

# Practical Magic

## METROLOGY PRODUCTS KEEP PACE WITH MACHINE TECHNOLOGY

Matthew Jaster, Associate Editor

Gear metrology is a revolving door of software packages and system upgrades. It has to be in order to keep up with the productivity and development processes of the machines on the manufacturing floor. Temperature compensation, faster inspection times and improved software packages are just a few of the advancements currently in play as companies prepare for new opportunities in areas like alternative energy, automotive and aerospace/defense.

Wind turbines—if you haven't heard—are growing at an extraordinary rate, no doubt keeping gear manufacturers busy in the foreseeable future. In turn, the components for wind power gears are currently produced to high quality standards throughout the world and the metrology must follow suit. The necessity to keep up with technology demands has allowed metrology companies to develop the kind of products and software packages that will continue to add value to new and existing customers.

### **Metrology Advancements**

Klingelnberg has presented a number of metrology innovations in the



In addition to a full range of inspection equipment for cylindrical and bevel gears, Mahr Federal has updated its software packages (courtesy of Mahr).

past two years and will be introducing new items in the near future. The company has equipped its P 26 to P 100 gear measuring centers with temperature compensation that can now make measurements outside an air-conditioned measuring space.

"This means that these measuring machines can be installed on the production line, avoiding waiting times and long transportation distances for conducting necessary tests," says Günter Mikoleizig, manager design and

**continued**

development gear inspection machinery at Klingelnberg. "Many companies have already exploited this advantage in planning new gear production lines."

In addition, Klingelnberg has improved software for dimension, form and position measurements enabling engineers to test typical gear parts to almost 100 percent.

"The option for integrated roughness measurement represents a great advance in simplicity," Mikoleizig says, "with significantly improved conditions for reproducible results."

Mikoleizig adds that the company is offering additional advantages to metrology users.

"One substantial advantage of our products is that hardware and software components are developed by the same company, allowing us to realize customers' special requirements. In the bevel gear manufacturing sector,

Klingelnberg supplies well adapted systems for a closed-loop solution."

Gleason-M&M Precision Systems is also working in conjunction with The Gleason Works on advanced development in closing the loop on gear processing for bevel gear manufacturers.

"This is where the Gleason *G-AGE* product and the Gleason-M&M *GAMA* measuring software work together," says Doug Beerck, vice president and general manager at Gleason-M&M. "We can send data back directly to the machine tool for automatic corrections to improve the manufacturing process of the gear."

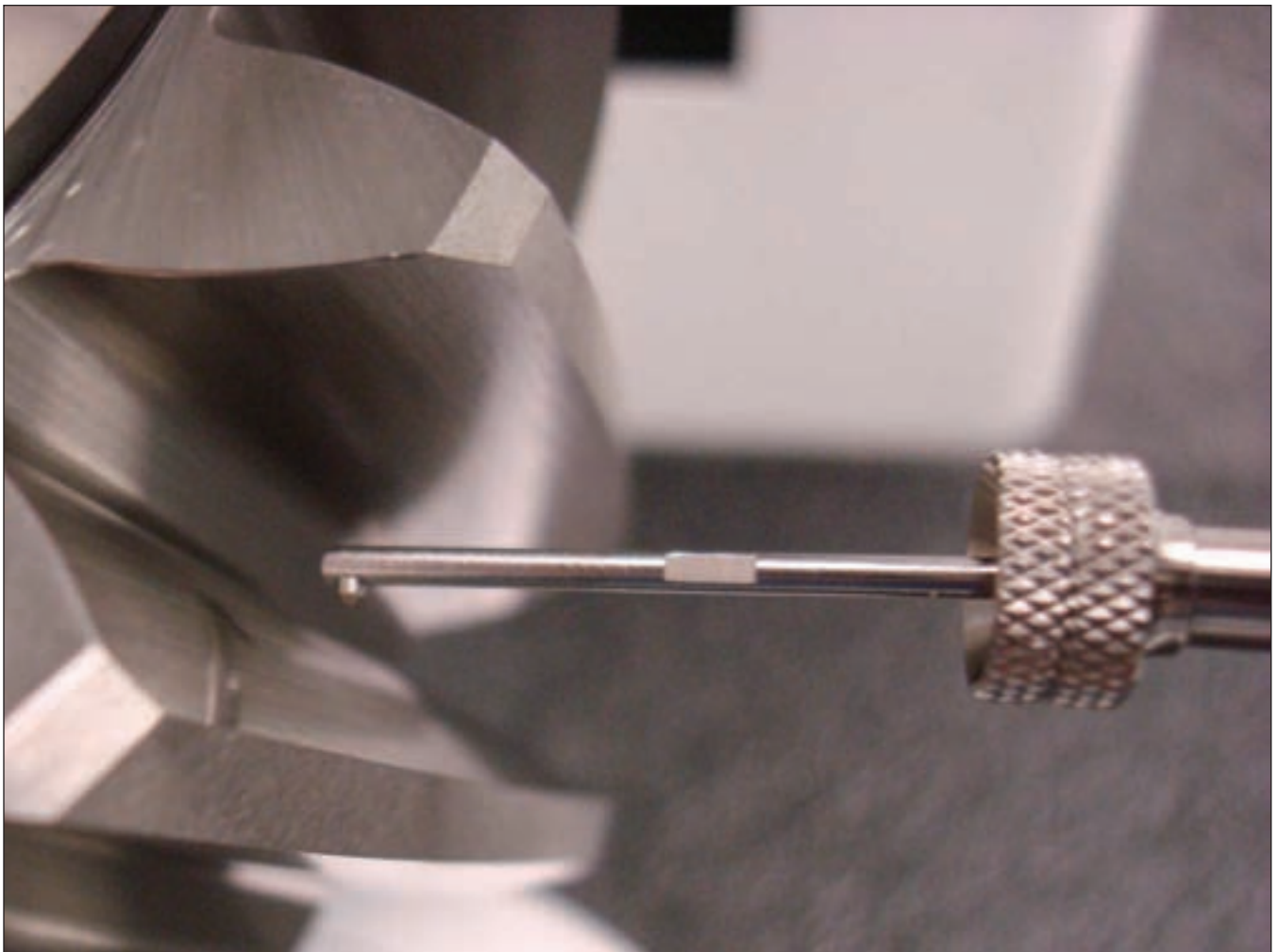
Gleason introduced its *GAMA* Windows-based software package more than two years ago, and it's now working with the *G-AGE* package and the *CAGE* package for integrating the design, manufacturing and metrology

