magdeburg. The newly developed material was tested at cutting conditions normally used for solid carbide hobs. The results prove the high temperature resistance of SpeedCore. In the laboratory tests machining real components, the SpeedCore materials were used at cutting speeds up to 350 m/min without any thermal overload of the cutting edge. The tool length achieved 7 m; these are conditions where PM-HSS materials would fail. In real-world applications, these results in the manufacturing environment mean customers can increase the cutting speed more than 30 percent to improve the efficiency of the gear cutting process. There are two options: the cutting speed is increased to achieve a predetermined tool life, or the process is adjusted to the capability of the SpeedCore material. The customer will achieve in both cases lower costs per workpiece.

The launch of the new cutting material means LMT has taken another step in developing its gearwheel production system. Following the Nanosphere coating, launched less than two years ago, the SpeedCore cutting material is another technological breakthrough. The LMT hob

continued

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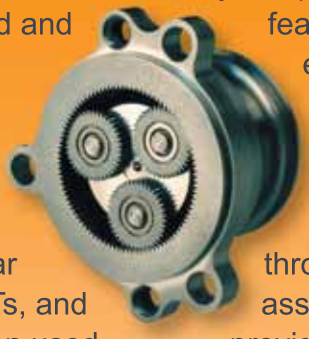

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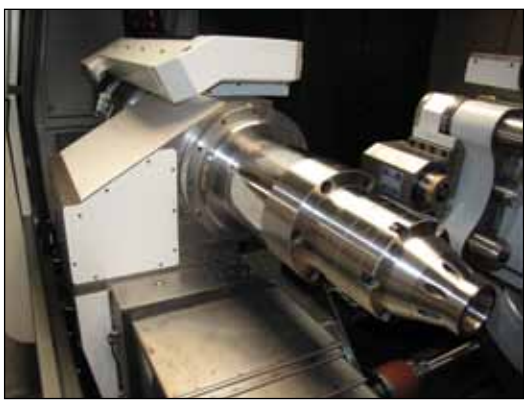
cutter system includes not only coatings and cutting materials, but also application-specific engineering and services likes LMT's global reconditioning and coating network. Its centers in China, Germany and the United States enable LMT to guarantee it will recondition hobs to original manufacturer quality for users worldwide. The new hob generation was officially launched in Germany in June as part of a specialist gear-cutting symposium in Schwarzenbek. "SpeedCore made its international debut at EMO Hannover in September, where we also introduced the start of a much larger product range," Falk says.

LMT Fette also presented a new cutting material at EMO Hannover that has been specially developed by its alliance partner Boehlerit for milling applications. Nanosilver, a nanostructured coating, has been applied to three new carbide substrates. The new TeraSpeed coating substantially improves the performance of LMT indexable inserts. The aluminum titanium nitride coating system offers a high level of thermal resistance of up to 1,100 degrees Celsius—200 degrees higher than comparable coatings. The XChange threading tap combines the advantages of carbide and high-speed steel: equipped for internal cooling, the tool is capable of twice the cutting speed of a conventional HSS tap. LMT presented a coating for thread rollers in the shape of Protec, an innovation that will expand the range of thread-rolling applications. The elastic and flexible thin-film coating has been specially designed for processing hard materials and increases tool life by up to 30 percent. In addition, LMT is pooling more than 50 years of experience in the machining of composite materials as part of its Composite Excellence initiative.

The main focus at EMO, however, was on SpeedCore and its various advantages, including higher productivity, higher operating safety, easy implementation on older machines and the resharpening and recoating options available.

"Speedcore has been incredibly successful in applications regarding productivity and tool life," Falk says. "The target is the increase of productivity in the gear wheel production and to guarantee a process security."

For more information:
LMT USA Inc.
1081 S. Northpoint Blvd.
Waukegan, IL 60085
Phone: (630) 969-5412
Fax: (630) 969-5492
www.lmt-tools.com



Zenith

OFFERS MULTIPLE GRINDING TECHNOLOGIES

Holroyd Precision Ltd. recently launched a new machine capable of using three grinding technologies at EMO Hannover. Holroyd's new Zenith machine combines the technologies of aluminium oxide, Electro plated CBN (cubic boron nitride) and vitrified (dressable) CBN. The Zenith

machine will have the capacity to grind some of the largest rotors in the industry at 420 mm and offer the flexibility to use tooling from customers' existing grinding machines. This is a new generation of grinding machine technology, encompassing modern innovations, coupled with an easy feel control system that incorporates both a development and production software suite to suit all potential user requirements in either research and development or mass production.

The Zenith machine is an extremely compact machine that gives high loop stiffness, good thermal resilience and rigid workholding. The machine's increased capacity can accommodate components up to 420 mm. in diameter. Thanks to careful orientation of axes and guide-way layout, overall length capacity could be increased with a reduction of machine footprint. Use of a single-piece iron casting using precision ground linear guideways removed traditional constraints regarding the orientation of the guideways.

Ease of access is significantly improved through a unique slideway design. A software 'wizard' guides the operator smoothly and efficiently through the CNC programming without the requirement for high levels of expertise while still offering options for personal operator control. Operator-free coolant application eliminates the possibility of human error. An inductive flute-finding probe allows rapid orientation of the part.

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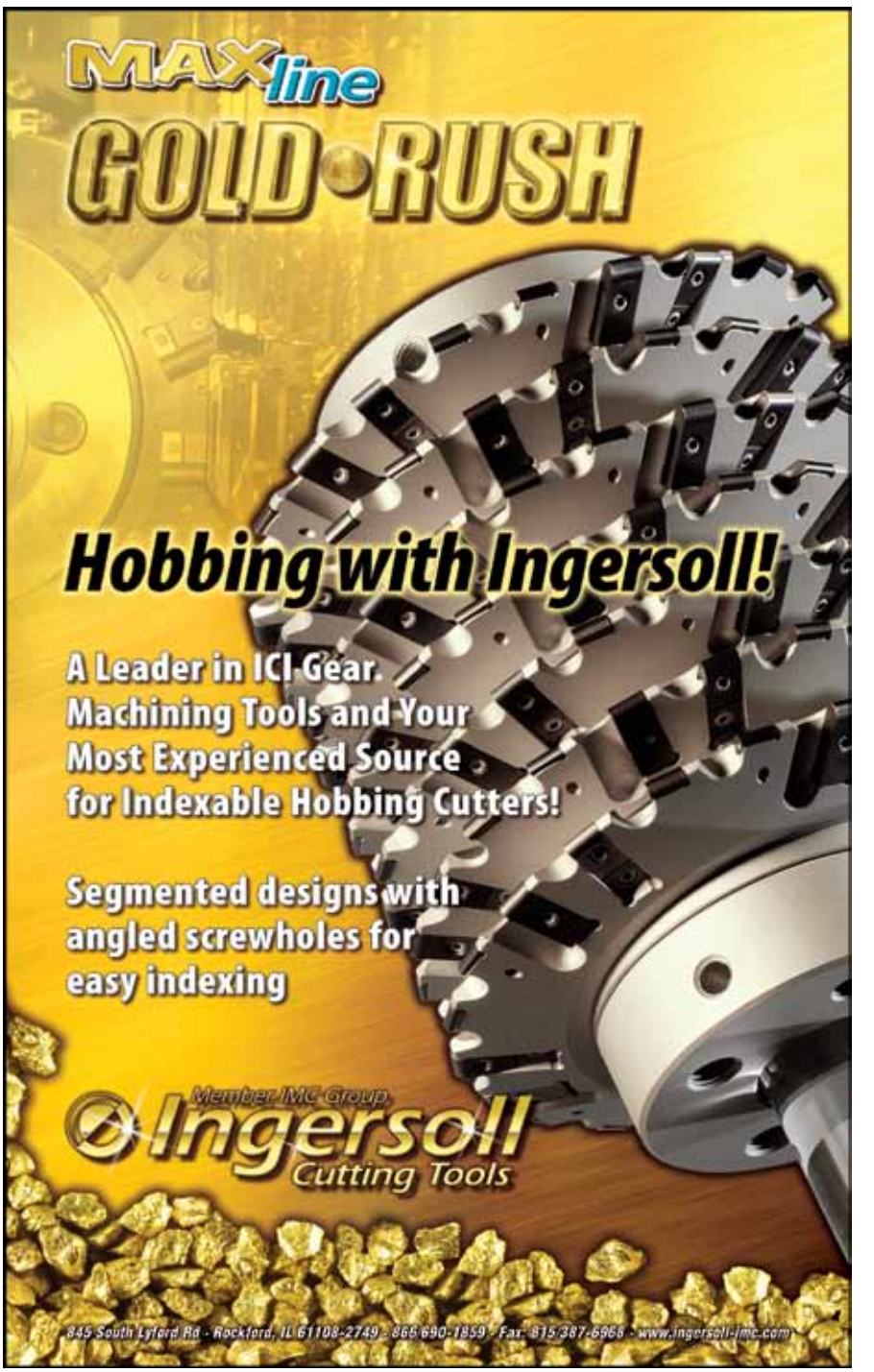

the grinding wheel to ensure economic dressing.

"The development of the new Zenith machine has provided an exemplary case study of the way in which we like to operate here at PTG," says Rod Macdonald, managing director of Holroyd Precision. "By taking as our starting point the concerns and considerations of our customers through a thorough and exhaustive market study, we believe that ultimately we have been able to develop an entirely new generation of helical grinding machines to satisfy the demanding needs of accuracy and versatility on the one hand and productivity and ease of use on the other. While the important and newly-emerging consideration of energy efficiency was also a very important factor in the development of what we believe to be a truly groundbreaking machine."

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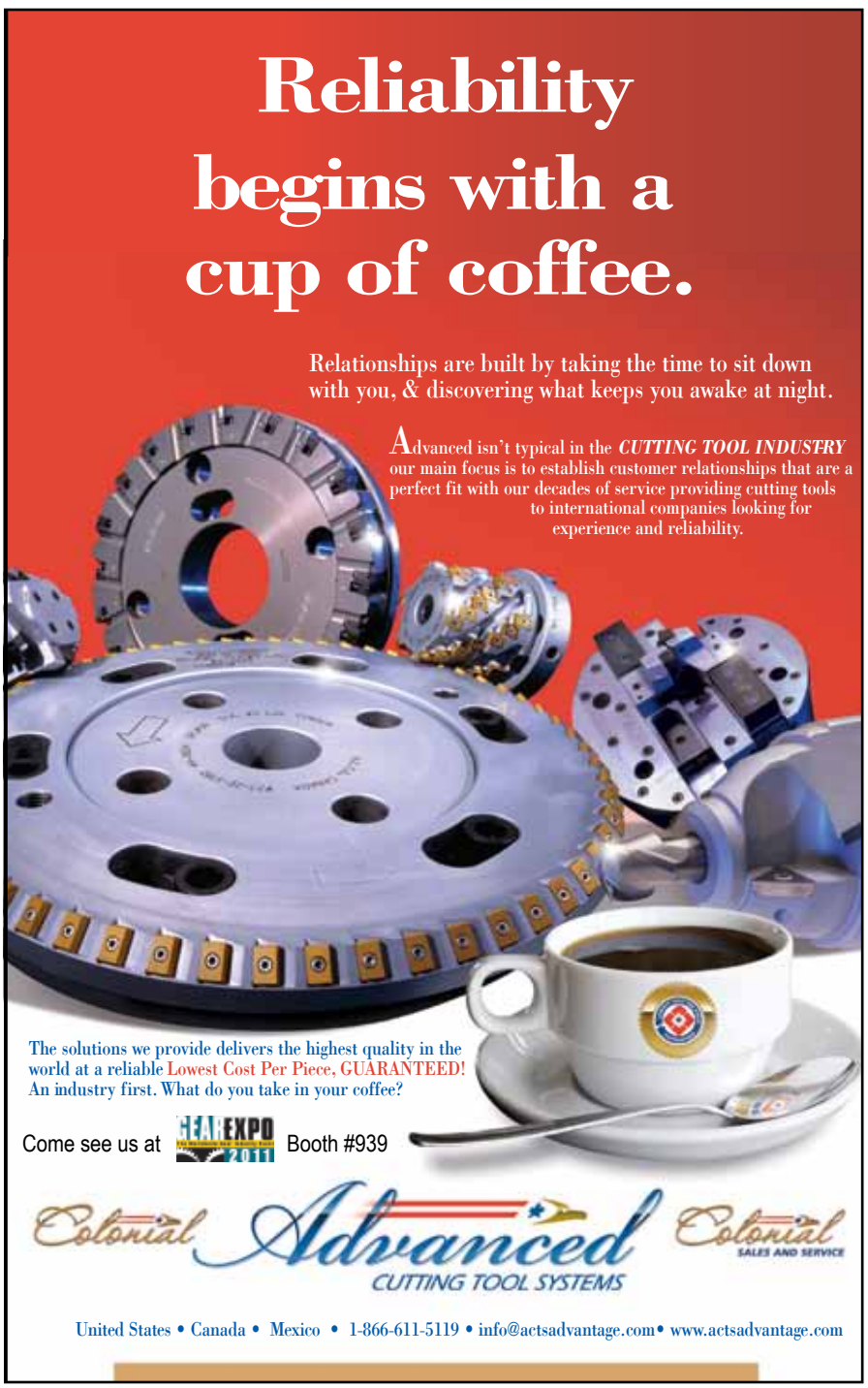

Advanced Machine

INTRODUCES DOVETAIL VISE CLAMPING COMPONENT

Advanced Machine and Engineering Co., located in Rockford, Illinois, recently introduced a new dovetail vise clamping component, the newest addition to their line of fixturing and workholding products. The dovetail vise is widely used in the aerospace industry for aluminum milling operations, but can also be used for many other applications. Benefits include: precision bushing holes allow

for quick and easy location of vise, 1/2"-13 SHCS and precision dowel screws are used to secure vise on 2" grid system, a 15 degree dovetail angle that holds pre-machined parts securely during machining operations, maximum part width 4" or 5", vise available in 5", 8", 12", 16" or 24" lengths, up to 12 jaws, depending on vise length and metric locating and mounting hole version available on request.

For more information:
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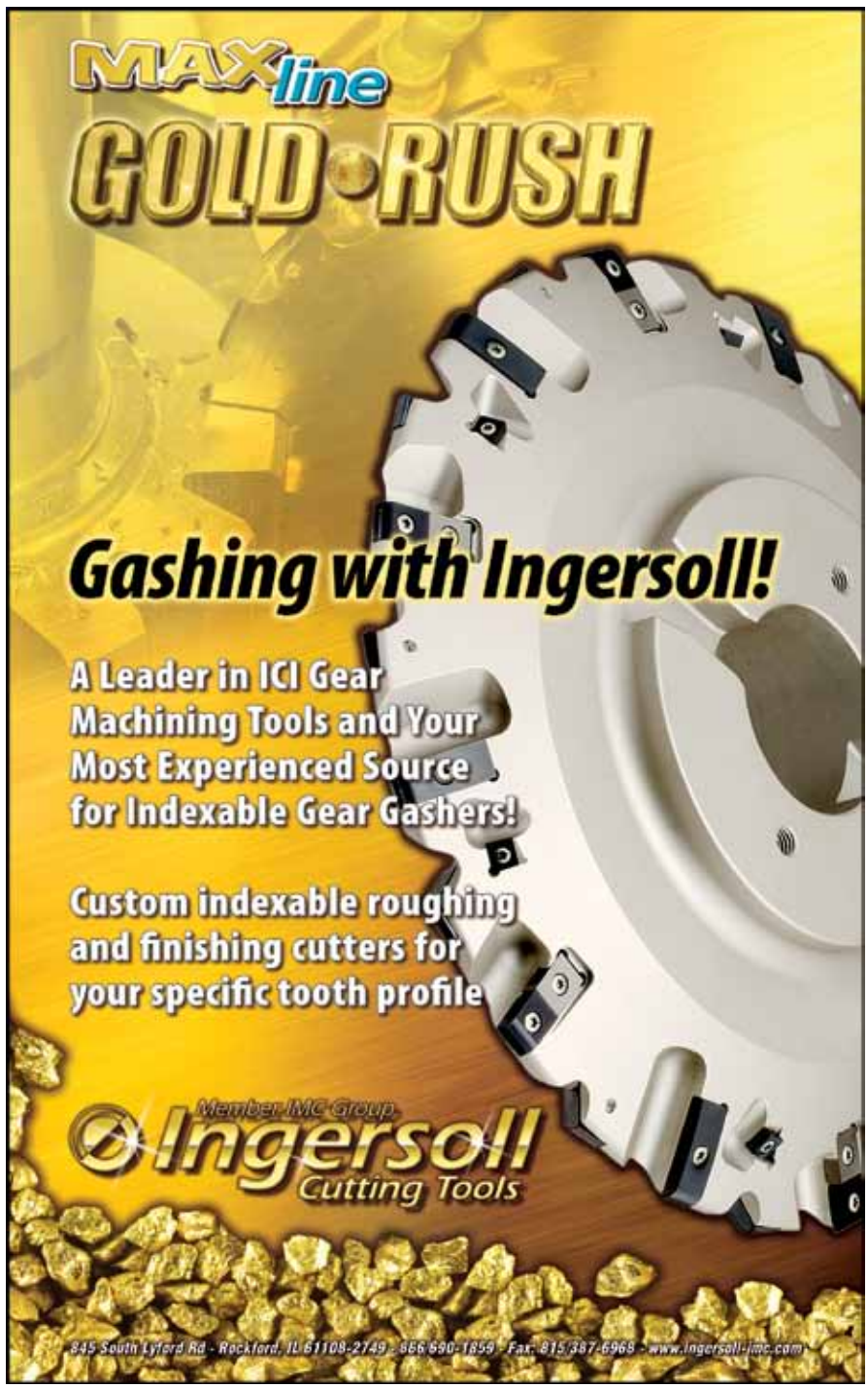
Rockford, IL 61103
Phone: (815) 962-6076
www.ame.com

LMC

RELEASES STATIONARY PNEUMATIC AND HYDRAULIC CHUCKS

Chandox brand stationary pneumatic and hydraulic chucks are available from LMC Workholding. The 2 actuating axes self-centering solid air chuck fixtures are suitable for machining centers and feature 4-jaw clamping but only require 1 air inlet-outlet for clamping. 2-jaw and 3-jaw hollow power chuck fixtures with built-in type cylinders are also utilized for machining applications. These chucks provide a gripping force range up to 44 kN (9,891 lb-f) on smaller models and up 142.1 kN (31,945 lb-f) on larger models for heavy-duty cutting. Other features include rust-proof cylinder and dust-proof and waterproof structure. Chandox super thin manual chucks and chucks for quality measurement and gaging are also available. Various models and specifications are offered. Hard jaws and soft jaws can be used alternatively. A chuck flange

continued



on the powerful type super thin chucks makes loading and unloading simpler and more convenient. Super thin square chucks offer repetitive gripping accuracy with hard jaws within 0.02 mm.

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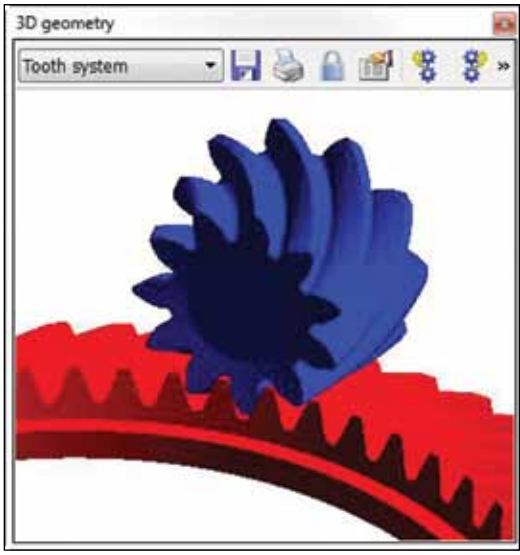

KISSsoft

RELEASE INCLUDES EXTENDED 3-D MODELS

Another highlight in the current *KISSsoft* Release is the extended 3-D models. 3-D models are now available for spur and helical bevel gears as well as bevel gears with spiral teeth. Based on the bevel gear geometry calculation according to ISO 23509, 3-D models after Gleason and Klingelnberg (*module ZC10*) can now be designed. There is a very good correspondence achieved with reference software. The position of the contact pattern can be influenced through various flank modifications and tested by the designer by using the contact line in the load-free state. Finally, the models can be exported in *STEP* or *Parasolid* format (*module CB1*) and used for further application on five-axis milling machines. Furthermore, models for worms with worm wheels (*module ZD10*) are now available.

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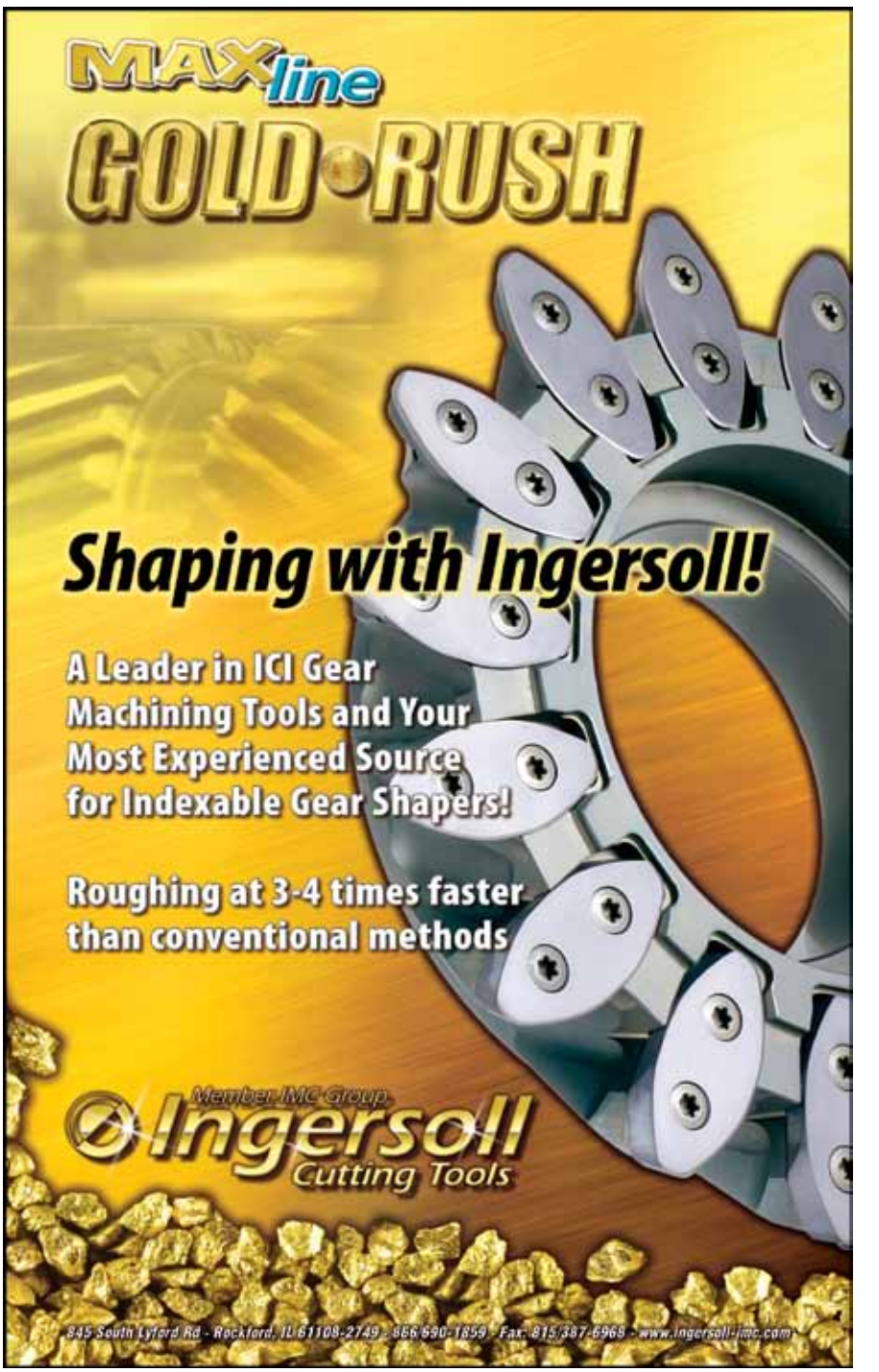
manufacturers the ability to outproduce—by up to 85 percent or more—six or more twin-turret CNC lathes with a single, flexible, high-speed, high precision machine that can work unattended over three shifts. The flexibility and capability of the machine is well-suited to batch production and for machining families of parts; the front and rear end machining options permit efficient, complete machining of production parts with complex geometry and/or extensive operations on the cutoff end. The core of the machine is

continued

Index

INTRODUCES MULTI-SPINDLE CNC LATHE

The new Index MS40P CNC multi-spindle automatic lathe includes a quillstock with six tool carriers and one counter spindle opposite the main six-spindle drum, making it possible to machine complex workpieces requiring many tools with highest precision in a single process. A new concept, the Index multispindle affords contract



