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INCREASING STATIC FRICTION WITH LASER
High static friction is important for improving safety and reducing costs.

By GERHARD FLORES

HYDRAULIC WORKHOLDING TAKES HOLD
New Gleason hydraulic workholding solutions are becoming an attractive alternative to traditional mechanical systems in an increasingly wide range of gear-manufacturing applications.

By PETER HARRISON

STILL STUCK WITH HAND DEBURRING?
With hand deburring, consistent quality and steady volume are vital concerns.

By WAYNE MOORE

TACKLING AGGRESSIVE GEAR-GRINDING APPLICATIONS
COMPANY PROFILE  With a history that dates back more than century, Weiler Abrasives has become a global market leader in abrasives, delivering innovative solutions to customers in targeted end markets.

By KENNETH CARTER
Manufacturers of:

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Visit Our New Website at www.broachmasters.com
New steel for gears opens up design possibilities.

Klingelnberg solutions in measuring technology on display at Control 2019.

In this section, the premier supporter of gear manufacturing in the United States and beyond shares news of the organization’s activities, upcoming educational and training opportunities, technical meetings and seminars, standards development, and the actions of AGMA councils and committees.

American Gear Manufacturers Association

Brian Dengel

Standards in Terminology for Gearin

Knowing the proper terminology is key for understanding gear design.

D. Scott Mackenzie

Back to Basics: Quenching, Tempering as Heat Treatments

A short look at the most common method of heat-treating steel.

New products, trends, services, and developments in the gear industry.

Dave Jones

Precision Workholding Product Manager at Emuge Corp.
Workholding and cutting tools go hand-in-hand

In order to cut a tool properly, it needs to be securely in place — seems like a no-brainer. But the expertise and technology required to accomplish perfect pieces every time, over and over again, is anything but simple.

That’s why this month’s issue of Gear Solutions is devoted to workholding and cutting tools, two extremely important facets of gear manufacturing.

Our cover story, by Gerhard Flores with Gehring Technologies GmbH, looks at laser machining of surfaces with high static friction as an established application of laser technology. The article argues that high static friction is important for improving safety, as well as reducing costs.

In the workholding department, we have an article from one of our good friends at Gleason. In the article, Peter Harrison discusses Gleason’s new hydraulic workholding solutions and how they are becoming an attractive alternative to traditional mechanical systems in a wide range of gear-manufacturing applications.

Also on the subject of workholding, is April’s Q&A. We chat with Emuge’s David Jones about his company’s workholding options.

In addition to our focus articles, this month’s issue also has an article from James Engineering on the challenges of deburring by hand. And our regular columnists are sharing their expertise about quenching and the need for standard terminology for gearing.

Our company profile shines a spotlight on Weiler Abrasives. The company has been around for more than a century, and its dedication and deep history has helped make it a leader in abrasives and delivering innovative solutions to its customers.

As you can see, there’s a lot to be found in our April issue to jump into. I’m sure you’ll find something to keep you informed.

As always, thanks for reading!

KENNETH CARTER, editor
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WE OWN WHAT WE SELL, AND WE KNOW WHAT WE’RE SELLING!
New steel for gears opens up design possibilities

The Swedish company Ovako is a leading producer of engineering steel for customers in the bearing, transport, and manufacturing industries, and a subsidiary of Nippon Steel Sumitomo Metal Corporation.

The integration of the clean steels 159X and 159Q into GWJ’s cylindrical gear modules took place in close cooperation between Ovako and GWJ Technology. 159X and 159Q are based on case-hardening steel of the type 18CrNiMo7-6. Because of significantly smaller-sized impurities in the steel, the steels have modified Woehler curves. Within the static strength, the steels are comparable with 18CrNiMo7-6. In the fatigue strength range, the IQ-Steel 159Q (Isotropic Quality ultra clean steel) is designed to increase efficiency by 30 percent for the flank load capacity and 60 percent for the tooth root load capacity. The fatigue strength values are based on Ovako’s in-house investigations and external verifications at WZL of RWTH Aachen University and at the Gear Research Centre (FZG) of Technical University of Munich.

The BQ-Steel 159X (Bearing Quality clean steel) delivers slightly smaller performance gains compared to 18CrNiMo7-6 and can be taken to improve existing designs. 159Q is ideal for new design solutions. It may be advantageous to focus on optimized scuffing load capacity, usually resulting in better gear efficiency and lower power losses. From GWJ’s point of view it can be said that Ovako steels open up completely new design possibilities for gearboxes and offer significant potential to increase the efficiency of gear drives and gear components.

Both steels, 159X and 159Q, are available in all three GWJ software solutions, the web-based software eAssistant, the desktop application TBK and the special software GearEngineer for 5-axis milling of gears.

Focusing on mechanical engineering, GWJ Technology stands for high-quality products and professional software development for mechanical engineering to support engineers and designers in their daily work. The GWJ product range of innovative calculation software is wide, from standard software for classical machine elements with 3D CAD integration modules to the determination of whole systems up to a complex special software for 5-axis milling of gears.

MORE INFO  www.gwj.de

Brelie Gear to build larger full-service facility in Wisconsin

Brelie Gear Co, Inc. announced plans to build a 36,800-square-foot facility on a recently purchased 4.3-acre site in Waukesha, Wisconsin. Construction is planned to start in April 2019 and will be completed in November 2019. The announcement comes on the heels of an all-time annual sales record in 2018. Upon completion, Brelie will be moving from the current plant in Milwaukee to the new, larger plant.

“We’re very excited to announce the building of our new facility,” said Steve Janke, president of Brelie Gear Co., Inc. "Our current building has had numerous additions over the years, but we didn’t have a good product flow or space to expand our staff.”

The new larger space will continue to run as a full-service gear manufacturing facility that houses the latest in equipment technology and automation. Brelie continues to reinvest revenue into state-of-the-art technology and training to stay on top of efficiency and quality assurance.

“This new space will increase our production and ensure continued quality to best serve our customers,” Janke said. “We will...
Klingelnberg solutions in measuring technology on display at Control 2019

Headlined “Control 2019 – Networking Science and Actual Practice,” the 33rd international trade fair for quality assurance will be in Stuttgart May 7–10, 2019. Klingelnberg and its portfolio of products and services will also be present in Hall 6, booth 6306, where the company will be exhibiting forward-looking Industry 4.0 solutions in measuring technology.

Klingelnberg will open its exhibit with no less than four measuring machines and numerous add-on options. The solutions provider’s “exhibition trunk” will include the P 16, P 26, P 40, and P 100 G Precision Measuring Centers, featuring an optimized machine design. In March 2018, the design earned Klingelnberg the iF Design Award, which is presented annually by the iF International Forum Design in Hanover, Germany.

