2024/2025

solutions

gear manufacturing technology magazine

The Future: Laser Inspection and Gear Noise Analysis

The Drive to Optimize NVH

KISSsoft, GEMS and RecurDyn

Success Stories

Chongqing Winstar and Maschinenfabrik Reinhausen

Total Gear Solutions Gleason

Welcome to Gleason

John J. Perrotti

Chairman and
Chief Executive Officer

Dear Valued Customer,

This new edition of Gleason's Solutions Magazine publishes in times of rapid transformation for many power transmission applications. Our strategy and mission focus on an integrated platform of "Design, Manufacture, Measure" to bring maximum value to customers.

Our design solutions include KISSsoft and GEMS bevel gear design which provide not only advanced design and analysis tools but integrate valuable information regarding manufacturing methods and settings. We follow with the broadest array of manufacturing solutions in our industry covering all gear types, of all sizes and all primary gear-making processes. This manufacturing portfolio includes a wide range of machines, cutting tools, workholding, and custom automation in addition to the full complement of global service and training support. Finally, Gleason offers tactile analytical gear measurement, but has also established a leadership position with optical measurement and roll testing solutions which are fast, accurate and repeatable. Measurement tools are complemented with sophisticated analysis packages which can identify and help troubleshoot key areas of interest for gear engineers including NVH.

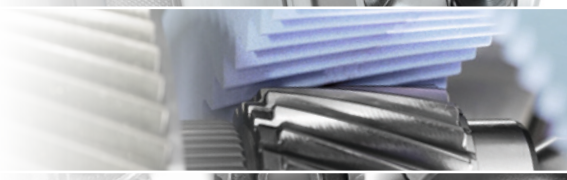
One of the key advantages of having such an integrated platform is the data which can be obtained and shared across the entire value chain. We have invested in the creation of a robust system to collect this data and seamlessly share it between the elements of our design, manufacture and measurement infrastructure. The connectivity between all elements in the value chain including to other business systems like ERP, MES and Quality system is what we refer to as the Gleason Ecosystem.

This is how we define our future, not just singular products but a highly connected network of data continuously feeding a series of Apps to provide real-time optimization to the quality, productivity and cost of gear and driveline products. While advanced technology such as described above will define customers' success in the future, it is matched by an older formula: consistently providing a fantastic customer experience. I can assure you that remains the centerpiece of our strategy and is what drives our team of more than 2300 dedicated employees every day.

Next year, Gleason will celebrate its 160th anniversary. We are proud of our past but more keenly focused on the future. It has been a fruitful journey, and we look forward to working with our customers to making the next years even more rewarding.

Enjoy this new edition of Solutions Magazine and thank you for your loyalty to our company.

Yours sincerely,



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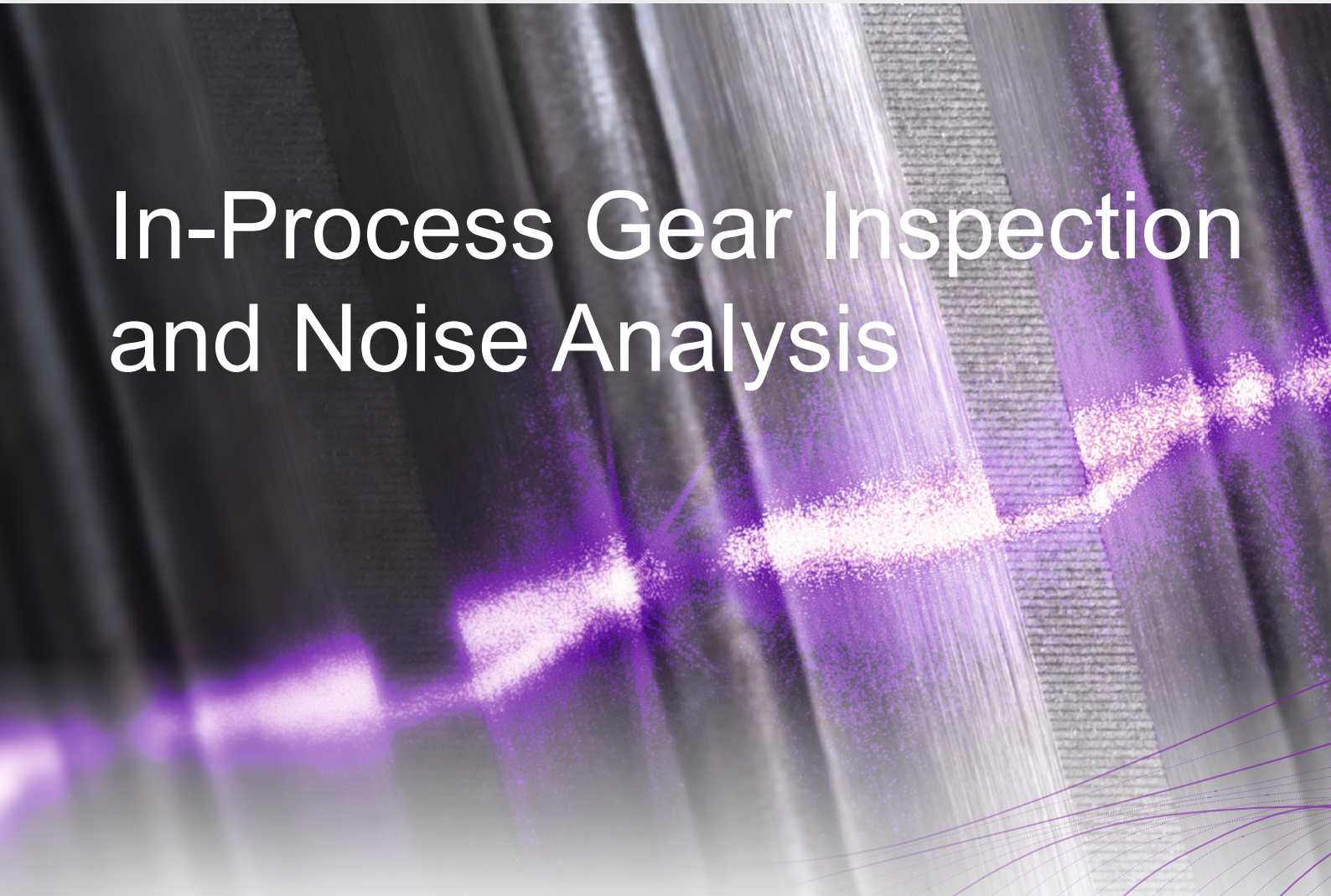


In-Process Gear Inspection and Noise Analysis

In-process gear inspection and gear noise analysis play a critical role in the manufacturing of gears for e-drive systems, helping to ensure high efficiency under low noise emissions. In addition, in-process inspection provides high-quality output by detecting defects before final assembly, or even before production.

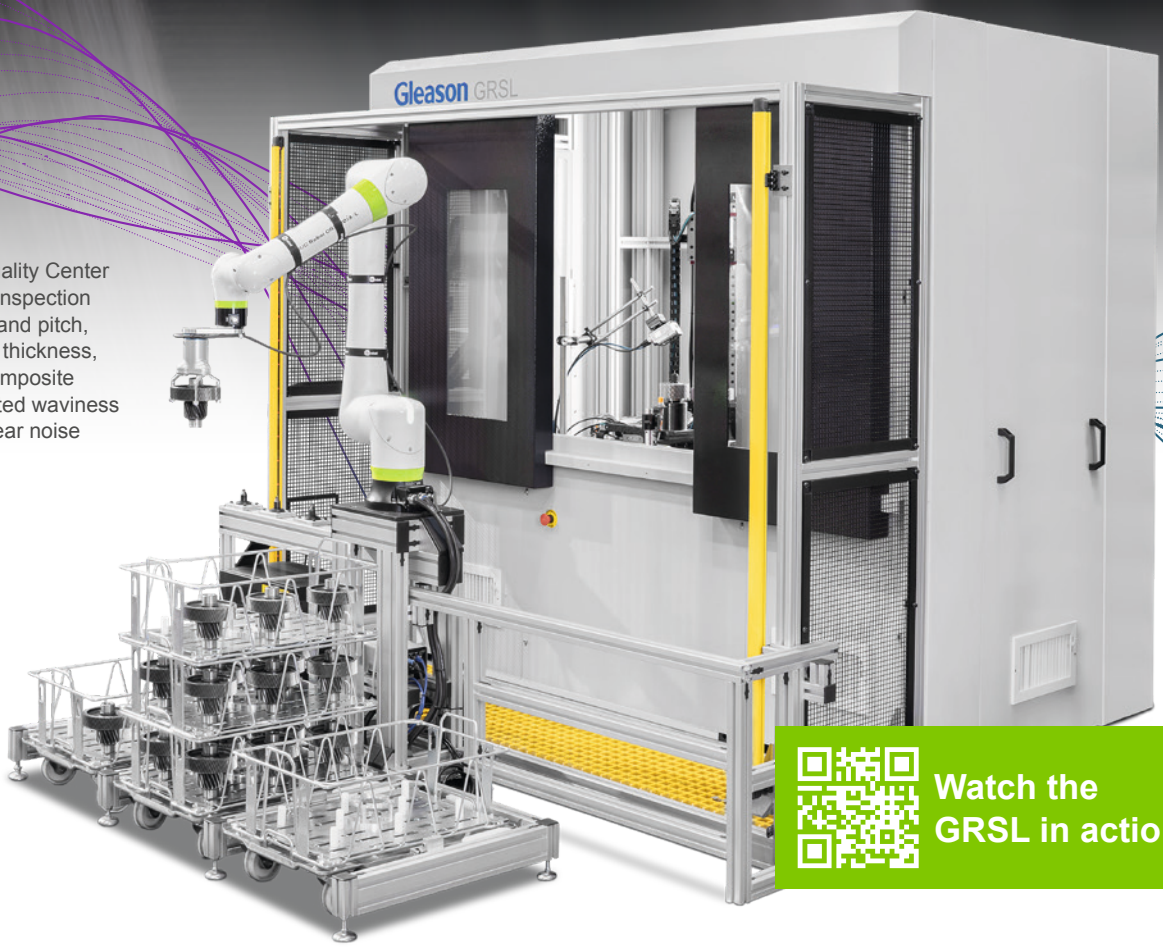
In conventional gear manufacturing, quality control is carried out for a number of pieces per batch. The majority of parts enter final gearbox assembly without any inspection. Among other things, this approach is based on two facts: measuring time is significantly longer than the machining time, and a limited measuring capacity is available. In hard fine finishing, for example threaded wheel grinding or gear honing, it is not unusual to measure only one or two workpieces per dressing cycle or directly after the machine setup. Depending on the dressing cycle, the number of inspected parts corresponds to only about 5% of workpieces produced in total. In order to supply only “good gears” to gearbox assembly, statistical evaluation is used. Typical measuring characteristics can be represented and statistically evaluated on a Gaussian Bell Curve. By deliberately narrowing down tolerances on the measured components in particular, it is possible to achieve compliance with the actually required drawing tolerances with a sufficiently high probability (typically > 99.99994%). This method is commonly used for machine and process capability studies and is globally recognized. The machine or process capability values cmk & cpk frequently taken as a basis are usually set above 1.67.

Statistically, the reject rate is only 0.57 workpieces per 1 million manufactured workpieces, which means that only about 50% of the actually intended drawing tolerances are available as manufacturing tolerances. This situation is aggravated by the fact of increasing quality demands especially with e-drive gears due to NVH and other topics leading to increasingly tight tolerances.