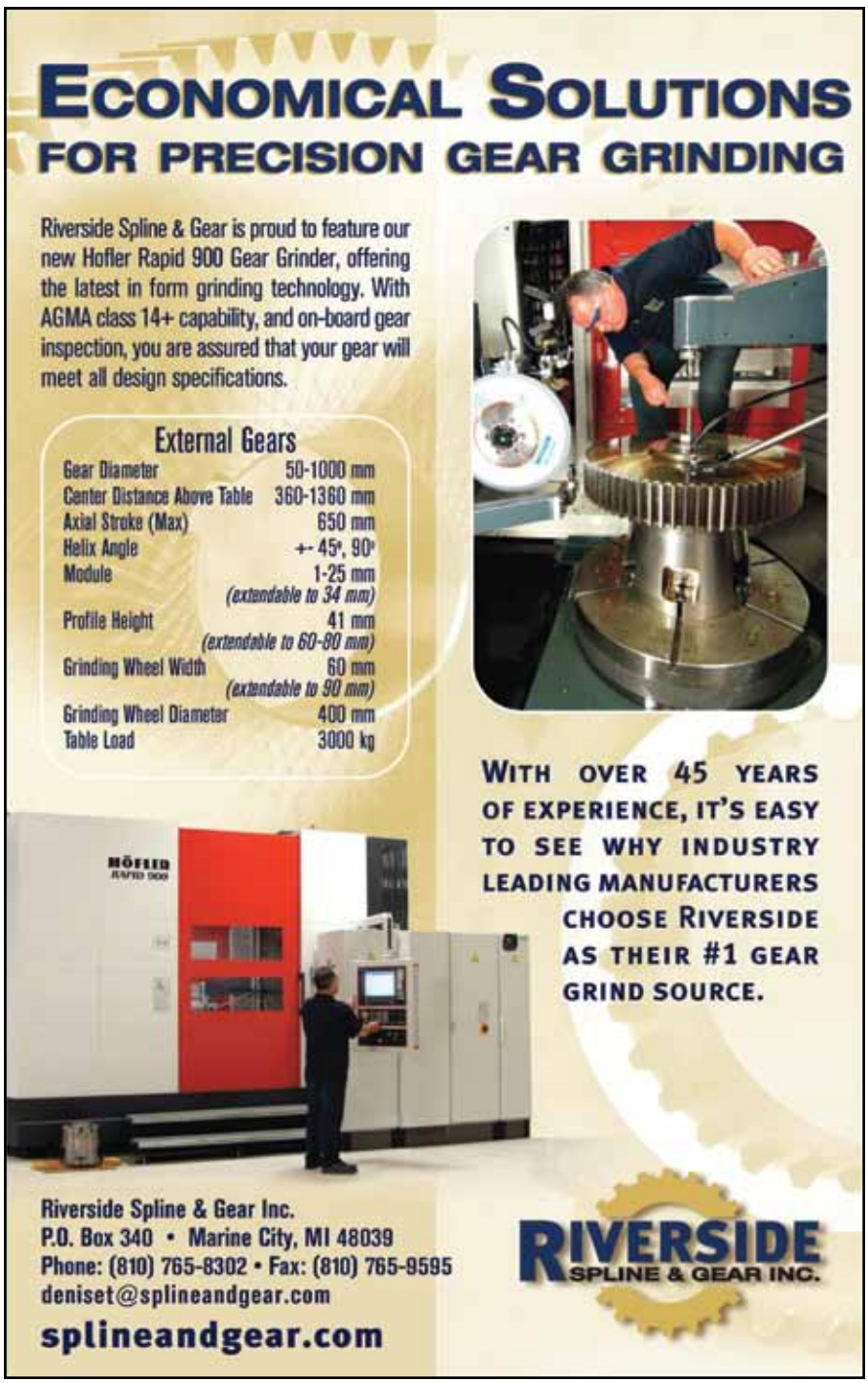
its compact spindle drum. Six fluid-cooled, infinitely variable hollow-shaft motors are able to drive up to 40 mm bar stock independently from each other. Other characteristics of the spindle drum are: high torque, small frame size, maintenance-free operation, and an advanced synchronous design. The enhanced machine concept is based on the added A-side (drum side) and an opposite quillstock on the B-side.

Besides the tool carriers in the spindle drum side of the machine, another six tool carriers and a counter spindle are located in the rigid monoblock quillstock. The tool carrier arrangement in the working area without a longitudinal slide block allows the use of more than one tool on each spindle. The generously dimensioned working area can be easily accessed through sliding doors on both sides of the machine. This is very convenient for the user and greatly reduces setup time. Chips drop directly into the base of the machine.

The Index modular system allows, on the A-side, customer-specific configuration of up to 12 hydrostatic bearing-supported CNC cross-slides, several Y-axes, and numerous stationary and live tools (for front-end machining), permitting a wide range of machining in a single setup: off-center drilling, deep-hole drilling, thread cutting, inclined drilling, cross drilling, contour milling, hobbing, and multi-edge turning are only a few of the many possibilities. The characteristic Index V-shaped arrangement of the tool carriers means the optimum machining sequence is the only factor determining the process. For example, external and internal machining operations using stationary or live tools can be performed in every station.

During machining, users can program the optimum speed for each independent spindle which can be varied during cutting. The result is excellent surface quality, short production times per piece, and extended tool life. It is also possible to make speed changes during drum indexing, thus avoiding any additional secondary processing times. This capability also makes it possible to machine difficult materials that previously were hardly suitable for multi-spindle machines.

For more information:
Index Corp.
14700 North Point Boulevard
Noblesville, IN 46060
Phone: (317) 770-6300
www.index-usa.com



Renishaw Probe

Allows Fully Automated Measurement on CMMs

Renishaw has added a new probe option to its Revo five-axis measurement system, which for the first time, allows surface finish inspection to be fully integrated within CMM measurement routines. With a measurement capability of 6.3 to 0.05 Ra, the SFP1 surface finish probe provides a unique 'single platform' that will eliminate the need for handheld sensors, or the necessity to move parts to costly dedicated surface finish measuring machines, reducing labor costs and inspection lead times. CMM users will now be able to automatically switch between part scanning and surface finish measurement, with analysis all contained in a single measurement report. As a fully integrated option for the Revo five-axis measurement system, users of the SFP1 surface finish probe will benefit from a range of powerful features that will boost inspection speed and flexibility.

The probe incorporates a C axis, which combined with the infinite positioning capability of the Revo measuring head and a choice of styli, allows the probe tip to be automatically orientated to any angle to suit the part, ensuring that the highest quality surface data is acquired. The SFP1 is supplied with two dedicated styli, the SFS-1 straight stylus and SFS-2 cranked stylus, which are selected under full measurement program control using the Revo system's modular rack system (MRS). This enables flexible access to component features combined with the consistency of a fully-automated CNC methodology.

continued

A skidded probe type with a 2 µm (0.000079 in) tip radius diamond stylus, the SFP1 surface finish probe outputs Ra, RMS and raw data formats to the metrology application client software via Renishaw's *UCCServer* software using the I++ DME protocol. The raw data can subsequently be presented to specialist surface analysis software packages for further detailed reporting. Calibration of the sensor is also automated and carried out within a CMM software program. A new surface finish calibration artifact (SFA) is mounted on the MRS rack and is measured using the SFP1 probe. Software then adjusts parameters within the probe in accordance with the artifact's calibrated value.

For more information:
Renishaw Inc.
5277 Trillium Blvd.
Hoffman Estates, IL 60192
Phone: (847) 286-9953
www.renishaw.com

Exsys Tool

PROVIDES ROUGHING/HOBBING ON SINGLE MACHINE

A special compact gear hobber system from Exsys Tool, Inc. allows shops to generate splines, spur or helical gears in one operation. The Exsys/Eppinger adjustable tool holding system, designed for Mazak horizontal turning centers, as well as most other machine brands, eliminates having to rough gears on one machine, then transfer them to another for gear hobbing. To compensate for different types of grooves or pitches in splines and gears, users simply set the ver-

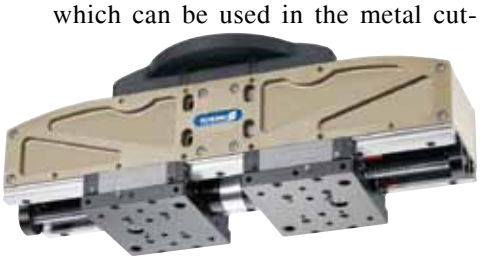
nier dial up to +/- 20 degrees. Software for gear hobbing is an option on most turning centers. Having a compact design, the system, in most instances, operates without interrupting its neighboring tool stations in a machine turret. Other comparable systems often require the room of two tool positions. Built for heavy machining loads, the gear-driven Exsys/Eppinger gear hobbing system has been designed for 45 N-m of torque and speeds of up to 3,000 rpm for hobs or slotting saws up to 2.480 dia. (63 mm). Arbor diameters are available for all standard sizes for use of both slotting saws and gear hobs. Changing tools takes just seconds by removing the yoke plate and sliding out the arbor. The base of the tool holder remains in its station.

For more information:
Exsys Tool, Inc.
11654 Corporate Lake Blvd.
San Antonio, FL 33576
Phone: (800) 397-9748
www.exsys-tool.com

Schunk

OFFERS MODULAR LIGHTWEIGHT GRIPPER

Schunk continues to expand its range of modular long-stroke electric grippers with the LEG 400, which can be used in the metal cutting and automotive industry, along with assembly and handling tasks. This weight-reduced, lightweight gripper is equipped with a servomotor and has a gripping force of up to 1,050 N as well as a variable stroke between zero and 103 mm. Having only one motor, it weighs 6.5 kg.



Designed according to the modular principle, the LEG gripper can be equipped with a pneumatic and electric drive. The user is able to choose the servo motor as desired. Robot manufacturers can thus use their own motors and control the gripper with the same

continued

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set of commands as the robot. In addition, the applicable forces can be measured and controlled with servo-electric drives. If the LEG is operated with a single servomotor, both drive spindles are coupled and the fingers move synchronously. With two motors on the other hand, the fingers can move to any position in the gripping range independently of each other.

The modularity of the LEG goes even further; both slides and guided slides as well as the supporting lateral cheeks and the connecting elements are available in different sizes and versions. The LEG gripper can thus be adapted economically to the corresponding task and load. Optional sensors or image processing systems make it a sensitive tool in the production, assembly, and packaging processes. A change system that can be used to change the fingers manually or automatically provides the user with additional flexibility. Due to the low weight of the LEG gripper, excellent acceleration and high speeds are possible, and thus shorter cycle times and a higher overall power. Alternatively, smaller actuators or robots can be used with identical cycle times. That saves energy, protects the environment and reduces running costs.

For more information:

Schunk Inc.
211 Kitty Hawk Drive
Morrisville, NC 27560
Phone: (919) 572-2705
www.schunk.com

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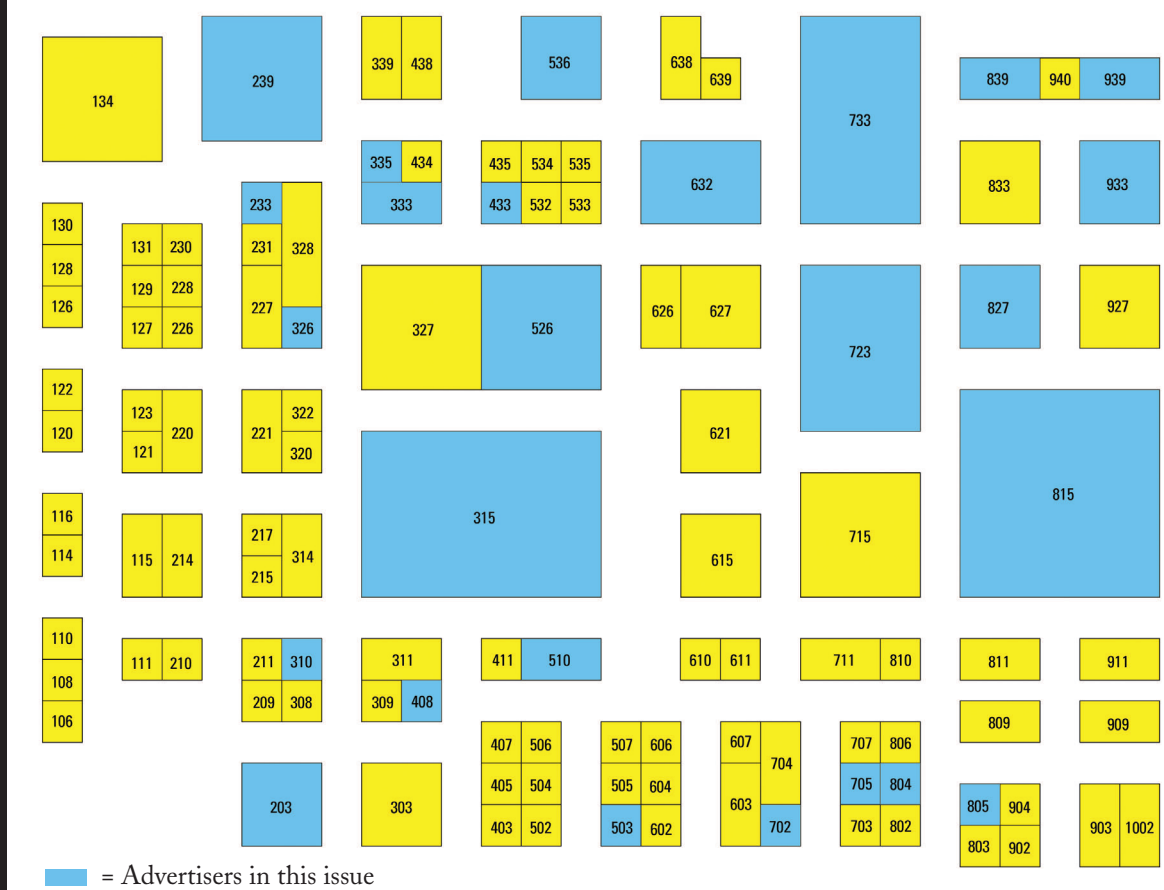

Alphabetical List of Exhibitors ⇒

See page 31 for these listings arranged by booth number. All listings are current as of September 23, 2011. For updated information, visit *www.gearexpo.com*.

Advertisers in the October 2011 issue of *Gear Technology* are indicated by bold type and highlighted on the show map.

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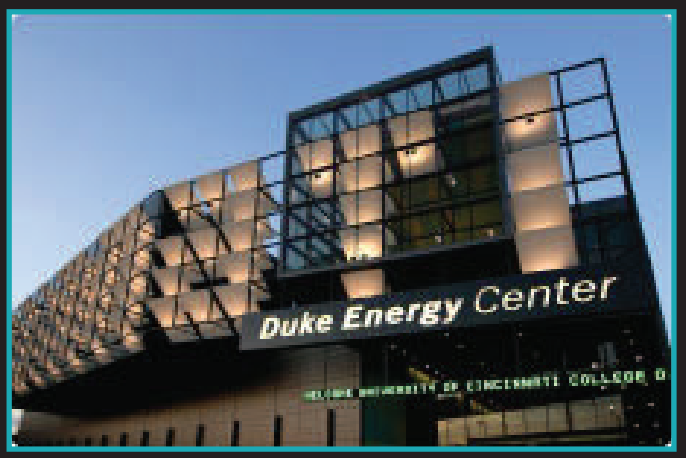
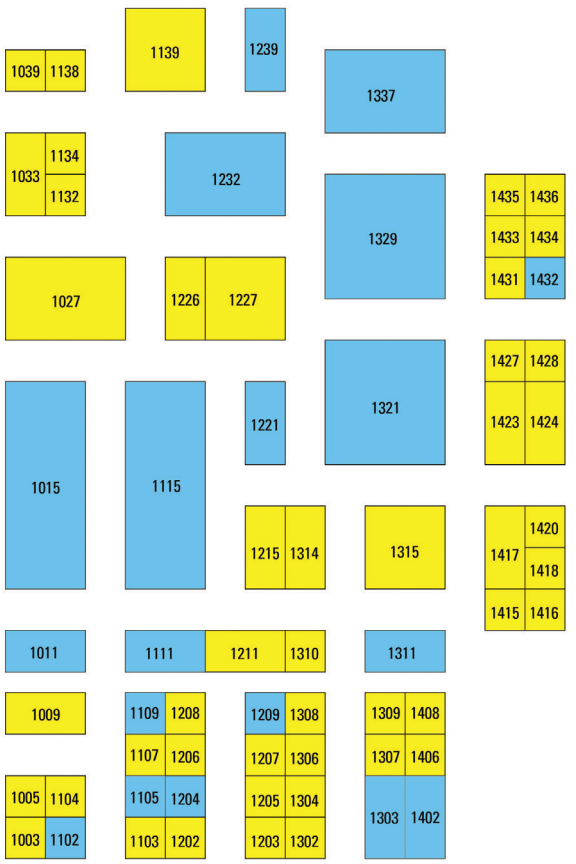
AA Gear, LLC	328
ABA-PGT Inc.	940
Acme Wire Products Co. Inc.	403
Acuger Precision Corp	1134
ADF Systems Ltd.	220





Advanced Design Industries, Inc.	215
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ALD Thermal Treatment, Inc.	1107
ALD-Holcroft Vacuum Technologies Co. (see p. 73)	**1109**
American Gear Tools/American Broach & Machine Co.	121

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Bodycote Thermal Processing	1005
Bourn & Koch Machine Tool Co. (see p. 101)	**1329**
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Broadwind Energy	217
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DTR Corporation (see p. 59)	**839**
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Eldec Induction, USA	615
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Oerlikon Fairfield Manufacturing Co., Inc.	1227
Parker Industries	610
Paulo Products Co.	606

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See page 24 for these listings arranged alphabetically by exhibitor. All listings are current as of September 23, 2011. For updated information, visit *www.gearexpo.com*.

Advertisers in the October 2011 issue of *Gear Technology* are indicated by bold type and highlighted on the show map found on pp. 24–25.

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EM Gear LLC	407
KISSsoft USA LLC (see p. 103)	**408**
Chamfermatic Inc.	411
Circle Gear and Machine Company (see p. 111)	**433**

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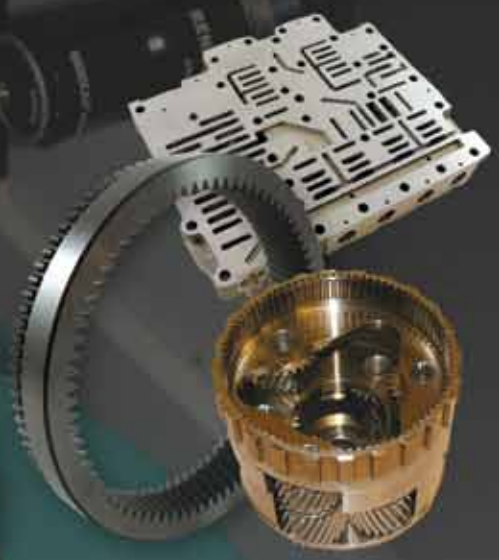

Aerospace Precision

As an AS 9100 & ISO 9001 Registered Company, Delta Gear provides aircraft quality gears and machined components at automotive prices. Since 1964, Delta Gear (formerly Tifco Gage & Gear) has been producing precision parallel-axis gears. It is our continued passion to expand our capabilities in high precision gears, machined components, assemblies and inspection – giving you the highest quality, convenience and on-time delivery.

Inspection & Testing

Our newest addition to the Delta Family of Companies is Delta Inspection. Inspired on the understanding that the industry needs expert abilities for contract gear inspection services, Delta Inspection has been introduced to meet your gear inspection and testing needs. Our abilities range from gear inspection up to 39 inches (1 meter) to prismatic inspection of machined components, roundness, laser guided concentricity analysis, surface testing, material testing, Nadcap certified magnetic particle inspection, nital etch and much more.

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www.delta-gear.com

www.deltaresearch.com

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www.star-su.com/dynamic

news

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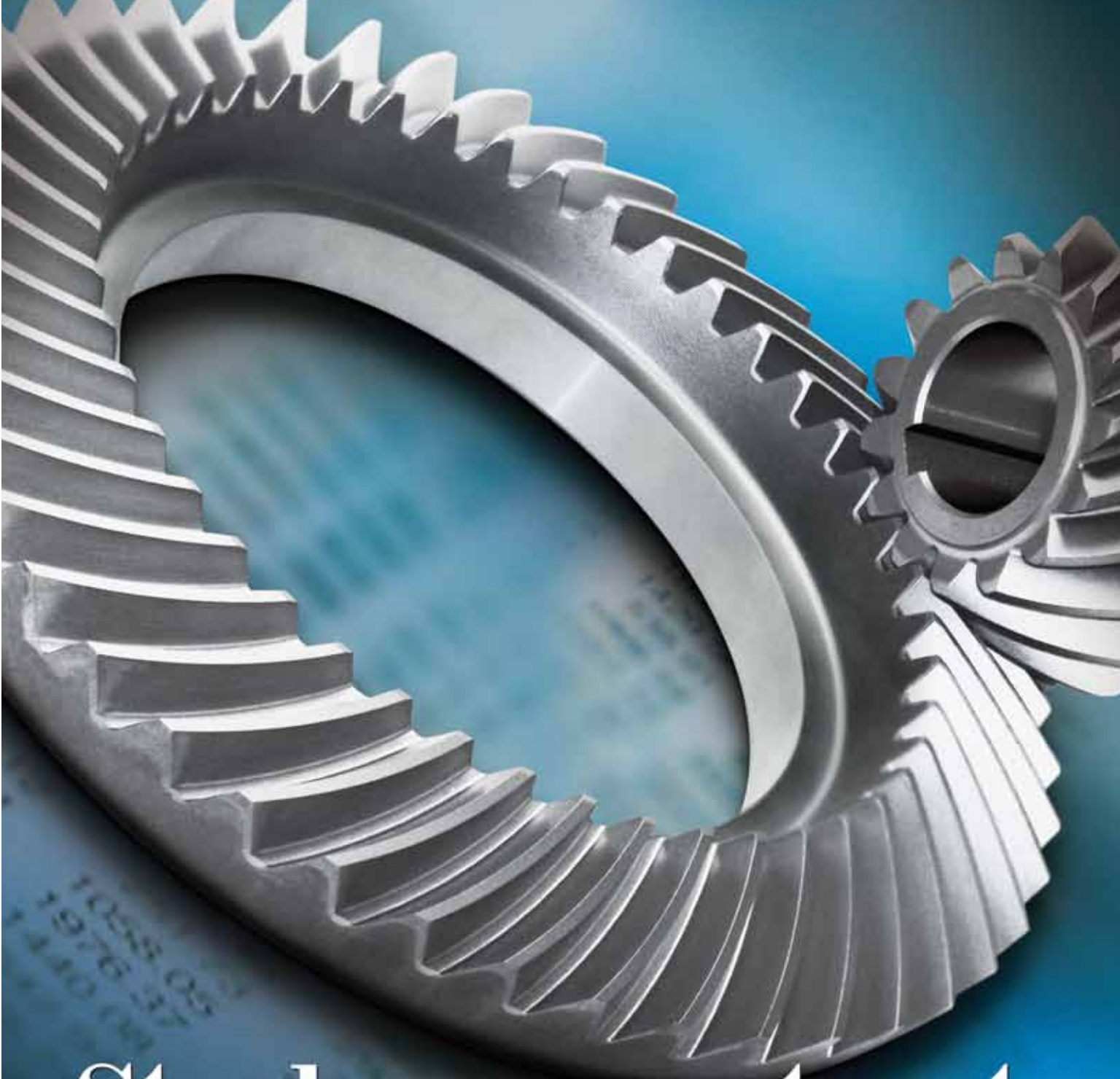

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Product Preview 2011

Matthew Jaster, Associate Editor

There will be plenty of time to talk shop, learn about the latest educational and research endeavors and network with peers. But the real reason the gear industry comes together every two years is to see all the new products and technology offerings. Gear Expo 2011, taking place November 1–3 at the Duke Energy Convention Center in Cincinnati, has its fair share of manufacturing ingenuity. Here's a peek at some "can't miss" opportunities you need to check out while roaming the exhibit floor:

Exterior toothing with gear wheel stylus kit.

Carl Zeiss
Booth # 909

With DuraMax, Carl Zeiss offers a compact 3-D coordinate measuring machine. DuraMax Gear marks the evolution of DuraMax into a shop floor gear wheel measuring machine. "This enables us to fulfill the requests of many customers and introduce gear wheel measuring technology with small machines that can be used as close to production as possible," says Alexander Dollansky, product manager at Carl Zeiss Industrial Metrology. The key features of DuraMax Gear are its suitability for a rough production environment, the high permissible temperature fluctuations, the proven and pioneering *Zeiss* measuring software, its small footprint and the attractive price. DuraMax—as a gear wheel measuring machine—is suited for process control on the production floor, for quick in-between inspections of small workpieces and for testing volume parts directly in production. Because of its accuracy, DuraMax is also suitable for many requirements in gear wheel measuring technology. DuraMax Gear comes with the required software and hardware, including stylus material for a broad range of applications. If the product being tested changes, standard inspection procedures often require new, expensive modifications. DuraMax Gear, however, is a CNC all-rounder that, when combined with CAD-based *Calypso* and *Gear Pro* involute measuring software, quickly, easily and reproducibly measures all changes. DuraMax Gear is available as a tabletop machine or with an optional base. Its design enables part loading from four sides.