This year’s show highlights include gear measurement for cylindrical gears using the closed loop method, the new hybrid technology for tactile and optical measuring technology, and solutions for measurement tasks beyond gear measurement.

**P 16** – Precise measurement with closed loop technology for cylindrical gears.

In extending the closed loop concept already established at Klingelnberg for bevel gears to the world of cylindrical gears, the machine manufacturing firm has linked machine tools to the measuring machine in this sector too. Thanks to a wide variety of associated applications and software, Klingelnberg has created a central production control system that standardizes machining results achieved on different machines, and even in different plants.

**P 26** – Hybrid technology: combining optical and tactile measuring technology.

The standards in gear measuring technology are extremely high, requiring accuracies in the nanometer range on the one hand, and short measuring times with a higher information density on the other hand. To meet this challenge, Klingelnberg launched a new hybrid technology in 2018 that combines the advantages of both tactile and optical measuring technology. The advantage of rapid sampling by the optical sensor is combined with the flexibility and extremely high accuracy of the 3D NANOSCAN tactile sensor system. This ensures that the new, highly appealing potential of optical measurement can be used without compromising the measuring accuracy.

**P 100 G** – Measurement tasks beyond gear teeth.

The “G variant” Klingelnberg Precision Measuring Centers are specifically designed for measurement tasks beyond gears, making them well-suited for measuring axially symmetrical components. The software for standard dimensional measurement...
tasks and form and position measurements included in the machine’s scope of delivery also covers special evaluations such as Fourier analysis. In addition to dimensional measurement tasks, even complex contour and surface measurements can be measured in a single clamping. This is ideal in particular for the high precision requirements in the automotive and commercial vehicle industry, as well as in mechanical engineering and plant engineering. But this range will also appeal to all manufacturers of rolling bearings, since it enables rolling bearings and rolling bearing elements to be accurately analyzed and measured to an extremely high degree of precision.

P 40 – Proven solutions for gear measurement.

Lastly, Klingelnberg will be presenting the proven P 40 series of precision measuring centers for small diameter ranges to the international audience in Stuttgart – optimal solutions for quality management processes on gears that are guaranteed to ensure future success. The machine and software concept of the P series is optimized for measurement of complex drive components. The technology replaces up to six conventional measuring machines: gear measurement, general coordinate measurement, optical measurement, form and position measurement, roughness measurement, and contour measurement. These measurement tasks can be fully automated in a single clamping.

All machine models can be enhanced with custom options and feature specifications that make them ideal for performing measurements in the production environment.

Klingelnberg will also be presenting its services and software solutions, alongside the measuring centers. Dr.-Ing. Günther Gravel, head of the Institute for Production Technology at the University for Applied Sciences (HAW Hamburg) will be on site as a measured value analysis expert. He will be available at the Klingelnberg booth for two days of the exhibition to offer his technical expertise and take part in lively discussions.

MORE INFO

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NordPro Lab lets employees, trainees learn lean management

Optimum customer satisfaction can best be achieved with optimally trained employees. This is the basic idea behind the NordPro initiative.

Employees receive training in the fundamentals of lean management and are given ideas for implementing these ideas in their daily work. The program is organized and managed by NORD trainees who use this opportunity to extend their organizational and representational skills. This “hands-on” experience is also an important part of the comprehensive NORD training program.

NordPro was founded in 2008 to sustainably ensure customer satisfaction in an age of increased expectations. The idea: To actively communicate lean management methods to employees in order to give them tools with which company processes can be optimized for the benefit of customers. The program first started with the five tools KAIZEN, FLUSS; SMED; TPM and Q-Groups, but has continuously developed to include new methods.

In 2011, the initiators went a step further with the NordPro Lab. Specially equipped areas were created at the Bargteheide site,
where various modularly structured training courses with a heavy practical emphasis are now held. Here, the theoretical knowledge of lean management which has been acquired is used and deepened using simulation games. By dealing with hypothetical problems, participants learn the effects of process improvements, in addition to which cross-departmental understanding of work processes is promoted. The NordPro tools can be used for assembly, logistic and production processes, as well as at an administrative level, so that the training is used equally by all Nord employees across the various sites.

A further special feature of the NordPro Lab is that it is now organized and led by Nord trainees and dual-training students who take on the organization and implementation of the courses. However, their remit is also to continuously develop the laboratory and the content of the courses. This requires organizational expertise as well as a confident manner and specialist theoretical knowledge, which will be a great advantage in their further careers.

Independent management of the NordPro Lab is a part of Nord’s sophisticated training strategy. Within the Nord Group, young talent can receive business, industrial, or technical training or even carry out a dual course of study at several locations. Nord provides training in the professions of industrial management, technical product design, mechatronics, IT system integration, industrial mechanics and cutting machine operation. Dual bachelor study courses are offered in industrial engineering, IT for business, applied IT, mechanical engineering, electrical engineering and mechatronics.

Setco adds another North American service center in Mexico

Setco has opened its fifth North American service center, in Ramos Arizpe, Coahuila, Mexico.

This newest Setco service center will offer a variety of solutions for spindle, slide, and milling head repair and rebuild services, including spindle removal and install, vibration analysis, and upgrades. Services are geared toward the automotive and aerospace industries that thrive in the Nuevo León, El Bajío, and Chihuahua regions.

Setco is capable of repairing and rebuilding more than 350 brands of spindles, and of virtually any type, with particular experience in Weiss, NTC, Kessler, GROB, and OKK spindles.

“We are excited to offer this new, enhanced level of support for Mexico,” said Jeff Clark, president of Setco. “Having a physi-

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Colonial isn’t typical in the CUTTING TOOL INDUSTRY - our main focus is to establish customer relationships that are a perfect fit with our decades of service providing cutting tools to international companies looking for experience and reliability.

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cational presence in Ramos Arizpe will speed up our repair turnaround time for our partners and customers in Mexico. We are confident that Setco’s attention to quality, and our 107 years of designing spindles, will benefit and support the manufacturing base in these regions to assist in the local economic growth. With five service centers in North America, we’re becoming a ‘local repair shop’ to customers across the continent.”

Headed by Héctor Torres, Setco’s regional service engineer, the facility officially opened in February.

MORE INFO www.setco.com

Abtex Corp. names business development manager

Abtex Corp., the world’s only manufacturer of customized, integrated machine/brush deburring solutions for the manufacturing industry, has hired John De Leon as business development manager. This is a new position created to focus on sustainable company growth through continued service of existing customers along with expansion into new markets.

“Everyone at Abtex shares the same goal — to provide excellent products and services to customers,” De Leon said. “This is what has gotten the company to its current industry leadership, and what will help us reach the next level. I am looking forward to working with this first-rate team.”

De Leon brings more than 20 years’ experience in highly engineered component and system sales, marketing, and business development to his new role. He has served in positions of increasing responsibility in engineering, project management, sales, marketing, business development, and business management for technology, robotics, and manufacturing companies serving customers in the industrial, automotive, aerospace, food and beverage and agriculture industries, along with many others.