processes into a single solution for the bevel gear manufacturer.

"*G-AGE* has historically worked with competitors' inspection equipment and we updated our software since our acquisition by Gleason to provide a seamless interface that allows both the inspection and bevel interface to work together," Beerck says. "As customer requirements change over time, both can be upgraded in a common path to add more features and capabilities and provide a complete solution from a single source."

Besides having a whole range of inspection equipment for cylindrical and bevel gears, Mahr Federal Inc. has completed its latest update on its software.

"We use *ESCO* software, which is globally used by many gear producers, to create a closed loop environment where our gear measuring machine



The Process Equipment Company recently introduced a surface finish package that measures surface roughness on both the helix and involute profile of a gear down to a 32 DP tooth size (courtesy of PECO).



Gleason-M&M is currently working on advanced development in closing the loop on gear processing for bevel gear manufacturers in conjunction with The Gleason Works (courtesy of Gleason).

provides the feedback for corrections to the production machine,” says Lutz Berndt, product manager gear systems at Mahr. “We have also upgraded our machine software to allow our gauge head to scan the root radius on gears.”

The Process Equipment Company (PECo) has introduced a surface finish package that measures surface roughness on both the helix and involute profile of a gear down to a 32 DP tooth size.

“Having the ability to measure surface roughness utilizing a skidless probe tip and our standard 3-D probe saves a tremendous amount of inspection time since it can be accomplished in one setup,” says Brian Slone, business unit manager, metrology systems division.

The company is also focusing on fine pitch gear measurement and can currently measure index, helix, profile and tooth thickness on a gear with a 150 diametral pitch.

“This is the finest pitch that has been measured with any analytical gear measurement machine that utilizes 3-D probing technology,” Slone says. “With the development of this fine pitch capability, manufacturers and customers no longer have to guess at the quality of gears that are finer than 64 DP. They are now able to measure all the way down to 150 DP.”

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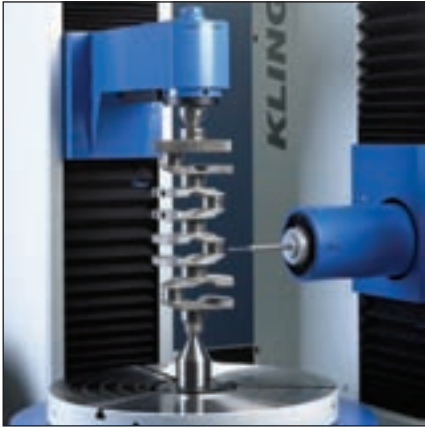
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Crankshaft inspection from Klingelberg allows accurate dimension, form and position measurements (courtesy of Klingelberg).

### Instant Data Equals Instant Results

Metrology companies are also focusing more on markets outside of North America and Western Europe, seeking opportunities in areas like China and India. The ability to manage a global presence is vital in every aspect of gear manufacturing, but when it comes to metrology solutions it's the driving force behind repeat business. Beerck says a key competitive advantage lies in Gleason's global support structure, especially in China.