For more information:
Carl Zeiss Industrial Metrology
6250 Sycamore Lane North
Maple Grove, MN 55369
Phone: (800) 327-9735
www.zeiss.com

EMAG LLC
Booth # 327

The EMAG Group products cover a wide spectrum of machining processes in the metalworking industry. Whether chucked, shaft-type or cubic components, the companies under the EMAG umbrella offer solutions for many customer requirements. With its variety of technology centers EMAG has become an important partner in the realization of complete process streams for the manufacture of transmission, engine and chassis components. The company's focus is on complete machining processes that allow the customer to machine everything in one set-up.

EMAG's VT 2 is suitable for the machining of small chucked components and shafts.

"EMAG will be presenting a new machining platform called the VT. We are hoping to get the word out about this incredible new line and allow the attendees of Gear Expo to see how EMAG is continuing to produce state-

continued

of-the-art manufacturing systems for precision metal components," says Peter Loetzner, CEO of EMAG LLC.

With its VT 2, EMAG is introducing a vertical turning machine specially developed for the machining of small chucked components and shafts. The machine is offered in two versions: equipped with pendular technology, for the high-output machining of chucked components of maximum 100 mm diameter; or featuring a tailstock, for the machining of shaft-type components with a maximum length of 400 mm.

For more information:
EMAG LLC
38800 Grand River Avenue
Farmington Hills, MI 48335
Phone: (248) 477-7440
Fax: (248) 477-7784
www.emag.com

Emuge
Booth # 510

At Gear Expo, Emuge Corp., a manufacturer of precision workholding devices for many industries, will showcase their comprehensive line of clamping solutions. Emuge's workholding division specializes in providing solutions for applications from low volume job shops to high volume automotive production environments.

The precision workholding lineup on display will include Emuge's System SG used in many machining operations such as hobbing, shaping and shaving for gear production, as well as milling and inspection. The System SG's large surface area in contact with the workpiece provides a clamping solution which is very rigid, accurate and repeatable. The high precision System SP is used not only to clamp workpieces but also to clamp tools. By applying an axial force, the

This device is used for grinding the teeth of a gear (courtesy of Emuge).

clamping sleeves move in the direction of the force and expand radially. This eliminates the clearance between clamping sleeve and body, and between clamping sleeve and workpiece. System SP achieves concentricity of < 0.002 mm (corresponding to < 0.0001 inch).

"Our workholding group stays close to our customers to learn about their unique challenges and production environments. Doing so helps us develop the best solutions for their applications," says David Jones, precision workholding manager at Emuge Corp.

For more information:
Emuge
1800 Century Drive
West Boylston, MA 01583
Phone: (800) 323-3013
www.emuge.com

Gleason Corporation Booth # 815

Gleason Corporation products and services include machinery for the production, finishing and testing of gears as well as a worldwide support system which provides cutting tools, workholding, replacement parts, field service, application development services, gear design and inspection software, training programs, engineering support and machine rebuild and upgrade services.

"Gleason will be presenting our full array of solutions, including new products like the Genesis 260H Hobber and the 475GMM Analytical Gear Inspection Machine," says John M. Terranova, vice president, sales. "We will also exhibit cutting tools, workholding and Gleason Global Services in the booth."

The 475GMM Gear Measuring Machines offer all the advantages of Gleason Metrology Systems technology in gear measurement, including four-axis, generative motion, state-of-the-art 3-D scanning probe systems, linear drive motors and Gleason Metrology Systems *GAMA* (*Gleason Automated Measurement & Analysis*) software.

The Genesis 260H Vertical Hobbing Machine, on display for the first time, is a new addition to the highly popular Genesis Series of gear hobbing machines. Its compact

continued

footprint and slim profile, optimized workholding and tool change, and universal automation make it suitable for the widest range of user requirements, whether small batch or automated high volume production.

Additionally, the 260H is available with two different direct-drive workspindles, three different high-performance hob heads, multiple tool interfaces and integrated chamfering, making it the most versatile solution today for the production of spur and helical gears and shafts up to 260 mm in diameter. A larger Genesis 400H model also is available for workpieces up to 400 mm in diameter. Both models are designed as well to help customers meet the need for greater sustainability, with a host of features that greatly reduce energy consumption.

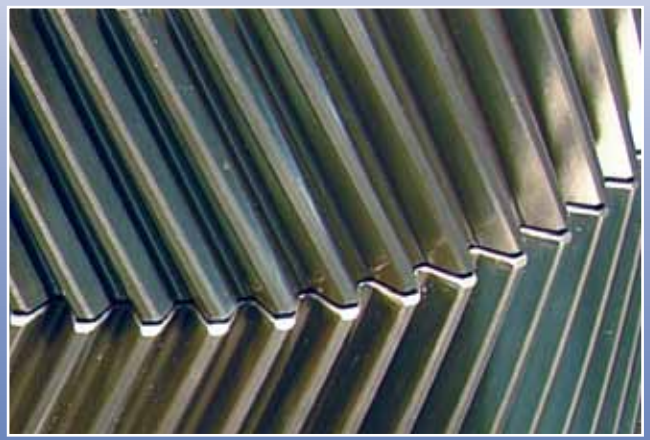
The Gleason 350GMS provides accuracy and flexibility to gear inspection. (courtesy of Gleason).

Also on display at the show will be one of a new family of GMS Series inspection systems (with models available for gears up to 3,000 mm in diameter). The 350GMS Analytical Gear Tester features a Renishaw 3-D probe head to provide maximum accuracy and flexibility for the complete inspection of all kinds of gears and gear-cutting tools. All Gleason analytical gear testers are equipped with the new Windows VB.NET-based Gleason GAMA 2.0 software for simple input screens for programming of workpiece and cutting tool data.

For more information:

Gleason Corporation
1000 University Avenue
Rochester, NY 14692
Phone: (585) 473-1000
sales@gleason.com
www.gleason.com

HERRINGBONE GEAR CUTTING MACHINES



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www.sw-gearmachines.de

The Ingersoll 2-Start Hob can be designed for rough, pre-grind and finish applications.

Ingersoll Cutting Tools Booth # 215

"We will be displaying new product offerings for shaping, finish gashing and hobbing, including our new 2-Start hob and indexable shaper in sizes starting at 6 DP," says Frank Berardi, product manager gear machining. The 2-Start indexable carbide insert Hob nearly doubles productivity for machining gears with large numbers of teeth when compared to single-start ICI hobs. The Ingersoll 2-Start hob features inserts with four cutting edges and simple set-up with no shims or adjustment required. The unique segmented design provides an expandable assembly, and simplifies repair. Ingersoll's 2-Start Hob can be designed for rough, pre-grind, and finish applications depending on the gear quality requirement.

Solutions offered include ID and OD roughing gashers for modules six and up, ID and OD finishing gashers for modules six and up, roughing and finishing gashers with through-tool coolant channels, carbide insert hobs for modules 6 and up, including multi-start hobs and shapers in modules 6–12.

For more information:
Ingersoll Cutting Tools
845 S. Lyford Road
Rockford, IL 661108-2749
Phone: (815) 387-6600
info@ingersoll-imc.com
www.ingersoll-imc.com

Kapp Technologies Booth # 723

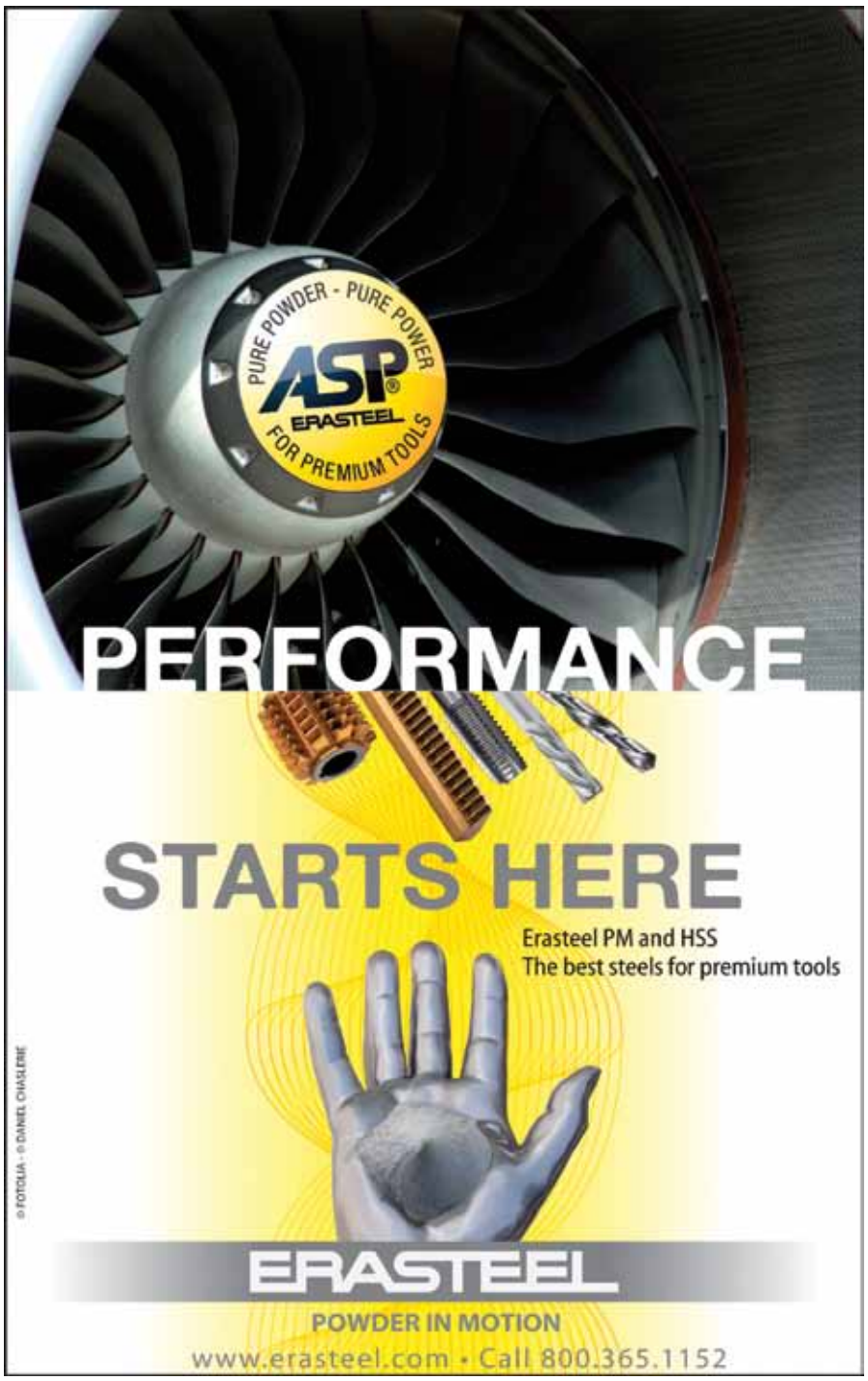
The Kapp Group will display their Niles ZE 800 Gear Center at Gear Expo. Grinding demonstrations will also be shown via live video links from different locations including, Indiana Tool and Machine Company's facility in Plymouth, Indiana, where their Niles ZPI/E 25 machine will demonstrate grinding of very large gears. The Niles ZE 800 Gear Center is a compact, ergonomic machine designed

continued

for precise grinding of external and internal gears with a tip diameter of up to 800 mm. Dressable ceramic tools as well as non-dressable CBN tools can be used. The ZE machine is engineered for high quality with maximum grinding torque. It comes fully equipped with a tailstock, CNC dressing device, and on-board measuring. High-speed measuring for full-contact grinding, and high-feed-rate grinding are available on all ZE Series machines, and nearly 400 ZE machines have been delivered to date.

Kapp and Niles application and tool design engineers will be present on-site to answer questions about specific applications. Machine modules will aid in understanding the basic processes and a display of CBN and diamond-plated tools will be showcased as well. The company invites attendees to see a presentation, "Considerations for Optimum Methods of Gear Finishing," on Tuesday, November 1, at 2:30 pm in the Solutions Center, and to stop by the Kapp booth to meet with their specialists in gear grinding solutions.

Niles ZE 800 Gear Center.



For more information:

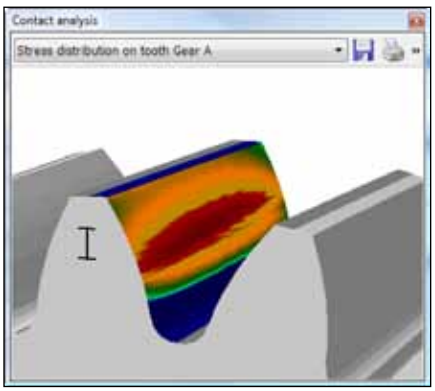
The Kapp Group
2870 Wilderness Place
Boulder, CO 80301
Phone: (303) 447-1130
Fax: (303) 447-1131
info@kapp-usa.com
www.kapp-niles.com

KISSsoft USA, LLC.
Booth # 408

KISSsoft is a software provider for gear design to AGMA, ISO and DIN Standards as well as intuitive custom inputs. They offer shaft and bearing analysis to the latest DIN and ISO Standards utilizing FEA core components as well as an entire

range of machine components. Design parameters include spur, helical, planetary, worm, crossed axis helical, bevel, spiral bevel, face gears, gear pumps, master gears with complete contact, stress and life analysis.

"We will be highlighting the latest software release *03/2011* at Gear Expo 2011," says Dan Kondritz, general manager. "Included will be the enhancements to contact analysis and micropitting solutions."



In the contact analysis of *KISSsoft,* the effects of shaft deformations may now be precisely evaluated (module ZA30). The results of shaft calculations can also be directly imported to the contact analysis. Bending and torsion of shafts are furthermore calculated load-dependent and considered in the tooth contact. In the *KISSsys* calculation, the shaft classification is done automatically. Additionally, the face load factor KHβ is calculated according to ISO 6336-1, Annex E. Another new feature is to combine the profile and lead correction factor within defined areas. Thus all variants are automatically analyzed in respect of the load distribution, transmission error, safety against micropitting, wear and flash temperature, and the stress curve (module ZA33).

For more information:

KISSsoft USA, LLC
3719 North Spring Grove Road
Johnsburg, Illinois 60051
Phone: (815) 363-8823
www.kisssoft.ch

Reishauer Booth # 239

"We plan to exhibit the RZ 260 Two-spindle Gear Grinding machine that can be used for high production runs utilizing the continuous generation style of grinding or for small lot sizes or parts with features that don't allow the use of a large diameter wheel using the single index or form grinding technique," says Dennis Richmond, vice president. "Also on display will be the small spindle which allows the

continued

Reishauer is growing, we're looking for the talent to grow with us!

Reishauer is a world leader of highly productive gear manufacturing machine tools and factory automation solutions with their US headquarters located in the Chicago suburbs.

We are in search of qualified individuals to fill the following positions:

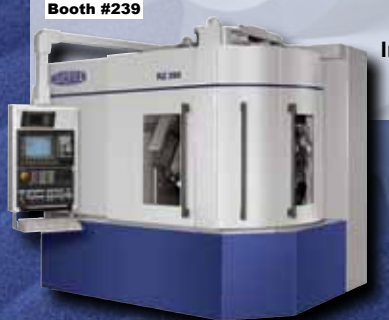
Service Technicians
Seeking individuals capable of installing and diagnosing/repairing electrical/electronic, hydraulic and mechanical systems of sophisticated machines tools and material handling equipment. Travel throughout the US, Canada and Mexico required. German speaking a plus, salary and benefits commensurate with experience.

Application Engineer
Seeking individual with theoretical and practical knowledge of gear manufacturing to interface with customers to establish machining parameters, provide production estimates, tool life studies, determine best suitable clamping means, work with suppliers to establish optimum machine configuration and generate technical proposals. Hobbing experience an advantage. German speaking a plus, salary and benefits commensurate with experience.

Project Manager
Seeking individual to manage project resource allocation and project staff, provide direction and support to project team, track deliverables, monitor and report on progress of projects. In addition this individual must also manage and implement changes and interventions to achieve project output goals. Automotive project experience an advantage. German speaking a plus, salary and benefits commensurate with experience.

Please send resume to:
Human Resources at **Reishauer Corporation**
1525 Holmes Road, Elgin, Illinois, 60123 or
email to *usa@reishauer.com*.
Inquires call **Dennis Richmond** at
847.888.3828

GEAR EXPO 2011
Booth #239



REISHAUER
Gear Grinding Technology

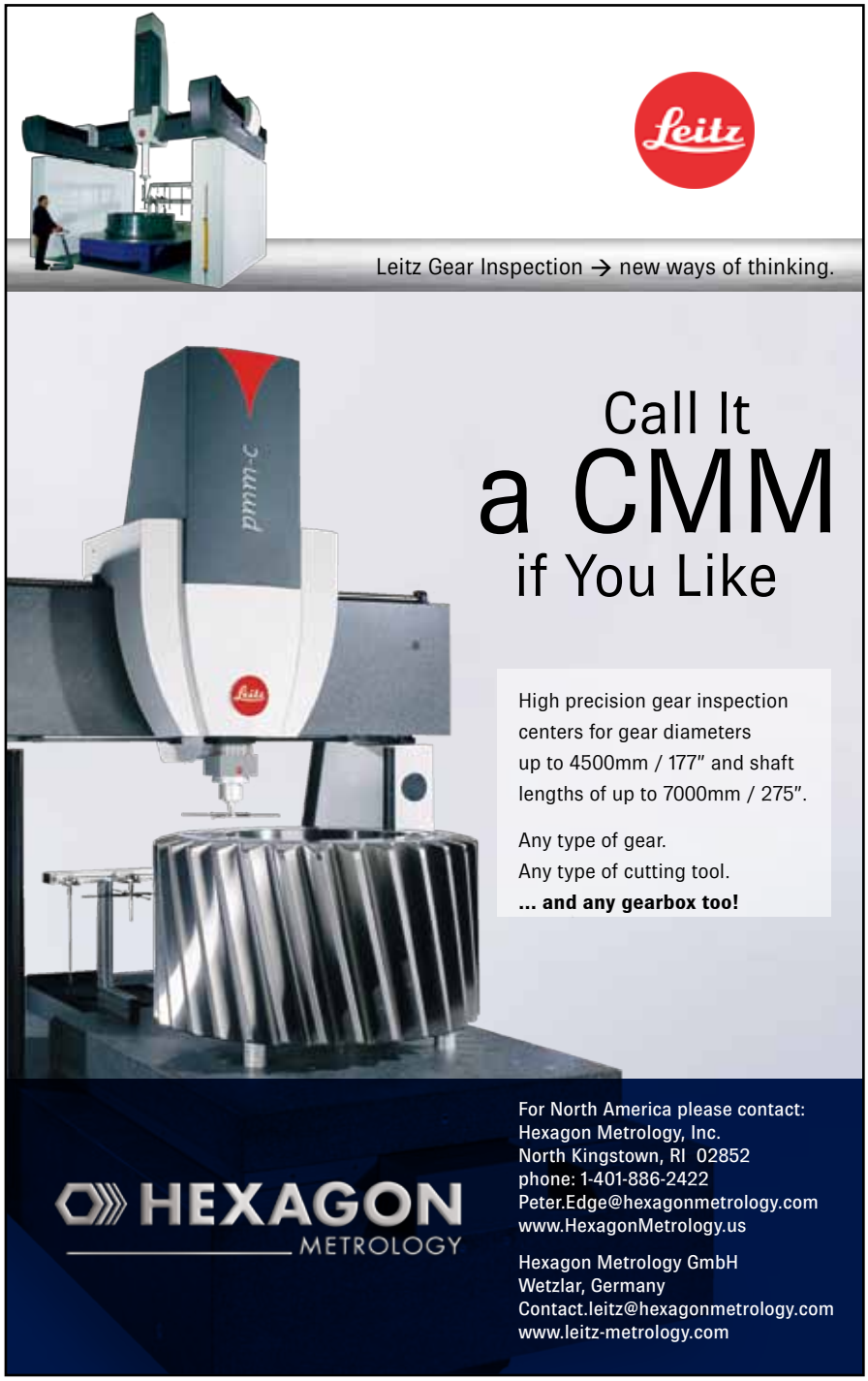
machine to use wheels as small as 60 mm. Our booth wouldn't be complete without an array of diamond and CBN tools that Reishauer has become well known for when it comes to accuracy, quality and usable life.

The RZ 260 is available in four versions. In the basic version, the RZ 260 is equipped with one work spindle. For loading, this is automatically moved into a well-accessible loading position. For very high productivity demands, the machine can be equipped with two work spindles. In this configuration, the ground gear can be exchanged while another gear is ground on the second spindle. The machine is equipped with a fixed dressing unit if only a small variety of gears is ground. Different gear geometries can be ground using workpiece specific dressing tools. Maximum flexibility can be reached by using a pivoting dressing unit. With this version, the dressing tools can be used for a larger range of gears.

Reishauer's RZ 260.

"Visitors to booth 239 will also learn about our newest alliance with Felsomat, a company specializing in gear manufacturing cells (machines and automation) that eliminate idle time, dramatically reduce floor space and offer exceptional productivity for high volume applications," Richmond adds.

For more information:
Reishauer Corporation
1525 Holmes Road
Elgin, IL 60123
Phone: (847) 888-3828
www.reishauer-us.com



Sandvik Coromant
Booth # 827

Sandvik Coromant will showcase a number of its new gear tooling solutions and offers, ranging from roughing, semi-finishing and finishing disc cutters, conventional indexable

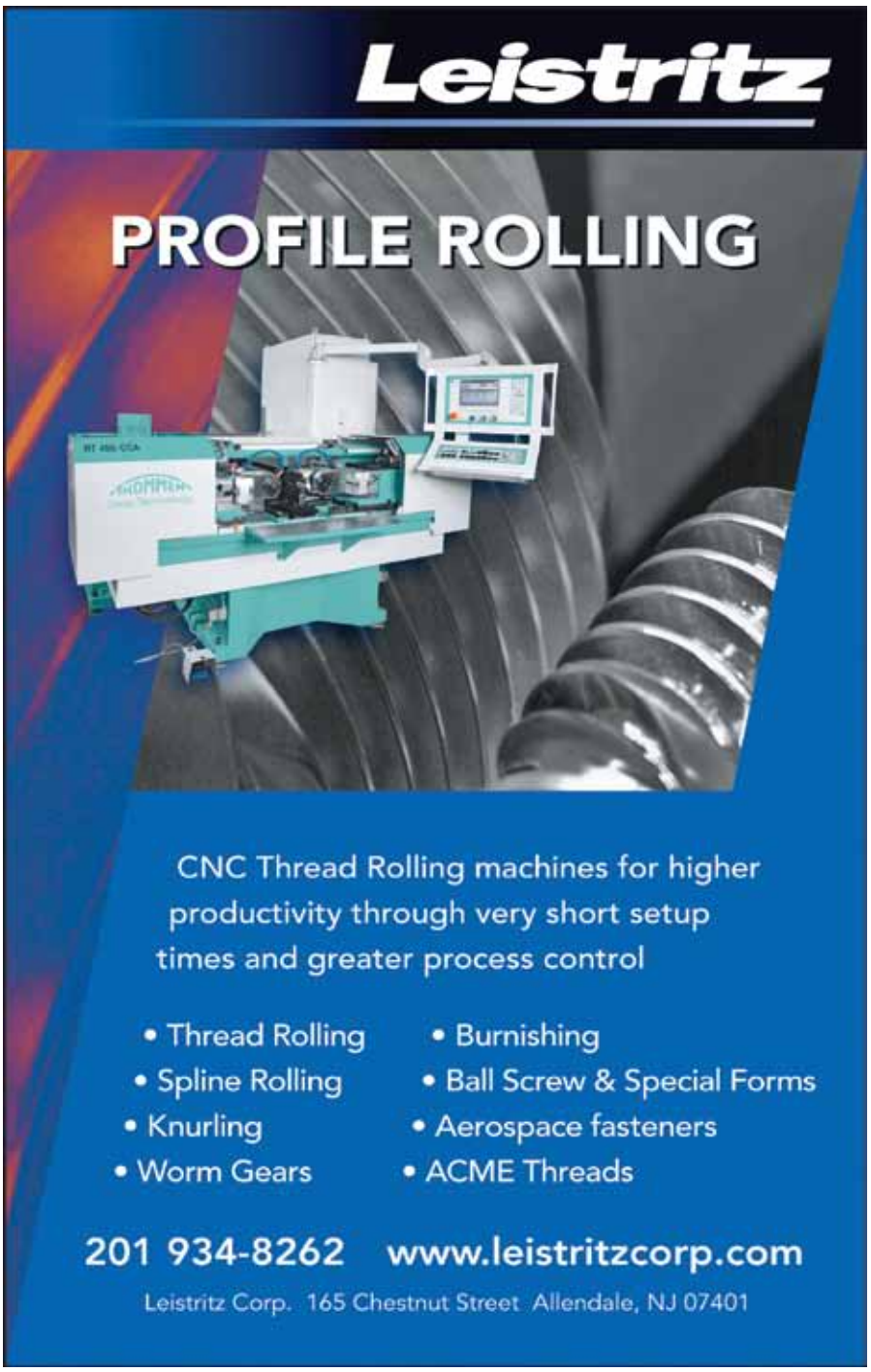
insert hobs and unique indexable insert hobs at Gear Expo 2011. Among the highlighted products is the CoroMill 170 high performance gear milling cutter used for precision and reliability in roughing external and internal gears. The disc cutter allows manufacturers to cut time in gear machining, leaving minimal and even allowance for subsequent operations. The high-precision cutter body and insert tip seats allow for secure insert mounting, resulting in improved productivity and longer tool life. The CoroMill 176, a new full-profile hob for gear milling, will be on hand at the booth to demonstrate how the indexable carbide insert hob can reduce cutting time and double tool life compared to traditional high speed steel cutters. For roughing, semi-finishing and finishing, the innovative hob tool solution covers a range of gear profiles. The iLock interface technology between the body and insert ensures tool precision and prevents any inserts from movement.