De Leon has an MBA from Rochester Institute of Technology and a bachelor’s degree in mechanical engineering from Iowa State University.

“As an experienced solver of manufacturing problems, John is a perfect match for Abtex,” said Jason Saner, Abtex president. “He will provide our customers a solid base of engineering expertise combined with a market-savvy approach to applying best practices for manufacturing efficiency.”

MORE INFO www.abtex.com

Emuge Corp. names Filippelli its new marketing manager

Emuge Corp., a leading manufacturer of high-performance taps, drills, end mills and other rotary tools, has appointed Shannon Filippelli as marketing manager effective April 1. Filippelli will be responsible for all marketing-related functions at Emuge including product launches, trade shows, social media, and web content, in addition...
to managing Emuge’s new membership program with Affiliated Distributors (AD).

“We’re pleased to have Shannon on board,” said Bob Hellinger, president of Emuge Corp.

“She brings a range of marketing abilities in addition to experience with industrial distribution marketing, which will be especially helpful moving forward as we continue to grow sales and develop our distribution.”

Before joining Emuge, Filippelli recently spent six years as director of marketing for IBC – Industrial Supply Plus, Inc., and held various marketing and communication roles since 2000. Filippelli is a graduate of Castleton University and has a Bachelor of Science degree in corporate communications.

MORE INFO www.emuge.com

CMS to hold 35th annual metrology conference in July in Orlando

The Coordinate Metrology Society (CMS) has opened registration for its annual Coordinate Metrology Society Conference (CMSC) for July 22–26, 2019. The event will be in Orlando, Florida. This celebrates the conference that has been dedicated to measurement professionals worldwide for 35 years. The CMS will also pay tribute to the 10th anniversary of its popular Measurement Zone, a main achievement for the organization. The CMSC is designed to meet the continuing education needs of the portable and traditional CMM communities. Since 1984, industry experts have presented more than 525 original technical papers at the yearly event. In celebration, the CMS Executive Committee has special programming in the works for this year’s seminal gathering.

In 2009, the Coordinate Metrology Society wanted to expand its education mandate with a large visible presence at the conference. The Measurement Zone was conceived and launched to provide engaging experiences for attendees through daily activities in various zone areas, including knowledge and hands-on competition challenges using the latest metrology systems. Located in the heart of the CMSC exhibition hall, the Measurement Zone provides access to e-Learning tablets providing a variety of metrology topics from measurement uncertainty to dimensional control techniques. Other popular programs have been added in the past decade including the popular CMS Quiz Show and the well-attended Ask the Experts event.

“We are excited to offer expanded professional development opportunities to

The CMSC is designed to meet the continuing education needs of the portable and traditional CMM communities. The annual Coordinate Metrology Society Conference is July 22–26, 2019. (Courtesy: CMSC)
our membership at the 35th CMSC,” said Scott Sandwith, 2019 chairman. “The CMS will pay tribute to those who blazed a trail for metrologists, who recognized early on that we are a unique, and important, community under the manufacturing and research science umbrella. The metrology sector needed mentorship and continuing education. The founders also recognized the importance of connecting conference delegates to leading original equipment manufacturers (OEMs), software developers and service providers. All of these priorities have made the Coordinate Metrology Society Conference what it is today. We are indebted to these industry pioneers who believed in sharing both practical and applied knowledge of metrology. In this spirit, the CMSC fosters a new generation of measurement professionals and creates a collaborative bridge between novice and expert practitioners,” Sandwith said.

MORE INFO  www.cmsc.org

Bel Air Finishing Supply holding mass finishing seminar/workshop

Steve Alviti, president of Bel Air Finishing Supply, announced the company’s biannual, all-day mass finishing seminar and workshop on April 25, 2019. The presentation will focus on both traditional mass finishing and 3D post processing for additive manufacturing.

Topics will include surface finishing, coating, metrology, media, compounds, and process technologies for all parts, including additive manufactured parts. The seminar will begin with a classroom session in the morning, followed by a luncheon, then a hands-on session with Bel Air's mass finishing equipment in its state-of-the-art process technology center. The workshop aims to provide ways to save time, cut costs, and improve product quality.

Bel Air’s wide range of machinery and media provide a variety of options for finishing parts in a way that best suits a customer’s “manufacturing culture.”

Bel Air has 52 years of serving the mass finishing industry, an experienced and knowledgeable engineering team, and a wide array of mass finishing equipment to cater to even the most specific finishing needs. Bel Air provides solutions for batch processing, single piece flow, and just-in-time manufacturing. Technicians’ analysis can provide guidance and recommendations for selecting the right equipment and process to guarantee maximum finishing and deburring function, efficiency, and the highest quality results.

MORE INFO  www.belairfinishing.com

Hexagon hosting PC-DMIS Users’ Group meeting at HxGN LIVE

Hexagon’s Manufacturing Intelligence division will host its third annual PC-DMIS Users’ Group at HxGN LIVE 2019, June 11–14, 2019 in Las Vegas. Users will get the big picture view of how Hexagon is driving the future of metrology, and a granular look at the software advancements making a major difference in measurement flexibility, productivity and efficiency. Participants will find an offering of continuing education tracks, product demonstrations, user feedback ses-
sions, and keynote presentations from industry thought leaders. Users’ group attendees will also have access to the entire HxGN LIVE cross-industry digital solutions conference including The Zone technology expo housing all of Hexagon’s newest technologies and more than 60 exhibiting sponsors.

“The PC-DMIS Users’ Group meeting at HxGN LIVE showcases our strategic work on PC-DMIS 2019 R1, culminating in a perfect balance between user experience and software capability,” said Ken Woodbine, product line manager for metrology software. “We focus on all aspects of this market-leading metrology software to ensure each iteration is customer-driven and incorporates groundbreaking features. We look forward to working with our power users at this year’s conference.”

MORE INFO  www.hexagon.com

HxGN LIVE hosting manufacturing leadership summit

Hexagon’s Manufacturing Intelligence division will host its third Manufacturing Intelligence Leadership Summit for industry executives June 11–12, 2019, at HxGN LIVE. The summit in Las Vegas is a high-impact forum that brings executives and thought leaders together to examine and discuss the transformational advancements moving manufacturing forward. The multi-faceted summit will provide essential intelligence on emerging trends including cloud computing, autonomous, AI, additive manufacturing, and more. The streamlined program will include keynote and technical presentations, workshops, and roundtables covering topics from machine learning to new advanced materials that shape products and processes in the digital manufacturing enterprise.