"It's hard to imagine being a serious player in the gear metrology market without a global reach. The customers expect to be able to replicate their inspection processes no matter where

they are located in the world. They have an expectation that their suppliers can support that replication," Beerck says.

The increased global support requirements include managing language, culture and time change factors. Technology allows Gleason to monitor inspection results in the field, look at global machines online and troubleshoot wherever need be.

"The ability to monitor machine performance and troubleshoot online from our Dayton, Ohio facility is invaluable," Beerck says.

According to Beerck, the required accuracies that come off the gear grinding equipment have improved significantly over time. "Some of this involves understanding the manufacturing process the customer is using, including workholding, environmental conditions and the tooling being used."

Mikoleizig at Klingelberg says the global gear industry prefers established producers of measuring equipment so that it can confront critical discussions of its product quality.

"A new supplier in the gear metrology sector is bound to meet difficulties in gaining acceptance," Mikoleizig says.

Berndt at Mahr Federal adds, "Mahr has a lot of customers where the central

purchasing department is making the sales decisions. These companies have production facilities and produce parts all over the world. Looking at all the metrology companies and the problems they face, for me personally, I would rather deal with a bigger company even if it meant I couldn't expect the flexibility of a smaller supplier."

Slone at Process Equipment describes the necessity of providing the same 24-hour response time no matter where the company is doing business.

"We've chosen our sales and service sites across the globe with companies that have been servicing their countries for years," Slone says. "They know the customer base better than anyone else and can successfully support their customer's manufacturing requirements at a local level."

Process Equipment has partnered with tooling companies such as Star Cutter in the United States and SMF/Klink in Germany to develop extensive in-depth hob and broach inspection packages.

"Both of these companies are leaders in their fields and have vast knowledge of what needs to be measured to produce the highest quality gear tools," Slone says. "Their expertise helped us perfect our cutting tool metrology packages so manufacturers can benefit from the ease of use and the information needed to solve processing issues in their plants."

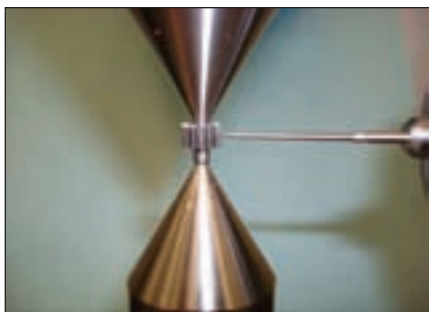
The interface between each program, from gear to hob to shaver is similar in nature, according to Slone. "This dramatically reduces operator training time and allows new users to inspect gears quickly and with confidence."

Gleason-M&M also has the ability to work with a variety of automation suppliers when needed.

"If a customer has a history with a specific automation supplier, we make sure our products can be integrated into the automation process," Beerck says. "The more players in the gear manufacturing industry, the more complexity, that's the biggest challenge—understand your customer and identify your customer's various process control needs."



Klingelberg provides several software options for roughness measurements (courtesy of Klingelberg).



Fine pitch gear measurement is another area the Process Equipment Company is focusing on in the metrology industry (courtesy of PECo).

### Separating from the Competition

This leads us to the most intriguing aspect of the metrology industry to date—a push for much more customer service.

“Our service and support team go beyond customer satisfaction,” Slone says. “We challenge Process Equipment employees to take this idea a step further with this question: ‘Did you delight the customer?’

“At times it can be difficult to differentiate one metrology manufacturer from another since machine accuracy and repeatability is based on an industry standard. Our aim is to provide a gear metrology solution, not just sell an inspection machine. This is what separates us from the rest of the industry,” Slone says.

Klingelnberg has seen positive responses from its customers concerning all its innovative developments, but the company always makes sure to stay in touch with its customer base for future software or hardware developments.

“In these cases, we try to find fresh solutions together with our customers,” Mikoleizig says.

As a part of Sigma Pool, Klingelnberg also offers international gear seminars in order to work together with its customers on meeting new market and technology challenges. Many of these metrology developments were recently addressed at the Sigma Pool U.S. Gear Seminar held last month in Ann Arbor, Michigan. (*Ed’s Note: Please refer to our events coverage on page 64 for additional information.*)

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# AN EXPANDING MARKET FOR CMM GEAR INSPECTION

More than 200 Wenzel Gear-Tec machines are operating in gear manufacturing plants all over the world. The company has nine new bridge type measuring machine models for a variety of internal and external gear inspection applications.

"The technology for inspecting gears and gear related products is evolving as the application of CMMs with more sophisticated probing systems and software have made it a viable and less costly alternative to dedicated 4-axis gear inspection machines," says Hans Helmet Rauth, managing director at Wenzel.

