

Simplified Tooling Improves Gear Inspection Processes

DUANE VEIT, VEITTOOL & GAGE

Introduction

Standard external gear sizing techniques include measurement “over balls” or “over pins.” For these measurements, a ball or a pin is inserted in teeth at opposite sides of the gear as shown in Figure 1. Using pins has the advantage of measuring the high spots of the gear surface, making the measurements more consistent. The figure on the left shows a measurement on a gear with an even number of teeth, on the right is shown gear measurement with an odd number of teeth.

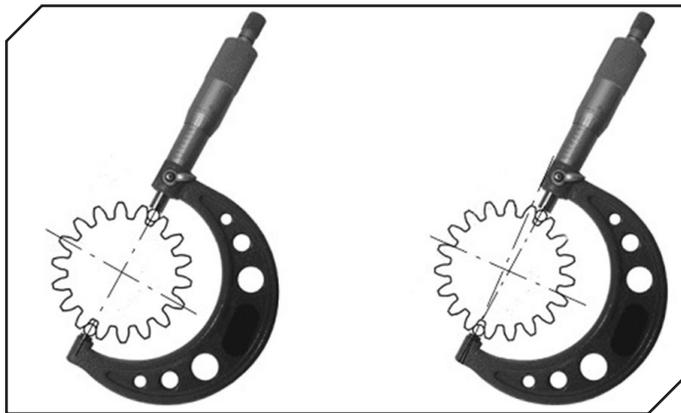


Figure 1 Tooth Thickness Measurement over Pins. Extracted from ANSI/AGMA 2002-D19 with AGMA permission.

Making over ball or over pins measurements using a micrometer requires careful test set up with a trained operator who has a good feel for the process to ensure proper measurement repeatability. Micrometers deliver absolute measurement

which require checking against a drawing, versus an absolute gage which directly delivers out-of-tolerance information. Testing with pins and a micrometer is difficult to do with a part that is in-process or still on a lathe or NC machine. Testing a gear while still on a machine can help validate processes and improve overall quality.

Inspecting gears with a CMM delivers high accuracy readings and helps ensure quality of multiple features. Using CMMs to measure every gear can be time consuming and costly and typically requires a trained operator. A CMM cannot make measurements with a part still on a production machine.

Simplified Tooling Speeds Measurement

Integrating balls or pins into the tooling of a hand-held comparative gage offers many benefits to using a micrometer and loose balls/pins and testing with a CMM. Process checking is fast and can be done by an untrained operator even with a part on a machine. With simplified integrated tooling, a gage can be used to measure multiple gear characteristics with a simple tooling change, reducing the need to stock and calibrate multiple gages.

Testing External Gear Pitch Diameter

Figure 2 shows a ONEGAGE measurement tooling with integral balls for testing external gear pitch diameter. The balls shown here are made of carbide or hardened steel with dimensional tolerances that meet the specifications called out in the gear manufacturing drawing. Tooling changeover is quickly made using two fasteners. Figure 3 shows a gear inserted into the tooling for measurement.



Figure 2 ONEGAGE tooling with integral balls for measuring external pitch diameter.

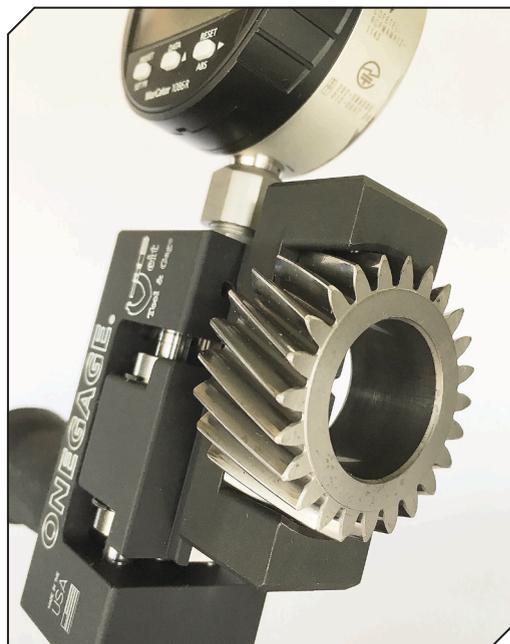


Figure 3 ONEGAGE measuring the external pitch diameter of a gear.

Figure 4 shows an engineering drawing of a dimension-over-pins test for a worm gear used on a snowmobile starter armature shaft. This test uses three pins to gage for proper pitch diameter. The pin diameters are called out on the specifications for measurement over pins on the worm gear drawing. The pitch diameter of the component gear will determine the placement location of the pins in the tooling. *SolidWorks* and customer part models were used to create the ONEGAGE tooling.

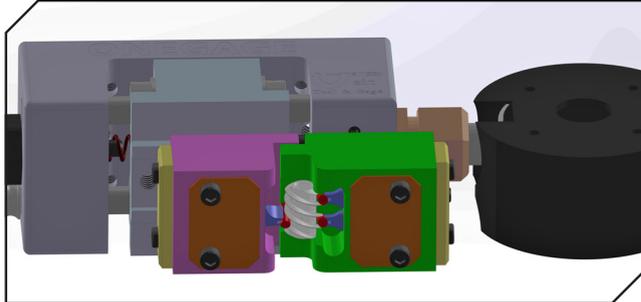


Figure 4 Tooling and pin placement on worm gear. Pins are shown in red.

