Tomorrow's Gear Inspection Systems: Arriving Just in Time

The gear inspection systems of the future will be very different from those found in many of today's quality labs. Part setup and programming, regardless of part type or complexity, will be largely automated and require minimal operator experience. The operating system will be native Windows-based so that gear inspection data in dozens of languages can flow seamlessly into the user's network, and every major industrial standard—from AGMA to GOST—can be easily supported. Operators will work in a much more ergonomic environment than they're used to, in close proximity to the work area or using a remote hand-held pendant that puts Internet connectivity right at their fingertips, and supports voice notes, work messages, even video telephony for record-keeping and remote diagnostics. The system itself will be much more robust, and built for the rigors and temperature swings of the shop floor. Most importantly, these inspection systems will inspect *all* types of gears, gear cutting tools, and even prismatic parts at speeds anywhere from 20 to 45 percent faster than existing systems.

Those are just some of the reasons forward-thinking gear producers like Eaton have begun using Gleason's new GMS system.

With installation of the next-generation Gleason 350GMS Analytical Gear Inspection System, Eaton Kings Mountain's gear lab is able to meet its high-volume gear and gear cutting tool inspection requirements: 1,500 parts per week, three shifts a day.

Wanted: An Inspection 'Workhorse' at Eaton.

For almost a century, Eaton has been supplying the trucking industry with products designed to improve vehicle performance and power, and increase profitability. Today, Eaton transmissions are used by many of the world's leading OEM vehicle manufacturers. At Eaton's Kings Mountain, North Carolina facility, meeting the company's growing demand for high-quality transmission gears that run smoother, quieter and more reliably has placed a heavy load squarely on the shoulders of the gear inspection lab, according to Eaton gear engineer Angela Hastings.

"We had been relying on two older M&M Precision Systems (now Gleason Metrology Systems) machines and two older competitor machines to inspect an average of 1,500 parts per week," Hastings says. "The lab inspects parts three shifts per day and most weekends, performing inspections on internal teeth and external teeth at various states of manufacturing; any delays in the lab would cause unacceptable production losses. We also routinely inspect shave cutters and periodically, shaper cutters—the accuracy of these inspections helps keep our production running smoothly."

The search for a new inspection solution to augment these older machines began in 2011 when Hastings and other Eaton engineers and a gear lab technician visited several suppliers of gear inspection equipment, and evaluated their products. "Along with the normal characteristics of cost, delivery and cycle time, we also considered the operating system, ease of programming (both inspection and alignment), training requirements, technical assistance and repair parts supply," recalls Hastings. "The Gleason GMS system emerged as the leader."

GMS Improves on Gleason's GMM Series

At IMTS 2010, Gleason Metrology Systems introduced the first of its new line of GMS model inspection machines. Today the line is comprised of seven different models, with capacities from 0–3,000 mm gear diameter. According to Gleason Metrology Systems' sales manager, Dennis Traynor, the GMS series has evolved from the company's GMM series and incorporates a host of design improvements and enhancements that make the GMS machines faster, easier to operate and more reliable.

"The GMS incorporates everything that was unique to the GMM series, like *GAMA*, Gleason's native Windows-based operating system, but takes it to a new level, with *GAMA 2.0*," says Traynor.

Like the original *GAMA*, *GAMA 2.0* easily communicates inspection results across a customer's plant-wide network, a process much more difficult for competitors who don't operate with Windows, Traynor says. But *GAMA*

2.0 also helps reduce cycle times. GMS series machines offer a 20–45 percent reduction in cycle times as compared to the GMM systems, Traynor says, and they offer a 10–25 percent reduction in cycle times versus competitive systems. These improvements result from *GAMA 2.0*'s faster calculation speeds, coupled with axis movement optimizations that have been made in the GMS.

Traynor also points out that the *GAMA 2.0* applications suite makes programming a remarkably simple task for almost any operator, regardless of part type or inspection requirement.

"When you open the *GAMA* suite, whether you go to cylindrical gear, spiral bevel gear, hob, shaper cutter, shaver cutter—any package for gear or gear tool inspection—the graphical user interface (GUI) is virtually identical, so the operator is as comfortable programming a hob as he would be a cylindrical gear," says Traynor. "You don't have to remember a special routine or rely solely on an operator's experience. Most importantly, we're able to support all major industrial standards—AGMA, DIN, JIS, ISO, GOST—and some 20 different languages, thus accommodating the needs of almost any user globally. The user can additionally choose a variety of chart output styles and configurations for analysis, and save documentation in many formats, including .jpg, .bmp, .gif or PDF."

Hastings agrees. "The ease of programming for part inspections and alignment functions is simple enough for even our new gear lab technicians to learn quickly," she says. "The ability to quickly change the part programs and parameters makes this our favorite machine to run prototypes or perform special inspections to troubleshoot production issues."

Support and Control Right at Your Fingertips

If and when one of Eaton's gear lab technicians need support, whether creating a part program, or managing an inspection, or troubleshooting a problem, there are only two things a Gleason engineer sitting hundreds of miles away can't help with or solve in real time: (1) physically setting up the part, and (2) pushing the start button. This might be one of the GMS system's most important new capabilities, says Traynor. "Through a simple Ethernet connection or a secure 'Team Viewer' web browser, we can view the screen, share part prints, even create a part program. We've also introduced a video telephony and voice mail messaging capability through a new remote pendant control, enabling the user to capture video, describe a particular programming issue and transmit it over the web to our support team."

The remote pendant is also particularly useful during setup, because it enables the operator to answer program prompts from anywhere in the work area and is equipped with twin thumb-controlled joysticks for controlling the speed and positioning of each individual axis.

The main operator work station is situated in close proximity to the work area. A control pendant with twin variable speed joysticks mounted close to the work zone also gives the operator excellent manual control, with axes-selectable operation, feed rate override selection, drive ON, reference point and E-STOP.

Better Sensors, Surface Roughness and Barkhausen.

GMS productivity and versatility are greatly enhanced through use of the Renishaw SP80H 3-D scanning probe, available in various probe configurations and stylus sizes, and with an automatic probe change system for every model. The Renishaw probe makes it possible for the GMS to deliver a faster, more accurate measurement capability for even the most complex gear tooth profiles, including crowning, hollow and taper. In addition, the SP80H is kinematically coupled to the drive system, thus helping minimize the potential for a costly collision and damage to the probe, part or machine.

GMS also has the capability to perform surface roughness testing for cylindrical gears (spiral bevel gear surface roughness testing is in development), with special probes pre-configured for the automatic probe changer.

Barkhausen inspection—a 'non-destructive' measurement of surface hardness and residual and compressive stresses—is also a GMS capability.

Built for Reliability

The GMS systems easily meet VDI/VDE Class 1 specifications, with 2 micron system accuracy. Exceptional accuracy, repeatability and reliability can be attributed to a number of unique design features. For example, all axes are made from highly stable, robust Meehanite cast iron, as compared to more common cast irons or weldment designs. The GMS systems also use linear drives for improved speed and positioning accuracy on all axes. All models use a solid-granite base as well, providing greater stability as compared to designs using cast-iron weldments or partial-granite bases.

Even the controls cabinet on the GMS systems has been re-designed and relocated for better access, safety and reliability, with a simpler design, fewer failure points and reduced noise.

"We knew from our experience with our M&M Precision Systems machines that the service and parts side of the business is excellent," concludes Eaton's Hastings. "We know from these calibrations that the machines are built to keep running accurately through many inspections without problems or the need for adjustments. They are pure workhorses."

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