The two-day event delves into management topics at the top of every manufacturing executive’s mind and blends in Hexagon viewpoints with conference keynotes from Ola Rollén, president and CEO of Hexagon, and Norbert Hanke, president and CEO of Hexagon’s Manufacturing Intelligence division. Last year’s Manufacturing Intelligence Leadership Summit attracted professionals from diverse industries including aerospace, automotive, power generation, medical, consumer electronics, software, autonomous vehicles, and more. The intimate gathering serves as a living laboratory of high-level insights and practical application knowledge that continues to shape Hexagon’s think tank and digital strategies paving the way to the ultimate Smart Factory and beyond.

“Keeping up with the fast-moving evolution of manufacturing technologies is mis-

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“Keeping up with the fast-moving evolution of manufacturing technologies is mis-
Jergens Inc. announces GM’s retirement, promotion to fill job

Jergens Inc. general manager Bob Rubenstahl announced his retirement after seven years of directing the division, which includes the workholding solutions group, specialty fasteners group, and lifting solutions group. Two years earlier, Rubenstahl was the manager of the workholding solutions group.

“We are going to miss Bob around here,” said Jack Schron Jr., president of Jergens, Inc. “In addition to his leadership, he has always brought a lot of enthusiasm and personality to the job. That’s something that comes from an experienced and confident person. We wish him the very best in his retirement.”

Rubenstahl joined Jergens with a robust career already in place. Previously, he had served in various senior management positions for Kennametal, as CEO of LMT-Fette, and CEO of Command Tooling Systems — in total, more than 35 years of experience in both international and domestic manufacturing and distribution environments.

“I’ve loved every minute of my career and the spectacular people I met have provided me with lifetime friendships. I’m really looking forward to spending more time with my family, and ready to pass the torch at Jergens to leaders who will continue to grow the business,” Rubenstahl said.

Jergens named Matt Schron to succeed Rubenstahl as general manager. Since 2007, he has been the general manager for Jergens Industrial Supply (JIS), the company’s dedicated, large-scale technical distributor of metalworking products that represents more than 300 top manufacturers in the United States. In his 18-year career at Jergens, he has also worked in three of
the four divisions for Jergens, including numerous positions in marketing, product management, and sales. He attended Ohio University, graduating with a B.S. in marketing with sales certification. He graduated from Cleveland State University with an MBA in 2007.

“We are all very enthusiastic about Matt taking on this lead position,” said outgoing general manager Rubenstahl. “Matt is very well-qualified and experienced and will no doubt continue the spirit of innovation in product development as well as providing solutions for our customers.”

“More Info” www.jergensinc.com

Breaux, Storer share 2018 GPC Manager of the Year award

Motion Industries, Inc., a leading distributor of maintenance, repair, and operation replacement parts has announced that its parent company, Genuine Parts Company (GPC), presented Randy Breaux (Motion Industries president – North America) and Kevin Storer (Motion Industries executive vice president U.S. Operations and president of Motion Mexico) the 2018 GPC Manager of the Year honor. It is the single highest individual recognition in Genuine Parts Company.

“This is the 60th consecutive year that we have recognized one Manager of the Year out of all our associates worldwide,” said Paul Donahue, president and CEO of Genuine Parts Company. “This year we decided to present the Manager of the Year Award to both Randy and Kevin to recognize the outstanding efforts of both leaders, resulting in a record year during a challenging time with the passing of Tim Breen, former president and CEO, in August. This award is the highest honor at GPC – a significant recognition of both Randy’s and Kevin’s exceptional leadership of the Motion Team in 2018.”

Before being named Motion Industries president in December 2018, Breaux was executive vice president of marketing, distribution, purchasing, and strategic planning for the company and has nearly four decades of experience in the industrial manufacturing and distribution markets. He joined Motion Industries in May 2011, following 21 years of leadership roles with ABB/Baldor Electric Company.

Storer is responsible for all U.S. branch and field sales operations as well as Motion’s Mexico operations. Storer began his career with Motion Industries in 1987, and was a branch manager and regional manager before becoming vice president/general manager of Motion’s Los Angeles Division. In 2006, he was promoted to vice president/group executive before being named senior vice president, Western U.S. and president of Motion Mexico in 2014. He was promoted to his current position in 2017.

“More Info” motionindustries.com

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SmartCAMcnc offers new software subscription options

SmartCAMcnc has announced a new software subscription option that cuts acquisition costs for computer-aided manufacturing (CAM) software. High acquisition costs are often cited as an impediment for CNC machine shops to obtain the CAM software they need.

In response to changing market demand, SmartCAMcnc is adding an annual subscription option to its existing ‘perpetual-use licenses.’ For many years, the computer-aided design (CAD) and CAM industries have seen accelerated growth in ‘subscription-only software’ offerings, which is a major departure from the decades-old ‘buy a software use license with maintenance contract’ method. Because both approaches have their place in the market, SmartCAMcnc now offers a choice.

New annual subscription customers pay no up-front software license fees, which for much of the CAM industry makes up the bulk of the start-up costs. An annual subscription for production level SmartCAM solutions start as low as $75 per month, and can be renewed at the customer’s option.

“SmartCAM customers now have more flexibility in their software configuration and deployment, and can benefit from the lower acquisition costs,” said Gregg Olson, founder and president of SmartCAMcnc.

MORE INFO www.smartcamcnc.com

Solar Manufacturing’s new building undergoes site inspection

Solar Manufacturing’s new facility is beginning to take shape. With the exterior of the building now fully enclosed, the project is closer to completion.

The nearly 20,000-square-foot two-story office building situated in the front of the manufacturing area is fully enclosed, enabling the next phase of building to begin.

“This plant will be one of the most advanced facilities in the United States for the assembly of vacuum furnaces,” Jones said. The new facility is built on the 44-acre Brownfield redevelopment site on the Sellersville Business Campus in Sellersville, Pennsylvania.

The $8 million project is approximately 85 percent complete and the company expects to be operational by late summer or early fall 2019.

MORE INFO www.solarmfg.com

Bill and Myrtle Jones, owners of the Solar Atmospheres family of companies, in the center of the 40,000-square-foot manufacturing area during the most recent site inspection. (Courtesy: Solar Atmospheres)
AGMA dives into the many facets of emerging technology

When we started the emerging technology committee work in 2017, we laid out a very straightforward directive for ourselves: provide relevant information on five specific topics to the AGMA members that will help them understand these technologies to make informed decisions for their own businesses. Well, I believe we have put forth a good start in the last 20 months. If you have not been watching closely, this article will provide a nice overview on our recent activities and will offer you, personally, many ways to plug in with these efforts at AGMA.

SUBCOMMITTEES
In October 2018, we held our second face-to-face meeting where, thanks to five volunteer chairs, we were able to establish subcommittees that were tasked to do a deeper dive into 3D printing of metal, electric drive technology, the industrial Internet of Things (IoT), new materials, and robotics and automation. Each committee works to find expert presenters, relevant research, case studies, and important new articles to pass along to the membership. These committees also have become active forums for information exchange. We are bringing experts in their respective technology together with gear manufacturers and suppliers to the industry and having some interesting discussions and, in some cases, interesting discoveries for both sides.