Testing Internal Features

Testing internal features such as splines and ID gear pitch diameters can be accomplished in a similar fashion. Balls or pins are situated facing outward on the tooling. Figure 5 shows tooling designed for testing-over-pins of an internal spline. The pins in this application are trapped semi-floating against parallel surfaces, allowing them to find and comply to true position in relation to the spline pitch diameter.

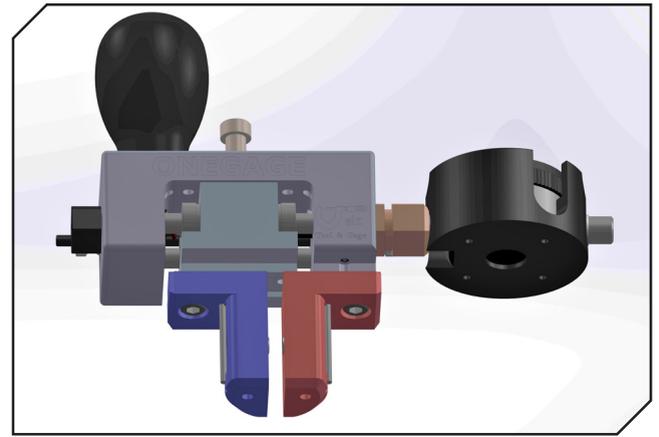


Figure 5 ID measurement using pins.

In-Process Testing

Enabling engineers and machinists to make in-process measurements with parts on a machine helps validate processes and improve overall part quality. Having a comparative measurement gage which uses a master as a standard eliminates the need for the machinist to check dimensions against a drawing.

The gage shown in Figure 6 uses sealed and lubricated circuit bearings with 62Rc hardened and ground guide shafts to eliminate contamination from chips or lubricants that may affect gage performance. The spring actuation mechanism makes it easy to use one handed and with gloves. The part shown in Figure 6 is an internal 10mm threaded gear and is being inspected for internal thread pitch diameter. Electronic indicators with integrated

GRUPOS DIFERENCIALES

High precision Gears and Components.

Short lead times for any volume environment.

Latest technology for high efficiency and competitiveness.

PRESENCE IN ALL SECTORS:

- **Marine**
- **Highway and Off-Highway**
- **Industrial**
- **Railway**
- **Aerospace**

www.gruposdiferenciales.es

Portal de Bergara 32,
01013 Vitoria-Gasteiz (Álava) Spain
Phone: (+34) 945 260 100
Fax: (+34) 945 261 446



wireless technology can also be used in place of the gage shown to collect data for trending or quality issues.



Figure 6 Machinist gaging internal thread pitch of M10×1.5.

Applications

Aerospace/Aviation

A helicopter manufacturer needed to inspect an ultra-fine pitch (220 tooth) internal spline on a 50mm diameter. The part needed to be inspected while remaining captured in the machine to allow for adjustments to the pitch diameter to ensure the correct geometry. The tooling consisted of 0.4mm balls on a 3-point contact to accomplish a successful gaging solution with an acceptable R&R. The solution significantly reduced the overall scrap rate.

Automotive Powertrain

An OEM powertrain manufacturer required tooling to inspect an internal 28 tooth spline over pins dimension. The solution used semi captured parallel floating carbide pin tooling on a standard ONEGAGE. The manufacturer was able to inspect parts on the floor, eliminating having to take them to an inspection lab to be ran on a CMM, saving both time and money.

Broach Manufacturing and Resharpener

A company that manufactures broaches needed a fast and easy way to validate the quality of their broaches. They used ONEGAGE to measure the diameter-over-pins measurement of their broaches. The same gage has also been used by a broach resharpener company.

Simplifying the Process – Tool Changeover

To eliminate gage proliferation, the ONEGAGE was developed to work with a standardized mounting feature for common mounting of all tooling. Tooling consists of one fixed and one

sliding tool. Female keyways are ground at assembly and have a single centered dowel pin to ensure perfect alignment with the opposing tools. A single screw is used to secure each tool. Tooling can be changed out in under one minute.

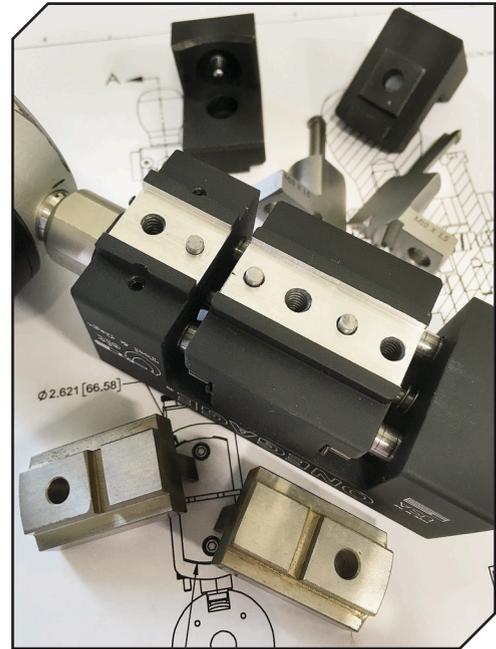


Figure 7 ONEGAGE Tooling Mounts.