Rauth anticipates that the gear inspection market will continue to grow with the expansion of CMMs into the field. "Using CMMs to inspect gears is not a compromise anymore. Their accuracy does not degrade from the smallest machine to the largest."

For many years, CMMs were not looked at favorably because it was perceived that the measurement accuracies were not good enough for gears," Rauth says. "That's all changed today with the advent of laser scanning probes with sub micron accuracy and new sophisticated software. We've been able to take our high degree of inspection know-how and experience and transfer the technology to the CMM."

Wenzel Gear-Tec recently installed a CMM at Vancouver Gear in British Columbia to inspect 9-ft-diameter gears for wind turbine gearboxes. The machine is a traveling bridge type design with a 19.68 x 9.84 x 6.56-ft measuring range. It is designed to use two three-meter measuring zones and has a 3.28-ft hydrostatic rotary table that can accommodate gears up to 3,000 lbs.

Another large machine was also recently installed at one of Liebherr's large construction crane manufacturing facilities to inspect large ring gears and bearings. Wenzel designed and built a special CMM



In the past, CMMs have been perceived as not being accurate enough for gears, but advances in software and laser scanning probes has changed this (courtesy of Wenzel).



Wenzel's dual arm gear measuring machine was designed to measure big gears (courtesy of Wenzel).

machine that combined standard components and a proven dual-arm measuring technology with the precision air bearing mechanics of the Wenzel WGT series of gear checkers and Renishaw scanning probes. The inspection machine is capable of inspecting bearings and ring gears up to 19.68-ft diameter.

"In applying the use of CMMs to inspect gears we've discovered that there still remains a stigma among some gear engineers that CMMs are not accurate enough or the data they provide is not reliable. At Wenzel, our gear CMMs use exactly the same controller and software as our traditional WGT gear inspection machines. From a marketing standpoint, we refer to these CMMs as gear measuring machines (GMMs). As gear applications increase, the need for this special designation will most likely disappear," Rauth says.

Gear inspection in markets such as wind, aerospace and gear shops, has always been expensive, according to Rauth. "We've identified close to 6,000 gear shops in North America that are targets for a shop floor GMM gear checker with an embedded rotary table that could sell approximately for \$100,000.

"But in the next five years, we will probably see more integration of gear measurement into the gear grinding machine itself, through the integration of scanning probes and new software. It makes sense to leave the gear right where it is to check it, and through adaptive control make the necessary changes on the machine to correct any detected machining errors. Of course, the GMM will still be required for final audit."

—Alan Hall,  
*industrialpublicity.com*

company remains a significant player in every facet of the gear industry, including metrology.

"What we're trying to do is provide a complete solution for our customers. Whether it's Gleason's specialized gear services, dedicated gear inspection laboratory or our aftermarket support, our ability to provide a complete solution really stands out in the market," Beerck says.

Mahr Federal decided to return to the gear market based on its reputation and established credibility in the industry.

"Our reputation with our customers is what brought us back to the gear market," Mahr's Berndt says. "We have invested a lot of energy and resources to improve our products and complete the software our customers continue to ask about. I believe we are well set for the challenges the gear industry is facing today."

These challenges include a global economic slowdown, a cautious approach to future investments and the need to keep up with machine technology in the future. Companies are handling these challenges in a variety of ways.

"We're using the recent slowdown time in manufacturing to develop new products and software packages that will continue to give added value to our customers," Slone says. "For some of our prospects, financing has been an issue and Process Equipment has been working with Key Bank to offer operating lease options to gear companies faced with capital or financial constraints."

For Mahr Federal, it's about getting back into a game that is full of competition. "A lot of companies standardized on a specific gear test manufacturer and are reluctant to consider a new supplier. We hope our calibration services, seminars and metrology training programs will identify the best solutions for our customers."


It's all about big gears at Klingelberg.

"Although we already supply measuring machines for large gears, we have many requests for equipment

that can be used to test even larger components," Mikoleizigs says. "The task of finding an unexceptionable concept for workpieces over 4 m in diameter that can also take cost effectiveness into account is certainly a great challenge and deserves careful consideration."

Beerck at Gleason-M&M says that the company now has more than 1,000 machines in the field worldwide. "This provides us the opportunity to support our legacy products by offering customers the ability to upgrade not only the GAMA software, but new probe and control technologies. Customers with vintage machines can extend the life of these machines with products Gleason is introducing to the market this year."

Beerck believes energy is going to be an important factor in gear metrology in the future, particularly wind turbine requirements and automotive design, thanks to new fuel efficiency regulations.

"I think there will be ongoing design work in gearing that will impact manufacturing processes and methods," Beerck says. "There will be no shortage of opportunities and we look forward to the gear manufacturing and metrology challenges that those opportunities will bring." 

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