The output of this work takes a variety of forms for your consumption. Our most established endeavors have been to bring presenters to AGMA events, the Emerging Technology Pavilion at the trade show, and to provide curated news on the AGMA website. More recent work includes the publication of our first white paper, partnerships with other associations, and a track (eight speakers) in the new Motion + Power Technology Conference this October.

WHITE PAPER
Our white paper debuted at the recent Annual Meeting. Justin Michaud, CEO of REM Surface Engineering, Chairman of AGMA 3D Printing Subcommittee; and Bill Bennett, Metallurgist, Ellwood National Forge, Chairman of AGMA New Materials Subcommittee; and their committee members worked with Kirk Rogers, Ph.D., of The Barnes Group Advisors LLC to author a white paper on the current state of 3D printing of metal specific to gear production. The white paper discusses the advancements both on the industrial machines and on the development of new materials for 3D printing metal. But it shines the focus on where all of this is relative to printing gears.

The white paper is free for AGMA members on the website and available for non-members for $99. Rogers will be available during a webinar later this month for your questions on the paper, and he is leading a tour of metal printing on the RAPID+TCT show floor in Detroit, May 20-22. We welcome your participation there. You can find details on the AGMA website.

NEW CONFERENCE
In the spirit of trying new things in emerging technology, we have created a new conference that we are tying to the M+PT Expo. The Conference will feature 16 speakers in two main tracks: Business and Emerging Technology. Our committees have worked to find speakers who can deliver informative presentations that the committee members want to hear. And with a full-conference price of only $295, I can attest that this is worth your attention and participation. A complete list of presenters and registration is available on the MPT website: motionpowerexpo.com.

We have been busy working hard to bring you relevant emerging technology information. So, come to the website and read the news, join a committee, and attend an event to get the most out of what we are providing. In addition, please reach out to me directly with any questions or join me and AGMA on Twitter (@MaryEllenAGMA and @agma) and LinkedIn (@Mary Ellen and @American Gear Manufacturers Association). We would love to have your perspective on this exciting development.
Upcoming Courses

**GEARBOX SYSTEM DESIGN**
April 23-25, 2019 | Charlotte, North Carolina
This course focuses the supporting elements of a gearbox that allow gears and bearings to do their jobs most efficiently. Learn about seals, lubrication, lubricants, housings, breathers, and other details that go into designing gearbox systems.

**STEELS FOR GEAR APPLICATION**
May 20-22, 2019 | Old Town Alexandria, Virginia
Gain a basic understanding of steel and its properties. Learn to make use of steel properties in an application and understand the potential that different steel and heat-treatment options can offer. Explore how performance of the material depends on how the steel is produced.

**GEAR FAILURE ANALYSIS**
June 12-14, 2019 | St. Louis, Missouri
Explore gear-failure analysis in this hands-on seminar where students not only see slides of failed gears but can hold and examine those same field samples close up. Experience the use of a microscope and take your own contact pattern from field samples.

**ONLINE EDUCATION**
Don’t have the ability to come to one of AGMA’s fantastic face-to-face courses? We understand that you are busy, and that is why we offer online education to meet your schedule. Now you can grow your gear knowledge, get the same quality AGMA education, and save money on travel by learning directly at your own computer.
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- Gear Failure Analysis.
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- Hobbing.
- Parallel Gear Inspection.

**JOIN AGMA AND IHS MARKIT FOR THE U.S. ECONOMIC AND GEAR INDUSTRY OUTLOOK**
May 14, 2019 | 2-3:30 p.m.
Financial markets enter the new year facing increased volatility, but will that slow growth? Economic data has been mostly good, especially jobs numbers. A slowdown does not imply that a recession is
on the horizon. Hear the latest economic data affecting the gearing industry.

AGMA’s economists from IHS Economics will review current market conditions and present their outlook for the general economy, key sectors, mechanical power transmission, and the user markets for your products.

THE AGMA 2019 STRATEGIC RESOURCES NETWORK

The AGMA Strategic Resources Network (SRN) is a group that brings together AGMA members at all stages in their gear industry careers. The goal of the SRN is to provide a dynamic, educational, and collaborative forum to help participants grow, both within the industry and the association.

The 2019 SRN event is packed with expert presentations, panel discussions, and tours at the following:

- MxD (formerly DMDII)
- IMS Global Gear & Machining
- Precision Arrow Gear Group
- Argonne National Laboratory

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CALENDAR OF EVENTS

Whether you’re looking for technical education, networking opportunities, or a way for your voice to be heard in the standards process, AGMA has something to offer you. If you would like more information on any of the following events, visit www.agma.org or send an email to events@AGMA.org.

APRIL

- April 11-13 — Annual Meeting — Scottsdale, Arizona
- April 16 — Gear Accuracy Committee Meeting — WebEx
- April 18 — Flexible Couplings Committee Meeting — WebEx
- April 23 — Helical Gear Rating Committee Meeting — WebEx
- April 25 — Wormgearing Committee — WebEx
- April 29 — Gear Accuracy Committee Meeting — WebEx
- April 30 — Metallurgy and Materials Committee Meeting — WebEx

MAY

- May 1 — Nomenclature Committee Meeting — WebEx
- May 2 — Bevel Gearing Committee Meeting — WebEx
- May 7 — Flexible Couplings Committee Meeting — WebEx
- May 14 — Wormgearing Committee Meeting — WebEx
- May 21 — Cutting Tools Committee Meeting — WebEx
- May 22 — Gear Accuracy Committee Meeting — WebEx
- May 23 — Metallurgy and Materials Committee Meeting — WebEx
- May 28 — Helical Gear Rating Committee Meeting — WebEx

JUNE

- June 4 — Aerospace Gearing Committee Meeting — WebEx
- June 5 — Bevel Gearing Committee Meeting — WebEx
- June 11 — Helical Gear Rating Committee Meeting — WebEx
- June 13 — Wormgearing Committee Meeting — WebEx

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Standards in terminology for gearing

Knowing the proper terminology is key for understanding gear design.

LOL, BRB, and LMAO are some of the terms that you might text to your teenager if you want to seem cool with their lingo. Unfortunately, you are more likely to invoke a CD9, P911 or PRW if you invade their space. If you don’t know what these mean, then you are at a huge disadvantage to understanding your child and the world they exist in. This occurs within the gearing world, also. Not knowing the correct terminology about gears can lead to a difficult conversation between a designer and a gear manufacturer.