Another problem of traditional gear inspection is the long (waiting) time between part removal for inspection and the actual availability of measured results. Waiting and inspection time can easily amount to between 30 to 45 min depending on the inspection room capacity. After inspection, a decision must be made whether a correction of machine settings is necessary. The implementation of such corrections must be carried out by the machine operator taking additional time, all while the production is continuously running, good or bad.

Now, how would an ideal solution to overcome the described challenges look like? Ideally, all parts could be inspected immediately after they have been produced, bearing various advantages. The quality achieved on each workpiece could be documented. Process deviations could be corrected immediately by a Closed Loop auto correction system. And even better, by inspecting up to 100% of parts, one could also monitor trends and apply preventive corrections before parts are getting out of tolerance. The ultimate goal would result in predicting whether a workpiece will cause noise issues within the gearbox after its assembly.

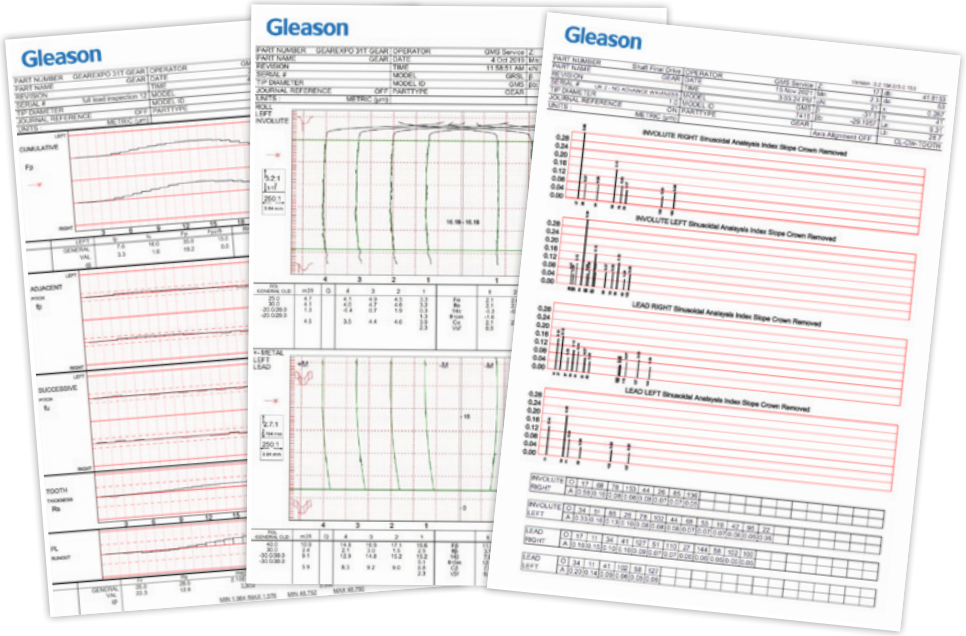
Consequently, key to creating an ideal situation is a metrology system which is capable of inspecting gears as fast as they are produced and which can be installed close to the production machine.



GRSL Gear Quality Center for fast optical inspection of profile, lead and pitch, DOP and tooth thickness, double flank composite testing, integrated waviness analysis and gear noise evaluation.

Watch the GRSL in action

Order analyses are shown for profiles (involute) and flank lines (lead) on the right and left tooth flanks. The lower section of the chart summarizes the most conspicuous orders and amplitudes in table form. This allows to quickly distinguish between mesh harmonics, mainly influenced by the gear design and other orders, so called ghost orders which typically have their root cause in manufacturing errors.



Gleason's GRSL Gear Quality Center combines the latest non-contact analytical gear inspection with proven double flank roll testing of gears applied in most of today's high-volume gear production environments. But the GRSL provides much more than these traditional systems. It gauges the individual gear characteristics of profile, lead and index error by laser scanning.

Two laser heads move automatically into position to scan both gear flanks (left and right) simultaneously. After the laser scanning of all tooth flanks, the roll testing cycle is initiated. In addition, different sections along the face width of the gear can be scanned to even inspect the lead. With laser technology, the overall inspection time is significantly reduced compared to a standard tactile measuring system. Example: The inspection time required for a typical, automotive planetary pinion can be reduced with laser technology by a factor of 4, from roughly 2.7 minutes down to 39 seconds. With the inspection time being greatly reduced, this process can even add additional value by measuring profile and lead on all gear teeth – not just the usual inspection of only 4 teeth around the circumference of the gear.

With such comprehensive data available through laser scanning, it is also possible to further evaluate gears beyond standard gear inspection criteria such as profile, lead, pitch, runout and size. In addition, the 3D laser used on the GRSL gather much higher density data at higher speeds than a traditional tactile probe. The gear flank area seen and scanned by the laser probe at any given instance during the measurement is much higher than using a contact probe. While a contact probe simply touches a single point, the laser scans a complete area at high frequency with samples being recorded on the laser line at a distance of a few µm. This allows to capture a large surface area with higher density at much faster inspection times. Compared to a typical 2D trace such as profile or lead trace used for gear measurement, 3D laser probe captures 10+ times more data points at much higher speeds than with a conventional tactile contact probe.

Understanding the profile and lead of all teeth makes it possible to perform a so-called "Advanced Waviness Analysis" resulting in an order analysis of the gear topography. In contrast to the traditional gear measurement technique, where periodic components or waviness are only captured as form errors ffa or ffb in the profile and/or lead, Advanced Waviness Analysis goes far beyond this. Advanced Waviness Analysis evaluates periodic errors in the profile, the lead or the pitch according to their frequencies/orders and their amplitudes and essentially corresponds to the waviness analysis according to VDI/VDE2612:2018. Measured profile and/or lead of all teeth are first connected to each other along the correct path of contact. The obtained "signal" represents a theoretical transmission

error and is then decomposed into its corresponding components (frequencies/orders and amplitudes) either by an FFT or with the aid of a Gaussian least square method.

Whereas in single flank roll testing the actual transmission error between gear and master gear is detected and displayed as an order analysis, in Advanced Waviness Analysis the transmission error is calculated from measured reduced topography data. This method has been performed for years and provides the advantage of employing existing analytical inspection equipment rather than an additional single flank roll tester. However, this process bears a specific disadvantage: it takes a long time on a standard metrology system to determine profile data of all teeth required for calculating the order analysis.

With Gleason's new GRSL, it is the profile and lead data that can be acquired extremely fast, eliminating the disadvantage of analytical inspection. With the calculated order analysis and its corresponding amplitudes (Advanced Waviness Analysis), it is possible to detect potential noise issues such as ghost orders. These orders are not related to the mesh harmonics of the gear and are typically caused by small irregularities during the manufacturing process or by the production machine itself. Such ghost orders can cause problems once they exceed a specific amplitude. To date, such order analyses are carried out on a random basis only due to the high inspection effort involved. With Advanced Waviness Analysis and the possibility to inspect up to 100% of the production output, it is now possible to evaluate every produced gear regarding potential noise issues, sorting out non-conforming gears before they are assembled into the gear box.

Gleason's GRSL can be integrated into the production flow with the fully automated "Hard Finishing Cell" (HFC) with threaded wheel grinding, washing, part marking, and a basket-based palletizer system. It is also available as stand-alone "GRSL Gear Quality Center" with cobot or robot loading to integrate independently in any manufacturing environment.

Gleason's GRSL with its Closed Loop system connects directly to customers' grinding machines – inspection results are directly returned to grinding machines without any involvement of the operator. The machine compares the measured values with the target nominal values and automatically performs the necessary corrections – results are available shortly after the workpiece has been ground, typically in less than 5 minutes. Compared to the traditional approach of gear inspection in a separate inspection room, reaction time is dramatically reduced. With the GRSL, it is now possible to evaluate every produced gear for potential gear noise issues.

Watch the HFC in action

Dr. Antoine Türich
Director Product Management
Hard Finishing

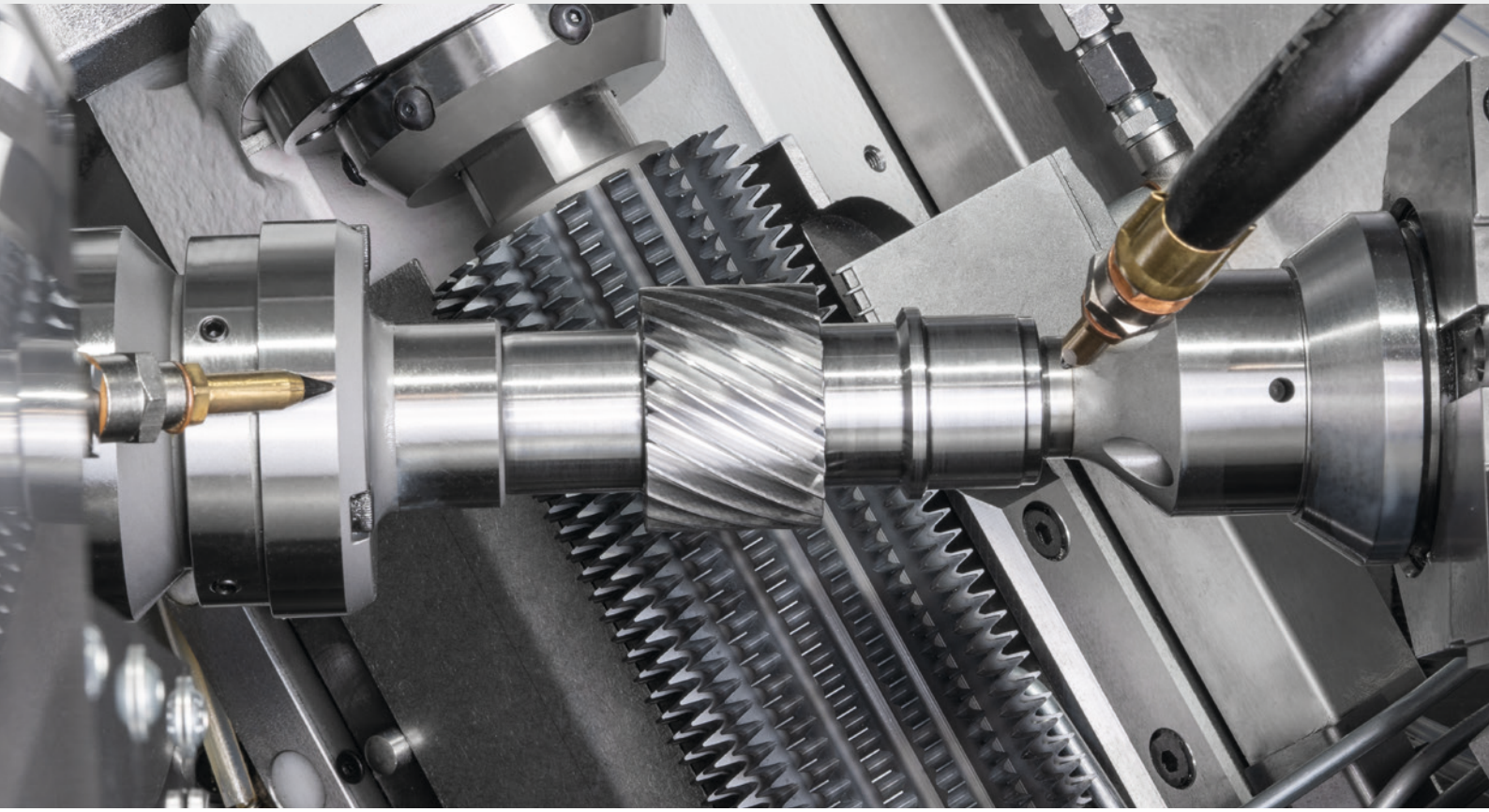
Radial Chamfering

for Gears with Interfering Contours

Watch the 100HCD in action

New 100HCD Horizontal Hobbing Machine puts radial chamfering in parallel to hobbing – the ideal solution for geared shafts with interfering contours, including EV transmission shafts.