High Repeatability

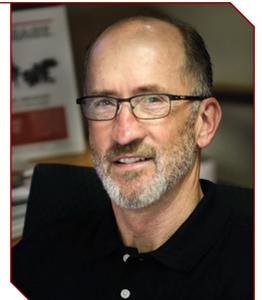
In the development of any gage and gage tooling, it is critical to ensure high accuracy and repeatability. Using precision machining for tooling, ONEGAGE can achieve accuracies and repeatability of 1 to 2 microns. Using a “setting master”, a gage R&R of 10.17% was achieved when testing an internal spline pitch diameter.

Conclusion

Comparative gaging with dedicated innovative tooling can simplify measurements, improve gear inspection processes, and reduce inspection costs and time. These types of gaging systems can enable inspection of parts while on a machine which helps improve the overall process and quality control. Having a gage with easy to replace tooling can reduce the overall number of gages that a manufacturer must own and maintain.

veit-tool.com

Duane Veit is the President of Veit Tool and Gage in Davison, MI which he started in 1988. Duane developed the ONEGAGE solution based on 30 years of gaging experience and input from industry leading gear experts. Veit Tool and Gage also manufactures gear roll test fixtures, dimension over ball/pin DOB/DOP gages, and gear burnishing systems. The company's website is www.veit-tool.com, and Duane can be reached at dveit@veitool.com.



Affolter Group

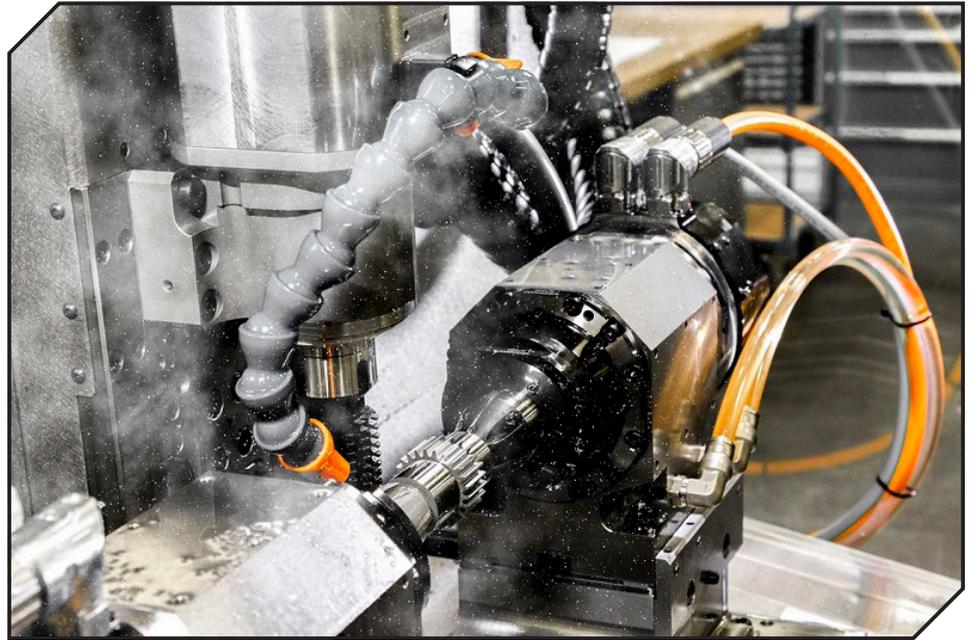
OFFERS VERSATILE AND EFFICIENT GEAR HOBBING MACHINE

Affolter Group has introduced the AF160 is the most versatile Affolter gear hobbing machine to date. “The AF160 is designed for high precision manufacturers that need versatility and maximum efficiency,” explains Vincent Affolter, managing director of Affolter Group. “With eight axes, a state-of-the-art digital CNC control, a variety of automation solutions and a maximum module of 2 mm, it is ideal for manufacturers in industries such as automotive, aerospace, aircraft, gearbox, medical or robotics.”

The AF160 can process parts with an outside diameter of up to 60 mm and a length of 250 mm. The machining length is between 110 and 180 mm. The eight axes — all of them independent — make the AF160 the most flexible Affolter machine to date. It can produce straight gears, helical gears, straight bevel gears, face gears, straight or helical crowned gears, worm screws, worm wheels, cyclo gears, and internal gears. Power skiving, the milling of worms and shafts, as well as chamfering is possible, too. Affolter continued, “The AF160 enables manufacturers to produce an impressive variety of high precision gears, worm screws and worm wheels on the same, compact machine.” The footprint of the machine is only 4m². Including the loader AF72 it is a little more than 6m².”