In addition, Sandvik Coromant also offers the conventional hob designed for high metal removal rates with maintained reliability. Redesigned with indexable carbide inserts, the tool offers superior productivity and reduced cycle times compared to HSS cutters. In collaboration with Heller Machine Tool, Sandvik Coromant offers flexible, productive and cost efficient solutions for a wide range of bevel gear sizes. Sandvik Coromant has also collaborated with machine tool builders to supply a flexible solution for spur and helical gear manufacturing.

"Although we are still fairly new to the gear industry, we hope to provide attendees with the cutting-edge knowledge and the state-of-the-art technology to optimize overall gear manufacturing," says Ken Accavallo, gear industry and milling specialist at Sandvik Coromant US. "Working in close cooperation with the customer, we not only have an entire tooling offer, but we can provide the technical support required in turn-key gear operations."

continued

Sandvik will showcase a number of its gear tooling solutions.



Star Su/Bourn & Koch/MAG Booth # 1329

For more information:
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1702 Nevins Road
Fair Lawn, NJ 07410
Phone: (800) SANDVIK
www.sandvik.coromant.com/us

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We seek engineers who are experienced in designing in AutoCad, and in windows based 3D/solids. Responsibilities will include application or modification of standard Felsomat automation modules, tooling, fixtures, integrated automation systems, and maintaining project timelines and budgets. Position will be based in Schaumburg, Illinois.

Service Technicians – Electro-Mechanical:
The candidates we seek will have experience in installing, setting up, and tooling high precision machine tools, performing acceptance tests, and machine operator training. Also important is the ability and experience to quickly and accurately diagnose electro-mechanical, pneumatic, or hydraulic faults through a logical process of elimination. Position will be based in Schaumburg Illinois, and travel throughout North America, or to Germany may be required.

Software Engineers:
We seek software engineers who are experienced in programming Siemens 840D CNC control Systems, Siemens Step 7 PLC, and Seimens HMI programs. Our software engineers must also be capable of diagnosing and correcting software faults. Industrial controls design experience is a plus. Position will be based in Schaumburg Illinois, and travel throughout North America, or to Germany may be required.

Additional consideration will be given to those candidates who have:

- **Experience in the Automotive Power Train and Drive Train industries.**
- **German language skills.**

We offer a competitive compensation package commensurate with experience together with a comprehensive range of employee benefits.

GEAREXPO 2011 Booth #239

FELSOMAT

Please send resume to:
Human Resources at Felsomat USA, Inc., 1700 N. Penny lane, Schaumburg, IL, 60173
or e-mail to ***hr@felsomat.com***

Star SU offers a wide variety of gear cutting machinery, tools and services including: vertical and horizontal gear hobbing machines; chamfering and deburring machines; gear grinding machines; gear shaping and shaving machines; tool grinding machines; gear hobs, milling cutters, shaper cutters and shaving tools; chamfer and deburring tools; gundrills and reamers; form tools; face mills and boring tools; carbide performs and blanks; remanufactured machinery, retrofits and recontrols; tool coatings; and tool life cycle management services. Star SU is the cooperative partnership of Star Cut Sales, Inc. of Farmington Hills, Michigan, SU America, Inc., the U.S. sales and manufacturing unit to Samputensili, S.p.A., and Bourn & Koch Inc. of Rockford, Illinois. Star SU also represents Galdabini, Federal Broach and Sicmat in the United States, Canada and Mexico, selling straightening systems, broaching equipment and tools, and gear shaving equipment; and MAG, selling hobbing and chamfering/deburring machines.

"For Gear Expo, we will be featuring new machine technology and combined machining applications such as turning, drilling, milling and gear cutting as well as enhanced gear tool coating technology for improved quality and tool life," says David Goodfellow, president.

In addition, Balinite Alcrona Pro, the second generation of AlCr-based coatings, is now available on new and re-sharpened tools from Star SU. Developed by Oerlikon Balzers, Alcrona Pro can be used in a wider range of applications than other aluminum-based coatings because it provides better heat resistance for high temperatures and better wear resistance for tough cutting applications. Lower thermal conductivity allows Alcrona Pro-coated tools to work well in low temperature applications and allows faster hobbing speeds—200 m/min is

Bourn & Koch 400 H CNC.

the new base speed.

Bourn & Koch. Star SU will demonstrate Bourn & Koch's 400 H CNC horizontal hobbing machine in booth #1329 during Gear Expo. This sturdy hobber can produce spur gears, helical gears, splines and threads on cylindrical blanks or shafts. Its powerful, direct-drive work spindle and extremely stable, steel-polymer composite components make it ideal for manufacturing large and heavy shaft parts up to 406 mm in diameter and 6.4 module. Shaft lengths up to 76" can be processed by the extended bed version on display at the show.

All axes' movements are supported by high-precision ball screws and linear roller ways, resulting in very fast setups and precise part machining. The through-hole, work spindle drive allows clamping of shaft parts that exceed the actual work area limitations.

A dual-tool setup allows for several gearings on one shaft or rough and finish cutting on one spindle. The standard model comes equipped with a NUM, Siemens or Fanuc CNC control; CNC operated tail center with variable load control; and it can hob wet or dry. Machine length extensions are also available.

For more information:

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5200 Prairie Stone Parkway
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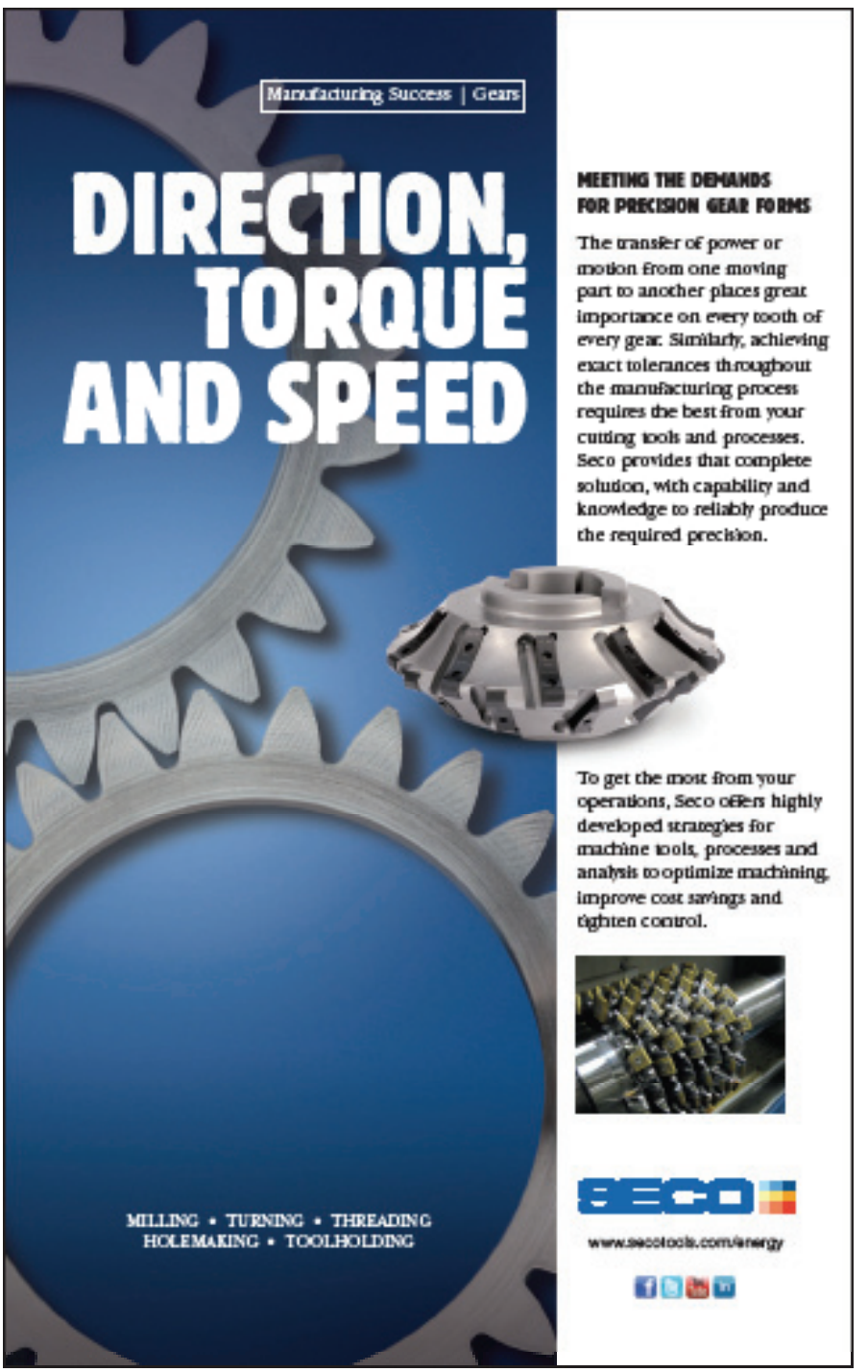
Fax: (847) 649-0112
www.star-su.com

Gear Technology/ Power Transmission Engineering Booth #1337

Stop by booth #1337 for a free cup of espresso, cappuccino or latte when you visit *Gear Technology* and *Power Transmission Engineering* magazines at this year's version of the *Cafe de Gears*.

You'll have the opportunity to meet

continued



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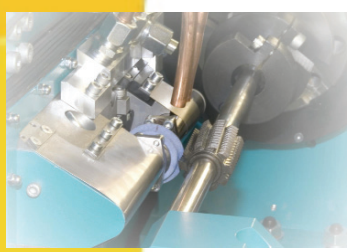

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in Franklin, PA

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- Analyze and rate multiple gear and planetary systems.
- Work with gear suppliers to develop prototype and production requirements.
- Review and approve gear production drawings.
- Select for use and evaluate ball & roller bearing L10 life and appropriate fitting practice.
- Design and evaluate shafts for adequate stiffness, torque capacity, and fatigue strength.
- Evaluate lubrication effectiveness, including lubrication life factors and scoring probabilities for gears & bearings.
- Analyze root-cause of gear, bearing and shaft failures, and develop appropriate solutions.
- Participate in customer & supplier meetings.

Required Skills:

- Four year degree in Mechanical Engineering (BSME), Mechanical Engineering Technology (BSMET) minimum.
- 3-5 years minimum experience with design in parallel axis and straight / spiral bevel gearing.
- Experience with design programs such as KissSoft, MASTA, or Romax.
- Understanding of AGMA design and quality standards.

Required Education:

- Four year degree in Mechanical Engineering (BSME), Mechanical Engineering Technology (BSMET) minimum.

Please send resumes to dmalacho@joy.com

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with the editors and sales staff, who will be introducing their concept for the new publication, *Gear Technology India*.

Gear Technology India will launch in January 2012. The new magazine will serve the Indian marketplace with news, information and technical articles about gears and power transmission components.

"*GT India* will bring to the Indian market a new magazine that combines the editorial concepts of both Gear Technology and *Power Transmission Engineering*," says managing editor Randy Stott.

The new magazine is being produced in cooperation with Virgo Publications, a sister company to Virgo Communications and Exhibitions Ltd., the organizers of the IPTEX 2012 show, which will be held in Mumbai February 9-11. Virgo is also exhibiting at Gear Expo, and they will be in booth #1204.

Subscriptions to all three magazines are available for free, and subscription forms will be on hand at the booth.

In addition, those interested in advertising are welcome to talk with our representatives and pick up a copy of the 2012 media kits, which feature a number of new advertising options for 2012, including our new "Product Alert" e-mail editions and sponsored categories in our online buyers guides.

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Jack McGuinn,
Senior Editor

LET'S TAKE A LOOK AT CINCINNATI—HENRY LONGFELLOW'S "**QUEEN OF THE WEST**" AND OHIO'S THIRD-LARGEST CITY (POPULATION JUST UNDER 300,000)—AS GEAR EXPO AND ASM ATTENDEES AND EXHIBITORS PREPARE TO DESCEND UPON THIS MIDWESTERN ENCLAVE ON THE BANKS OF THE OHIO RIVER.

Aside from being one of the world's most difficult place names to spell—just for good measure, Cincinnati residents are known as "Cincinnatians"—and a world-class center for all things chili, the city's convention and tourism site (*cincyusa.com*) boasts of the more than $2 billion invested in recent downtown and riverfront development, including a $135 million renovation and expansion of the convention center and a $43 million redevelopment of Fountain Square, a popular downtown meet-and-greet nexus offering year-round programming and entertainment for the young, old and in-between. The Square has served as an incubator for new restaurants, shopping destinations and nightlife—all in short proximity with the convention center and hotels.

Chosen by *Esquire* for its list of top-ten list of U.S. "Cities That Rock," did you know that Cincinnati was the first American city to have a professional baseball team, is home to the world-class Cincinnati Zoo & Botanical Garden (also known, intriguingly, as the "world's sexiest zoo") and is where William Procter and James Gamble established the Procter & Gamble empire? And something else you probably didn't know: abolitionist and novelist Harriet Beecher Stowe lived in Cincinnati for a time, where she had the opportunity to meet and question escaped slaves. She used their stories as a basis in part for *Uncle Tom's Cabin*. And one more thing: in 2012, the city will host the 2012 World Choir Games—reportedly the largest choral competition in the world. Cincinnati is the first North American city to host the event.

So what might participants at the Gear Expo 2011 pilgrimage want to see and do in Cincinnati once the curtain comes down each night of the show? For events and attractions, the convention/tourism site is your best and most reliable resource.

Dining out is of course a necessity on the convention circuit, and there is no shortage of spots within easy reach of Duke Energy Center. Following is a small, decidedly arbitrary sampling of restaurants—some old, some new—offering everything from BBQ to bread pudding. For hours of operation, menu information, etc., telephone or simply go to their website.

Restaurants

Jeff Ruby's Steakhouse
700 Walnut Street
Cincinnati, OH 45202
513-784-1200
jeffruby.com

Maggiano's Little Italy
7875 Montgomery Rd.
Cincinnati
513-794-0670
maggianos.com

Scott's BBQ
637-A Northland Blvd.
Forest Park, Ohio
Cincinnati
513-742-8646
scottsbbq.org

Skyline Chili
4180 Thunderbird Lane
Fairfield, OH 45014
513-874-1188
skylinechili.com

Henke Winery
3077 Harrison Ave.
Cincinnati
513-662-9463
henkewine.com

Cock & Bull English Pub
2645 Erie Ave.
Cincinnati
513-533-4ALE (4253)
theenglishpub.com

Sung Korean Bistro
700 Elm St.
Cincinnati
513-721-7864
sungkoreanbistro.com

Buckhead Mountain Grill
35 Fairfield Avenue
Bellevue, KY
859-491-7333
eatatbuckheads.com

Chart House
405 Riverboat Row
Newport, KY
859-261-0300
chart-house.com

The Montgomery Inn
(original of various locations)
9440 Montgomery Rd.
Montgomery
513-791-3482
montgomeryinn.com

Nightlife

And for those of you just looking for a place to relax and imbibe—or imbibe and make a fool of yourself—the city is home to a number of cocktail lounges, martini bars, brew pubs and various other watering holes, many within easy walking distance—though the return trip may prove otherwise—of Expo-guesting hotels. Phone ahead and or check their websites for Happy Hours, entertainment offerings, etc.

Bartini's
580 6th St.
Cincinnati, OH 45202
513-381-5001
bartiniscincinnati.com

Pigall's Twist Lounge and Bar
127 W. Fourth St.
Cincinnati
513-721-1345
jeanrobertgroup.com/pigalls

Mynt Martini
28 Fountain Square
Cincinnati
513-621-6968
myntcincinnati.com

Tonic on Fourth
125 West 4th Street
Cincinnati
513-721-1345
toniconfourth.com

Below Zero Lounge
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cadillacranchhome.com

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4029 Hamilton Ave.
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Phone: 513-591-2100
clubbronz.com

The Dock
603 W. Pete Rose Way
Cincinnati
Phone: 513-241-5623
thedockcomplex.com

Kick'n-Rock'n Country Bar
3620 Harrison Ave.
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Phone: 513-662-0555
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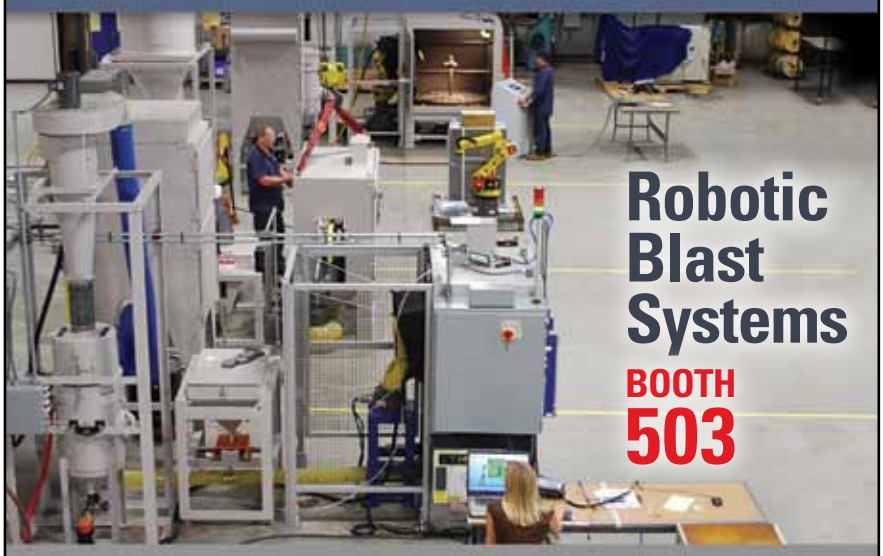

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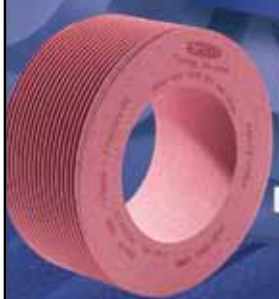

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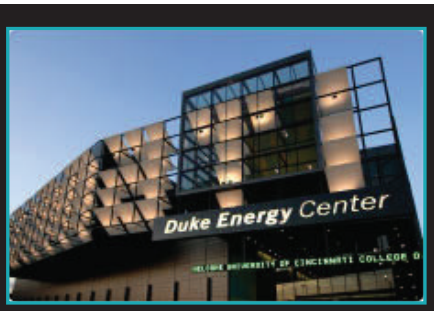
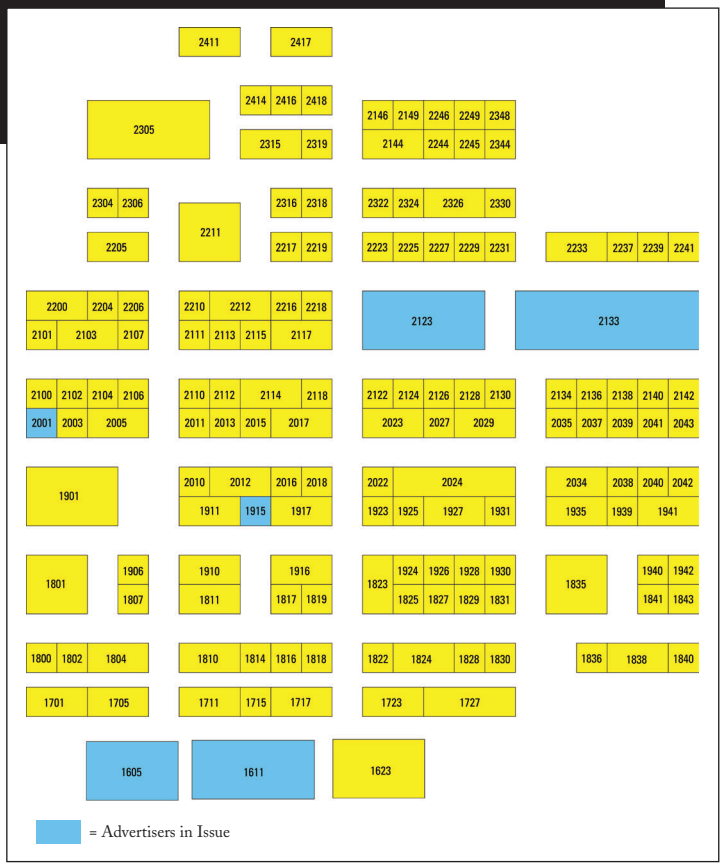


Alphabetical List of Exhibitors

All listings are current as of September 23, 2011. For updated information, visit *www.asminternational.org/content/Events/Heattreat/*.

Advertisers in the October 2011 issue of *Gear Technology* are indicated by **bold** type and highlighted on the show map.



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ASM Heat Treating Society 26th CONFERENCE and EXPOSITION

ASM Heat Treat Show 2011

Matthew Jaster, Associate Editor

Co-located with Gear Expo once again is the ASM Heat Treating Society's 26th Conference and Exhibition. Here are some of the new products and technologies available to attendees at Heat Treat 2011:

Inductoheat Booth # 1611

Inductoheat provides quality induction heating and heat treating equipment with flexible and innovative systems that offer long-life performance. At Gear Expo/Heat Treat 2011, the company will present its gear hardening systems. Just like gears, induction heating is all about precision. The company's accurately controlled, induction gear hardening systems provide specific metallurgical patterns, minimum shape distortion, increased wear resistance and contact fatigue strength.

Inductoheat offers gear hardening patterns for flank hardening, flank and tooth hardening, hardening of the tooth tip, root hardening, hardening of the entire tooth, profile hardening (uniform and non-uniform) and flank and root hardening. Gears include spur, helical, bevel, hypoid, ring, worm, rack and pinion, planetary gear sets, involute, bearing races, idler, spiral, helical and differential. The company provides process development, metallurgical analysis, hardness pattern verification, single-coil dual-frequency technology, single-shot, scanning tooth by tooth and a large range of gear and bearing diameters.

Additionally, Inductoheat offers the Single Coil, Dual Frequency Induction Gear Hardening System that can be used for high-volume, single-shot induction hardening of internal wide-face, gear-like components. The company has recently designed and built an induction heating system for medium and large gears that can harden the gear teeth or flanks, along with ball races.

For more information:
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Ipsen, Inc. Booth # 2123/2133

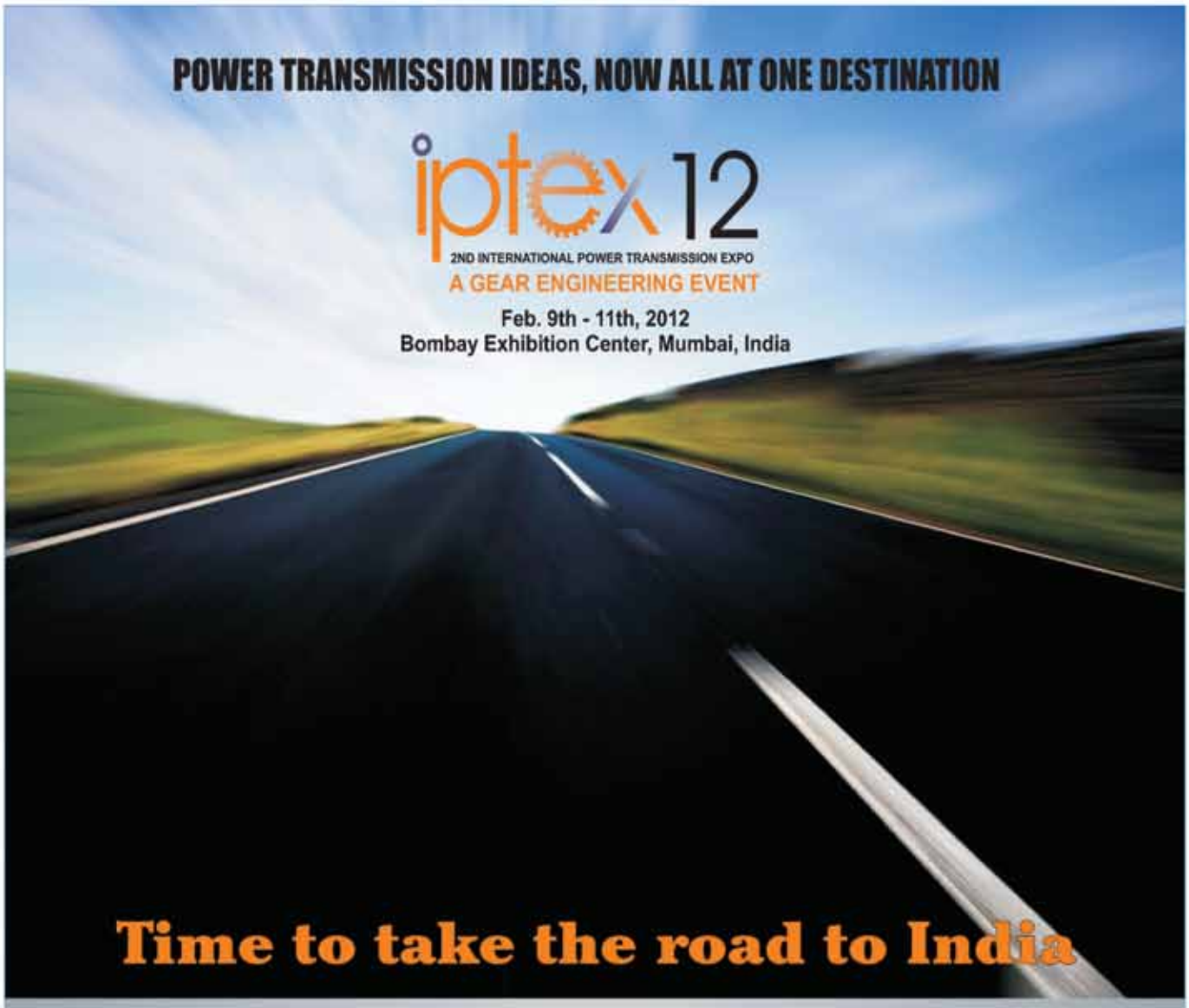
With more than 60 years of thermal processing expertise, Ipsen provides the solutions for energy and cost efficiency, reliable robust equipment, manufacturing and service, aftermarket support, engineered components, retrofits and upgrades, thermal processing and furnace maintenance training. Ipsen's thermal processing

systems can be found in the aerospace, medical, energy, chemical and automotive industries.