Where once chamfering and deburring operations were almost an afterthought, they're now considered a primary soft machining process, with widespread recognition that anything less than a flawless tooth flank can result in premature transmission failure, less-than-optimal efficiency, and unacceptable noise. Additionaly, a reliable chamfering solution optimizes life time of hard finishing tools like grinding worms and honing rings.
Gleason has been relentless in its pursuit of new chamfering technologies that can be more easily, and economically, integrated into gear manufacturing processes, whether for production of smaller automotive gears, pinions and



The 100HCD is designed for a wealth of geared profiles up to a workpiece diameter of 120 mm, module 4, and a shaft length of 450 mm.

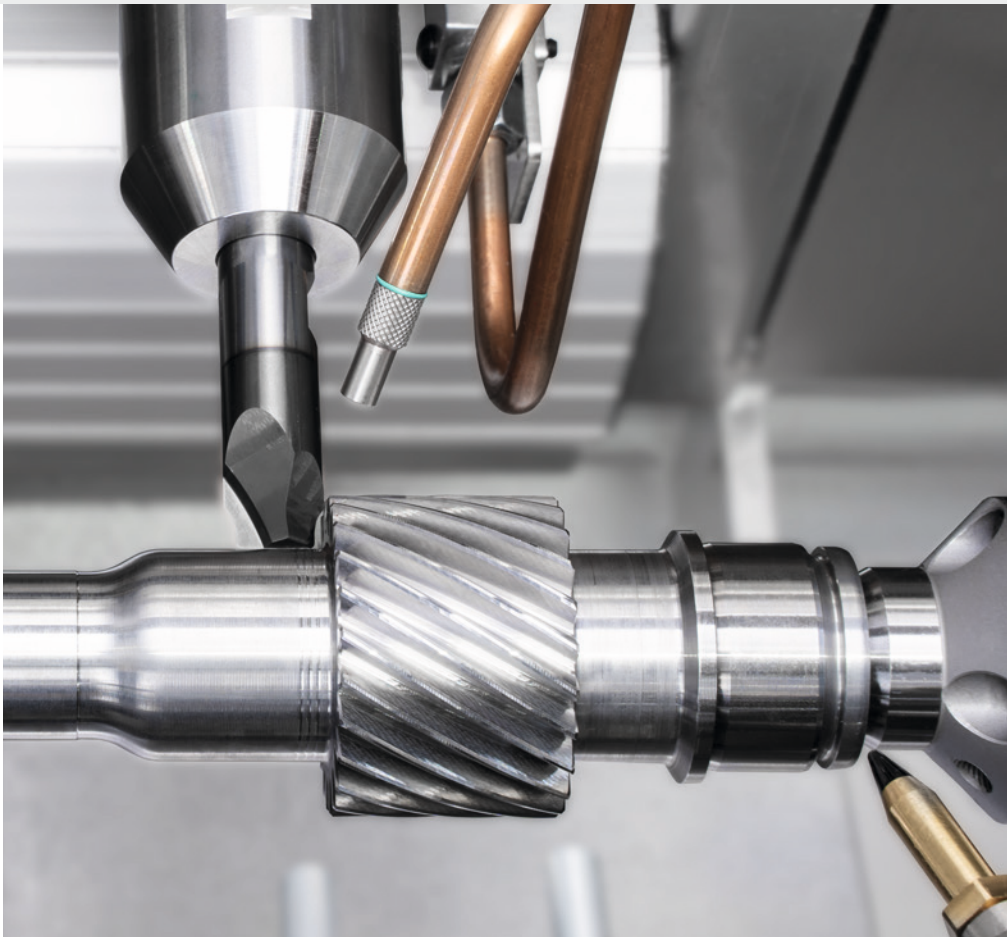
shafts, or larger gears for trucks and tractors. In every instance, these new technologies have been combined with proven horizontal or vertical hobbing machines so that the chamfering operation can be performed with minimal impact on cycle times and tool cost per piece. One such example is the recent introduction of the vertical Genesis® 280HCD Gear Hobbing Machine, which combines two chamfer cutting processes: Chamfer Hobbing, ideal for high volume automotive and light truck applications, and Fly Cutter Chamfering, delivering exceptional flexibility for lower volume, small lot jobber applications. Both are performed in parallel to the hobbing operation.

Introducing the New 100HCD

Now, Gleason is again raising the chamfering bar, this time for smaller e-drive transmission gears, pinions and shafts that require both production in high volumes, and the cutting of precise, repeatable chamfers. With introduction of the new 100HCD Hobbing and Chamfering Machine, and the world's first application of radial chamfering in parallel with hobbing, a platform now exists that is ideally suited to meet the challenges posed by today's very high precision, ultra-quiet e-drive transmission gears and shafts.

But first, some background:
The new 100HCD is a variation on Gleason's recently developed 100H Horizontal Hobbing Machine platform – the next generation of the well-known P90 series, with improvements in design, functionality and operator interface. This new series, including variants such as the 100HCD, are designed to handle a wealth of geared profiles up to a workpiece diameter of 120 mm, module 4 and a shaft length of 450 mm. With design improvements to hob head and workspindle, and the use of the new Gleason GEMS® HMI, the 100H series delivers extremely fast cutting and processing times, making it ideally suited for large batch production of gears and pinions. And like the P90 series, which was the industry's first to offer integrated chamfering/deburring along with horizontal hobbing, the new 100HCD also combines this new and improved hobbing platform with an integrated chamfering/deburring station.

New Radial Chamfering
Most importantly, with the 100HCD, a significant improvement has been made compared to the P90, with the replacement of the traditional chamfer rolling process with Radial Chamfering. How are they different? Chamfer Rolling, also known as Rotary Deburring, is a fast, versatile forming process which creates chamfers along the tooth edges using gear-shaped tools which mesh with the workpiece. Excess material flows mainly to the face side of the gear, where it is then cut away by single blades, deburring discs or file discs, depending on gear shape and/or machine configuration. However, small amounts of material can also flow into the gear tooth flank itself, thus forming a secondary burr, necessitating that this secondary burr be removed by either edge zone burnishing or a two cut-hobbing process prior to the subsequent hard finishing operations downstream.



Radial Chamfering – the chamfer is produced with a cutting process using one or two single-point cutting tools. This eliminates subsequent operations needed to remove the secondary burr that often resulted from the chamfer rolling process used in the past.

With Radial Chamfering however, applied for the first time ever in parallel with hobbing by the 100HCD, the chamfer is produced with a cutting process using one or two single-point cutting tools, rather than rolling, thus eliminating altogether a subsequent operation needed to remove excess material in the form of the secondary burr that can result from chamfer rolling. With cycle times and tool cost per piece of paramount importance, replacement of chamfer rolling with Radial Chamfering makes perfect sense. And while Gleason's new Chamfer Hobbing process, first introduced with the 160HCD and the aforementioned 280HCD, is ideal for disc-type parts, Radial Chamfering is better suited for shafts typically produced on a horizontal hobbing machine. These shafts, often with the root diameter of the chamfered gear and the shaft diameter in very close proximity, are inherently more difficult to chamfer and deburr due to the clearance requirement. The hob-type cutting tool used in the Chamfer Hobbing process, while ideal for disc-type parts, makes it challenging to chamfer shafts with interferences typical of those found in today's most common e-drive transmissions. Another strength of Radial Chamfering is its extremly short cycle time – even when cutting planetary pinions, Radial Chamfering stays within the short cycle time required for hobbing.

Parallel Perfection
The 100HCD operates in similar fashion to its P90CD predecessor. By performing chamfering/deburring in parallel with hobbing, it delivers a remarkable cycle time, with the assistance of high speed gantry load/unload automation and Gleason workholding with a very fast clamp/unclamp capability. The gear is first hobbed and the rough burr that results from hobbing removed in a single setup at the hobbing station. The gear then is unloaded by the gantry and loaded into the chamfering/deburring station, where Radial Chamfering is performed simultaneously while

Gleason's Radial Chamfering process uses economical, resharpenable carbide cutting tools, with one to three cutting edges.

another gear is hobbed. Depending on the application requirements, the chamfering station can be equipped with a single tool spindle or optional two-tool spindle for single or two-tool Radial Chamfering. Economical, highly productive resharpenable carbide cutting tools, with from one to three cutting edges, and sourced through Gleason are used in both cases. A single tool can be designed for chamfering the gear flanks, and with or without root chamfering. The two-tool option adds more flexibility to adjust the chamfer angle with tools specifically designed for the obtuse and acute edges (particularly advantageous in the case of gears with high helix angles where obtuse and acute angles can be quite different) to meet customer's specific design requirements in advance of the subsequent hard finishing operations. In both cases, Radial Chamfering is fast and efficient, with no impact whatsoever on chip-to-chip times since the operation is performed in parallel to the hobbing of more workpieces.

The Complete Package

The new 100HCD has so much to offer. The redesigned direct-drive hob head, delivering speeds up to 12,000 rpm and with three different power options, combined with several hob clamping alternatives, ensures the best possible cutting tool solution for every application, now and in the future. For dry cutting, for example, the latest G50, G90, or carbide hob cutter material is ideal. Several chip evacuation options ensure that dry, hot chips don't interfere with the highly productive cutting process. For those customers who do not want to move to dry machining, wet cutting options with magnetic chip conveyor are available. The CNC tailstock will support clamping of disc- and shaft-type parts, as long as 450 mm. The fast, adaptable Quik-Flex® Horizontal clamping system cuts changeover of hobbing and chamfering workholding to a few minutes. More efficient, error-free operation also result from Gleason's GEMS HMI hobbing software, which makes setup and changeover more intuitive and simple. This Human Machine Interface, coupled with the latest Siemens Sinumerik One control, provides several new process options and guides the operator intuitively through the workflows of the machine, both Hobbing and Radial Chamfering.

Like all the latest generation of Gleason machines, the 100HCD is supported by Gleason's complete manufacturing system, including hobs, Radial Chamfering tools, modular workholding and smart grippers, as well as process engineering and on-going training to help ensure the system is operating at peak efficiencies and producing the optimum in quality.

Gleason's GEMS HMI hobbing software guides the operator intuitively through the workflows of the machine, for both hobbing and Radial Chamfering processes.

Gottfried Klein
Director of Product Management Soft Machining Solutions

The Drive to Optimize NVH

Gleason KISSsoft and GEMS design software, along with RecurDyn from FunctionBay, work seamlessly together to greatly improve NVH characteristics in e-axles with hypoid gearsets.