“We think of it as a solution, not a machine — a solution that meets the needs of our customers. Thanks to the new CNC Control, various automation systems and peripherals, and the versatility of the AF160, we can offer maximum productivity for high-precision manufacturers in a very broad range of applications,” Affolter added.

The engineers of Affolter Group cooperated with Beckhoff Automation to launch the brand-new CNC Control Pegasus. The high processing power ensures extremely fast regulation. “It controls all machine axes as well as a multitude of peripherals for various options and automations,” said Affolter. Programming is simple,



intuitive, and user-friendly with a 19-inch touch screen. The new CNC Control integrates IoT. Data can be shared on the cloud, streamlining after-sales service and preventive maintenance, and therefore minimizing downtimes. Software updates can be done remotely.

Depending on the application and production processes, manufacturers need automation solutions to facilitate an autonomous operation for 12 to 24 hours. Affolter provides a range of such automation solutions: The universal multi-axes part loading and unloading system AF72 was especially designed for the AF160. It features a double gripper system for parallel loading and unloading and offers different methods of feeding based on the volume, product, and application. The AF160 can also be equipped with the deburring unit AF54, integrating the deburring process into the gear production. Different clamping systems provide for added versatility. Customizable coolant systems and chip extraction conveyors are available as well.

www.affoltergroup.ch

Liebherr

OFFERS SOLUTION FOR ROBOTICS AND SPECIAL APPLICATIONS IN GEARING

Precision gears for industrial applications have to deliver a top-class performance. In order for a robotic arm to achieve precise gripping movements, for example, extremely small and lightweight components are required that must also provide enormous transmission ratios. Cycloidal drives or Harmonic Drive gearboxes are used in particular. These simply constructed gearboxes are characterized by their precise transmission of motion, zero backlash and high transmission ratios, and they are also free from wear and tear. Furthermore, they are very compact in size. In order to manufacture these demanding parts, Liebherr has developed solutions and made its range of

the quality even more,” said Dr. Andreas Mehr, who is responsible for gear grinding and gear shaping at Liebherr. Due to the faster grinding times, generating grinding is comparatively less expensive.

For internal profile grinding of the roller seats on the inner ring, a grinding wheel had to be developed that is capable of grinding a full radius. Liebherr succeeded in doing this by producing its own CBN grinding wheels with electroplated bonds that are dressing-free and wear-resistant. This ensures maximum process stability and process quality. The user is also more flexible when changing from external to internal grinding on one machine: changeover is possible in less than 30 minutes.

The gear teeth of the Harmonic Drive gearbox presented another manufacturing challenge. Here the load is distributed over a large number of tiny teeth, which, in extreme cases, are so tiny that they are barely visible to the naked eye. “When it comes to gear hobbing and gear shaping, we are sometimes at the limits of what is both technically feasible and still measurable” said Dr. Oliver Winkel, head of technology application at Liebherr. “But when it comes to extreme requirements in the production, handling and measurement of such small-modulus components, Liebherr is the perfect partner.”

Liebherr sees itself as a solution provider for the growing performance requirements resulting from the boom in automation, and is constantly working to expand its range of manufacturing processes. In the future, for example, the internal gear of the circular

spline for Harmonic Drive gearbox can also be produced by gear skiving, like on Liebherr’s LK 180 — another option for greater flexibility and efficiency. This also applies to other special cases, for which there may not yet be a solution already on the market but which will be developed in cooperation with the customer.

Liebherr also sees itself as a competent partner when it comes to meeting the growing demand for components for robotic applications and increasing productivity. Winkel explains: “Whether setting up a new production from scratch, supplying machines, defining processes, training employees or providing service and support,” Winkel said. “We have the expertise to advise and accompany our customers throughout the entire process.”

www.liebherr.com



processes more flexible.

Dimensional stability, excellent surface quality, and high profile and pitch quality must all be ensured in cycloidal gears, and the rollers must fit perfectly with the inner ring. New from Liebherr and specially developed for cycloid gearing: externally toothed cams can now also be produced using single or precisely paired double clamping by means of generating grinding. Thus, depending on the number of pieces required, not only is profile grinding available to users but also a further grinding method for the cam discs.

For this application, generating grinding offers a number of advantages over profile grinding such as higher pitch accuracy, improved dimensional stability and an even profile over the whole cam disc, thanks to the improved wear distribution of the grinding worm. “By avoiding the undesirable ‘steps’ in the profile, we have been able to improve

PTG Holroyd

COLLABORATES WITH SIEMENS ON GEAR GRINDING CENTER

A new precision gear grinding center from PTG Holroyd hasn't simply been designed to bring greater levels of efficiency and accuracy to the production of specialized gears and tooth forms. The new machine, called the HG350-G, is also the first from PTG Holroyd - and believed to be the first in the UK - to use Siemens' new Sinumerik ONE future-proof CNC, the successor to the automation specialist's 840D CNC.

PTG Holroyd has committed in excess of £1.6 million to develop its brand new gear grinding center, a machine which has been designed to give the company a significant edge in the horizontal form grinding of high-quality gears. "We plan to build two HG350-G machines to begin with," comments Regional Sales Director, Mark Curran. "One will remain on site in Rochdale for R&D purposes. The other has been purchased by a long-standing PTG Holroyd customer."