The latest innovations from Ipsen include the Titan, an all-new, modular, standardized, skid-mounted heat treating system that is delivered in half the time of competitive furnaces, and is installed in just a few days. The control system supports multiple languages, provides real-time data acquisition and stores up to a thousand recipes. Titan's small footprint, manufacturing versatility, operational simplicity and financial flexibility (purchase, lease or rent) all add up to greater profitability and response time. Ipsen's talented team of engineers was able to create a quality heat treating furnace at an affordable price by developing an all-new design and by standardizing the production process. Titan offers a wide range of sizes, versatility of processes, speed and uniformity, while maintaining cost effective pricing, delivery and operation.

Additionally, the company will be exhibiting its new HybridCarb system.

continued



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Sandvik Heating Technology Booth # 2118

Sandvik Materials Technology, of which Kanthal is a brand, is a manufacturer of products based on advanced metallic and ceramic materials. The company's products and services contribute to their customer's productivity, reliability and cost efficiency while reducing their environmental impact in a wide variety of industry segments. Earlier this year, Sandvik launched new furnace rollers made from Kanthal APMT that outlast rollers made from conventional alloys by more than four times. Kanthal APMT, an iron-chromium-aluminum (FeCrAl) alloy, is suitable for high temperature applications such as furnace rollers, used for transporting products that are annealed in air atmosphere. In particular, Kanthal APMT is characterized by a unique combination of high creep strength and excellent resistance to oxidation at high temperatures, critical for high-performance furnace rollers. Tubes made from Kanthal APMT can withstand temperatures up to 1,250 degrees C (2,280 degrees F).

Consequently, furnace rollers made from Kanthal APMT remain straight and rigid at these temperatures, reducing the tendency to sag and bend—problems commonly associated with conventional metallic tube materials such as nickel-chromium (NiCr) alloys. The superior performance of these rollers boosts productivity, reduces maintenance costs and contributes to a cleaner environment. For traditional rollers, excessive oxidation in standard high-temperature furnaces with open-flame burners limits these rollers' lifespan sometimes to only six to 12 months before reconditioning is required, compared to up to four years with rollers made from Kanthal APMT.

The new rollers require only one maintenance stop instead of two, providing seven to eight days extra production. With a typical production rate of one ton an hour, the steel mill can expect to produce an extra 170 tons a year. The higher reliability also means that costs for large numbers of spare rollers can be eliminated.

Rollers made from Kanthal APMT, together with a new roller design, offer a superior surface that actually improves the quality of the tube products. In contrast, traditional rollers can compromise the quality of tubes due to the rough and uneven surfaces formed on these rollers. In addition to the higher temperature capabilities, rollers made from Kanthal APMT require less, if any, water for cooling purposes, reducing energy requirements and providing a furnace designed with these rollers a greener approach to tube manufacturing.

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Solar Manufacturing Booth # 2305

Solar Manufacturing and Solar Atmospheres, Inc. will share a booth at the exhibition. Solar founder and CEO William R. Jones will be honored with the William R. Jones Honorary Symposium, held on Monday October 31 from 3:00–5:30 p.m., followed by a meet and greet reception. Several representatives from both companies will present materials in the conference sessions. Solar Atmospheres will also discuss low-pressure vacuum carburizing that minimizes distortion and discoloration along with repeatable results. An in-house R&D team of metallurgists is also available for process development and consultation. Solar Atmospheres recently welcomed a custom-built horizontal 20-bar vacuum furnace (40" wide x 50"deep x 36" high, 3,500 maximum load) to its Hermitage, PA facility. Designed and built by sister company Solar Manufacturing, this new furnace is the fastest cooling furnace in the Solar fleet, and one of only a few of its kind in the United States. The excessive pressure and high-speed gas velocities of the 20-bar furnace simulate the benefits of oil quenching. Using inert gas as an alternative to oil minimizes distortion and provides a much cleaner and greener process. Solar can also better serve customers requiring vacuum carburizing by increasing core hardnesses of large cross-sections—a particular benefit to those in the gear industry. President Bob Hill states, "By adding these unique capabilities of the 20-bar to our resources, we can now effectively process a wider range of materials and assist more customers than we could with our 10-bar furnaces." The high-tech furnace was designed with many innovative features to improve cost-efficiency and results including an improved gas-flow system to minimize pressure drops and a radial heat

exchange. State-of-the-art technology is incorporated throughout including an interactive touch screen interface and compact design.

For more information:
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United Process Controls Booth # 1623

United Process Controls (UPC) recently upgraded the system controls of two surface combustion batch IQ furnaces used by precision gear manufacturer United Gear and Assembly. Located in Hudson, Wisconsin, United Gear and Assembly is an ISO/TS 16949 registered contract manufacturer of precision gears and shafts and is a strategic/core supplier to several global OEMs. While the three-decade-old HMI systems performed satisfactorily for the lifetime of the installations, they were falling behind the technological curve on important functions such as recipe development and management, digital data processing, and SCADA integration. Other concerns included availability and cost of spare parts, as well as lowering operating costs through improved energy efficiency. A CQI-9 compliant control system was also a key requirement.

The modernized HMI platform based on Protherm 600 controllers from UPC offers a new level of speed, accuracy and flexibility in creating and modifying carburizing recipes. Menu screens and programming are much more user-friendly when it comes to finding data and making changes, and new recipe entries are easier to create, thus reducing set-up time. Furnace I/Os and all process data coming back to the Protherm 600 are trended automatically, which helps pinpoint problems quickly and efficiently, saving operator hours and downtime. The enhanced controls also provide the United Gear plant with the option to integrate UPC instrumentation with SCADA at a future expansion. Furthermore, with quenching functions embedded into the Protherm 600, the system achieves effective utilization of the quench cycle and eliminates standby power consumption, conserving energy and reducing utility costs.

Future enhancements are planned for more furnaces, which will allow the company's heat treat operations to achieve operational reliability and maintenance savings.

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Comparison of Test Rig and Field Measurement Results on Gearboxes for Wind Turbines

Dipl.-Chem. Mark Zundel

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Management Summary

This article describes some of the most important tests for prototypes conducted at Winergy AG during the product development process. It will demonstrate that the measurement results on the test rig for load distribution are in accordance with the turbine measurements. The results of vibration measurements depend on the environment—i.e., the stand-alone gearbox has values other than those of the gearbox on the test rig or in the turbine. Measurement data show that resonance and Eigen frequencies are a critical issue; these effects cannot be eliminated, as they are endemic to every system. Multi-body analysis (MBA) is introduced here as a tool in calculating and simulating frequencies, amplitudes and gearbox behavior.

Product Development Process

The development of gearboxes for wind turbines is based on the requirement specifications provided by the customer. In these specifications all of the necessary needs—general description, available space, power and loads, etc.—are defined. The development follows a well-defined product life cycle management (PLM) process in which each step is determined.

The main steps—from specification to serial production—are:

- Calculation according to specification; i.e., pinions, teeth, bearings, housing, etc.
- Mechanical design
- Prototype testing

Figure 1—Back-to-back test rig at Winergy/Voerde during prototype test.

Prototype Testing on a Test Rig

All prototypes are dynamics-tested in a back-to-back configuration on a test rig (Fig. 1). Also, testing according to standard procedures of the gearbox manufacturer and customer requirements is conducted and the design improved if the results warrant it.

There are three essential—yet different—types of tests conducted during the prototype test phase:

- Dynamic tests on load, load distribution and efficiency
- Structure-borne noise and air borne noise tests and measure ments
- Lubrication tests; i.e., oil distribution, leak tightness and climate chamber tests

Typically, load tests are carried out

to check gearbox behavior; the gearbox is therefore typically tested at overload and according to the specification—occasionally up to 300% nominal load. The gearbox is then dismantled and every single part is inspected.

Load-Distribution Measurement

To validate the gears' calculated and ground tooth profiles, a load-distribution measurement must be done at different load stages. Strain gauges are therefore applied at the tooth to observe the forces during the tooth mesh over the whole tooth width; Figure 2 shows schematically the application of, for example, six strain gauges over the tooth width of a sun pinion. It can be seen that the width is divided in equidistant parts. It is important that the strain gauges are applied as following:

- No interference with each other
- No influence of the border
- Sufficient covering

With this application (Fig. 3) on several teeth of the gear, different load stages are tested; typically the load distribution is measured at 20/40/60/80/100 and 120% of nominal load. Since the profile is calculated for one fixed load point, the correspondence is provided for only this. Deviations due to deformations are possible; nevertheless, it must be assured that the tooth contact is optimal over the entire range of performance. In doing so, a visual contact-pattern check after the test run must be done and the results considered.

During the test run, the measured force of each strain gauge is recorded. Figure 4 shows a typical run of the curves for the strain gauges of two applied teeth. It can be seen on the left side that during the mesh, every strain gauge signal has a maximum relative stress dependent on mesh, loading and position. The maximum value of each strain gauge is plotted against its position for each applied tooth. The resulting diagram on the right side shows the load distribution over the whole tooth width. This distribution is valid for one single meshing position, but will change for others.

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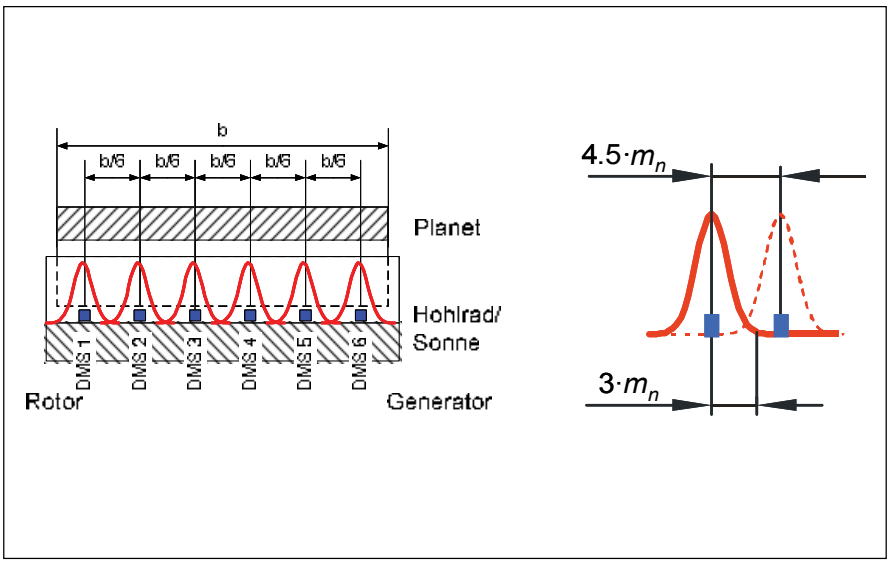

Figure 2—Distribution of strain gauges over the tooth width.

Figure 3—Application of strain gauges for load-distribution measurement on a sun pinion.

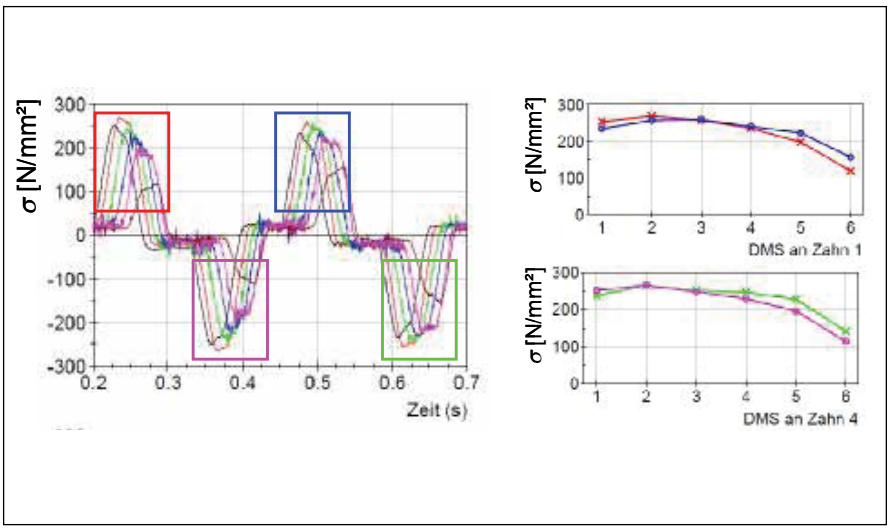

Figure 4—Typical results of a load-distribution measurement.

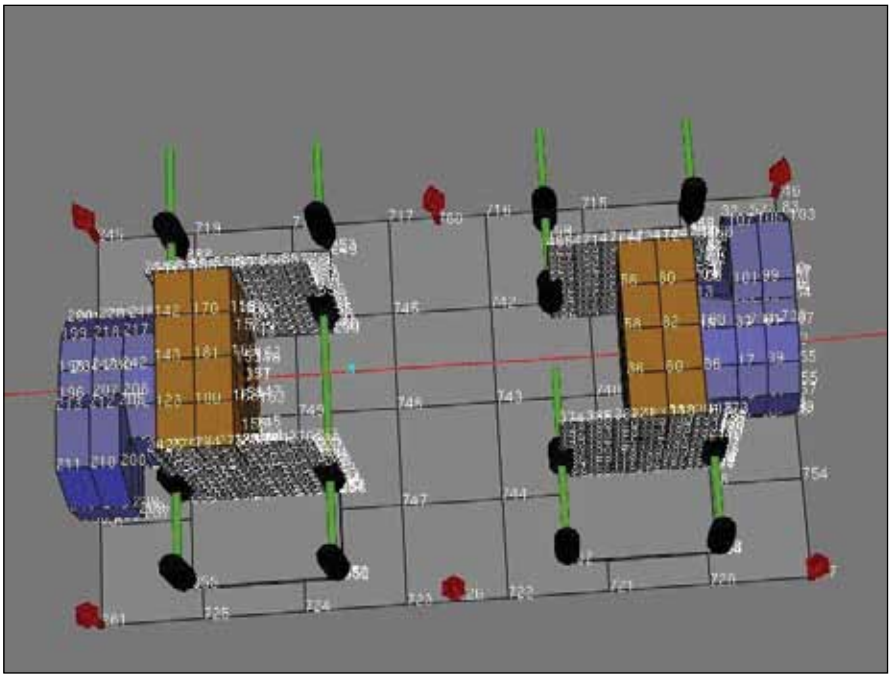

Figure 5—Typical excitation and measurement points for a modal analysis.

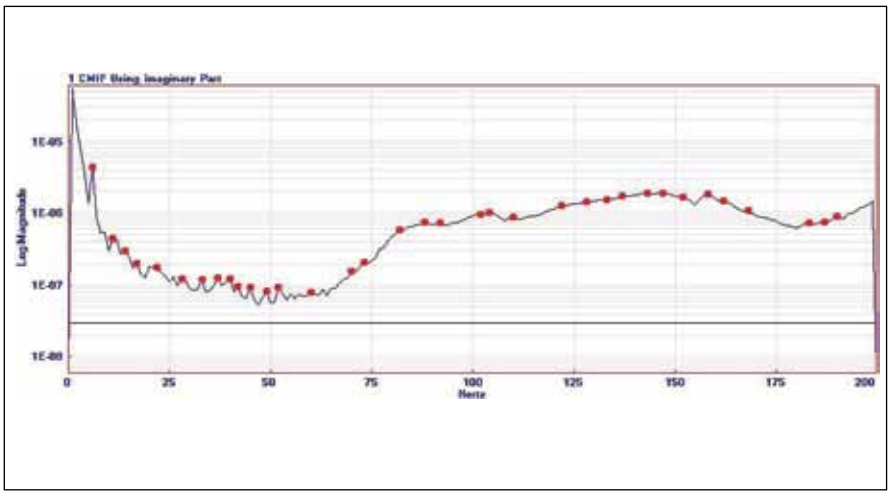

Figure 6—Result of modal analysis of a stand-alone gearbox.

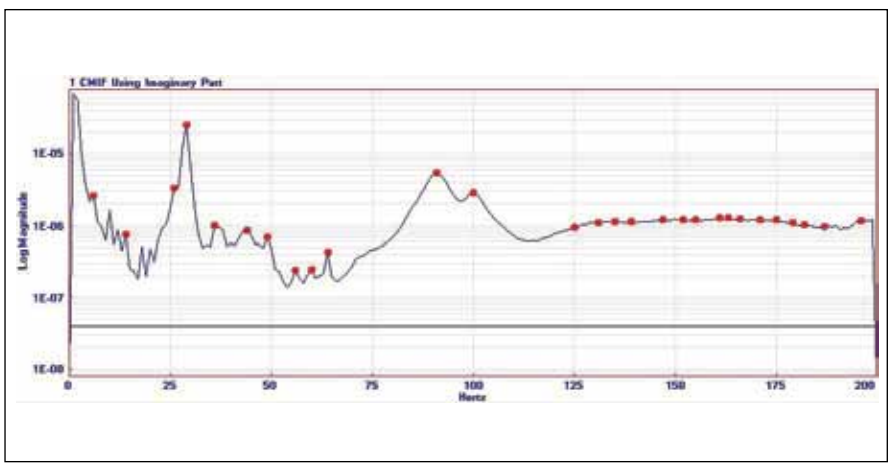

Figure 7—Result of the modal analysis of the gearbox on the test rig.

Sound and Vibration Analysis

Structure-borne noise and airborne noise result from the meshing gears. The gear mesh works as a sound generator and propagates over the housing. Gear mesh frequencies of the different stages can be measured on the gearbox housing and are taken into account as an indicator of gear quality. Every specification provides limit values of the amplitudes for each frequency or frequency range.

One must also be aware that resonance phenomena of the housing can increase those amplitudes, so attention paid to the mechanical design can aid in avoiding structural resonance.

To determine the Eigen frequencies of a gearbox, modal analysis of the individual parts, stand-alone gearbox and gearbox in the test rig configuration is done. Those results are then compared with the calculations. During the test run, an operational deflection shield analysis (ODS) is also conducted. Figure 5 shows the typical excitation and measurement points for a modal analysis of a gearbox on the test rig.

Figure 6 shows the result of a modal analysis of a gearbox hanging in a crane. It can be seen that no resonance frequency occurs between 0 and 200 Hz. Figure 7 shows the result of the modal analysis of the same gearbox installed in a back-to-back configuration on a test rig. It can be seen very clearly that resonance frequencies occur around 29 Hz and in the range of 85–100 Hz.

Figure 8 shows the mode shape of the gearbox in the test rig at 29 Hz; due to the fact that the gearbox is clamped in the test rig, an Eigen mode results that is not present when the gearbox stands alone. This fact must be taken into account when vibration values are discussed—not just regarding the behavior of the gear unit on the test rig, but on the turbine as well.

Multi-Body Analysis

To understand more regarding gearbox behavior in different environments, multi-body analysis (MBA) is the tool of choice. Calculation of the relative movements of the gearbox and its parts—in all three spatial

directions—and possible resonances is conducted. A model of the gearbox is built, and different operating conditions are analyzed. Figure 9 shows the model of the gearbox used for this analysis; Figure 10 shows the model of the gearbox in the test rig configuration.

Figure 11 displays the results of the time-based frequency analysis of the virtual measurement points at the torque arm. It can be seen that the simulation results correspond with the results of the modal analysis (Fig. 7). Resonances at 29 Hz and in the range of 85–100 Hz are also found in the simulation, meaning that critical frequencies or amplitudes can be calculated. If more data about the installation parameters of the gearbox in the wind turbine are available, calculation of gearbox behavior in the turbine is possible.

Comparison of Measurement Results from Test Rig and Field Measurement

Test rigs and wind turbines are very complex systems, with many components and many influencing parameters. Therefore it is very important to analyze the behavior of a wind turbine gearbox in both situations. Figure 12 shows schematically the differences in the installation situation in the test rig and on the gearbox. One main difference is the elasticity of the surrounding structure. While the test rig situation is very stiff, the situation on the wind turbine is weak. This leads to other Eigen frequencies and more deformation as the mode shapes change. Measurements of Eigen frequencies, vibration and sound were carried out and compared to the results of the test rig results. Unfortunately, since most of the measured data are proprietary, it is not possible to reveal them here.

To validate the load distribution values, measurements are done on the turbine. Given the varying, onsite wind conditions, it is not always possible to reach the same load level as on the turbine. Figure 13 shows the good correlation between the values on the test rig

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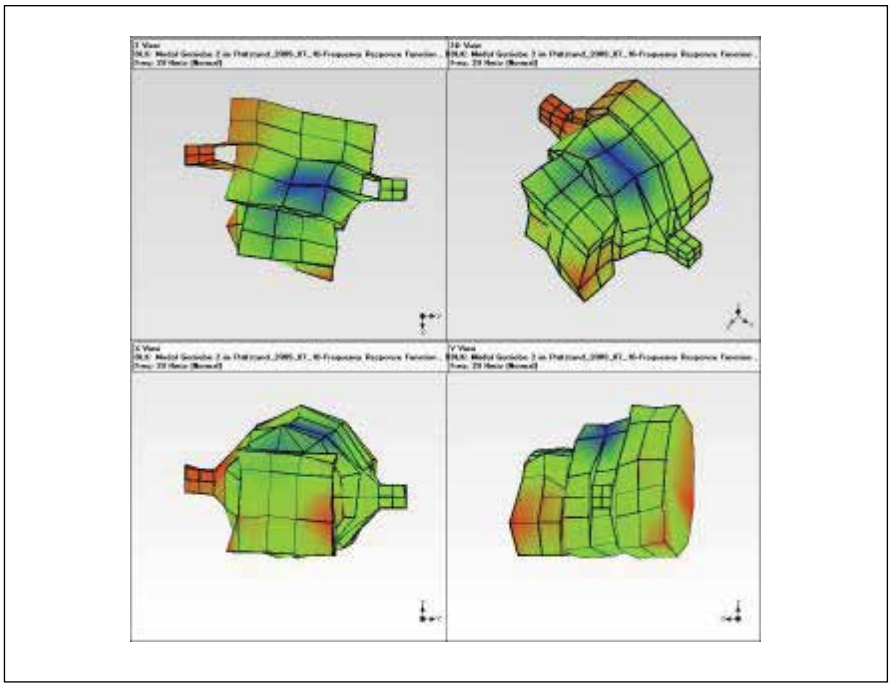

Figure 8—Mode shape at 29 Hz of the gearbox on the test rig.

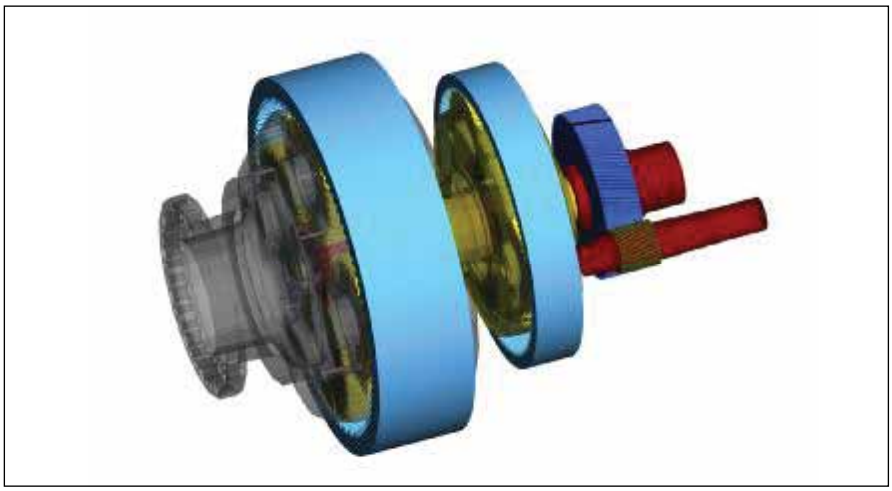

Figure 9—MBA model of the gearbox.