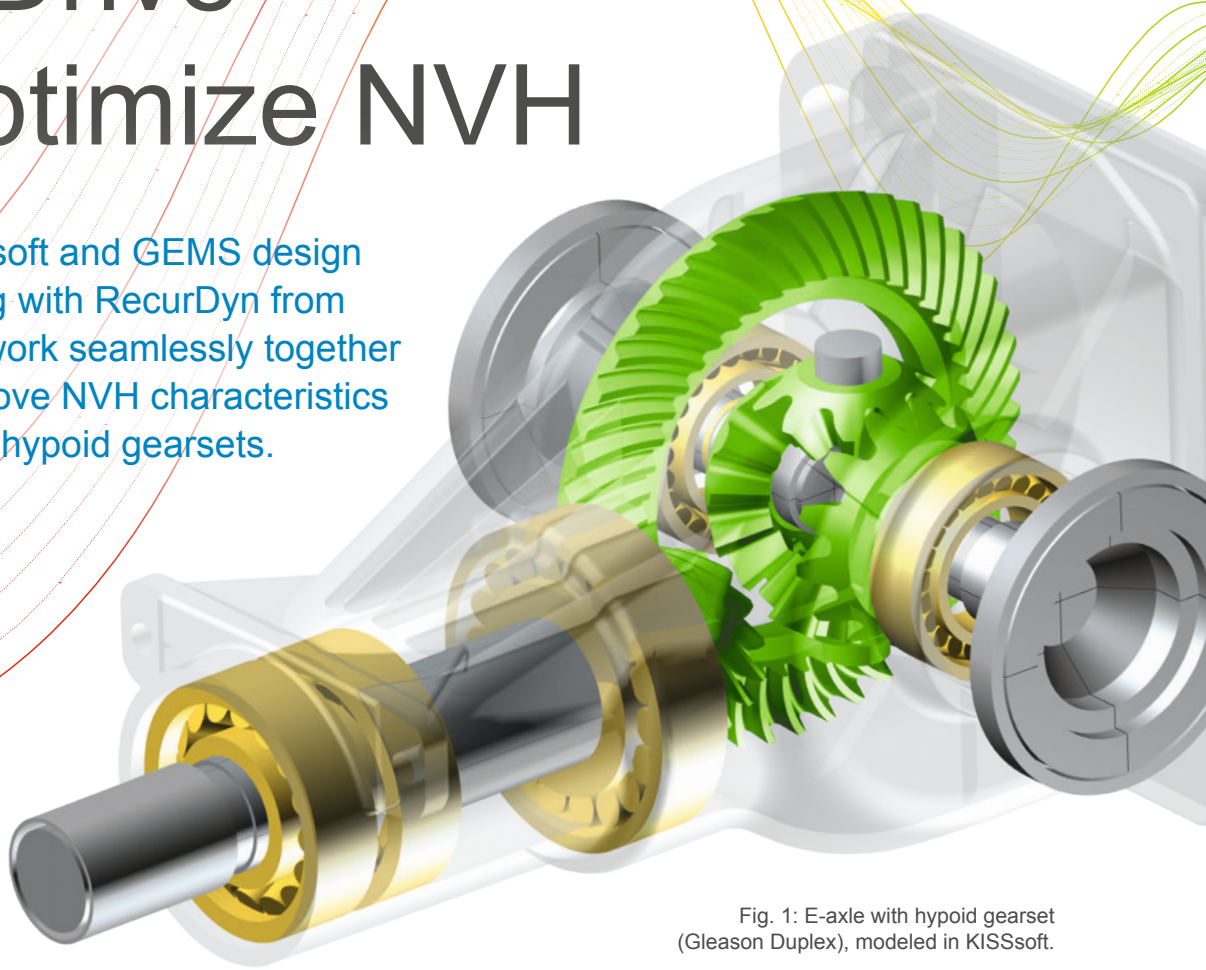


Fig. 1: E-axle with hypoid gearset (Gleason Duplex), modeled in KISSsoft.

In bevel and hypoid gears, the spiral angle allows for a smooth and gradual engagement of teeth, improving noise, vibration and harshness (NVH) characteristics. NVH optimization of bevel gears to the very high standards required by today's electrical vehicles is a challenging task. The noise behavior of bevel gears is influenced by the soft machining process and subsequent processes downstream, as well as the mesh misalignment in operation. While considerable improvement of the NVH characteristics can be achieved by gear macro- and microgeometry modifications made in the design phase, this optimization can be quite challenging for gear designers. Fortunately, achieving a design offering the best possible compromise between a sufficient load carrying capacity and acceptable noise level can be reached by simulating the vibration excitation and response on components and the complete system.

This article features a case study of such simulation, and how KISSsoft® and GEMS gear design software tools, in combination with RecurDyn® by FunctionBay, are used to achieve the optimum result.

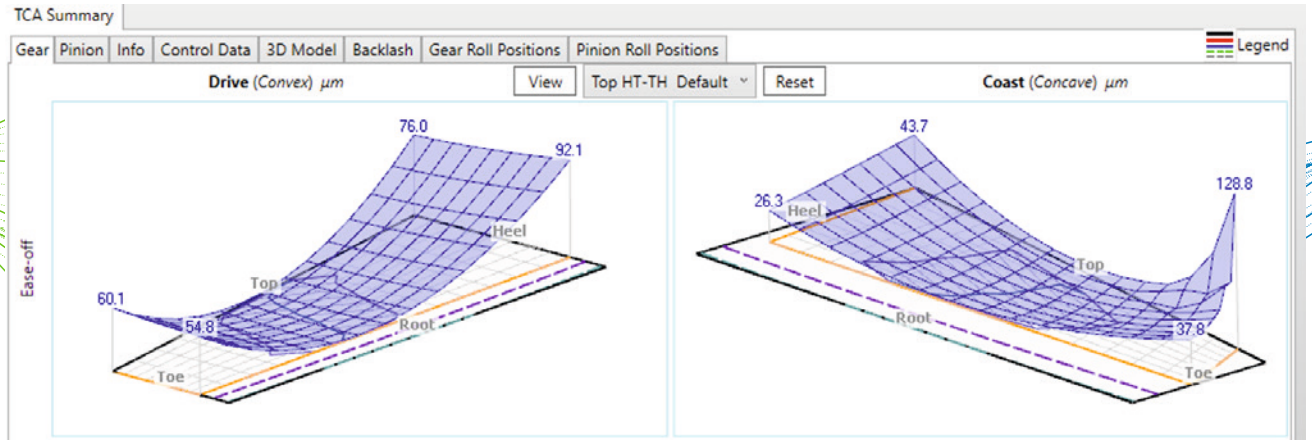


Fig. 2: Ease-off applied to bevel gears in GEMS.

E-Axle with Hypoid Gearset

The electric axle analyzed in this case study is a single-speed gearbox used to power the wheels of an electric vehicle. Power is supplied by a permanent magnet synchronous motor to the input shaft and the output gear stage is integrated into the differential case.

The design and optimization of macro geometry, such as the number of teeth as well as spiral and pressure angle of the hypoid gears are determined during the design phase in KISSsoft, the gear design software. Criteria for optimization are the safety numbers, axial and radial forces on the bearings, efficiency requirements, load spectrum, and many more.

The optimization of the micro geometry uses the ease-off topography of the mating tooth flanks using GEMS, Gleason's powerful software platform for bevel gears. The ease-off is comprised of tooth flank modifications (profile crowning, lead crowning, flank twist and higher-order motions), applied to the tooth surfaces of pinion and gear. Ease-off topography of the bevel gears is shown in Fig. 2.

Bevel Gear Misalignment Parameters

Gear mesh misalignments usually result in shifts in the load distribution and affect gear noise. For example, with reference to the mounting distance deviation H (axial offset of pinion), a positive deviation will move the contact pattern towards the ring gear tip, while a negative deviation will move the contact pattern towards the ring gear root.

A Loaded Tooth Contact Analysis is performed using GEMS on the bevel gear geometry, changing the pinion offset from negative to positive values. In Fig. 3, the dramatic change in contact patterns is shown.

Multibody Modeling of the E-Axle

For the dynamic analysis, a multibody model is generated. In the present study, a penalty contact formulation has been chosen. The penalty approach allows the calculation of the contact force as a function of the penetration of two contact partners. The contact force is calculated as the product of the contact stiffness, multiplied by the penetration depth, and the damping, multiplied by the penetration velocity.

Modal analysis is the process of determining dynamic system characteristics regarding natural frequencies, damping factors, and mode shapes, using them to formulate

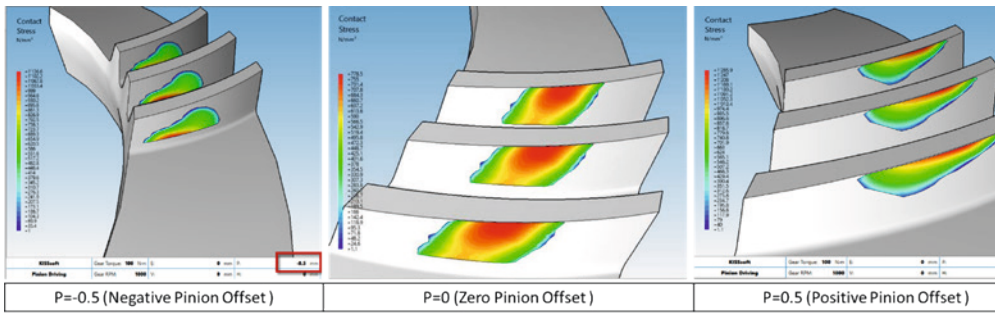


Fig. 3: Bevel gear contact pattern and pinion offset, results simulated in GEMS.

a mathematical model to describe its dynamic behavior. Once the Loaded Tooth Contact Analysis is performed, the resulting vibration excitation levels are transferred to the housing. In RecurDyn, the response of the housing to the excitation is calculated using a Finite Element Method (FEM) model of the system.

NVH Analysis of the E-Axle with Mounting Offset

Now, simulations are carried out to evaluate the influence of both positive and negative mounting offsets (± H) on the vibration behavior of the system; five scenarios are considered: H= 0 mm (zero offset), H= ± 0.1 mm, H= ± 0.5 mm.

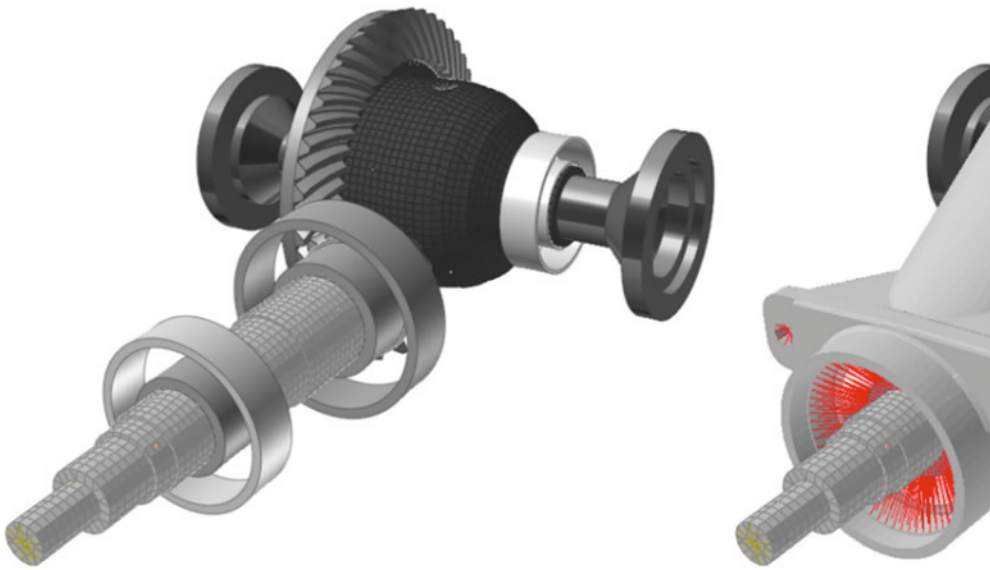


Fig. 4: On the left, FEM model of internal system. On the right, FEM model including system housing. Modeled in RecurDyn, based on KISSsoft calculations.