In designing the HG350-G, PTG Holroyd's goal was to offer customers much more than a new generation machine for the one-off and batch grinding of high-accuracy precision spur and helical gears, as well as worms and screws up to 350 mm in diameter. "We wanted to

create a machine with class-leading integrated safety and failsafe features, rich, real-time reporting of machine health and performance data, as well as the highest levels of industrial security," adds Curran. "Other non-negotiables for the HG350-G included being exceptionally intuitive for operators,



aicheilin group

AFC HOLCROFT
industrial furnace solutions

AFC-Holcroft furnaces with integral salt quench systems: Higher flexibility and increased strength for lightweight metal parts

A century of professional experience and specialized know-how; together with satisfied customers and thousands of installations worldwide, make AFC-Holcroft your first choice for industrial furnaces for the heat treatment industry.

- Salt quench processes are performed under a protective atmosphere for increased safety and better results.
- Available as UBQA (Universal Batch Quench Austemper) furnaces for larger parts.
- Available as Mesh Belt Furnaces for smaller parts such as stampings and fasteners.
- Easy to maintain and feature a modular design for seamless integration into your individual production lines.

Please visit us at www.afc-holcroft.com



AFC-Holcroft Europe - Świebodzin, Poland
AFC-Holcroft USA - Wixom, Michigan
AFC-Holcroft Asia - Shanghai

Reliability at work

easily able to accommodate each customer's Industry 4.0 strategy and being future proofed against legacy software issues. These were all attributes that the Sinumerik ONE CNC was able to offer. Additionally, the associated software suite's ability to create a digital 'working' twin of the machine on the desktop before build commenced was a considerable advantage."

"Typically, when creating a new machine tool, you begin with a vision — a concept of what you would

like your new machine to achieve," says Curran. "That said, software can't normally be written or mechanical components ordered until the design is complete and has been verified — and, even then, changes may be required. By working in close collaboration with Siemens, however, we were also able to embrace the 'Create my virtual machine' and 'Run my virtual machine' software capabilities of the Sinumerik ONE suite, in order to create and run a 'digital twin' of the proposed HG350-G."

Used in tandem with its own internal machine design packages, these capabilities enabled PTG Holroyd to build a virtual machine on the desktop, then grind virtual gears and threads, test safety and failsafe capabilities and eliminate potential problems before commencing the machine build. "At PTG Holroyd, we pride ourselves on a 'right first time' approach," adds Curran. "The virtual machine build and run capabilities offered in the Sinumerik ONE suite further helped us to fulfil this ethos, enabling us to input and observe entire manufacturing cycles before commencing a physical build. This will also make acceptance testing with future HG350-G customers simpler and straightforward. In short, they will be able to sign off on their gear grinder before it has even been built."

"It has been a privilege to work with the PTG Holroyd team to incorporate the capabilities of the new Sinumerik ONE CNC into the HG350-G gear grinder and to help utilize the benefits of the Sinumerik software suite to perfect the machine's design," comments Garry Mephram, application engineer at Siemens, "PTG Holroyd is an important customer of Siemens in the UK and I am confident their decision to use Sinumerik ONE will provide significant benefits — both in terms of machine design & development and by providing customers with future-proof capabilities and control."

Replacing PTG Holroyd's well-established GTG2 model, the HG350-G features the high power required for deep grinding operations. A specially developed extended machine bed allows screws and worm shafts of up to one meter in length to be accommodated. Dedicated software compensates for helical twist, and full topological capability comes as standard.

Embracing the Sinumerik ONE CNC's Profinet capabilities, IO-Link communication technology will be offered with all new HG350-G machines.

www.holroyd.com



Gearing your past to power your future.



Breakdown Services

We understand the urgency of meeting critical deadlines. We offer our customers expedited services without sacrificing quality.

