Inside Look at the Hard Finishing Cell

Gleason Combines Threaded Wheel Grinding with GRSL Gear Inspection

Dr. Antoine Türich, Gleason Corporation

At the 2019 MPT show in Detroit, Michigan, Gleason unveiled for the first time its new Hard Finishing Cell (HFC) with integrated, 100% inspection of all gears in process. The new manufacturing system was among the most noteworthy of the new technologies introduced and heralded the beginning of a new era in the manufacture and inspection of high-quality gears. For the first time, the HFC combines the latest Threaded Wheel Grinding with GRSL gear inspection with laser scanning in a single system to finally solve the problem of random gear inspection in conventional gear production.

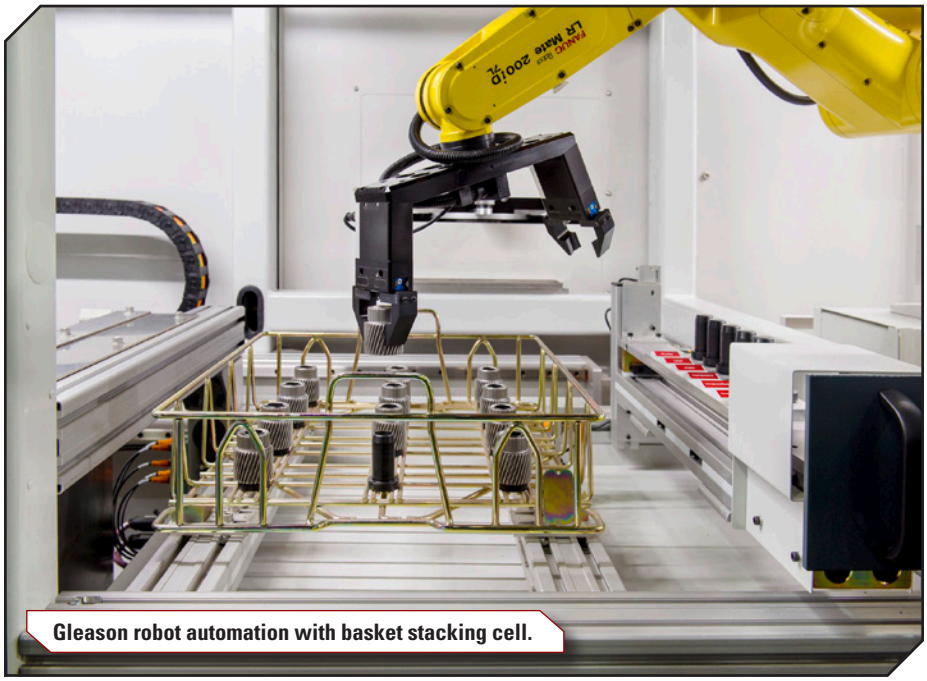
Today: 95% of Gears Go Untested

In conventional gear manufacturing, quality control is carried out only randomly. This is due, among other things, to the significantly longer measuring times required in comparison to the actual production time and the limited measuring capacity available. In hard fine machining, for example, it is not unusual in continuous generating grinding to measure only one or two components per dressing cycle. Depending on the dressing cycle, this corresponds to only about 5% of the components produced. In order to guarantee an almost 100% reliability, statistics are instead used to validate most of the gears produced. Typical measuring characteristics can be represented and statistically evaluated on a Gaussian bell curve. By deliberately narrowing down the tolerances on the measured components, it is possible to guarantee compliance with the required drawing tolerances with a sufficiently high probability (typically > 99.99%). This method is commonly used for machine and process capability studies and is recognized worldwide. The machine or process capability values cmk & cpk frequently taken as a basis are usually above 1.67. Statistically, the reject rate is only 0.57 components per 1 million manufactured components, but this means that only about 50% of the intended drawing tolerances are available as manufacturing tolerances. In today's world, that's not good enough. The constantly increasing power density of gears and the growing importance of noise behavior are leading to increasingly tight tolerances. Clearly, the heavy reliance on statistics poses a significant problem for a growing number of gear manufacturers.

But up until now, much of the focus on production floor inspection has been concentrated on achieving objectives such as establishing a 'closed loop'

Hard Finishing Cell (HFC) consisting of a Gleason Genesis 260GX, Gleason 70ARC robot automation and a Gleason GRSL Gear Rolling System with Laser Scanning.

connection of inspection to production machine, and putting the measuring machine on the shop floor in close proximity to the production machine, e.g. by using shop hardened measuring machines. Gleason's new GRSL roller testing device with integrated optical measuring technology, however, takes a completely different approach: reducing measuring time so that it can realistically be done within the actual production time. This provides the possibility of 100% inspection of all manufactured components. There is no need for additional narrowing of tolerances and the 100% inspection of all manufactured components can be accomplished in-process.



Gleason robot automation with basket stacking cell.

Many Technologies, One Closed-Loop System

The HFC thus offers significant added value. It's a fully automated system with robot loading that integrates modules for auxiliary processes in order to meet specific customer requirements easily and flexibly. The concept presented for the first-time last year demonstrated a complete process sequence including gear grinding, washing, laser marking, measuring and part handling in a stackable basket system. The HFC can nevertheless be configured for any desired process, with a single system replacing many machines.

HFC's 100% inspection capability results from the new GRSL roller inspection unit which is fully integrated into the system. The component to be tested is loaded by the robot onto the two-flank rolling test device. During the gear inspection, a laser scanner is used to measure all gear characteristics. Thus, all relevant information for profile, pitch, and runout and, if desired, lead measurement is available. This is done for each tooth and not, as is usually the case, only on four teeth distributed over the circumference.

The deviations determined in the

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process — provided they are within the tolerance — are fed back directly into the production machine by means of a closed correction loop. Both fully automatic correction and real-time adjustment of the corresponding parameters can be achieved. Compare that to the conventional measurement process in the Quality Lab, where 45 to 60 minutes may well pass between removing the component from the machine and providing the measurement result. With HFC's in-process inspection and Closed Loop, the desired correction ensuring optimum quality during the ongoing production process is much faster.

Components whose characteristics lie outside the tolerances are automatically rejected. It is also possible to create extensive trend analyses of individual features and perform further gear noise analysis.

4.0 Inside

In addition to the many analysis options that the system provides for optimizing workpiece quality, the Hard Finishing Cell is also equipped with the latest 4.0 functions. The Gleason Fingerprint Machine Analysis for predictive maintenance allows the user to keep planned machine availability at peak levels. Gleason's "gTools" tool management system reduces operator errors and tool wear and optimizes the use of tools. Of course, the HFC is equipped with the latest Gleason accessories, including the Quik-Flex Plus modular fixture, which allows changeovers in minutes, and Gleason dressing tools.

In Summary

HFC with its many new technology features shows what a global team with a common vision can achieve. HFC is indeed a highly desirable solution for many industries and applications where consistent high quality is important, such as the production of high precision eDrive gears with minimal noise characteristics. A single system for the fast and high-quality production with 100% gear inspection, long the dream of many customers, is now a reality.

GRSL — double flank roll testing with integrated laser scanner, fully integrated for in-process, high volume 100% inspection of gears in a Closed Loop. Also available as a stand-alone machine.

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