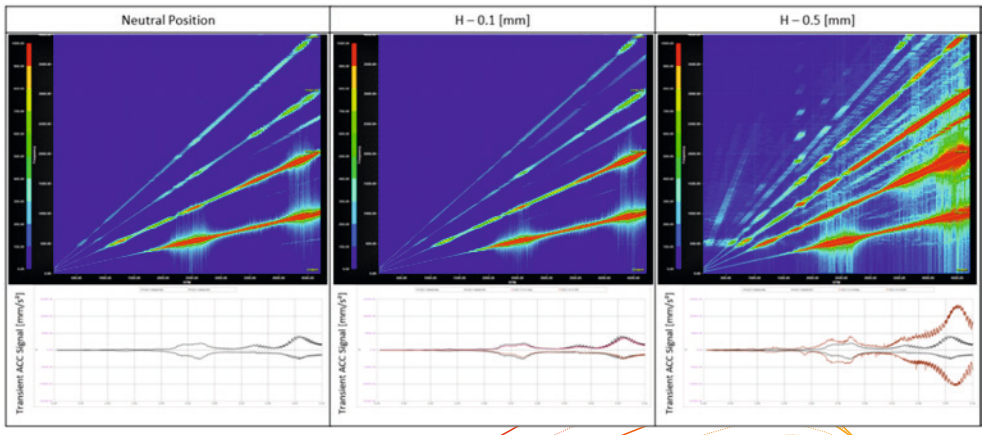


Fig. 5: Campbell Diagram of acceleration on control point – positive pinion offset.

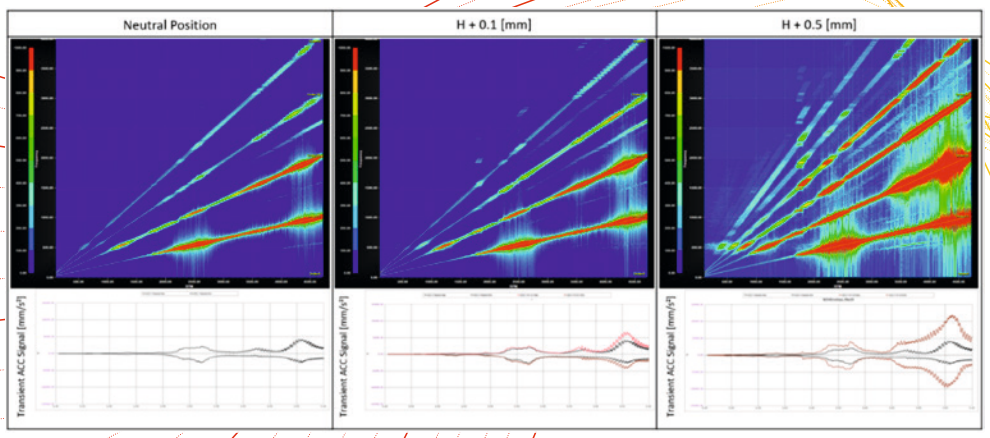


Fig. 6: Campbell Diagram of acceleration on control point – negative pinion offset. Note the changes in intensity of the red areas in the plot (results from RecurDyn).

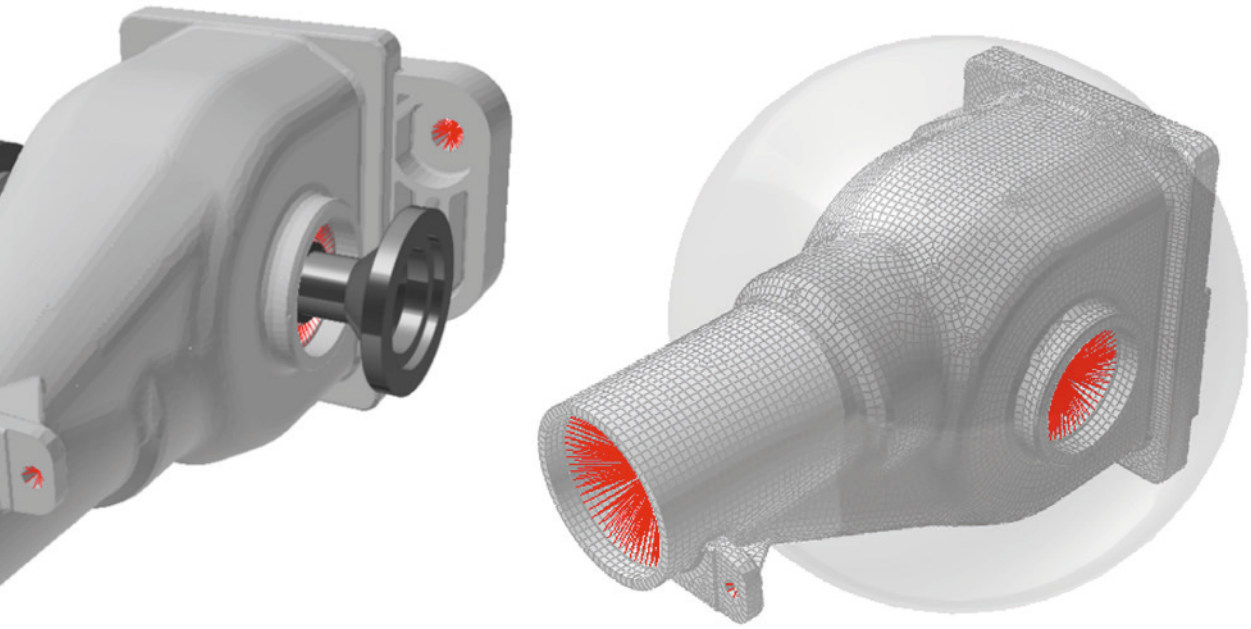


Fig. 7: Spherical radiator enveloping the e-axle housing.

H+ / H- Shift of Pinon					
Mesh misalignment	-0.5 [mm] Shift	-0.1 [mm] Shift	Neutral Position	+0.1 [mm] Shift	+0.5 [mm] Shift
Change in sound	+4.37 [dB]	-2.0 [dB]	±0.0 [dB]	+1.77 [dB]	+5.06 [dB]

Fig. 8: Sound pressure level vs pinion offset.

Accelerometers are typically placed on the selected measurement points on the housing. The results, relative to an accelerometer on the housing, and the accelerations, normal to the surface, are shown in the Campbell Diagrams in figures 5 and 6.

Sound Pressure Calculation

To compare the results based on the emitted sound pressure level, FEM or BEM methods can be applied based on the results generated in the multibody simulation for near field and even far field analysis of the airborne sound using RecurDyn.
First, the sound pressure level (SPL) on a sphere enveloping the system is calculated. Then excitation, housing response and sound pressure level on the sphere are calculated for different H values – the resulting changes in the sound pressure level are shown above.

Summary

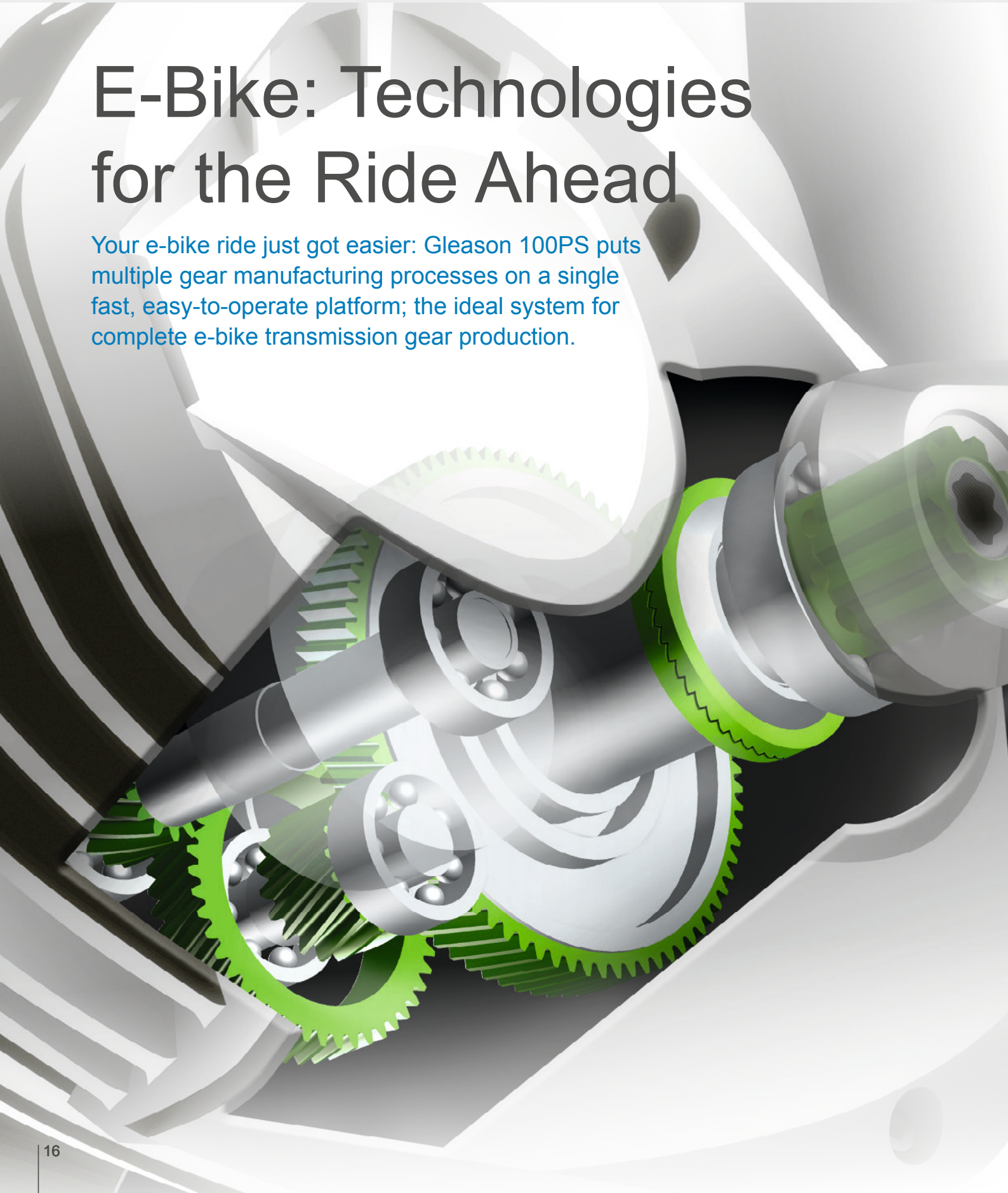
Using KISSsoft, GEMS and RecurDyn, the NVH performance of an e-axle with a hypoid gearset can be easily assessed. Combining these three tools allows gear designers to quickly evaluate the impact of anticipated mounting errors and mesh misalignments under load on e-axle NVH characteristics, and to make modifications in order to optimize NVH to the desired levels.

Jürg Langhart
Director Global Sales
KISSsoft Products

Learn more about KISSsoft

E-Bike: Technologies for the Ride Ahead

Your e-bike ride just got easier: Gleason 100PS puts multiple gear manufacturing processes on a single fast, easy-to-operate platform; the ideal system for complete e-bike transmission gear production.