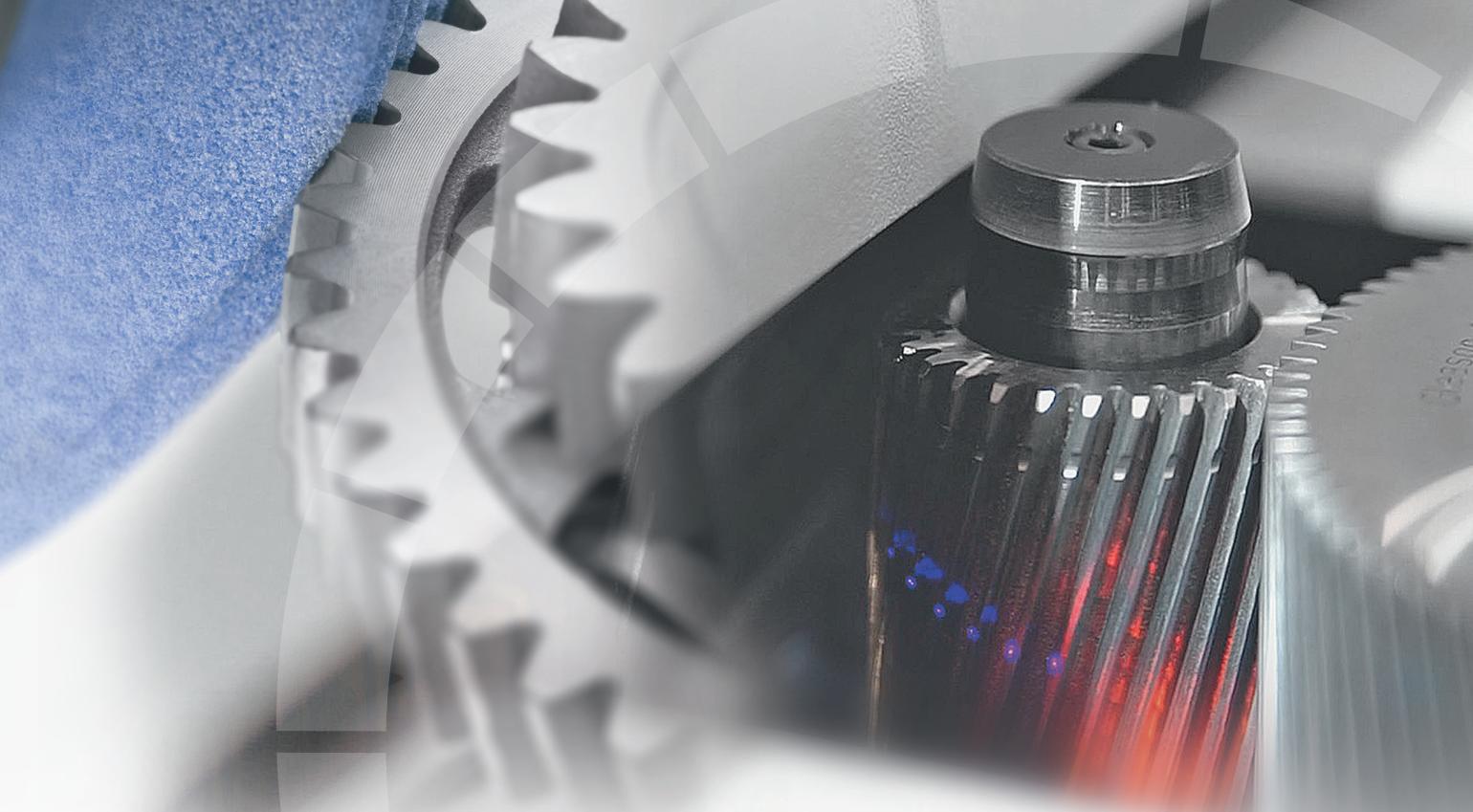
Heat Treatment

Our in-house heat treat facility performs a full range of services that include annealing, carburizing, and thru hardening.



B&R Machine and Gear Corporation is a full service gear manufacturing facility driven to power your equipment with reliable and durable gears that are built to perform and last. Find the perfect mesh. No matter the gear, we've got you covered.

VISIT OUR WEBSITE BRGEAR.COM FOR MORE INFORMATION

A close-up photograph of a gear being inspected. A laser scanning probe is positioned against the gear's teeth, with red and blue laser lines visible. The background is a blurred image of other gears.

Game Changer: 100% In-Process Inspection

100% inspection – analytical, composite and noise detection – of all your gears in high volumes is now a reality. Gleason's new GRSL Gear Rolling System with quick change laser scanning, operating in a Closed Loop with the HFC Hard Finishing Cell or in a stand-alone mode fully inspects every gear tooth in just seconds. Corrections are fast and fully automated. Just in time to meet the quality requirements of your next e-drive project.

www.gleason.com/grsl



Total Gear Solutions **Gleason**

BMW Motorrad

USES JUNKER JUCRANK
FOR VARIETY OF GRINDING
OPERATIONS

BMW Motorrad uses the JUCRANK non-cylindrical grinding machine for different grinding operations on boxer crankshafts. These are assembled into the latest BMW two-cylinder



boxer engines for efficient motorbikes. Impressed by the level of precision and extensive experience in developing CBN high-speed grinding machines, BMW Motorrad has been putting their trust in the Junker grinding experts for more than three decades, with 45 machines at five sites worldwide.

In-process measuring systems guarantee high process reliability and dimensional accuracy. The fully automated system measures the exact workpiece data and adjusts automatically during the grinding process if needed. This procedure reduces auxiliary process times and increases output.

Preventive Maintenance Assistance — the software-assisted solution from Junker. The online help system notifies of an upcoming maintenance or repair operation on the machine. The Junker machine notifies of upcoming repair operations and ensures reliable planning. Continuous monitoring of the results is possible with the new protocol manager. In addition, all data can be evaluated in freely selectable recording intervals. Thanks to digitalization possibilities with partner 4JU, the industry pioneers can adapt the digitalization of machines and systems precisely to the needs of BMW Motorrad.