The fundamental term in metric gearing is the designation of pitch. This is called the Module and is detailed as \( m \). Other key values are the Pressure Angle \( (\alpha) \) and the Number of Teeth \( (z) \). These are the core values that drive the geometry of the gear. (Figure 1)

From these values, we can determine the Center Distance \( (a) \), as it is derived from the formula:

\[
(a) = \frac{(z_1 + z_2) \times m}{2}
\]

We can also derive the Reference Diameter \( (d) \), which is also known as the Pitch Diameter. The formula for this value is:

\[
d = z \times m
\]

The Base Diameter \( (d_b) \), is used in the manufacture of the gear. It has a formula of:

\[
d_b = d \times (\cos \alpha)
\]

Additional items that can be calculated are the Addendum \( (h_a) \), and the Tooth Depth \( (h) \). These are derived from:

\[
h_a = 1.00 \times m
\]

\[
h = 2.25 \times m
\]

With these two values, we can calculate the Tip Diameter \( (d_t) \), also known as the Outside Diameter, and the Root Diameter \( (d_r) \). These are derived from:

\[
d_t = d + (2 \times m)
\]

\[
d_r = d - (2.5 \times m)
\]

These terms and their associated values represent the geometry of the gear teeth. Independent of these are the geometry of the rest of the gear body. These include the bore, the hub diameter, the hub width, the face width, the length through the bore, the keyway width, and the keyway depth.

The bore is the hole into which the motor shaft is inserted. For some gears, the gear is already mounted on a shaft and thus the need to specify the bore does not exist.

The hub diameter is the outermost diameter of the boss that projects out of one or more sides of the gear. It usually functions as a shoulder to which the bearings are matched to. Its relative, the hub projection, is the distance from which this diameter projects from the gear face. If a gear is produced “A” style, then it does not have a hub.

The face width is the distance across the gear teeth, in the direction perpendicular to the Reference Diameter.

The length through the bore (LTB) is the total width of the gear and is used to confirm that the face width and the hub projection have been measured properly as the LTB = the face width + the hub projection. For “A” style gears, the LTB and the face width are identical.

The keyway width is the value of the horizontal portion of the slot in the bore. The distance that this slot projects out of the bore, towards the Root Diameter, is the keyway depth. Not all gears are produced with a key slot, so these dimensions are not always present.

Other terms that are specific to certain types of gears are Toe & Heel, Throat Diameter, Helix Angle, Spiral Angle, and Direction of Hand.

With miter and bevel gears, the portion of the tooth that exists at the outermost diameter is known as the heel, and the portion of the tooth that is nearest to the bore is known as the toe. For spiral bevel and spiral miter gears, the angle at which the teeth twist is the Spiral Angle, and the direction in which that spiral occurs is the Direction of Hand. This value can be either Left hand, if the tooth curves counterclockwise, or Right hand, if the tooth curves clockwise.

Worm Wheels have an additional geometric feature in the tooth mesh. The depression into which the worm is seated is the Throat. The measure of this feature is the Throat Diameter. The inclination of teeth in a worm gear mesh is the Helix Angle. Both the worm and the worm wheel must have the same Helix Angle in order for the pair to mesh at 90 degrees. Worms and worm wheels also have Directions of Hand. Whereas a bevel gear set must have one Left hand and one Right hand member to engage, worm gear pairs must share the same direction of hand in order to work.

Hopefully, armed with this knowledge you will be better able to communicate your gear requirements with your gear supplier and you won’t have to worry about HHIS because @TEOTD IDK gearing.
ELEPHANT in the Room?

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A short look at the most common method of heat-treating steel.

This article describes the most common type of heat treatment of steel. This includes austenitizing, quenching, and tempering. In this process, the part is heated to the austenitizing temperature; quenching in a suitable quenchant; and tempering in a suitable quenchant. This is shown schematically in Figure 1.

In this example, the part is austenitized, and then quenched in a quenchant fast enough that the surface and center of the part miss the “nose” of the TTT curve and is completely through-hardened. The slowest possible quench to achieve through-hardening corresponds to the quench rate sufficient to just miss the “nose” of the TTT curve. Slower quench rates than the minimum will result in the formation of non-martensitic transformation products of ferrite, pearlite, and bainite. It should be noted that the TTT curve has no bearing on the tempering reaction.

This is the most common type of heat-treating of steels and is applicable to a wide variety of heat treatments of all type of components, including aerospace, automotive, and agricultural parts. For most applications, the austenitizing temperature is approximately 25-30°C above the A₃ temperature. After properly soaking at temperature, the part is then quenched rapidly into brine, water, polymer, or oil. The quenchant is generally less than 80°C for oil, and at ambient temperature for the water-based quenchants (water, brine, and polymer). The part remains in the quench until it is at approximately the temperature of the quenchant. The part is then removed from the quenchant and immediately tempered. If the part is not tempered immediately (usually within 90 minutes of quenching), the part may be prone to quench cracking. This type of heat treatment is prone to distortion and residual stresses. To minimize distortion and residual stresses, the quenchant is selected to achieve properties and minimize distortion.

While the A₃ temperature can be calculated for a specific chemistry, in most applications, the heat-treating temperatures are specified, as well as the quenchant. Examples are provided in Table 1.

In general, for most furnaces used in industrial practice, parts are heated using natural gas or electricity (including induction). This furnace can be a simple box furnace, or complicated like an integral quench furnace. The principle is the same. The part is heated to the austenitizing temperature and allowed to soak for some period of time, then quenched into the appropriate quenchant.

Heating of the part is usually monitored by a thermocouple, either placed with the parts (load thermocouple), or with the furnace (process thermocouple). The part is heated until the part reaches typically within 25°F (18°C) of the desired set point or austenitizing temperature when measured by the process or load thermocouple. Generally, the load thermocouple will lag the process couple. At this point, the soaking of the parts begins. Historically, the rule of thumb of “one hour per inch (2.5 cm) of cross section” is used to determine the appropriate amount of soaking time required. This was based on the response of the process thermocouple. It is likely that the “one hour per inch” rule of thumb is very conservative. Typical times for heating times in furnace and salt baths, as well as soak times, are shown as a function of temperature in Figure 2.

Once the part has been properly heated and soaked, the part is withdrawn from the furnace and quenched. While previous articles have discussed quenchants, there has been little discussion of the quench tank. There will be a brief discussion of the quench tank here, and more in a later article.

The quench system, at its simplest, is a material handling system to transfer parts from the furnace to the tank; a container to hold the quenchant; the quenchant; and the agitation system. The material handling can be a man holding a pair of tongs like the village blacksmith, or it can be large overhead cranes transferring massive forgings to the quench tank (Figure 3).
The quench system, at its simplest, is a material handling system to transfer parts from the furnace to the tank; a container to hold the quenchant; the quenchant; and the agitation system.

Agitation systems can be manually swirling the part by hand or complex agitation systems consisting of pumps or impellers. Whether the part is small and held by tongs or a massive forging, the principle is the same — to quench the part uniformly.