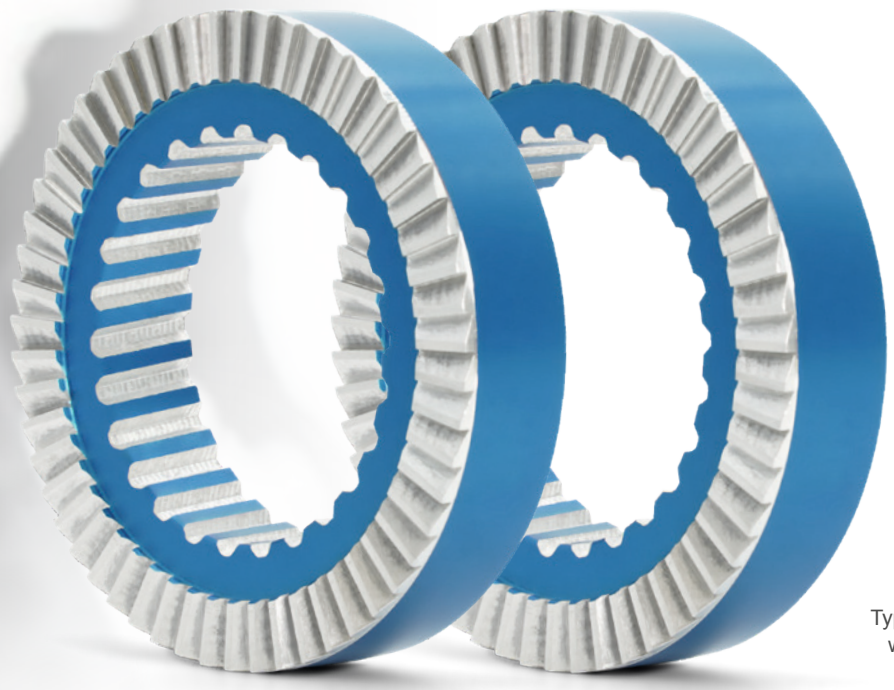


Making the case for e-bike ownership is almost as easy as riding one. They're perfect for a short commute in a crowded city, or to give you that last assist up a difficult climb out in the country. They're clean, efficient and, best of all – fun. No wonder about half the bicycles sold in Germany today are e-bikes. Sales are booming even in America, where cars are king; e-bike sales there grew by 240% last year.

The latest e-bikes with mid-drive motors are simple – but highly sophisticated. They are equipped with advanced drive technologies that deliver a smooth, quiet and efficient riding experience. The gears that transfer battery power to chain are small, highly precise, and come in a variety of types as well as sizes. Different gears require various machining processes to deliver optimum productivity and quality. Fortunately, there's now a machine for that.

100PS: Single Platform, Multiple Processes

For soft cutting, and even hard finishing of internal gears and small external e-bike gears with contours that can't be easily hobbed, Power Skiving is the ideal process. While in the past, Power Skiving was a promising but challenging alternative for shaping, today it is in wide-spread use for cylindrical gears. Besides excellent quality, Power Skiving is much more productive than shaping if the process is applicable.
The 100PS Power Skiving Machine is the latest example and the closest thing yet to a universal gear production machine. The 100PS is the smallest machine in the Gleason Power Skiving family, and an ideal solution for both e-bike and e-drive transmission gears. But not just for Power Skiving – the 100PS in fact features the same proven, rigid platform used for the H series of small, horizontal hobbing machines in over 1,000 installations worldwide.



Typical e-bike workpieces.

As a Power Skiving machine, the 100PS is ideally suited for the economical production of gears with interfering contours and internal gears up to module 2.5 mm. The 100PS' horizontal axis also makes the machine highly suitable for shaft-type parts. In the case of external gears with small overrun space, Power Skiving may even close the gap to hobbing, since hobs with very small diameters may not be applied economically.

For the production of external gears which can be hobbed with much higher productivity, the 100PS "Universal" can be quickly converted from its Power Skiving configuration to gear hobbing in less than two minutes: The Power Skiving cutter is replaced by a hob; the counter bearing is manually installed for added stiffness required by hobbing; sealing air is mounted at the counter bearing; and the workholding is changed depending on the application.

In addition, the 100PS can perform hard skive hobbing after heat treatment as a finishing operation. As a special feature, the machine provides the option for milling of worms and face gears.

Putting Power Skiving and hobbing on the same machine, also makes the 100PS "Universal" an ideal solution for producing stepped pinions common in e-drive planetary transmissions. Power Skiving can be used to cut the smaller gear with interfering contours while the larger of the two gears can be efficiently hobbed on the same machine.

Watch the 100PS

Additionally, the 100PS can be equipped with an integrated chamfering/deburring station for external gears. The chamfering process is performed before the final cut and helps achieve finished machining quality. For internal gears, the 100PS has a patented deburring unit which can be programmed via two CNC axes. These additional, fully programmable axes can also be used for light turning operations. Finishing a diameter in the same setup as the gearing allows for minimal coaxiality errors.

Face Milling.

100PS Power Skiving machine features multiple processes on one platform.

Power Skiving of internal gears.

For medium and high volume production, several options for automating the machine are available. Internal loading takes place with a gantry, while conveyor or basketized systems can be used for parts storage before and after machining, making the machine a fully automated production cell.

Optimizing the Process
Most importantly, Gleason offers comprehensive Power Skiving technology and simulation software that makes it easy to simulate the entire cutting process and determine the most effective process strategy. The software can analyze the influence of different cutting tool geometries and process parameters on chip formation, gear quality, collision situation and cycle time. Now, the total cost per gear can be calculated, factoring in the optimum cutter size, the cost for a new cutter, and the cost for resharpening in combination with anticipated cutter life. Design of Power Skiving tools is always based on a simulation and technology requirements. Ultimately, it makes the implementation and application of Power Skiving as simple and familiar as gear shaping.

The Complete System
As a Total Gear Solutions provider, Gleason is also the source for the most productive Power Skiving and hobbing tool technologies. The capabilities of the machine are well suited for the application of the most advanced, productive cutting tools.

Carbide Power Skiving tools are made from high-quality carbide material and feature the latest coatings for maximum productivity and tool life. These tools are designed to perform skiving operations on gears with high precision and accuracy, resulting in a high-quality finished product.

Gleason's carbide hobs are similarly known for their high durability, toughness, and resistance to wear and tear. These tools are designed to cut the gear teeth with exceptionally high precision and accuracy. Depending on the application, Gleason PM-HSS Power Skiving tools and hobs with the appropriate coating are also available.

Closing the Loop on Quality
KISSsoft design software can be used as well to help optimize the entire design, manufacturing and inspection process. KISSsoft, in conjunction with a Gleason metrology system, can analyze NVH of the manufactured gear, determine how machining errors influence the contact pattern under load, compare vibration characteristics of the machined gear to the designed gear for modification, and much more.

The entire process can run seamlessly in Gleason's Smart Loop to help optimize the production process. By networking the 100PS directly with Gleason GMS® metrology equipment, measurements and the resulting corrective actions can be applied fast, accurately and automated.

Carbide hob and Power Skiving cutter made by Gleason.

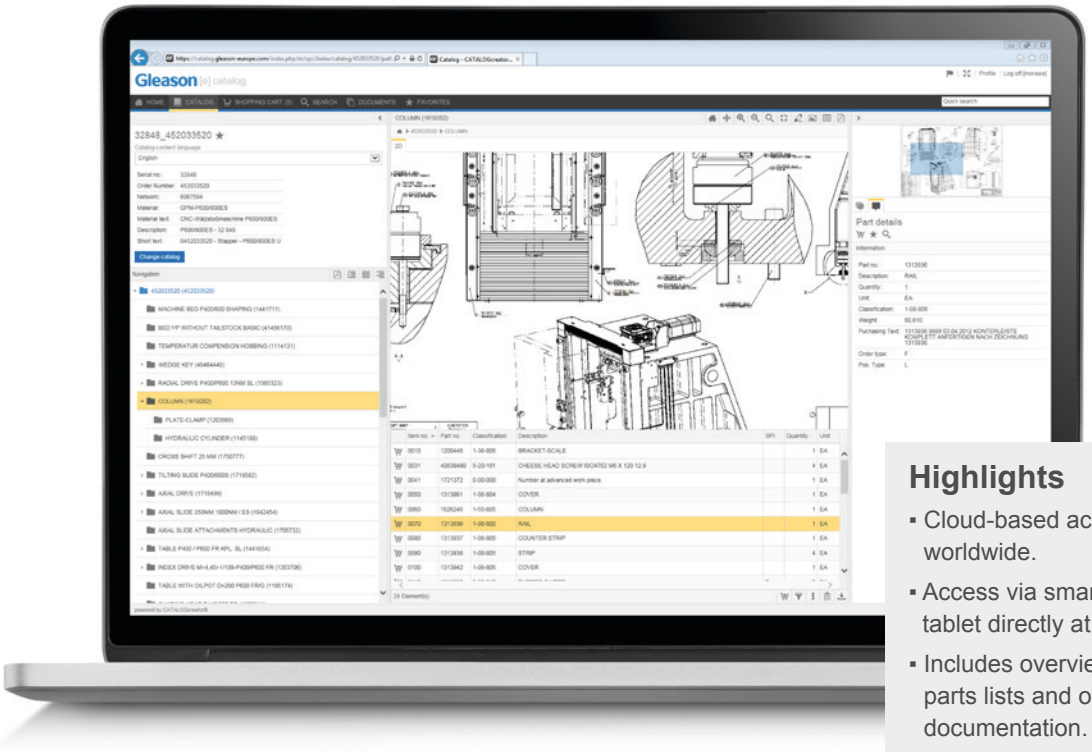
Raymond Graf
General Manager
Gleason Switzerland AG

Gleason [e] Catalog

Service Digitalization

In recent years, digitalization has gained increasing importance in maintenance and service of machine tools. The benefits offered by digitalization in this field are manifold and help increase the efficiency and productivity of machines.

More information on Gleason Services



Highlights

- Cloud-based access 24/7 worldwide.
- Access via smartphone/ tablet directly at the machine.
- Includes overview drawings, parts lists and order documentation.
- Time-saving search due to digital documentation.
- Fast and accurate part identification.
- Shopping cart with export function for simple and fast quoting.

One essential aspect of machine maintenance is the procurement of spare parts. Digital and rapid identification of required spare parts, an efficient request for quote process, and fast order processing are key to reducing downtime. Gleason's latest development to optimize customers' business processes is the new electronic spare parts catalog, the so-called "Gleason [e] Catalog". With the development and introduction of this platform, the spare parts procurement process is optimized, fundamentally simplifying the identification process as a preliminary stage for e-commerce.

The cloud-based electronic parts catalog extends the digital service information offering. The Gleason [e] Catalog provides 24/7 access to all data and documents relevant for spare parts identification, maintenance support, as well as fast inquiry and order processing of parts for all Gleason machines.

Users can access comprehensive drawings, bills of material, detailed part information, and order documentation for many Gleason machines. The intuitive user interface with powerful search and hotspot functions facilitates simple and fast part identification. Defined shopping carts can be exported directly as inquiry for individual and fast quoting. Time-consuming search through paper documentation is eliminated.

The Gleason [e] Catalog also contributes to Gleason's global environmental efforts. By digitalizing service documentation on a broader scale, savings in print materials have a significant impact on the CO2 footprint of Gleason and its customers.

The Gleason [e] Catalog is available for many Gleason machine models and can be accessed on mobile and stationary devices.

Sven Stark
Director
Aftersales Service

Hard Finishing with ‘Pinpoint’ Accuracy

Gleason Pitch Line workholding greatly improves accuracy of hard finish grinding and turning of bevel and hypoid pinions and gears, while delivering unprecedented reliability.

Heat treatment and other post-soft operations can often lead to distortion of critical features and gear teeth. The result is undesirable runout and other part deformations that must be corrected. While rework can be an option, it may become cost-intensive, too complex or simply not feasible if available stock is insufficient.

Perfecting the Pitch Line

This, however, poses a challenge for the workholding used in grinding and turning machines: how to best securely position the gear member such that subsequent machining can be performed to reduce the level of undesirable runout that can occur between gear teeth with distortion, and the journals and bores being machined?