When Service issues arise, the Junker experts can connect directly to the machine through a secure tunnel safely outside of the customers network. The Junker experts quickly analyze the data and reliably take all necessary measures.

It is possible to collect operating data efficiently and in a user-friendly way, with status determination (such as, for example, job start/end, ongoing updates and output. The advantage is that the entire production process can be

Tired of the 'Whether'? GO SOUTH.

Whether it fails...whether it gets there on time... Southern Gear has the experience and resources to take all the uncertainty out of your custom precision gear production.

Aerospace and defense. Medical to marine. When there's a lot at stake and it needs to be done right. The 'whether' is always better at Southern Gear.

There's a Better Way.

SOUTHERN GEAR

800.248.5152 | southerngear.com | 3685 NW 106 St. Miami, FL 33147

Established in 1957 | Veteran-Owned | ISO 9001:2015 | AS9100D | ITAR Compliant

monitored at any time and from anywhere.

BMW Motorrad and the Junker Group have been enjoying a positive business relationship for more than 30 years. BMW successfully uses Junker OD non-cylindrical grinding machines for machining crankshafts at their production sites in Germany, Europe and Asia.

www.junker-group.com

Ransohoff

MINI JET WASHER OFFERS EFFICIENT HIGH-VOLUME PARTS CLEANING

Ransohoff, a division of the Cleaning Technologies Group LLC, has introduced its Cell-U-Clean Mini Jet spray cabinet. This new small footprint platform provides an energy efficient, reliable solution for your high-volume cleaning needs, along with an innovated design for those smaller part cleaning applications.

The Mini Jet a member of the Cell-U-Clean line of parts washers, is an excellent cabinet washer for both small and large parts up to 500 Lbs. where floor space comes at a premium. This spray washer was designed as a

high-capacity solution with low energy as an alternative to our heavy-duty cabinet washer product line. The rotary hide away door eliminates the extra floor space required for the door swing while ensuring a dry floor when loading and unloading.

The new Cell-U-Clean Mini Jet is a wash and blow-off machine in a small footprint of 5 ft. wide x 8 ft. long x 7.6 ft. tall. The part production rate is 60 seconds cycles, with a variable speed table drive. The Cell-U-Clean Mini Jet is constructed of all stainless steel and comes with a robot loading option. The new Cell-U-Clean Mini Jet comes standard with the industry leading 3-2-1 warranty.

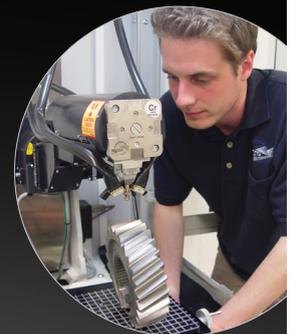
www.ctgclean.com/cell-u-clean-mini-jet



RESIDUAL STRESS MEASUREMENT

State-of-the-art facilities
and superior service.

No compromises.



www.protoxrd.com

1-734-946-0974
info@proxrd.com

PROTO
X-RAY DIFFRACTION

Helios Gear Products

ANNOUNCES NEW CNC GEAR DEBURRING MACHINES

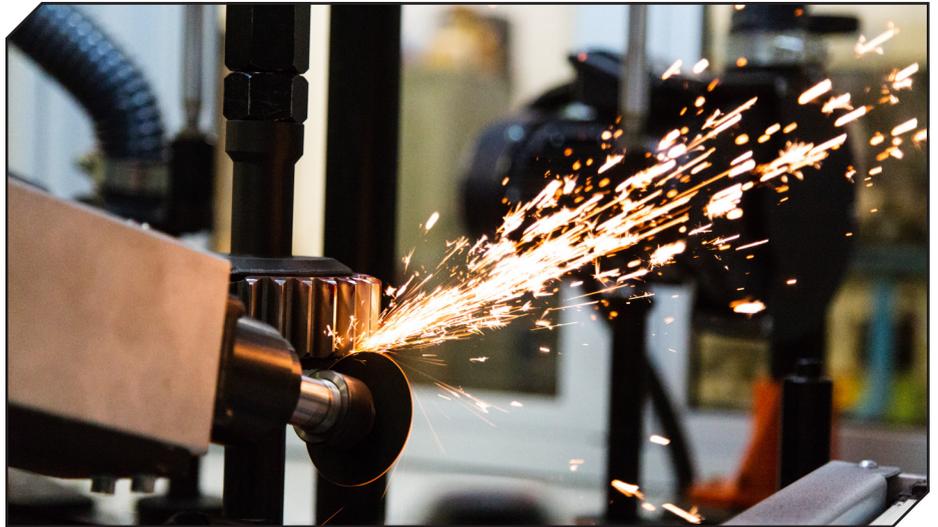
Helios CNC gear chamfer-deburring machines increase profitability for job shops and high-mix manufacturing.

“Gear manufacturers need a new level of gear chamfer-deburring that offers quick and easy setups with repeatable high quality,” said Adam Gimpert, president of Helios Gear Products. To meet this demand, Helios announces new CNC advances to its line of Tecnomachine chamfer-deburring machine tools. These CNC improvements offer manufacturers a machine platform with maximum flexibility for a high mix of part sizes and types including spur and helical gears, bevel gears, bore- and shaft-type parts, and others. These abilities are driven by a new CNC system that programmatically controls all factors for the chamfer-deburring process. This equips manufacturers with a process that is easy to set-up and change-over for reliable and consistent quality.