Historically, the focus of many heat-treating specifications has been on the quenchant, with specification and auditing agencies requiring monthly or quarterly testing of the quenchant. This testing could include cooling curve testing; kinematic viscosity; flash point (where appropriate); and other testing. However, no attention was paid to the quench tank. It was assumed that if the quenchant was good, then the parts would be acceptable.

The recent specification AMS 2759F [1] tries to address this issue, testing requirements on the oil and the entire quench system to verify that the “quench system” is capable of meeting process requirements. Whether it is successful in preventing heat treating failures or producing unnecessary “audit bait” remains to be seen.

CONCLUSION
In this short article, we have described the most common method of heat-treating steel. In the next article, we will be discussing mar-tempering and austempering for distortion control.

Should you have any comments or questions, please write the author at smackenzie@houghtonintl.com.

REFERENCES

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INCREASING STATIC FRICTION WITH LASER
High static friction is important for improving safety and reducing costs.

By GERHARD FLORES

Flat and curved surfaces with functionality of high static friction are increasingly needed for force-fitted nonslip power transmissions. The motivation is driven by the desire to have a higher safety of function and further cost reductions in manufacturing. Expensive solutions such as diamond layers, diamond coatings, or form-fitting design are increasingly being substituted. A modified laser process with defined exposed micro-structures is the alternative for innovative manufacturing. The tool is exclusive with the laser beam, which produces a high density of energy.

Laser machining of surfaces with high static friction is an established application of laser technologies. Exposed micro melting burrs of less micrometer height with martensitic material structures are the precondition for the required high friction. So, such high static friction surfaces can be produced economically with repeatability of small tolerances in high volume productions. Machines with laser structuring with high automation degree are part of the production lines of modern manufacturing plants.

Beside the lasering process, machine design and handling, the design of structures for each individual application needs the specialist’s know-how. Based on these test applications and case studies, mass production of high-volume applications can be realized. Con rod and cam structuring for high torque resistance or front face connections of sprockets, gears, or camshaft adjustments are frequent applications of this technology.

LAYOUT OF CONTACT SURFACES ACTUATED BY ADHERENCE

This presentation of laser structuring technology shows in detail the tribological background of adhesive friction, different topographies of exposed laser structures, possible design of frictional connections for taking high forces or torques and examples of high-volume solutions of laser-structuring. The intention of this paper is to show production solutions which lead to higher efficiency and lower input for simple and lean manufacturing.

The production of surfaces giving static frictional connections with the counterpart is more and more realized with the modified laser beam. For this purpose, the contact surfaces actuated by adherence are laid out with topographies that assure the function of work pieces as components and that can be produced in a cost-efficient way. The requirements of such connections consist of the loads by torques and shearing forces. The system is to be kept in the state of adhesive friction during the different operational conditions and it does not allow any relative movement of the contact areas. As shown in Figure 1, the maximum of the adhesive coefficient is to be increased as far as possible by a suitable laser structure of the surface. The control of friction-type connections is done at adhesive test benches or by function tests loading up the system to the adhesive limit at which the system is set in motion with sliding friction.

Figure 1: Increase of adhesion by laser structuring.

This principal feature of the adhesive system is demonstrated in the stress test as shown in Figure 2. Hardened and structured contact surfaces are loaded against non-structured and unhardened ones with an axial force of 80 kN more than 60 seconds up to a twist angle of 4 degrees. The course of torque is indicated as target value. The contact areas (di = 15 mm, da = 30 mm) were dry and free of grease. At the passage of adhesive to sliding friction there is a maximum of the adhesive...
value. Two structures each were tested with cross hatch structure having 8 μm (V1) and 15 μm (V2) of profile height. A point structure with profile height of 15 μm (V3) was also tested.

The determination of the adhesive friction value as direct system figure or as indirect functional criteria delivers profound research results. At the adhesive friction bench or in the functionable aggregate the structures can be evaluated regarding their effects. They can be further developed and also be defined for a serial application. Every structure for the increase of the adhesive friction is characterized by a raised profile contour having invasive influence to the surface of the counter body. It is pressed into the usually non-structured contact surface. Following manifold micro form profiles are produced which can absorb shearing forces. They produce a frictional connection with high adhesive friction value. Apart from the elevation characteristic and structure density, the structure hardness is of high importance. By means of the thermal effect of the laser beam, a transformation of hardness is generated due to the short time of heating. The high cooling off velocity delivers local martensitic structures. As a function of the material alloy different hardening is formed. Besides the twist tests, shear tests are also possible.

The SEM pictures of Figure 3 show different roughening topographies. Structure (a) can be exclusively raised, having low profile elevations, without deepening. In this case, material is melted evenly, which extends during the smelting process in a raised matter and solidifies in appropriate contours. The structure lines are equidistant superposed (b) at e. g. the fine bored profile of the pre-machining operation. The examples (a) and (b) are suitable to absorb torque of shaft-hub-joints. The structure lines are hereby orthogonal to the tangential force direction. Between the structures (c) with higher profile elevations, there are often deepenings caused by the material transfer as shown by the meandering band structure of a front face connection.

Distinct deepenings with lateral melting burrs and with surfaces being melted evenly distinguish this kind of structure. This meandering band structure is suitable to assure the transmission of torque within front face connections. Profile (d) shows a squamous structure with micro-recesses. It is suitable to join layer materials to substrates.

Laser-structuring of adhesive friction surfaces in rigid friction-type connections can substitute positive locking design connections or other expensive friction-type connections such as diamond interlayers. The achievable adhesive value is depending on the depth or the height, respectively, and the profile shape of the laser structured roughness profile, the arrangement of the structure density, the martensitic properties of lasered materials, the normal force and whether lubricant is embedded in the contact surfaces or not. Referring to unstructured surfaces, the adhesive values can be trebled up to f = 0.6 up to 0.9 by laser structuring compared with untreated smooth surfaces of f = 0.05 up to 0.15. However, the user makes more and more functional tests by measuring functional parameters, without any knowledge of real friction coefficients.

Figure 4 shows different examples of connections with torsional strength having cylindrical contact surfaces. A shrinking connection (a) with the laser-structured inner surface, e. g. of a cam and the shaft only, enables the cost-effective built camshaft in serial production. Laser-structured adhesive structures are easier to realize than inner or outer broached micro toothed systems. In example (b) the laser-structured contact surfaces are engaged by clamping. The alternatives of positive connections are expensive. In this manner pin or fitting connections can be replaced by friction-type contact surfaces with high adhesive friction generated by the laser structuring process. Also, the possibility is given to improve friction-type designs

Figure 3: Laser-structured adhesive friction surfaces of cams (a), connecting rods (b), front face connections (c) and pre-treated substrate surfaces (d).

