

The Measure of Success

Software Advancements in Gear Metrology/Inspection

Matthew Jaster, Senior Editor

Thoughts on data-driven manufacturing? What does it mean? What are the benefits? How will these solutions change the gear shop floor in the future? These are the questions many customers in our industry are asking right now. How can my organization become more productive via connectivity, flexible databases, or factory status reporting systems?

These are questions Klingelberg has been answering for more than 10 years, not only with the machine tools they produce, but all the products and technologies available to gear manufacturers to meet changing production demands. Metrology software is one area, in particular, that continues to evolve—the Closed Loop for cylindrical gears is one example of this.

“The focus is on the digital transfer of

measuring results to the manufacturing machine to enable automatic corrections,” said Dr. Christof Gorgels, director precision metrology at Klingelberg. “This procedure is well known and state of the art for bevel gears. For cylindrical gears we have chosen the open GDE standard to ensure compatibility of our measuring machines with machine tools from different sources.”

High-Precision Gear Measurement

The basis for Klingelberg metrology has been high precision gear measurement for decades including parallel measurement software for different types of rotational symmetric parts, such as shafts and rings.

“In recent years, the importance of those measurements has increased. Today,

we offer our customers Done-in-One solutions for different types of parts such as geared shafts, crank shafts and even bearing rings,” said Gorgels. “The combination of coordinate- and form measurement plus surface roughness enables the Done-in-One principle—meaning all those measurements can be performed in one automated cycle. Thus, measuring time can be reduced up to 40 percent.”

According to Alexander Troska, head of software development, measuring devices at Klingelberg, the strength of Klingelberg metrology is the high number of different software options for measurement and evaluation. Klingelberg’s strategy is the close collaboration with customers to find tailored solutions to fit their needs best.

“There are two major fields for customization in our software. The in- and

Done-in-One metrology solutions allows Klingelberg to measure parts in one automated cycle.



output interfaces are highly individual from customer to customer,” Troska said. “The other big field is the evaluation. If you are looking into gears for example, it starts with different standards such as AGMA, ISO, JIS etc. But even looking into details many individual settings are needed like K-Charts. Another example can be the roundness measurement on bearing seats where different settings for filtering or FFT analysis are needed. Most of those settings are set by the operator.”

Connectivity and Data-Driven Manufacturing

Industry 4.0 is all about data and communication. In fact, a measuring machine produces data only. Handling this data together with different customer’s systems is part of Klingelnberg’s daily business. Even communication with machine tools and servers providing nominal data has been part of Klingelnberg’s strategy for more than 20 years. A good example here is the Closed Loop for Bevel Gears.



By establishing a fast, continuous scanning cycle, measuring times could be reduced by nearly 50% without compromising on accuracy.

“The demand for data communication among our customers is highly increasing. Measuring programs are selected and started by scanning a DMC-Code and data needs to be collected from the production system. This is only one example where data connection makes

the machine handling easier,” added Jan Häger, head of new software development at Klingelnberg.

In E-mobility, for example, Häger said the requirements for gear design are increasing. This is related to load carrying capacity as well as noise behavior.

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This results in a need for tighter tolerances and better surface finish.

“For Klingelberg, this means putting a focus on measuring times since measuring frequency will increase as well as improving surface finish testing to cope with better surfaces. Also, the Gear Deviation Analysis software looking into gear noise will see higher demands.” Gorgels said.


Klingelberg’s latest development is the fully integrated optical system as part of its hybrid metrology. This enables significantly faster gear measurement while maintaining the high accuracy standard

Klingelberg is known for.

Last year Klingelberg introduced a new measuring software for cycloidal gears. The main challenge here is that all teeth have to be measured within a reasonable timing. By establishing a fast, continuous scanning cycle, measuring times could be reduced by nearly 50% without compromising on accuracy, Gorgels said.

“In the Industry 4.0 context, we have introduced the OPC-UA standard now also for measuring machines. It has been part of our gear machinery for some time but in the metrology area this is

new in the industry, but the demand is rising,” Häger said.

For bearing ring measurement, Klingelberg has introduced the G-Series. “Especially for thin rings a smart clamping system is available to avoid radial forces during measurement. Those radial forces cause deformations which influence the measuring results. Thus, we can ensure that deviations measured are really in the part and not caused by the clamping system,” Gorgels said. 

www.klingelberg.com

Back to Basics: Closing the Loop

Gear cutting and gear grinding is faster and more efficient today thanks to the integration of gear design and evaluation software. The Closed Loop is the result of this gear manufacturing system which enables manufacturers to reduce gear development time.


The Closed Loop uses a modern software architecture to enable the exchange of data between design, production, quality assurance and statistical evaluation, and also to actively bring information to the consumer or, in another development stage, to initiate process steps automatically.

To meet the changing energy requirements in the automotive industry, many engines will be required to meet—and in some cases—exceed certain performance standards. Reproducible quality in series production with the fastest possible manufacturing times is the key requirement in this industry.

Spiral bevel gears are used to transmit torque “from the transmission to the road” in the all-wheel and rear-wheel drive systems in cars. Due to increasing performance requirements, some of the drives have to be able to transmit output of more than 300 kW. The bevel gears must also be efficient and

low-maintenance, and above all quiet.

The first step in modernizing a bevel gear production system is to implement a digital data transfer between the measuring center and the gear grinding machines. This means that information must be transferred digitally to the operator software of the gear grinding machine.

Now and in the future, gear manufacturers will be able to examine failure analysis if problems occur in the field. The data will provide a ‘digital roadmap’ for quality improvements and process optimization. Software products will be integrated into the closed loop system. As functions are added, this gear manufacturing platform will evolve as the technology does. 

For additional material on the Closed Loop System visit:

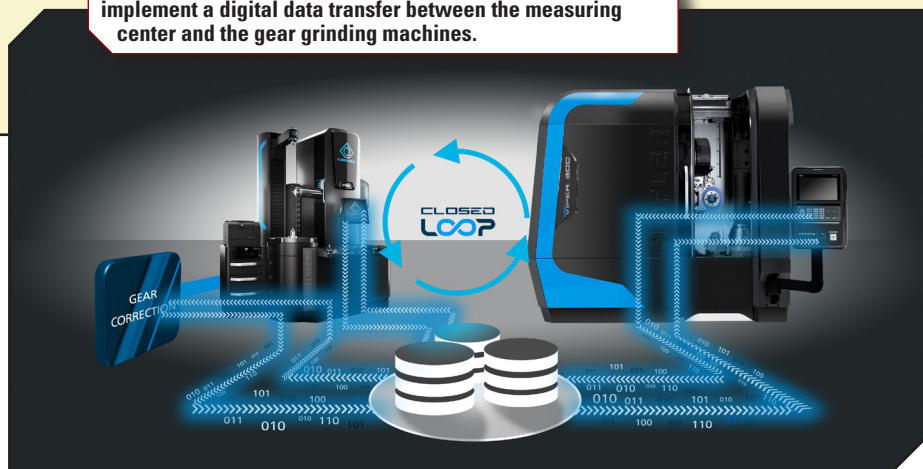
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The first step in modernizing a production system is to implement a digital data transfer between the measuring center and the gear grinding machines.



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