Increasingly, Pitch Line fixtures are being used for these operations, as well as the secondary operations at a later point in time, such as inspection. These fixtures are designed to accommodate the change in pitch diameter that results from gear teeth distortion. Pitch diameter (Pitch Line) is the primary reference point that gear accuracy is specified around. It targets the point where two mating gears make contact – the exact point where a gear tooth’s surface will not slide relative to the other. A Pitch Line fixture precisely locates the pinion or gear on its new, post-heat treat gear tooth pitch diameter, thus establishing a more precise relationship between the gear teeth and the pinion/gear datums. The end result: minimal runout on those datums relative to the pitch diameter (Pitch Line) of the pinion or gear.

A Better Mousetrap

Gleason’s new series of Pitch Line fixtures offer significant improvements over the conventional products previously available. They are designed with average gear member runout of just 0.0005” (0.0127 mm) to the Pitch Line – and can be built

for accuracies of as little as 0.0002” (0.005 mm) Total Indicator Runout (TIR). The application determines the required accuracy. If, for example, the fixture is used in a grinding application, where normally 0.004” (0.1016 mm) of stock is removed off each gear flank, then the runout to the bearing journals of 0.0005” (0.0127 mm) would be sufficient. However, if used for hard turning with no subsequent finishing or lapping applications, then 0.0002” (0.005 mm) would be more appropriate.

Most importantly, Gleason Pitch Line fixtures are designed with the pitch pins perpendicular to the gear tooth pitch diameter, for optimized strength, accuracy, and wear. This offers significant advantages over conventional Pitch Line fixture designs, where the pins point straight up (parallel to the axis of the part) resulting in a reduction in radial accuracy and stiffness of the centering function. For example, in pinions with a slim pitch angle of 20°, the forces on the balls and the pins are not pointed in the axial pin direction. This results in reducing the force perpendicular to the pitch angle to only 34 percent in the axial pin direction, and 94 percent perpendicular to the pin. This high perpendicular force will ultimately wear the pin sleeves and also bend the pins. In the case of ring gears, this effect is smaller, but the same accuracy and wear issues will occur over time.

‘Pitch Perfect’ for More Applications

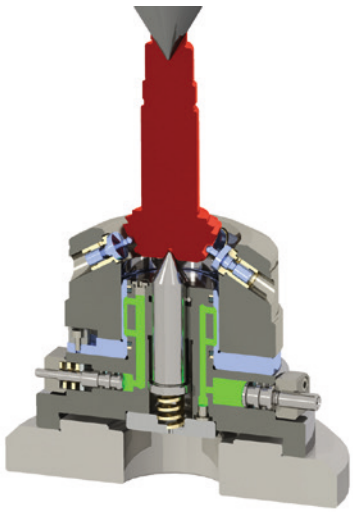
Pitch Line fixtures can be designed to meet the needs of a wide range of customer workholding applications: mechanically or hydraulically actuated, tailstock-driven, compatible with quick-change base equipment, incorporating a spring-loaded pre-centering mechanism, and including mechanically activated holding jaws.

The recommended clamping method is determined by the application. For example, a pinion being held in the Pitch Line fixture by a tailstock would not require clamp blocks on the pinion head for holding the pinion in place. For a ring gear member, straps are often used on the back angle if the process requires that the bore be machined as well as the mounting surface. These Pitch Line features can be incorporated as required into the design of the fixture.

In applications requiring frequent changeover for different parts, Gleason makes life easier for the operator and reduce non-productive time through use of the quick-change base equipment in conjunction with a system of Pitch Line fixtures. It‘s an ideal solution for applications with multiple parts, and requiring quick changeover of numerous fixtures. A single base component is installed that can clamp onto the the ID of all the fixtures, which then can be changed in just minutes, using just a single tool.

Custom fixtures can be designed to accommodate a wide range of pinion and gear sizes, including shaft-type parts and cylindrical gears.

Possible machining areas marked on bevel gear shaft.



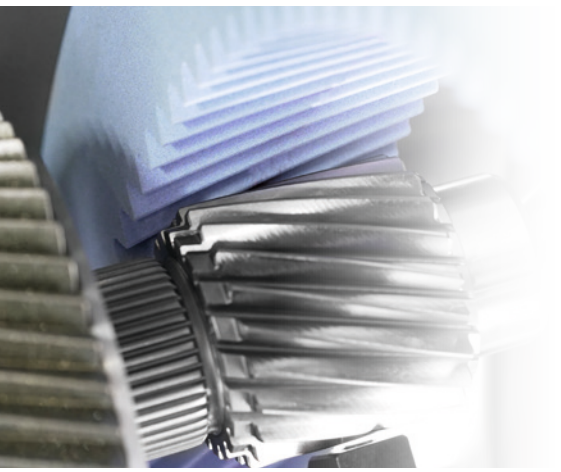
Pitch Line workholding with hydraulic quick-change base.

Watch the free webinar about Pitch Line fixtures

Robert Peyr
Director Product Management
Global Services

重庆永达精密机械有限公司

Chongqing Winstar Precise Machinery Co.,Ltd.



Gearing Up for E-Drive

Chongqing Winstar ramps up for production of over 10,000,000 high-precision, ultra-quiet e-drive transmission gears a year with Gleason's latest honing technologies.

China's new energy vehicle (NEV) production and sales will exceed the 10 million mark for the first time in 2024, representing a growth rate of 22% compared to 2023, according to China Association of Automobile Manufacturers (CAAM). China has become the main battleground for global competition in NEVs. In fact, over half the world's EVs are now produced in China, with three of the four largest EV manufacturers being domestic Chinese producers.

An important supplier to the largest of these domestic EV producers, including BYD, SAIC, and Changan Automobile, is precision gear manufacturer Chongqing Winstar. Located in Chongqing, a modern metropolis of over 30 million people at the confluence of the Yangtze and Jialing rivers in Southwestern China, Chongqing Winstar is today ramping up to produce millions of high precision, ultra-quiet transmission gears for the next generation of electrical vehicles. Founded in 1999, the company quickly became a well-known, highly respected producer of gears for conventional manual and automatic transmissions. Over the course of the last six years and in anticipation of the new EV area and the special quality and noise requirements of EV transmission gears, Chongqing Winstar has steadily added impressive new resources and capacity, culminating with a large order for Gleason 260HMS Gear Honing Machines and 350GMS Metrology Systems for analytical gear inspection.

Power Honing:
Speed and Precision

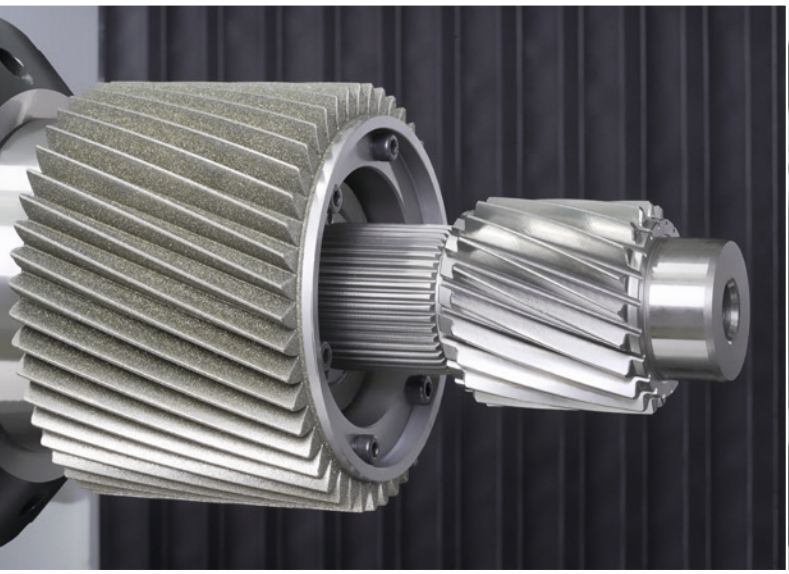
Where in the past honing was used just as a post-grinding operation to further improve surface roughness of the tooth flanks without removing much stock, the development of a new generation of rigid CNC machines with direct-drive spindles and highly productive ceramic honing tools has seen the emergence of Power Honing as a stand-alone finishing solution on par with, or even exceeding, gear grinding. It is now possible, and highly advantageous, to proceed directly from soft machining and hardening processes directly to honing.

"For EV transmission gears, honing is particularly beneficial, since honed components can have a lower noise behavior than even their ground counterparts, due to their specific, curved surface structure," says Dr. Antoine Türich, Gleason Director, Product Management, Hard Finishing Solutions. "Gear honing is also a suitable process for machining gears with interfering contours such as stepped gears found in planetary transmissions commonly used in electrical vehicles."

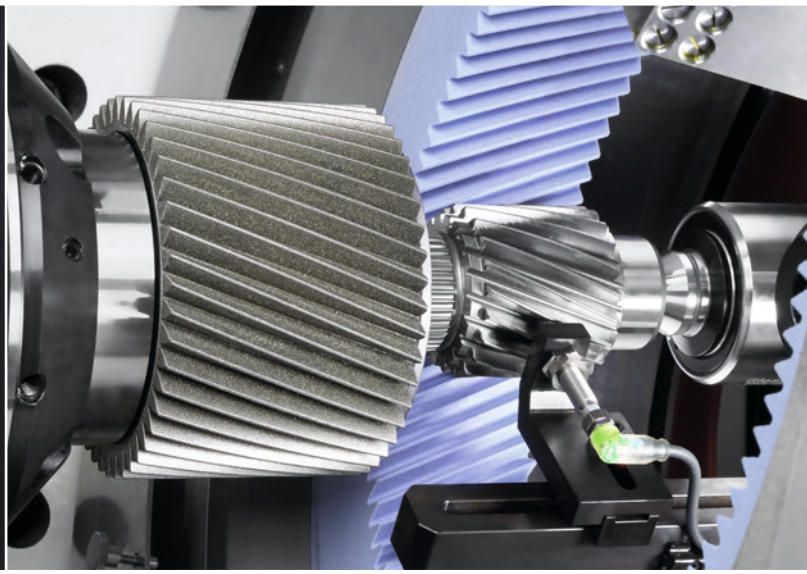
> "It only takes 10 honing machines to hard finish over 10,000,000 EV transmission gears a year."
>
> Gilbert Leutwiler, Sales Manager, Gleason Switzerland AG

The decision to purchase Gleason honing machines, according to Chongqing Winstar officials, was the result of careful research and on-site performance tests that compared a Gleason 260HMS Gear Honing Machine to its closest competitor. Chongqing Winstar determined that the Gleason machine outperformed in every category, including efficiency, cost-per-piece, delivery time, and localized service and support. Most importantly, the tests also confirmed that these machines would deliver exceptionally fast cycle times across a wide range of part types, diameters and shaft lengths – all to DIN 4 (AGMA 12) and with a profile form deviation of less than two µm (micrometers). This is critical to reducing NVH (Noise, Vibration Harshness) to the levels required by Chongqing Winstar's EV customer base.

"The subsequent order was then based on a simple calculation: how many machines would it take to hard finish over 10,000,000 EV transmission gears a year, with floor-to-floor times ranging from 38 to 46 seconds, running 22 hours a day, six days a week," says Gilbert Leutwiler, Sales Manager, Gleason Switzerland AG. "The answer was – just 10."



The diamond dressing gear is directly mounted right onto the work spindle to minimize non-productive time.



The solid tailstock and high precision tooth sensor grant highest quality.

The Perfect Fit for E-Drive
As Chongqing Winstar's tests discovered, the Gleason 260HMS seems almost tailor-made to meet the challenges of their EV transmission gear production. This latest model of Gleason gear honing machines offers highly productive and flexible manufacturing of gears, shafts and stepped pinions, creating excellent surface qualities while guaranteeing minimum cost-per-piece.