Several factors impact successful chamfer-deburring with abrasive wheels

and carbide end mills. These include the tool position (radial, axial, tangential, and inclination), tool pressure, tool rotation speed, tool rotation direction, workpiece rotation direction, and workpiece rotation speed. Traditional machine tool deburring often requires manually

setting several if not all these items. Today, Helios offers its gear chamfer-deburring machine tools with friendly dialog programming of all these items. This allows a setup technician to store a complete application to later be recalled by the CNC with just a few software



SMT

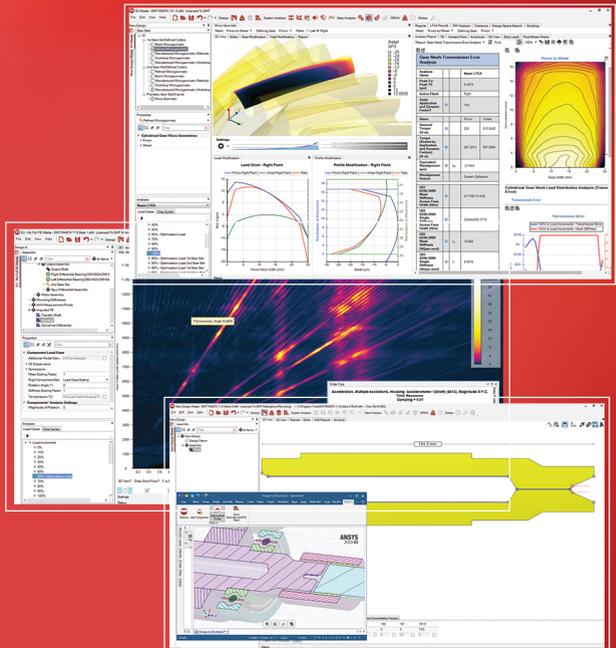
Gearbox & Driveline Design, Analysis & Optimisation

MASTA enables engineers to design robust, efficient, light weight and quiet transmissions from concept design, all the way through to manufacture.

Run and generate reports on a wide variety of analyses including NVH, system deflection, durability, FE & more.

Visit smartmt.com/masta to learn more.

MASTA ¹¹



Visit smartmt.com/evaluation-GT to request a FREE evaluation of MASTA for up to 3 months.

Mitutoyo

RELEASES EJ COUNTERS AND LG100 SERIES LINEAR GAGES

steps. Additionally, tool spindles can be configured with brushing units for CNC brushing within the same chamfer-deburring cycle.

As one example, manufacturers use the Helios TM 250-CNC machine for profitable gear chamfer-deburring. This machine features a rotating table with two stations: one for loading/unloading parts by hand or integrated robot; the second for chamfer-deburring and brushing of the workpiece. This feature minimizes machine idle time and drastically improves productivity of the solution. Moreover, the machine implements a complete CNC system for the abovementioned abilities: quick and easy changeovers from saved setups of all tool and work positions and parameters. Changeovers can be accomplished in just a few minutes rather than the traditional 30-45 minutes.

For productive gear chamfer-deburring, the new series of Tecnomacchine equipment from Helios Gear Products offers manufacturers an ideal machining solution. With complete CNC functionality, these machines minimize change-over time, maximize repeatable quality, are easily programmed, and minimize idle time. Consequently, gear manufacturers can achieve top levels of productivity from their chamfer-deburring operations.

Heliosgearproducts.com

Mitutoyo America Corporation has released new EJ Counters and LG100 Series Linear Gages to its expansive sensor lineup of metrology products.

EJ Counters and LG100 Series Linear Gages are designed to be used inline or in measurement cells, enabling real-time measurement and data management in any type of work environment. Features of the EJ Counters and LG100 Series Linear

Gages include:

- Environmental Resistance: Sliding durability of more than 50 million cycles*, with protection level of IP67G. A highly oil-resistant material is used in the rubber cap and cable sheath, so it can be used even in harsh environments (*10 mm range models).
- Reference Point Detection: Reference point signal output functions are featured throughout this series. When incorporating into a device the master setting value is easy to set and is retained after shutdown.

- Combines compact size and ease-of-use: High-speed and compact, delivering production site visualization, improved productivity, and information feedback. Up to 8 compact EJ Counters can be linked providing the capacity to connect to 16 gages. On a DIN rail, each unit can be connected directly without using cables to maximize space. All linked units and gages can be driven by a single power source.
- CC-Link connection, USB connection: Data can be output through an industrial interface (CC-Link) by linking a compact EJ Counter with an interface unit. Constant data monitoring and positional management are performed. A USB interface is also provided for easy connection with a computer.
- Calculation Function: Enables sum difference operations between two gages connected to the same counter. Additionally, functions such as tolerance judgment and peak hold are included.

www.mitutoyo.com