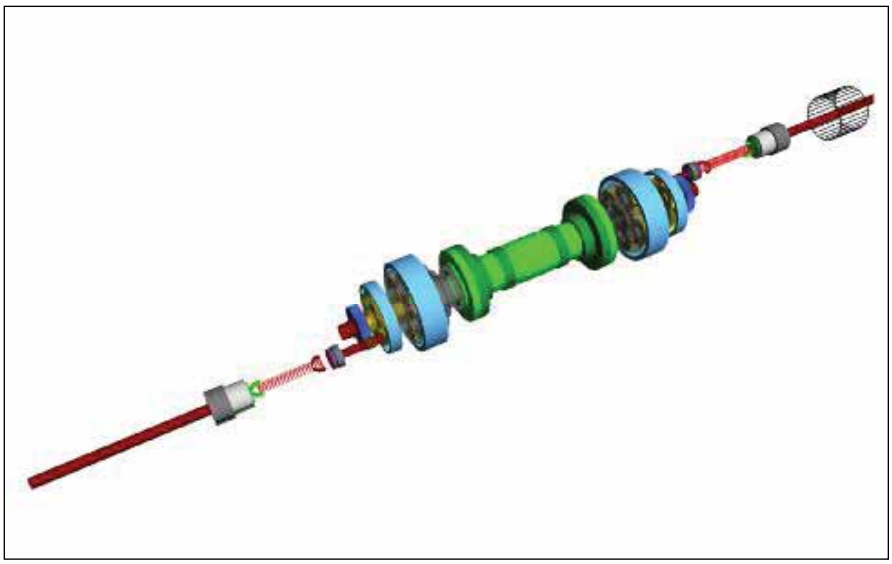

Figure 10—MBA model of gearbox and test rig.

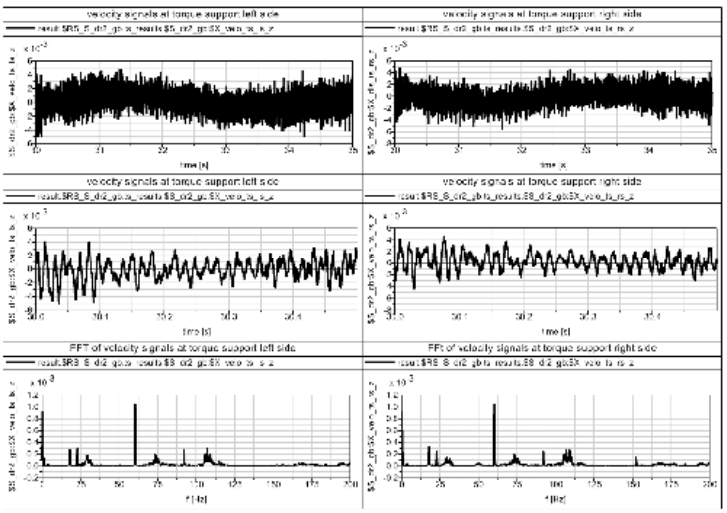

Figure 11—Results of simulation of the vibration velocity of the gearbox.

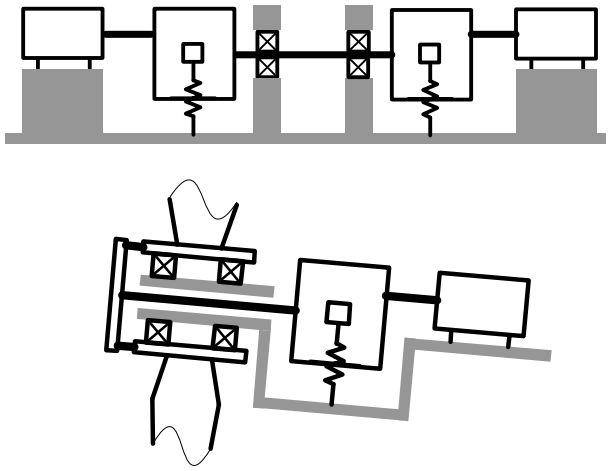

Figure 12—Installation conditions of the gearbox on the test rig (top) and turbine (bottom).

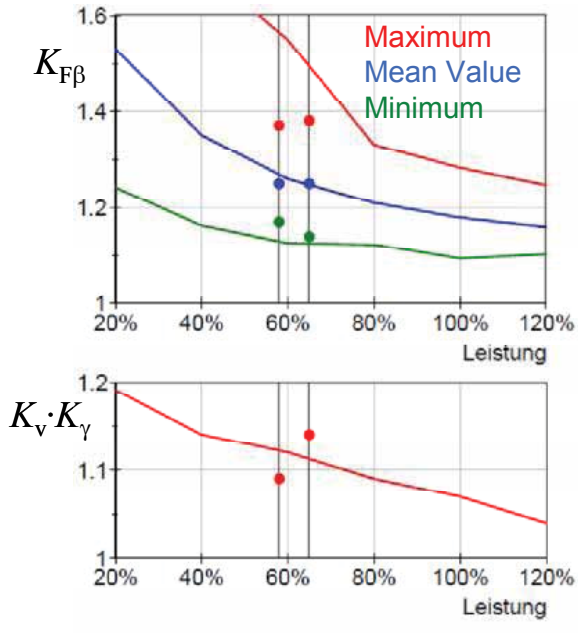

Figure 13—Comparison of load-distribution measurements.

(lines) and the values on the turbine (dots).

Conclusion

The comparison of different types of measurements on gearboxes for wind turbines reveals that the operational behavior of the gearbox is not determined solely by its properties, but by application conditions as well; vibration behavior is particularly influenced by the clamping, dampers and base frame. Tests on the test rig are never an alternative to measurements on the turbine when determining vibration values. Limit values are often given for several frequencies that cannot be achieved due to test rig influences, as behavior on the turbine is sometimes very different. In accepting that premise, relying on final prototype gearbox testing conducted on only the turbine requires a good deal of consideration.

Mark Zundel *is a chemistry graduate of the University of Duisburg and a certified RAMS/LCC engineer. From 2002–2008, he was a member of the condition monitoring department at Flender Service GmbH, Herne focusing on condition diagnostics of gearboxes and drivetrains. Zundel also worked on the development of an oil sensor while also serving as a lubrication and maintenance management consultant. Since 2008 he has worked at Winergy AG, Voerde as head of modeling, verification and tribology, concentrating on the planning of field and test rig trials of WT gearboxes, simulation of gearboxes during the development process and lubrication approvals, tests and tribology.*

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Low-Distortion Heat Treatment of Transmission Components

Dr. Volker Heuer, Dr. Klaus Löser, Donald R. Faron and David Bolton

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Management Summary

In many applications the high demands regarding service life of transmission components can be reached only by the application of a customized case hardening. This case hardening process results in a wear-resistant surface layer in combination with a tough core of the component.

However, as a side effect, the components get distorted during heat treatment. This distortion has a significant cost impact because distorted components often need to be hard-machined after heat treatment. Therefore the proper control of distortion is an important measure to minimize production costs.

By applying the technology of low-pressure carburizing (LPC) and high-pressure gas quenching (HPGQ), heat treat distortion can be significantly reduced.

HPGQ provides a very uniform heat transfer coefficient. The predictability of movement during quenching is more certain and uniform throughout the load. Further improvements can be achieved by the "dynamic quenching" processes where the quenching severity is varied during the quench sequence by step control of the gas velocity. Proper fixturing is another factor for distortion control. Modern CFC (carbon-reinforced carbon) materials are well suited as fixture material for gas quenching.

This paper presents how LPC and HPGQ processes are successfully applied on internal ring gears for a six-speed automatic transmission. The specific challenge in the heat treat process was to reduce distortion in such a way that subsequent machining operations are entirely eliminated. As a result of extensive development in the quenching process and the use of specialized CFC fixtures, it was possible to meet the design metrological requirements.

The internal ring gears addressed in this report have been in continuous production since 2006. Subsequent testing and monitoring over a two-year period progressively demonstrated that consistent metrology was achieved and quality inspection was reduced accordingly.

Introduction

Proper distortion control has become more important than ever before: To answer the demand for fuel-efficient vehicles, modern transmissions are built much lighter; therefore the components of the transmission exhibit less wall thickness, which makes them more sensitive to distortion. And distorted gear components cause noise in the transmission, may require post-heat treat machining processes and may even create problems during transmission assembly.

By applying the technology of low-pressure carburizing (LPC) and high-pressure gas quenching (HPGQ), heat treat distortion can be significantly reduced. LPC is a case-hardening process performed in a pressure of only a few millibar, using acetylene as the carbon source in most cases. During HPGQ the load is quenched using an inert gas stream instead of a liquid quenching media; typically, nitrogen or helium are used as the quench gas.

With an optimized distortion control, it is possible to simplify the process chain significantly. Figure 1 shows how the process chain can be simplified if the specified geometrical values of the components can be guaranteed after gas quenching.

If the simplified process chain can be applied, then this

will result in lower costs per part, lower throughput times and lower energy consumption during production. Since there is no need to dispose any oil after the quench, and cleaning operations after the quench are unneeded, the simplified process chain is much more environmentally friendly as well.

For the internal ring gears addressed in this report, the parts used to be heat treated with an induction hardening process. This process requires a 50-carbon and high-alloy steel grade that is very challenging for machining, or a nonferritic grade of cast iron that is challenging for casting. The intent was to change from induction hardening to case hardening, and to guarantee a low level of distortion after case hardening to allow for direct assembly into the transmission.

Distortion Mechanisms

The plastic deformation of metallic components during heat treatment is referred to as distortion; distortion occurs if the stress in the material exceeds the yield stress of the material. During case hardening the components are exposed to high temperatures in the range of 880°C to 1,050°C, and the yield stress decreases strongly with increasing temperature of a component. Three different types of stress in the material need to be distinguished:

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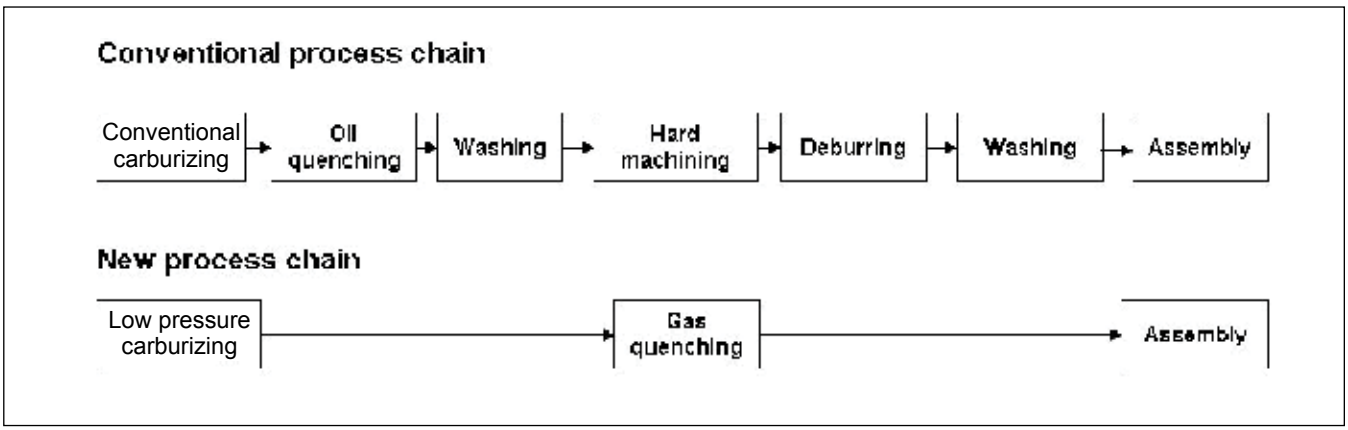

Figure 1—Conventional and new process chain for the manufacturing of gear components.

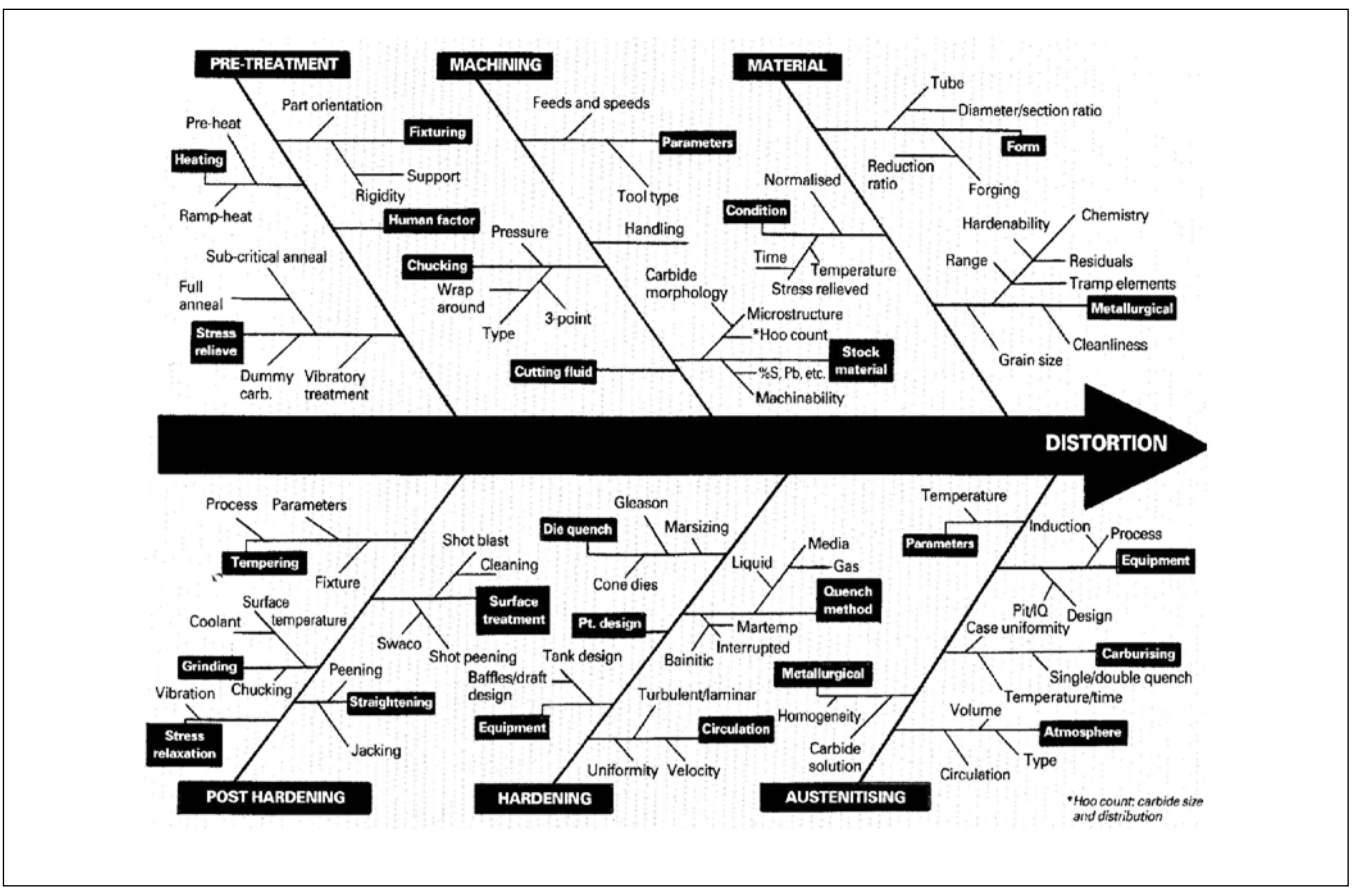

Figure 2—Potential factors influencing distortion of bearing rings (Ref. 2).

- Residual stresses induced before heat treatment by casting, forging, machining, etc. (Ref. 1)
- Thermal stresses caused by the temperature gradient while heating and quenching
- Transformation stresses caused by the transformation from ferrite to austenite during heating, and transformation from austenite to martensite/bainite during quenching

These three types of stresses overlay with each other and add up to the total stress in the component. They are influenced by part geometry, steel grade, casting, forging, machining, etc., and they depend on heat treatment. If the total stress in the component exceeds the yield stress, plastic deformation (distortion) of the component occurs. The chronology and the height of the three types of stresses leading to distortion are dependent on numerous different factors (Fig. 2).

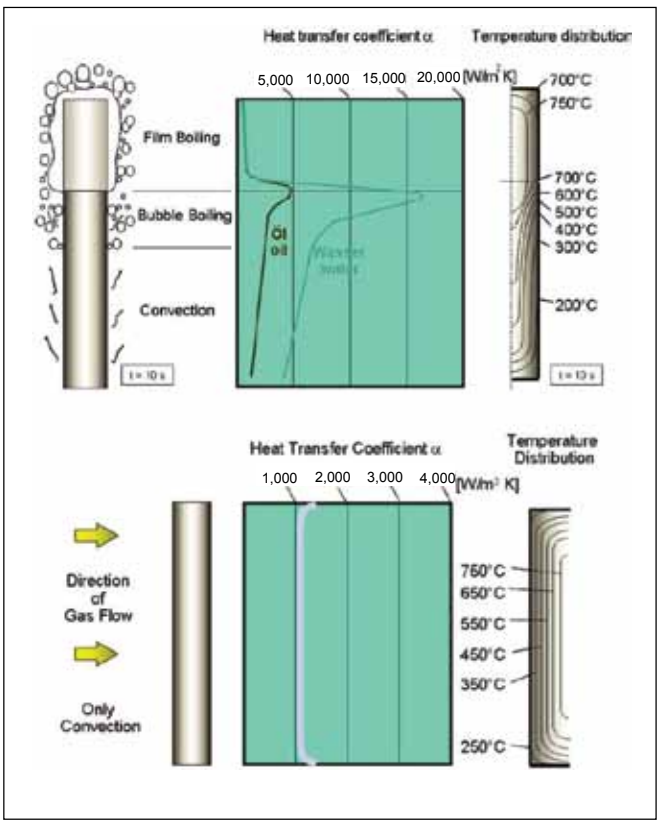

Figure 3—Heat transfer coefficient and temperature distribution in liquid and gas quenching (Ref. 3).

Figure 4—ModulTherm heat treat system with gas quenching chamber.

High-Pressure Gas Quenching (HPGQ)

The technology of HPGQ offers a tremendous potential to reduce heat treat distortions. Conventional quenching—technologies such as oil- or polymer-quenching—exhibits very dissimilar cooling conditions. Three different mechanisms occur during conventional liquid quenching: film boiling, bubble boiling and convection. Resulting from these three mechanisms, the distribution of the local heat transfer coefficients on the surface of the component are very inhomogeneous. These inhomogeneous cooling conditions cause tremendous thermal and transformation stresses in the component and subsequent distortion. During HPGQ only convection takes place, resulting in much more homogeneous cooling conditions (Fig. 3).

Significant reductions of distortion by substituting oil quench with HPGQ have been published (Ref. 9). Another advantage of HPGQ is the capability of adjusting the quench intensity exactly to the needed severity by choosing quench pressure and quench velocity; typical quench pressures range from 2 bar to 20 bar. The gas velocity is controlled by a frequency converter and typical gas velocities range from 2 m/s to 15 m/s, depending on part geometry and steel grade of the component.

Equation 1 describes the heat transfer coefficient as a function of gas velocity, gas density and the type of gas (Ref. 4):

$$\alpha = C w^{0.7} \rho^{0.7} d^{-0.3} \eta^{-0.39} c_p^{0.31} \lambda^{0.69} \quad (1)$$

Where:

C	Constant factor (depending on quench cell)
W	Gas velocity
ρ	Gas density
d	Diameter of component
η	Viscosity of the gas
c_p	Specific heat capacity of the gas
λ	Thermal conductivity of the gas

Typical gases applied for HPGQ are nitrogen and helium (Ref. 5). To achieve the required core hardness in gears of low-alloyed, case-hardening steels, helium as a quenching medium and a gas pressure of 20 bar are necessary for many applications. The usage of this low-density gas allows quenching with very high gas velocity by using reasonable motor power. In combination with an advanced gas recovery technology and exhibiting a recovery rate > 99.5%, gas quenching is very economic in spite of the helium gas price. The positive experiences with gas quenching have induced gear suppliers to use case-hardening steels with better hardenability, thus being able to quench bigger transmission components as well.

For many applications it is not the absolute height of dis-

tortion causing manufacturing problems—it's the spread of distortion. So for many applications the challenge is to optimize the HPGQ in such way that it provides a heat treatment process with very little spread of distortion within a load and, over time, from load to load.

Furnace Equipment and Fixturing for Distortion Control

The design of the gas quenching chamber is of key importance to minimize distortion. The chamber needs to provide a high gas velocity to ensure that the core hardness specification is met, and the chamber needs to provide a very uniform distribution of the gas velocity to minimize the spread of distortion within the load. Intensive numerical flow calculation (CFD studies) and experimental studies with the Institute for Industrial Aerodynamics at Aachen University led to the design of the quenching chamber of the ModulTherm system (Fig. 4; Ref. 6).

Two high-powered gas circulators arranged to left and right of the cylindrical housing accelerate the quenching gas to a high velocity in the chamber; a very homogeneous flow through the charge is reached by means of several flow guides.

The design of the chamber is modular and can be equipped with a gas flow reverse system. The quench chamber is suitable for standard gas quenching processes with constant gas pressure and gas velocity, as well as for new quenching processes such as dynamic quenching.

As in the case of liquid quenching, proper fixtures and optimized loading of parts is important for gas quenching. Alloy fixtures are widely used in heat treatment; however after long-term service the fixtures tend to deform due to high temperature deformation that has a negative effect on the distortion of the loaded parts. Moreover, due to the pick-up of carbon and subsequent formation of carbides, the fixtures undergo dimensional growth that create further problems during handling in automated, external-transportation devices.

As an alternative, carbon composite materials—e.g., CFC—were introduced for use as fixtures in heat treating applications. Low-pressure carburizing furnaces with high-pressure gas quenching are perfectly suited for the use of CFC fixtures (Fig. 5). With the usage of walking beam transportation, any wear and overstressing of the fixtures are avoided. The use of oxygen-free hydrocarbons in a vacuum environment and the inert quenching gases during the quenching process avoid any surface reactions with the fixtures. In this service environment, one can take full advantage of the excellent material properties of CFC, which has very high deformation resistance at high temperatures, low thermal expansion coefficient, and very low specific weight. Fixtures from CFC are designed to carry more parts while exhibiting less gross weight and thereby increasing productivity and reducing energy costs. The major advantage, however, is that CFC fixtures do not show deformation during the heat treatment process, thereby assuring optimum

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Figure 5—Load of internal ring gears on CFC fixturing.

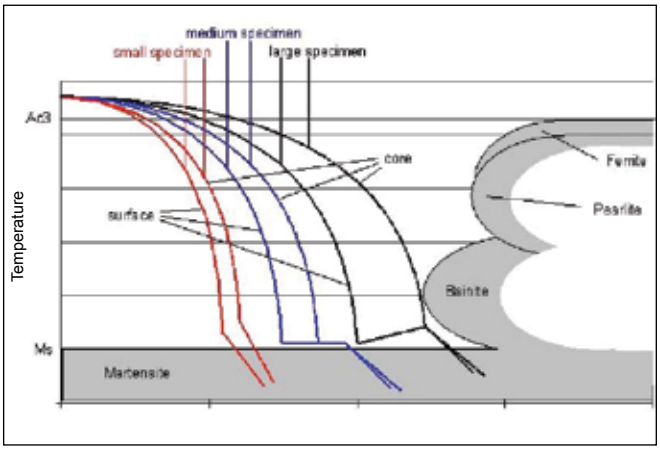

Figure 6—Schematic illustration of dynamic quenching for specimen of different sizes.

Figure 7—Geometrical inspection of an output internal gear with a CNC analytical gear checker.

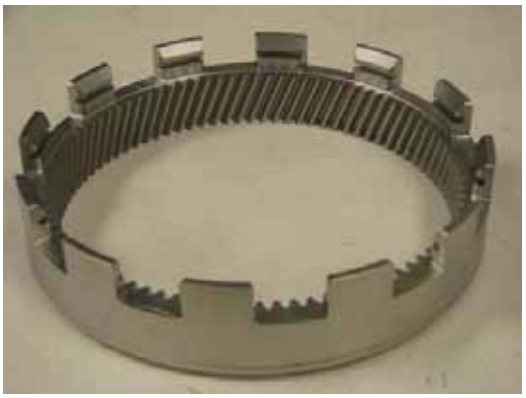

Figure 8—Input internal gear (*d* = 139 mm, 89 internal teeth).

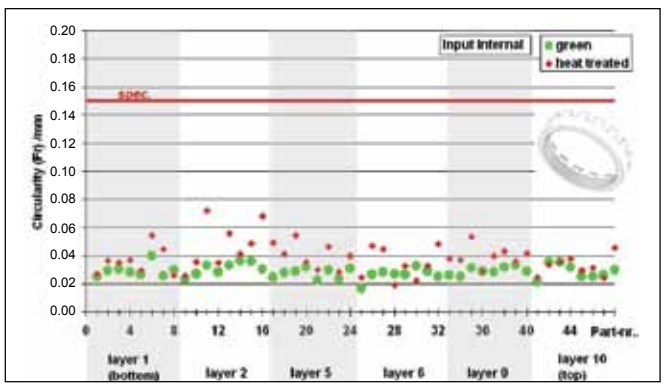

Figure 9—Circularity of input internal gears before and after heat treat (LPC and HPGQ with dynamic quenching); specimen maximum after heat treat—150 μm.