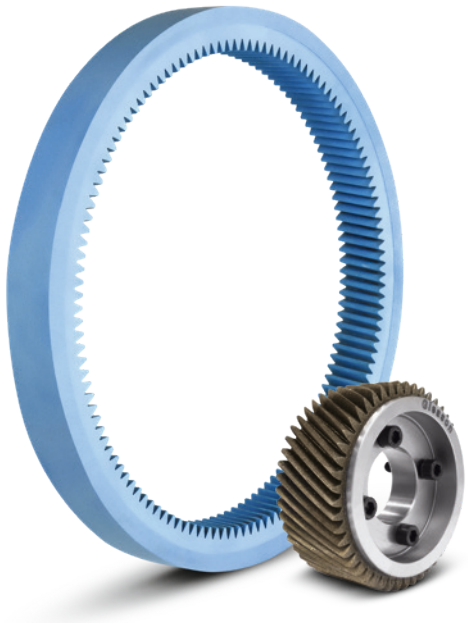
The 260HMS features a single spindle design, an additional rotary B-axis for gear flank modifications during the manufacturing process, and an integrated tailstock for shaft lengths up to 450 mm. The machine is suited for all gear honing requirements, whether shafts, workpieces as large as 270 mm in diameter and module 6, or for workpieces as small as 20 mm in diameter. Additionally, the particularly large honing ring diameter of 400 mm results in higher cutting speeds, longer tool life, and high degree of flexibility for a wide range of workpieces.

The 260HMS' exceptionally fast floor-to-floor times are achieved with the help of a simple, compact and exceedingly fast automation system serving both disc- and shaft-type parts. Workpieces are removed straight from the conveyor belt using a high-speed loader with double gripper and positioned directly above the work spindle. One gripper removes the finished workpiece, and the second gripper then loads the new part directly into the work spindle.

Optionally, the automation can be fitted with an integrated double flank roll checking device. The double flank roll checker reliably monitors the quality of incoming workpieces and sorts out any workpieces that are off tolerance and thus prevents honing stone damage.

Finally, the diamond dressing gear is mounted right onto the work spindle so that dressing can be performed on the fly to greatly minimize non-productive time typically associated with a separate loading process.

Dressing of honing rings is performed following a calculated number of parts based on the specific application. All of these tools are sourced through Gleason, which uses its extensive experience to design and manufacture the honing rings, diamond-plated dressing gears and rolls to meet the unique requirements of every application.



> “High precision, quiet pinions are achieved with Gleason.”

Mr. Duan Hanhui, Vice General Manager,
Chongqing Winstar Precise Machinery Co., Ltd.

Combi Honing

The Gleason 260HMS can also be equipped for Combi Honing, a unique process that uses two honing rings for the hard finishing of two gears on one workpiece in a single setup. It's a highly productive solution, for example, for delivering the tight tolerances required by the synchronized stepped pinions commonly used in e-drive planetary transmissions.

The Combi Honing process can also be used for Polish Honing (Super Finishing) of gears. With Polish Honing, two honing rings in one clamping are used to deliver two completely different tool specifications for rough finishing and polishing of a gear.

A Tried and True, 'Cut and Paste' Approach

According to Gleason's Gilbert Leutwiler, Gleason's ability to provide a complete system of machine, tooling and localized service is imperative to both reducing risk and helping ensure the project's ultimate success: "A honing system of this kind is designed to run with the operator doing almost nothing except loading and unloading the parts conveyor," explains Mr. Leutwiler. "The process itself is created by the honing technology experts at Gleason, and essentially built into the machines, the honing tools, and dressing gears that bestow the desired part characteristics onto the honing ring. It's a time-tested, foolproof approach to gear honing. We design the perfect system, and then 'cut and paste' it into the customer's application so it runs predictably and performs exactly as planned; a stable and highly efficient production process."

Both Mr. Leutwiler and the customer are quick to credit the exceptional Gleason application expertise and local tooling service provided through Gleason China as a key to helping Chongqing Winstar realize its ambitious production goals with these new machines.

Analytical Inspection, Noise Analysis

The Gleason order also includes 350GMS Gear Metrolgy System, which provides many of the latest inspection capabilities into a single, compact platform for the complete inspection of gears up to 350 mm in diameter and shafts up to 650 mm in length. These systems can also apply multiple analysis tools to help identify the root cause of gear noise, including tooth contact analysis, Advanced Waviness Analysis, and Kinematic Transmission Error Prediction Software (KTEPS).

Gilbert Leutwiler
Sales Manager
Gear Honing Machines

About Chongqing Winstar

Established in 1999 in the Bishan District of Chongqing, China, Chongqing Yongda Precision Machinery Co., Ltd. (Chongqing Winstar) has grown to become one of China's leading gear jobbers specializing in the production of all types of automotive transmission gears, and in particular, gears for EV applications. The company today employs over 520 people in its modern, fast-expanding ISO/TS 16949 and ISO-9001 certified facility.

For more information, visit:
http://cqwinstar.cn

The Power Behind Power

The departure from fossil fuels and the massive expansion of wind and solar plants is only one side of the coin when it comes to the future of the grids. The other is that at the same time the demand for electricity is rising rapidly. Not only because mobility and heat are becoming electric, but also because more and more people need electricity to live: According to UN forecasts, the world's population will rise to around 10 billion by 2060. But if more electricity is to flow, more lines and larger transformers are required.

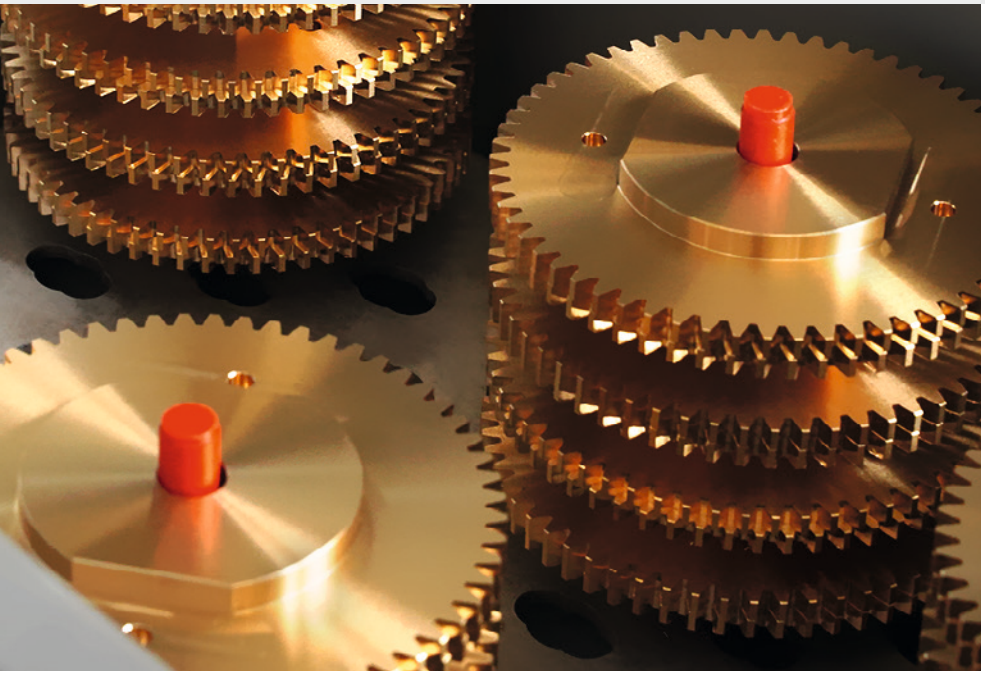
As an expert in the regulation of power transformers, Maschinenfabrik Reinhausen in Regensburg manufactures over 5,000 different parts, the majority of which are for on-load tap-changers for monitoring, control and regulation technology.

With so many different parts, integrating new machines into the production process is a major challenge, especially when it comes to replacing a single machine for a specific technology such as gear production. The existing Pfauter P253 Hobbing Machine from 1985, which was equipped with a SIEMENS 840C retrofit in 2002, has served its terms faithfully, but after so many years of service the availability of electronics and control spare parts could not be guaranteed any longer.

Maschinenfabrik Reinhausen at a Glance

Founded 1868 in Regensburg, Germany.
3,600 employees worldwide.
45 subsidiaries and 4 joint ventures.
Development of on-load tap changers for power transformers.
Production in Germany, Italy, USA, China and India.

www.reinhausen.com



“We enjoy honest and direct communication – we simply like authentic people”, says Hans-Jürgen Heizmann, Department Foreman Parts Manufacturing. “We selected 3 suppliers, but only with Gleason the ‘total package’ did fit. The machine is extremely accessible and easily set up, important when manufacturing many different parts and small lot sizes. If a machine is well accepted by its operators, performance will come along almost automatically.”

One of the GP300 operators at Maschinenfabrik Reinhausen puts it with his own words: “The functions, software, operability and training concept leave nothing to be desired – this machine is complete in itself.”

Maschinenfabrik Reinhausen´s Ambitious Sourcing Strategy

Living up to its ambitious sourcing strategy, Maschinenfabrik Reinhausen considers many variables when choosing a supplier and new manufacturing assets, from technical and quality requirements to internal regulations and contracting, and – very important – an effective training concept for operators. All required criteria are aready clarified in the run-up phase.

For the investment of its new gear cutting machine, the Maschinenfabrik Reinhausen buying team carefully reviewed all facts including the operators’ input regarding the machine to be replaced. After walking through the complete performance review, Maschinenfabrik Reinhausen went to see a reference at an existing Gleason customer, a visit that really helped the decision process.

Because at Maschinenfabrik Reinhausen, the operator is also the setup person. Frequent and fast setup is of great importance for overall productivity. So Maschinenfabrik Reinhausen asked for support – and Gleason delivered: In a special machine setup workshop the efficiency of tooling changes was further improved, with Reinhausen’s operators really enjoying Gleason’s flexible workholding systems. In order to employ all existing tools, Gleason designed a special adapter to fit the standard HSK-B80-D25. In addition, Reinhausen had specific ideas to support future workpiece expansions, and Gleason helped making the required adjustments – a flexibility that Maschinenfabrik Reinhausen really appreciated.

Specific tool adapter to use existing tools with Maschinenfabrik Reinhausen’s new GP300.

> Apart from all technical and contractual requirements, we found a common language with Gleason and ‘meshed’ – this is very important to us when choosing a long-term partner.
>
> Hans-Jürgen Heizmann, Department Foreman Parts Manufacturing

The universal nature of the GP300 suits the broad workpiece range of Maschinenfabrik Reinhausen perfectly.

> The functions, software, operability and training concept leave nothing to be desired – This machine is complete in itself.

Bernhard Winter, Michael Meisinger, Machine Operators GP300

The next generation: Genesis® 280H/HCD

The brand-new successor to the GP300 Hobbing Machine features gear hobbing and optional chamfer cutting in one complete package, with or without automation.

Learn more about medium size gear hobbing

Multiple Gear Types on One Universal Machine

With the large variety of components and many new parts, ongoing optimization is an issue. Therefore, the extensive correction options and pre-programmed cycles in the application software were very important since they are commonly used.

Hans-Jürgen Heizmann concludes: “Why Gleason you may want to ask? References and recommendations pointed to Gleason. Gleason quoted fast and had immediate answers to questions.

The machine itself has the right size, features great functionality, caters to a broad workpiece spectrum including cast iron and steel, is cost-efficient, with great accessibility, simple setup, and convenient operation. Without being overly sentimental the Pfauter history is a bonus and pays off with long-standing experience and knowhow including the reliability experienced with the former machine. With Gleason we have definitely made the right choice.”

Florian Reitberger
Regional Sales Manager
South Germany

Complete Solutions from One Source

Gleason

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