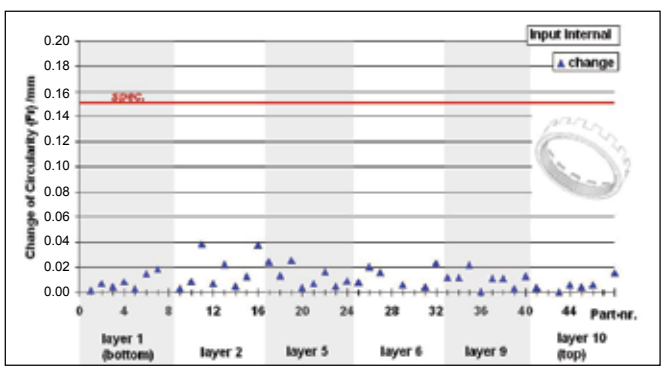

Figure 10—Change of circularity of input internal gears during heat treat (LPC and HPGQ with dynamic quenching); specimen maximum after heat treat—150 μm.

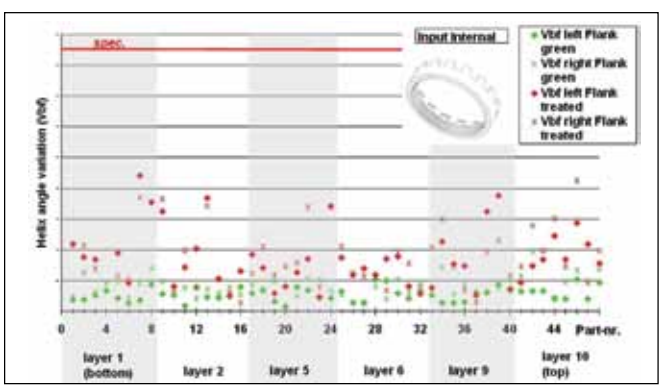

Figure 11—Helix angle variation of input internal gears before and after heat treat (LPC and HPGQ with dynamic quenching).

positioning of the parts. This has a significant, positive effect on part distortion.

Dynamic Quenching

To achieve optimum quenching results with respect to microstructure, hardness and distortion, the gas quenching parameters need to be well adjusted.

To further reduce distortion, a quenching process has been developed where the quenching parameters' gas pressure and/or gas flow velocity are varied stepwise during quenching (Fig. 6).

The process of dynamic quenching is typically divided into three steps (Ref. 7):

1. High quenching severity until a certain part temperature is reached
2. Quenching severity is reduced for a set time to allow for temperature equalization in the part
3. Quenching severity is increased again until the end of the quenching process. The control system in the quenching chamber allows for control of the dif ferent quenching steps of dynamic quenching in a very accurate way and with good reproducibility.
4. Optimum results are achieved when using helium. The light quenching gas helium can be decelerated and accelerated very precisely for optimum distortion control.

Distortion Study

An intensive process optimization program was started before the start of production of the six-speed automatic transmission; the specific challenge was to optimize distortion control of the internal ring gears. The goal was to eliminate hard machining completely on these components, thus simplifying the process chain as postulated in Figure 1. Furnace supplier and transmission manufacturer worked in close cooperation and successfully implemented a serial process for the start of production in 2006. The process consists of LPC using acetylene as the carburizing source and HPGQ using helium as quench medium. Prior to carburizing, the parts are heated under an atmosphere of 1, 2-bar nitrogen. This "convective heating" is applied to achieve uniform temperature distribution inside the load while heating up. Once the carburizing temperature is reached, the pressure is lowered to a few millibars and carburizing is initiated. The application of HPGQ with dynamic quenching and the use of CFC fixtures made subsequent machining operations unnecessary. The findings were published by the authors of this paper in 2006 (Ref. 8).

Initially all internal ring gears from each load were checked for excessive distortion with a "roll checker"—an automated measurement system utilizing a rolling master held by a pivoting yoke. The yoke enables the roll master spindle to move in the lead and taper directions as the rolling master rotates in tight mesh with the test component. Separate transducers located in the gimble head monitor lead and taper travel.

To become more cost-efficient, the transmission manufacturer wanted to abandon this 100% roll checker inspec-

tion of all parts and change to a spot-wise control of distortion. The goal was to inspect only two gears per load. Therefore it was necessary to further reduce the amount of distortion, and the quenching process was optimized again in 2008. Distortion studies were performed accordingly on the three internal gears—i.e., reaction output and input of the internal gears.

For each part, the current standard production process was used and complete load sizes were treated. Forty eight pre-measured parts were equally distributed into different layers of each load. Additionally, to cover all "extreme" positions in the load, it was made sure that parts from all eight corners and parts from the middle of the load were geometrically inspected. All measurements were performed with a CNC analytical gear checker. Figure 7 shows the inspection of an output internal gear with the probe of the gear checker moving along one tooth of the gear. Four teeth are inspected for each gear and both left flank and right flank are examined per tooth.

The production process for all three gears includes convection heating for a fast and uniform heating up of all parts. After being properly heated, the parts are carburized at 900°C by using acetylene. The temperature is reduced to an intermediate temperature and then the parts are quenched with helium using an optimized dynamic quenching process.

Input internal gears. The components have an outer diameter of 139 mm, 89 internal teeth and are made of 5130 material (Fig. 8).

The case-hardening depth (CHD) after heat treat is specified as 0.3–0.6 mm and surface hardness is specified as 79–83 HRA. The geometry after heat treat is specified with a maximum circularity of 150 mm.

Figure 9 shows the circularity of the 48 measured parts before and after heat treatment. The change of circularity during heat treat is shown in Figure 10. When evaluating and comparing heat treat distortion, the change of geometry from the green to the treated component should be considered.

Figure 11 shows the variation of the helix angle per part for the left and the right flank. Four teeth were measured per part, and the variation *Vbf* represents the difference between the maximum helix angle and the minimum helix angle measured on the four teeth per one gear.

As shown in Figures 9–11, the achieved level of distortion is very small; maximum change in circularity amounts to 38 μm and the average change in circularity is as low as

continued

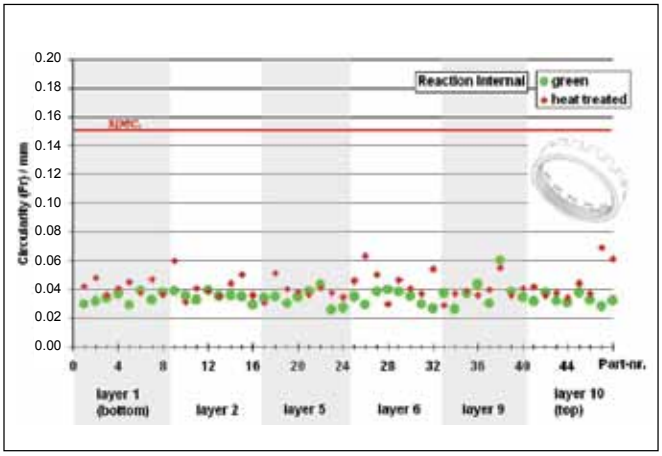

Figure 12—Circularity of reaction internal gears before and after heat treat (LPC and HPGQ with dynamic quenching); specimen maximum after heat treat—150 μm.

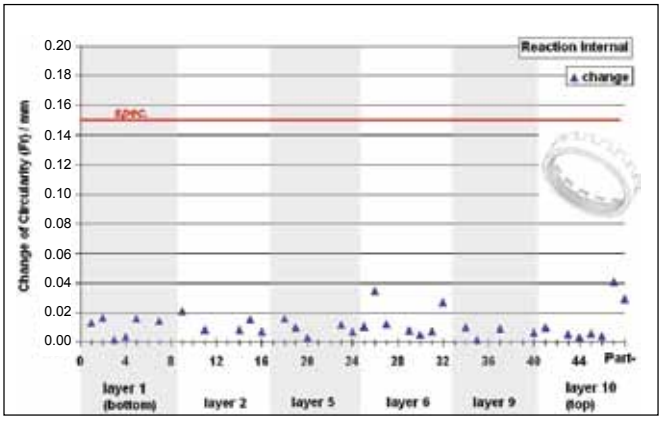

Figure 13—Change of circularity of reaction internal gears during heat treat (LPC and HPGQ with dynamic quenching); spec. maximum after heat treat: 150 μm.

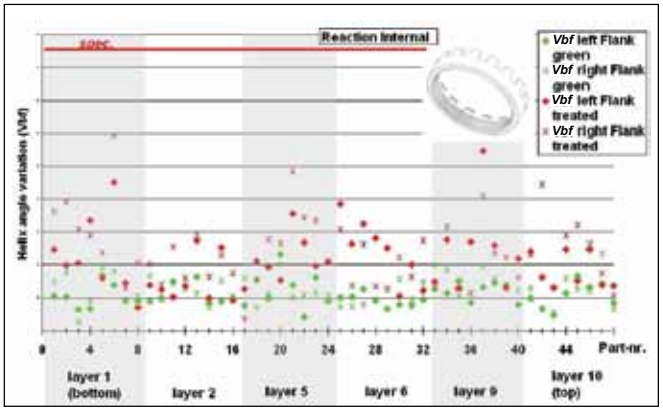

Figure 14—Helix angle variation of reaction internal gears before and after heat treat (LPC and HPGQ with dynamic quenching).

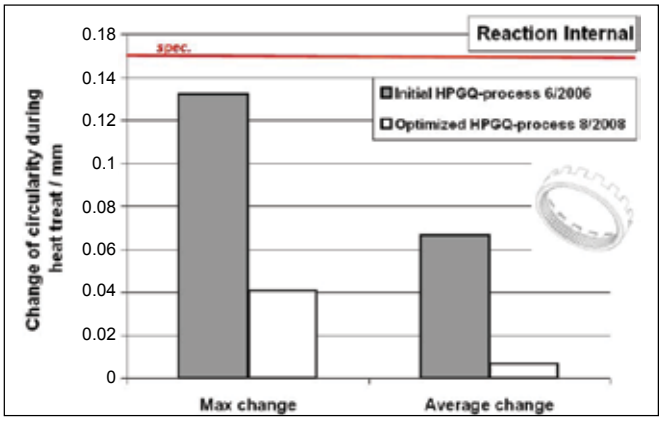

Figure 15—Maximum and average change of circularity during heat treatment in a load of reaction internal gears; comparison of initial production process from 2006 and the optimized production process used since 2008; specimen maximum after heat treat—150 μm.

10 µm; all circularity values after heat treat are well below the specified maximum of 150 µm; helix angle variation after heat treat is well below the specified maximum as shown in Figure 11; average change during heat treat in helix angle variation is 12 µm for the left flank and 9 µm for the right flank.

Reaction internal gears. The reaction internal gears have an outer diameter of 152 mm, 103 internal teeth and are made of 5130 material as well. Specification of the parts after heat treat is identical to the input internal gears.

The circularity of the 48 measured pieces before and after heat treatment can be found in Figure 12; Figure 13 shows the change of circularity during heat treat.

The helix angle variation (*Vbf*) for each part is shown in Figure 14; as shown in Figures 12–14 the achieved level of distortion is also very small for the reaction internal gears; maximum change in circularity amounts to 41 µm and average change in circularity only 7 µm; all circularity values after heat treat are well below the specified maximum of 150 µm; the helix angle variation after LPC and HPGQ is below the specified maximum as well; the average change during heat treat in helix angle variation is 10 µm for the left flank and 11 µm for the right flank.

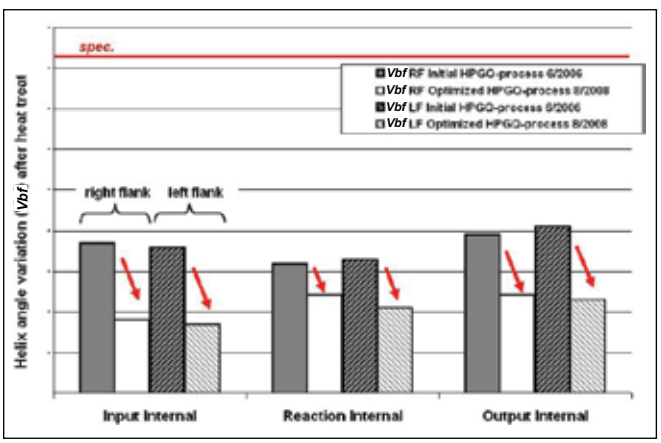

Figure 16—Helix angle variation after heat treatment averaged per load for input reaction and output internal gears; comparison of initial production process from 2006 and the optimized production process since 2008.

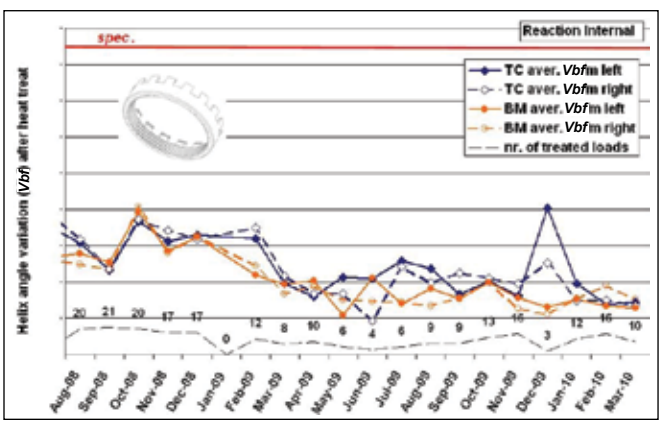

Figure 17—Reaction internal gears: helix angle variation after heat treat averaged per month of production: (*TC = sample from top corner of the load; BM = sample from bottom middle of the load; the number of inspected loads is indicated per each month; the total number of inspected loads from 2008 until 2010 was 229 loads; no production in 2009*).

Output internal gears. The components have an outer diameter of 139 µm, 99 internal teeth and are made of 5130 material (Fig. 7). The level of distortion achieved on these gears is slightly higher compared to the values achieved for the input and reaction internal gears; maximum change in circularity amounts to 81 µm and average change in circularity is 28 µm, meaning that all circularity values after heat treat are well below the specified maximum of 150 µm. The helix angle variation after LPC and HPGQ is within specification as well; average change during heat treat in helix angle variation is 9 µm for the left flank and 10 µm for the right flank.

Comparison of the Initial and the Optimized HPGQ Process

The data presented in the previous section represents a significant reduction of the already-low distortion values from 2006; the dynamic quench process was optimized in 2008. To do so the hold temperature was manipulated in the vicinity of the estimated martensite start (MS) temperature by an adjustment of the gas speed and timing for all three steps of the dynamic quench process. This process optimization, in combination with the very stable manufacturing process chain before heat treat, led to the significant improvements demonstrated in Figures 15–16.

Figure 15 shows a comparison of two loads of reaction internal gears; one load was treated in 2006 with the initial HPGQ process (Ref. 8), the other with the optimized HPGQ process. The average change of circularity during heat treat was reduced from 67 to 7 µm and the biggest change of circularity inside the load was reduced from 132 to 41 µm.

The helix angle variations after heat treat from six different loads are presented in Figure 16. One load of each type of internal gears was treated in 2006 with the initial HPGQ process, and one load of each type treated with the optimized HPGQ process. The helix angle variations were significantly reduced for both for the right and left flanks. As discussed earlier in this paper, the residual stresses inside the components can contribute to distortion, which means that the level of residual stress inside these gears before heat treat must be very low to allow such a low level of distortion after heat treatment.

Distortion Monitoring in Serial Production

Serial production of the transmission started in 2006. Initially all internal ring gears from each load were checked for excessive distortion with a roll checker. As distortion proved to be very consistent after introduction of the optimized process in 2008, the transmission manufacturer decided to abandon the 100% inspection of all parts. Since 2008, only two gears per load are being measured with a CNC analytical gear checker. One part from the top corner and one part from the bottom-middle are being inspected in each load; these two positions were chosen to cover the "extreme" positions in the load.

Results from distortion monitoring since introduction of the optimized process in 2008 until today are presented in Figure 17; the diagram shows the helix angle variation after heat treat (*Vbf*) averaged per month of production. TC represents the sample from the top corner of the load and BM represents the sample from the bottom-middle of the load. Additionally, the number of inspected loads per month is indicated in the diagram; total number of inspected loads from 2008–2010 was 229 loads.

Figure 17 demonstrates that the distortion values in serial production are very stable. This was achieved with the help of the optimized LPC and HPGQ process, in combination with the stable manufacturing process chain of the components.

Necessary Steps for Low-Distortion Heat Treatment

The necessary steps that need to be accomplished to provide low distortion values are given in Figure 18.

The design of the gas quenching cell is of key importance to minimize distortion. The chamber needs to provide a very uniform distribution of the gas velocity to minimize the spread of distortion within the load. Another important factor is proper fixturing; modern CFC materials (carbon reinforced carbon) are well-suited as fixture material for gas quenching.

Further improvements can be achieved by optimized LPC processes using convective heating for homogeneous temperature distribution and by application of dynamic quenching processes where the quenching severity is varied during the quench sequence by step control of the gas velocity. However, if the components inhibit high residual stress, it is then impossible to achieve low distortion values during heat treat. Therefore an optimized and stable manufacturing process chain including melting, casting, cutting, soft machining, etc., is mandatory to create low levels of residual stress in the components before heat treating.

Summary

LPC and HPGQ processes were successfully applied on internal ring gears for a six-speed automatic transmission. Helium was chosen as quench gas. Distortion studies were conducted to analyze the geometrical stability of the input, reaction and output internal gears during heat treat. In each case 48 pre-measured parts were blended into a full production load. For reaction internal gears, the maximum change of circularity during heat treat was 41 µm and the average change of circularity was as low as 7 µm. The average change during heat treat in helix angle variation was 10 µm for the left flank and 11 µm for the right flank. All values after heat treat are well below the specified maximum. Measurements of input and output internal gears showed similar results, with all gears being well within specification. The level of distortion stays at such a low level that subsequent machining operations are entirely eliminated. This led to enormous cost savings for the transmission manufacturer.

Production of the gears started in 2006; results from continuous distortion monitoring during production prove that the distortion of the LPC and HPGQ process is very stable. Therefore in 2008 it was decided to reduce the quality inspection drastically, which resulted in significant cost savings.

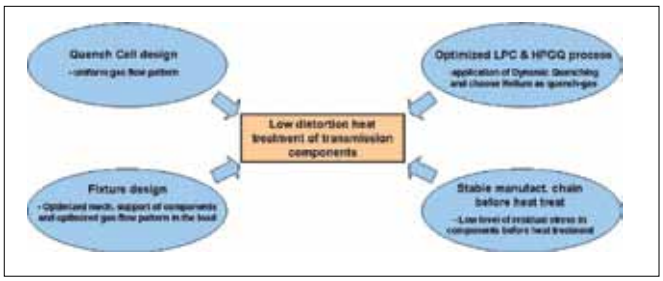

Figure 18—Necessary steps for low-distortion heat treatment with LPC and HPGQ.

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David Bolton *founder of Bolton & Associates, is a senior manufacturing engineer with over 30 years experience in gear manufacturing. His expertise includes both domestic and international plant start-up and the purchase, run-off and oversight of installation of new equipment; he is also well-versed in the field of statistical problem-solving.*

Donald R. Faron *studied metallurgy and materials engineering at the New Mexico Institute of Technology (BS) and Northwestern University (MS). He is lead materials engineer of the central manufacturing department at General Motors Powertrain (automatic transmissions).*

Dr.-Ing. Volker Heuer *studied metallurgy and materials technology at the RWTH Aachen. He received his Ph.D. as a scientific assistant at the TU Bergakademie Freiberg. He is development engineer in the R&D department of ALD Vacuum Technologies GmbH, Hanau.*

Dr.-Ing. Klaus Löser *studied mechanical engineering and received a Ph.D. as scientific assistant at the Institute of Materials Science of the Technical University in Darmstadt. He is director of the R&D department of ALD Vacuum Technologies GmbH, Hanau.*

November 2–4—AWEA Wind Energy Fall Symposium. La Costa Resort & Spa, Carlsbad, California. This exclusive event sets the stage for sharing successes, strategies, and lessons-learned with wind industry peers. Giving the information and tools needed to operate in a complex and global marketplace, the 2011 AWEA Wind Energy Fall Symposium's educational program will outfit attendees with sessions that address not only industry trends and innovations, but teach you how to best communicate wind energy's benefits to external audiences. Continuing on the success of last year's event, this year's Fall Symposium will include the relaxed yet professional environment that allows for insightful and valuable interacting. Initiate, develop and rekindle relationships with your wind industry peers through the WindPAC Reception, Networking Receptions, the 60-Minute Idea Exchange and the annual AWEA Golf Tournament. For more information, visit *www.awea.org*.

November 8–9—AmCon Design and Contract Manufacturing Expo. Novi, Michigan. AmCon is a contract manufacturing expo for all job shops and contract manufacturers that provides custom metal, plastic, rubber or electronic parts and related manufacturing services to OEMs. Attendees include top level purchasing, engineering and production managers who are directly involved in buying custom contract manufacturing services. Representatives from companies of all sizes attend from a range of industries, often with blueprints in hand. The AmCon shows occur regionally throughout the year. For more information, visit *www.amconshows.com*.

November 28–December 1—Defense Manufacturing Conference. Anaheim, California. The Defense Manufacturing Conference (DMC) 2011 is the nation's largest forum for scientists, technologists, engineers, managers, leaders and policy makers in the defense manufacturing industrial base. The meeting is the product of a partnership of the U.S. military departments and agencies of the Department of Defense. The 2011 DMC will feature a keynote address, "Increasing Industrial Capability in the Current Environment" by Hon. Ashton Carter, under secretary of defense/acquisition, technology and logistics and nominee, deputy secretary of defense. All of the military departments, defense agencies, many non-defense agencies, industry and academia will participate in this seminal national event for both defense and non-defense related manufacturing technology development and applications. For more information, visit *www.dmc2010.com*.

December 6–8—Gearbox System Design. Sheraton Sand Key Resort, Clearwater, Florida. The design of a gearbox system is much like a Hollywood movie production—the "stars" often get the recognition, while the "supporting cast" barely gets a mention! In a gearbox system, the stars are the gears and bearings. The supporting cast is everything else, including seals, lubrication, lubricants, housings, breathers and other details. Explore the gearbox system supporting cast of characters at the Gearbox System Design Seminar. The treatment starts with basics, such as some history of design, the environment in which the gearbox must "live" and the loading to which the system will be subjected. Loading includes starting/stopping, continuous, reversing, cyclic and possible errant load conditions. AGMA member: $1,895 first registrant, $1,695 for additional registrants from same member company. Nonmember: $2,395 first registrant, $2,195 for additional registrants from same company. For more information, visit *www.agma.org*.

February 9–11—IPTEX 12. Bombay Exhibition Center, Mumbai, India. IPTEX is an exclusive exhibition focused on gear engineering and power transmission technology. The show features products and services in gears and gearboxes, gear machines and tools, linear transmission and drive systems, metrology products, software, bearing, belts and other mechanical transmission products. Supported by AGMA and organized by Virgo Communications and Exhibitions, IPTEX 12 will help attendees learn the latest trends in gear and power transmission technology and provide solutions for an array of manufacturing needs. Visitors to the 2010 show included industry leaders from the aerospace, automotive, machine tool, material handling, sugar, textile, and thermal plant industries. For registration information, visit *www.virgo-comm.com*.


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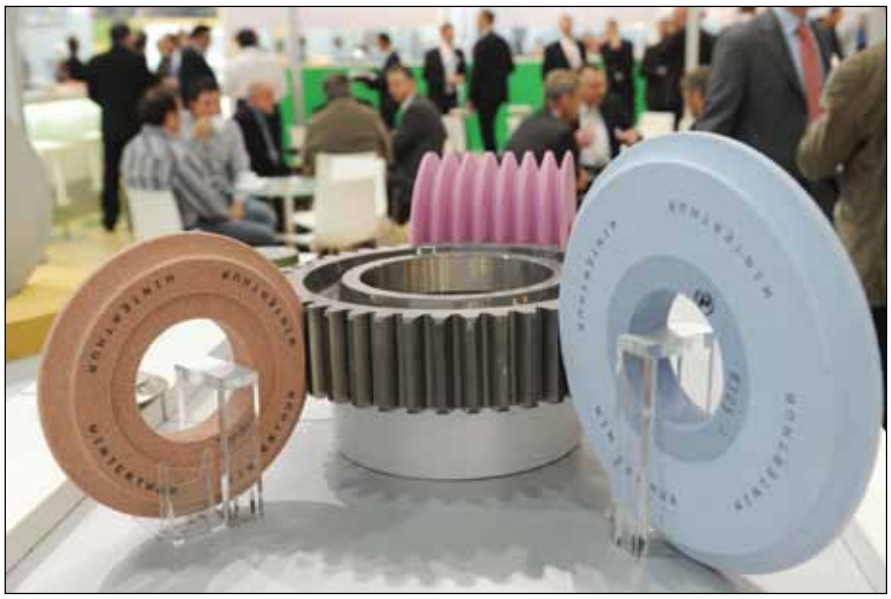
EMO Hannover—More Than Machine Tools

From September 19–24, EMO Hannover highlighted machine tools, manufacturing systems and computer technology. Sponsored by the VDW (German Machine Tool Builders Association), the exhibition started off with an optimistic look at the future of the machine tool industry. "The international machine tool industry is in excellent health and demand continues at a very high level," stated Martin Kapp, chairman of the VDW, in his opening address. "The VDW looks forward to a successful trade show and continued strong international demand for machine tools."

Highlights from this year's "More Than Machine Tools" theme included Kapp's machine tool integration, Höfler's gear hobbing technology, machine tool automation from Stäubli Robotics, SolidCAM's *iMachining* software and new measurement technology from Renishaw.



Winterthur grinding wheels were on display at EMO Hannover 2011 (courtesy of EMO).

Kapp's System Integration. The exhibitors from Kapp were on hand to discuss the advantages of the new Weisser-Kapp Cell. As the company points out, a reduction of cycle times in machine tool manufacture is realized via systems integration, whereby intelligent solutions are called for if technologies cannot be combined easily in the workspace. The cell presented was billed as an innovative solution for the highly productive finish machining of gears. In the cell, the machining of reference surfaces is performed by Weisser rotational turning on a Univertor AC-1 machine. Finally, the tooth flanks are machined by generation grinding using a Kapp KX 100 Dynamic center. The innovative two-spindle pick-up concept is claimed to ensure minimal process auxiliary times and a small set-up input. With an integrated loading system and automatic changing of the workpiece clamping device, the machine solution as a standalone unit is suitable for the highly productive mass production of external spur and helical gears. For more information, visit *www.kapp-niles.com*.

Höfler Gear Hobbing. Höfler is a German specialist for gear grinding and gear hobbing machinery. As the company points out, gear hobbing machines are workhorses and operate with extreme forces. This means they have to be solidly constructed as well as meeting the highest possible requirements for machining accuracy. Höfler announced that a new hobbing head with an innovative hob arbor holder of the type Capto has been added to their gear hobbing machines in the HF series. Thanks to the technical improvements of the hobbing head as well as the robust and particularly rigid machine design, the machine series is suitable for highly productive dry processing. For more information, visit *www.hofler.com*.

Stäubli Automation Solutions. At EMO Hannover, Stäubli Robotics presented the new RX170 hsm milling robot as well as automation robotic solutions for the loading and unloading of machine tools. With its five-axis articulated RX170 hsm robot, Stäubli has created an alternative to the machine tool with high-speed precision machining. Stäubli has identified a whole series of operations such as milling, deburring, trimming, drilling and tapping suitable for this new product. The second major theme of Stäubli's trade fair display is the automation of machine tools. Robot solutions from Stäubli are aimed at enhancing overall productivity. This starts with the reduction of idle times by means of rapid, fully automatic loading and unloading of machinery, continues with the minimization of machine downtime and culminates in the semi-autonomous operation of machine tools in unmanned shifts. For more information, visit *www.staubli.com*.

iMachining Demonstrations Attendees witnessed an entirely new level of metal cutting performance when they visited SolidCAM's booth at EMO Hannover. Guided by the company's "Technology Wizard," the latest CAM system offering, iMachining, boasted shortened cycle times, extended tool life, programming speed and the ability to use even the smallest tools in cutting the hardest materials. Visitors were welcomed with real-time, live cutting demonstrations that could save up to 70 percent of machining time and simplify CAM programming.

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For a full recap of EMO Hannover 2011, visit *www.emo-hannover.de*

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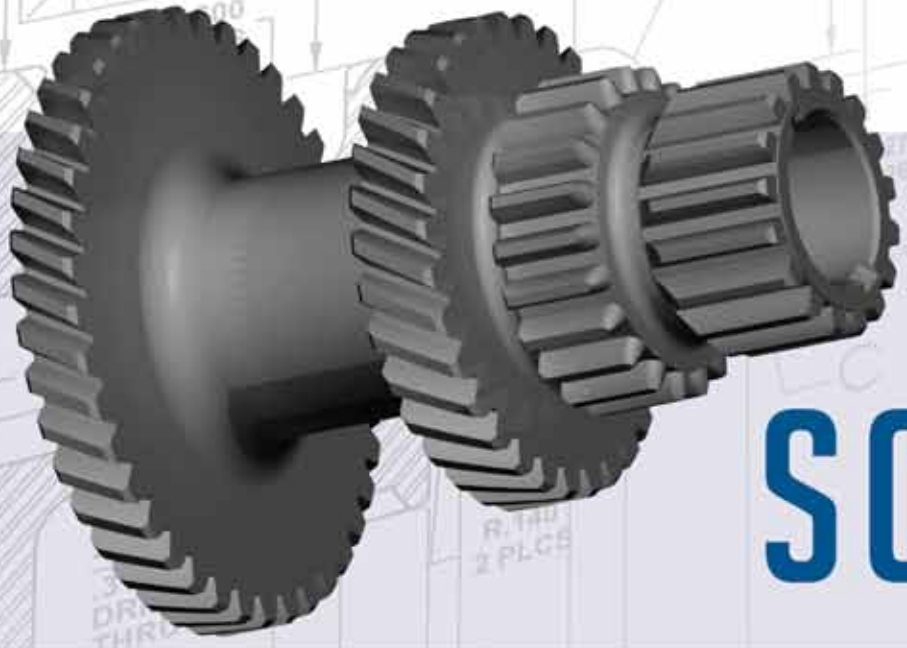

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Gleason and Heller

COLLABORATE ON FIVE-AXIS MACHINING CENTERS

The Gleason Corporation and Gebr. Heller Maschinenfabrik GmbH recently announced the formation of a strategic alliance to serve the global gear manufacturing technology markets. Effective in September, Gleason and Heller will now cooperate in the development and sale of five-axis machining centers for gear production applications.

Udo Stolz

Manfred Maier

Udo Stolz, vice president for worldwide sales and marketing of Gleason Corporation said, "Heller's gear cutting solutions are complementary to our own, and strengthen our ability to offer the best possible solution to our customers. Heller's innovative solutions are particularly interesting for flexible and highly productive machining of gears in small to medium batch sizes and where combined machining operations are desirable. Gleason will act as the exclusive distributor of machining centers incorporating Heller's existing gear solutions and

the two companies will cooperate to further improve the capabilities of producing gears on such a platform. By leveraging Gleason's global reach and leadership in gear technology, we believe opportunities exist to expand sales of Heller's solutions."

Manfred Maier, managing director of Heller, said, "Heller has developed alternatives to traditional gear production processes, alternatives that do not require dedicated machines but are very productive and well suited to certain applications. We are excited about our alliance with Gleason that we believe will open our access to those applications and market segments."

For more information, visit *www.gleason.com*.

PMA

TO HOST INAUGURAL WOMEN IN MANUFACTURING SYMPOSIUM

More than 150 women executives, managers and supervisors will gather in Cleveland, Ohio, on October 25–26, 2011 for the first annual Women in Manufacturing Symposium hosted by the Precision Metalforming Association (PMA). The event, designed exclusively for women who have chosen a career in the manufacturing industry, will provide a unique opportunity for participants to share perspectives and network with colleagues and with leading female executives in the manufacturing sector.

Moira Forbes, vice president and publisher of *ForbesWoman*, a multi-media platform serving successful women in business and leadership, will deliver the keynote presentation at the event on "Management Best Practices." Forbes also is the associate publisher of *ForbesLife* and the host of *Success with Moira Forbes*, a weekly video series featuring candid, one-on-one interviews with today's top women leaders.

"The first-ever PMA Women in Manufacturing Symposium brings together women in manufacturing to focus on best practices and interaction that will provide another plat-

form for engaging the industry," says Kellie Johnson, president of ACE Clearwater Enterprises and board member of the National Association of Manufacturers. "Manufacturing is at a pivotal point in our nation's history. This event represents productive knowledge, innovation and enterprise and will help shape the future of manufacturing through involvement in policy, education and networking."

The symposium also will feature panel discussions on "Manufacturing Best Practices" and "The Importance of Sponsoring and Mentoring." Panelists include representatives from high-profile manufacturers including Boeing, Ford Motor Company, General Motors, GE Appliances and American Greetings.

Additional presentations are scheduled on the topics of "Bridging the Gap: Attracting, Retaining and Promoting Women in Manufacturing" by a representative from Deloitte Services; "The Eight Principles of Leadership" by Martha Mayhood Mertz, founder of ATHENA International; and "Communication Strategies for Women in Leadership" by Claire Scott Miller, Weatherhead School of Management/ Case Western Reserve University. For more information, visit *www.womeninmanufacturing.org*.

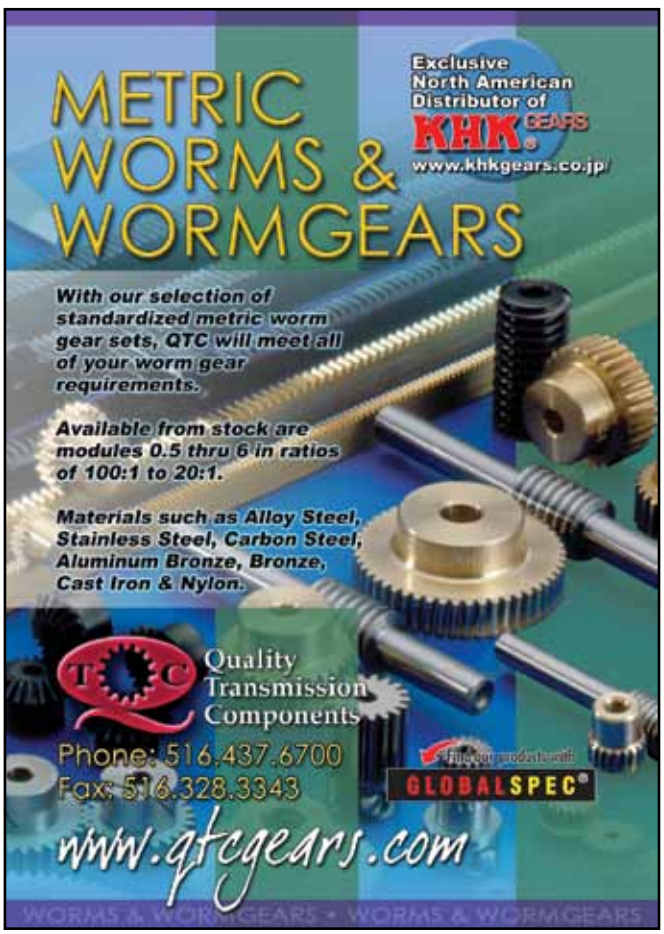
Gleason

ACQUIRES K2 PLASTICS

Gleason Corporation has announced it has acquired the assets and business of K2 Plastics, Inc., of Bergen, New York, a producer of precision plastic gears and other complex plastic parts. "Gleason is continually seeking ways to extend the solutions we can offer our customers," says John J. Perrotti, president and CEO, Gleason Corporation. "K2 Plastics provided Gleason with an opportunity to broaden ourselves further into the gear market, particularly in the fine-pitch area where both plastic and steel gears are used. While the applications for plastic gears may broaden over time, the electronic, medical equipment and appliance markets are some of the existing markets for plastic gears, and are all markets in which we have had limited market penetration."

K2's products utilize "no-weld-line technology" to achieve superior strength and accuracy for its plastic injection molded parts. "A weld line is the interface in an injection molded gear where two flow fronts meet," says Klaus Kremmin,

continued



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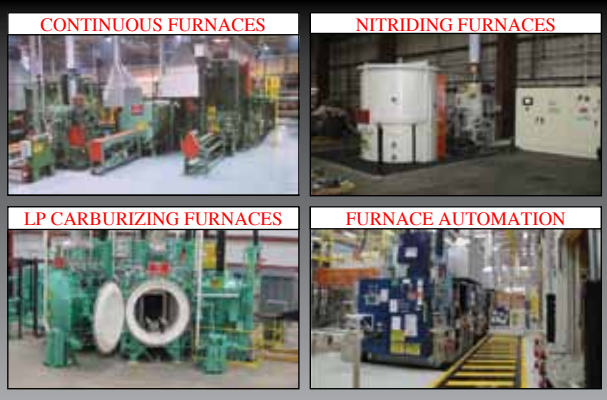

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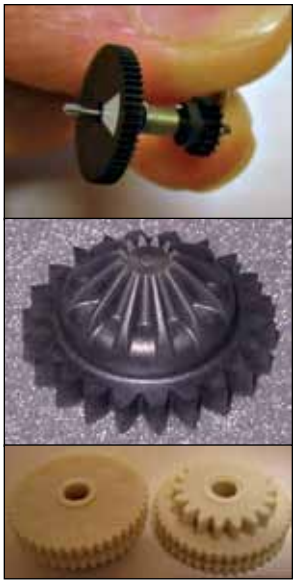

general manager, Gleason-K2 Plastics. "These weld lines usually occur between two gates (points where plastic is injected into the gear during manufacturing). A weld line is the weak link in a gear. The material strength at the weld line may be 10–50 percent of the strength outside the weld line. This means you cannot rely on material data sheets for strength calculations without factoring in the effect of weld lines. You can also achieve 2–3 levels of accuracy higher without weld lines. K2 has optimized the molding of plastic gears and other precision components without weld lines and with no secondary machining."

K2 also provides comprehensive engineering consultation from design to material selection to prototyping. "Klaus Kremmin is a highly respected designer of plastic gears with a thorough knowledge of the plastics injection molding process," Perrotti adds. "His entrepreneurial instincts and proven business acumen make him a valued member of the Gleason team. Both companies are technology leaders within the gear industry and we believe that benefits from the synergies between the two companies will allow each to extend their market reach."

Gleason offers incremental technical resources, global sales and distribution channels, synergies emerging from Gleason's current capabilities related to design and machining of steel gears, and capital to accelerate the expansion of the existing business. These factors will only help to serve K2 Plastics in the future. Gleason will retain K2's existing management team, and Gleason's newly-formed Gleason-K2 Plastics Division will continue to operate at K2's current manufacturing facility in Bergen, New York.

"There are already many gear applications for which plastics or injection molded gears are ideally suited," Perrotti says. "While we do not see explosive growth in the use of plastic gears, we do see further opportunities as markets look for cost-savings, weight reduction, reduced noise and a minimized use of wear-reducing external lubricants. Continued advancement in new injection moldable materials also creates a broader market for injection molded gearing."

Michigan Congressman Levin

TALKS JOB CREATION WITH SUPREME GEAR

On August 25, 2011, Michigan Congressman Sander Levin, State Representative Marilyn Lane and Assistant Macomb County Executive, Dr. Albert Lorenzo paid a visit to Supreme Gear Company. The topic of conversation was how to create more jobs, specifically defense jobs, in Macomb County. At a roundtable discussion, then later during a plant tour to meet the employees, the Congressman spoke of the resources available to small businesses in Michigan, as well as what Washington was considering for the future. Supreme Gear Company was founded more than 60 years ago in an effort to provide creative machined solutions to aerospace, defense, commercial and other related industries. The company specializes in the production of highly critical aircraft engine and missile gears, complete gearboxes, gear shafts, drives, sprockets, housing assemblies and many other precision-machined gear components up to 16 inches in diameter. They also have the capability of machining parts up to 32" in diameter. For more information, visit *www.supremegear.com*.

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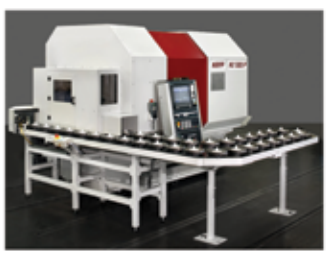

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mally joined with Koepfer America LLC to be represented in the North American gear market. Additionally, Drake has partnered with D-Mark Corporation to represent their entire product line in southern California. According to Drake's press release, both organizations are well respected in the machine tool industry and bring the technical and product knowledge that customers have come to expect from Drake, providing application solutions for continued growth. For more information, visit *www.drakemfg.com*.

Manufacturing Technology Orders

UP 92.7 PERCENT FROM JULY 2010

July U.S. manufacturing technology orders totaled $506.97 million, according to the American Machine Tool Distributors' Association (AMTDA) and the Association for Manufacturing Technology (AMT). This total, as reported by companies participating in the United States Manufacturing Technology Orders (USMTO) program, was up 7.3 percent from June and up 92.7 percent when compared with the total of $263.14 million reported for July 2010. With a year-to-date total of $2,975.10 million, 2011 is up 102.9 percent compared with 2010.

These numbers and all data in this report are based on the totals of actual data reported by companies participating in the

USMTO program. "The manufacturing beat goes on. Machine tool sales continue to exceed forecasts for 2011," said Peter Borden, AMTDA president. "The stock market's volatility and the traditional summer slowdowns as budgets are depleted were no match for the ongoing demand to get new machines into production as soon as possible. This pace will slow; but for USMTO 2011 so far, there are no signs of what we hear on the nightly news."

The USMTO report, jointly compiled by the two trade associations representing the production and distribution of manufacturing technology, provides regional and national U.S. orders data of domestic and imported machine tools and related equipment. Analysis of manufacturing technology orders provides a reliable leading economic indicator as manufacturing industries invest in capital metalworking equipment to increase capacity and improve productivity. For a regional geographic breakdown of manufacturing technology orders, visit *www.amtonline.org*.

Jaworek and Euliano

JOIN SECO/WARWICK

Seco/Warwick Corporation recently announced that Katanya Jaworek has been added to Seco/Warwick's Thermal Team sales staff as a sales application engineer. Jaworek brings an extensive science and business background to the Seco/Warwick staff. Among Jaworek's responsibilities will be presenting and negotiating custom engineered furnace proposals with customers and developing project concepts and project proposals to solve customer needs. Jaworek graduated from Gannon University in Erie, Pennsylvania in 1999 with a bachelor of science in biology and earned a master of science in forensic science with a concentration in advanced investigation from the University of New Haven in 2003. Jaworek most recently spent four years as a sales engineer at an Erie-based manufacturing company that also provided heat treating ser-

Katanya Jaworek

continued

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Bill Euliano

vices. She also worked as a chemist for three years prior to attending graduate school and was a traffic accident investigator.

Additionally, Bill Euliano was recently named operations manager at Seco/Warwick. Euliano brings more than 30 years' manufacturing experience to Seco/Warwick Corp. He will report to the president and is responsible for the company's day-to-day operating activities. Euliano will oversee the effective and efficient use of facilities and personnel, as well as conformance to schedules and budgets. Euliano has a bachelor's degree in mechanical engineering from Gannon University, Erie, Pennsylvania. He also completed graduate degree courses for an MBA from Gannon University, and he has an associate degree in elementary education from Butler County Community College. He has worked in the automotive, fabrication, LED lighting and heavy truck industries. For more information, visit *www.secowarwick.com*.

McInnes

TO INSTALL NEW RING MILL

McInnes Rolled Rings has moved forward with the installation of a RAW 160/160 Radial-Axial ring rolling machine from SMS MEER GmbH Ring Rolling Division (Wagner), in conjunction with Girard Associates. The mill will be complemented with a new 3,500 ton press from Erie Press Systems located in Erie, Pennsylvania. The new mill and press are scheduled to be delivered early in the 4th quarter of 2011 with full production to begin in the 1st quarter of 2012. The progress of this installation can be viewed by clicking on the construction fence located in the top right-hand corner of the company's home page (*http://mcinnesrolledrings.com*). This commitment will allow McInnes Rolled Rings to produce rings up to 144" in diameter and up to 8,000 lbs. in carbon, alloy and stainless steel. The new mill will target and expand the company's existing base of business in the power transmission, energy, and the commercial/aircraft bearing markets. The new 160/160 will complement the existing RAW 63/63 and KFR-630 mills currently producing rings from 4" (100 mm) to 72" (1,825 mm). The new mill will be located at the company's headquarters in Erie, Pennsylvania.

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THE ANTIQUE GEAR SHOW

We're hoping many fans of Addendum are also fans of the PBS program *Antique Roadshow* or the History Channel's hit reality series *American Pickers.* One features antique appraisers traveling around the world to put a value on lost treasures, the other follows two self-proclaimed "pickers" that travel around the United States in search of rare oil cans, bicycles and gas station signs.

While the cable networks seem to be inundated with collectible television shows, the Addendum staff believes there's room for one more. *Antique Gear Show* would combine the best elements of both programs, putting a price tag on rare gear artifacts while roaming the globe in search of gear manufacturing's vibrant history.

Take for instance The Bale Grist Mill State Historic Park in Sacramento, California. This site boasts a gristmill and granary built with local materials, including Douglas firs and coast redwoods. The mill includes a 36 ft. overshot wheel with an unusual external gear system featuring wood on wood and metal on metal gears. A fascinating find, indeed, though historical preservationists will likely frown upon asking them what they want for it!

The Corliss Bevel Gear Cutting machine (pictured right) was used in cutting large bevel wheels. It was featured in the Philadelphia Centennial Exhibition in 1876 and was also illustrated in the July 29, 1876 issue of *Harper's Weekly* (a wonderful addition to any gear aficionado's collection if you happen to have the trunk space).

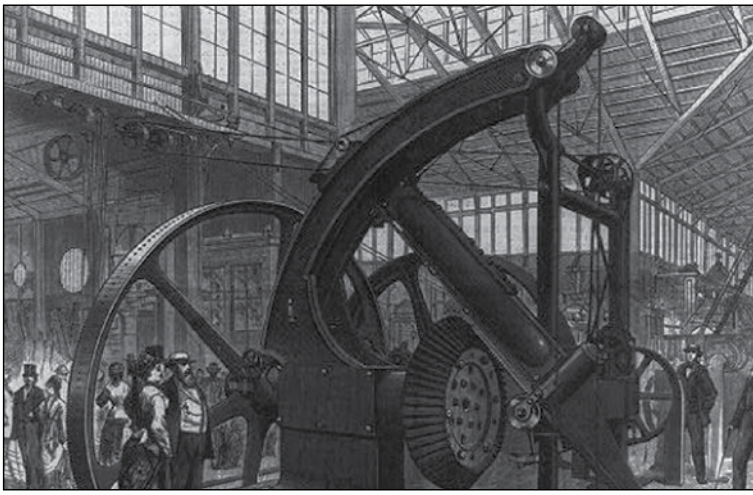
For the right price you can find a copy of *Gleason's Spiral Bevel Gears Teeth Proport Manual*—published in 1922—on Ebay. You can keep this in your machine shop library to remind your staff that books used to have covers, pages and illustrations, or you could hand it over to one of your young gear engineers and tell them to study for the test the next morning.

In order to validate our claims that a reality television series on gears could work—and could make us a lot of money in the process—we spoke with Bruce Rosenbaum, owner of Modvic, a home restoration firm in Massachusetts (*www.modvic.com*). Rosenbaum knows the reality television genre very well as his steampunk-inspired house has recently been featured on MTV's *Extreme Cribs* and the Discovery Channel show *Oddities*.

"It's been lots of excitement, but also a lot of work and waiting," Rosenbaum says. "Our recent MTV *Extreme Cribs* appearance was about 13 hours of filming with only about eight minutes of actual footage that made it on TV. The episode did not appear until about seven months after filming."

For the *Oddities* program, Rosenbaum filmed a perfect segment at the New York City antique shop that the director was extremely proud of. "I got a call about two weeks later saying the producers loved the filming, but I did not look 'steampunk' enough and they wanted me to reshoot the whole segment."

Rosenbaum is in the middle of pitching his own steampunk design reality show that combines elements of *American Pickers, American Restoration*, *Pawn Stars, This Old House* and *Oddities*. "Three high-profile L.A. reality television producers are pitching the show to cable network executives for the Fall/Winter 2011."



If you happen upon a Corliss Bevel Gear Cutting machine like the one seen here at the Philadelphia Centennial Exhibition in 1876, give the Addendum editors a call (courtesy of the Library of Congress).

Bruce Rosenbaum's steampunk-inspired home was recently featured on episodes of MTV's *Extreme Cribs* and the Discovery Channel's *Oddities*.

So would Rosenbaum watch a program that digs up old gear artifacts and gives cable television viewers a slice of gear manufacturing history?

"Steampunk is all about gears and physical mechanisms where you can see and understand how things work," Rosenbaum says. "A whole show on gears and how gears work in different applications from past, present to future is sure to be a winner!"

Have your agent call our agent.

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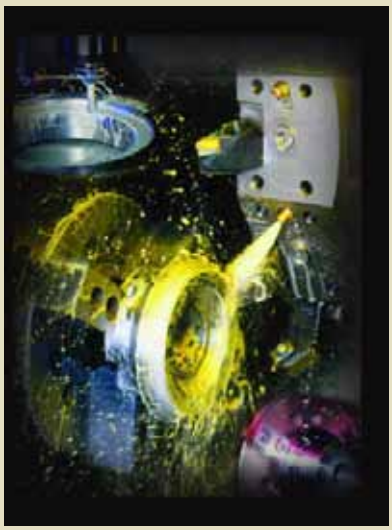

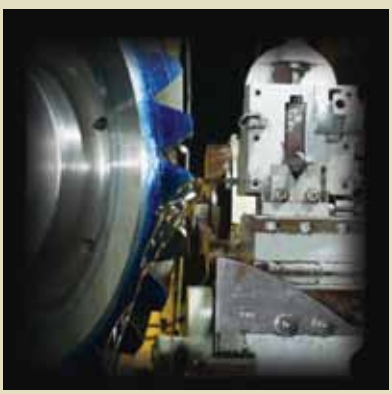

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