Figure 4: Friction-type connections of cylindrical surfaces by means of laser structured adhesive profiles, (a) Shrinking connections shaft – cam, (b) Clamping connection shaft – hub, (c) Assembling of bearing shells in the big connecting rod eye.
such as shell or taper couplings regarding their torsion strength. Laser structuring of big connecting rod eyes (c) assures the torsional strength of the bearing shell. In conventional production, the adhesive friction between bore and outer side of the bearing shell is achieved by roughly honed surfaces. In the innovative laser process, single structured areas are partially added. Their elevated peaks are pressed into the bearing shells by the assembling forces.

Principally, there is the possibility to structure the shaft as well as the bore. Even though it is easier to structure the shaft, which is freely accessible from outside, it is, however, of importance at which part the higher structure hardness is applied. Therefore, the hardened cam or the tempered material of the connecting rod eye is structured so that the structure is pressed into the softer counterpart as far as possible.

It must be assured that during the joining operation of the components, the elevated topography is not damaged by shearing effects. The contact surfaces are to be fitted by a normally aligned movement only. During connecting a shrunk or clamped joint, sufficient clearance for the positioning of the parts without any risk of collision is required.

The contact surfaces should be preferably dry and free of grease. This increases the load capacity of the connection.

Another category represents the frictional connections of plain functional surfaces for the transmission of shearing forces or torques respectively as shown in Figure 5. The laser-structured front surface (a) often designed with an alignment element replaces cost-intensive solutions such as form-locked joint coupling with frontal toothing or inserted diamond or SiC interlayers as slices for the increase of the friction value. Applications related to the combustion engine such as pinion, camshaft adjuster, ball bearing, or related to the chassis frame are more and more demanded alterna-
scanners with each two galvanometer mirrors according to the structure layout. There is no mechanically actuated displacement or positioning of the beam. The focal movement at the component surface is carried out extremely fast, line by line with highest precision and simultaneously by the movable optics of the integrated scanning heads.

The local melting and solidifying processes create elevated structures without any deepening. They have a width of approximately 60 μm and a peak height of 2 to 4 μm (compare with Figure 3b). The use of two source beams enables the machining time for the big connecting rod eye of approximately 8 seconds.

LASER-STRUCTURING OF CAMS

For the manufacture of built camshafts, the shaft and cams are machined as single parts and they are afterwards assembled by thermal friction-type connecting processes. To achieve a sufficient torque strength of the cams, their bores are structured for adhesion increase, and here again raised melting burrs are created. This production strategy of the shrunk cams is more advantageous with regard to the costs than the conventional camshaft production with monolithic design. The cam bores are ground internally. Four segments of the bore surface are laser-structured, such as for the connecting rod [2].

The layout of the laser technique is similar to the connecting rod example. But the machining time is 2 seconds only and in case of two laser beams 4 seconds, as the surface to be structured is smaller. Besides the structuring of the four bore segments, also the data matrix code and a clear text (Figure 7) for documentation purposes are marked at the front side. The structuring result is similar to the connecting rod result. Instead of the grooves resulting from the turned structure, there is a fine ground topography in the background visible (see Figure 3a). Here the structure lines are also orthogonal to the tangential load.

LASER STRUCTURING OF FRONTAL SURFACE CONNECTIONS

Another example shows friction-type connections applied in many sectors of the mechanical engineering and vehicle design for the transmission of shearing forces and torques. Besides taper and cylindrical friction-type connections, especially frontal face connections with plain contact surfaces are laser-structured in serial production [3]. Camshaft adjuster, chain pinions, or gears are in the focus of this process. This technology offers the pre-condition to join reliably the innovative camshaft setter with the central valve of Schaeffler with the camshaft in serial production. This technology is a valuable contribution to the CO2-reduction. Figure 8 reveals the single radially-arranged structure lines of a machined frontal surface belonging to a frontal surface connection of a chain pinion.

Different structuring models are shown at a component in Figure 9. The bearing cap of a main bearing can be also structured, such as the counterpart of the crankcase. In conventional production exists the conflict of objectives between form and surface by honing. At one side, a rough surface is desired to avoid the twist of the bearing shell. At the other side, the function needs a high accuracy of the roundness, enabling the contact surfaces a narrow form locking for a good heat transfer. By laser structuring of the main bearing, a high-torsion strength of the bearing shell can be realized by the roughly structured areas (1) of a cylindrical friction-type connection as well as a good heat transfer by the smooth unstructured areas (2). Further, the plain assembly areas (3) are structured as plain frictional connections so that a non-movable arrangement for the bearing cap is possible.

SUMMARY AND OUTLOOK

The existing experience of laser structuring of surfaces with high adhesive functionality in serial production meets the expectations of this innovative machining process. The advantage of laser struc-
turing with integrated scanning is that the structuring segments on curved and plain surfaces can be freely dimensioned and positioned. In addition, the structure data and the tolerances of the different surface values can be adjusted by the beam parameter. The only tool is the laser beam with its high energy density. Tooling costs do not exist as known in common technical understanding. The structuring process is completely automatable and can be integrated in a production line. The measures of laser protection class according to EN60 826-1 are to be respected.

Laser structuring allows an increase of the static friction value up to five times. Compared with diamond interlayers, the costs/parts are significantly lower, depending on the volume and on the degree of automation.

The manifold applications of laser structuring of adhesive surfaces are shown in Table 1 exemplarily. Comprehensive serial production experience has been made in the meantime. The high process reliability and qualitative repeatability make such kinds of laser process to a procedure of high-efficiency regarding production quality, automation, and operational costs.

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ABOUT THE AUTHOR

Gerhard Flores is head of Research and Development and patents at Gehring Technologies GmbH.
HYDRAULIC WORKHOLDING TAKES HOLD

Hydraulic arbor with long expansion sleeve, well suited for automotive planet pinion applications. Activation is done using the function of the machine draw rod. (Courtesy: Gleason)
New Gleason hydraulic workholding solutions are becoming an attractive alternative to traditional mechanical systems in an increasingly wide range of gear-manufacturing applications.

By PETER HARRISON

In the brave new world of smart factories, Internet 4.0 and highly automated machines and cells, workholding rarely gets top billing. It’s surprising that workholding gets so little attention, given the profound impact it can have on reducing cycle times, scrap, and ultimately, cost per workpiece. Fortunately, most gear manufacturers in recent years have begun to take notice, as a new generation of these under-appreciated components doing the “dirty work” prove their worth — and help manufacturers “clean up” like never before.

THE FLEXIBILITY OF ‘FLUIDS’

As awareness of workholding’s importance has grown, so has customers’ willingness to explore alternative clamping solutions, all in the quest for more flexibility, reliability, and economy. Hydraulically actuated workholding solutions for bores and shanks, for example, are now being developed by Gleason for applications once considered strictly the domain of better-known traditional mechanical clamping systems.

Most recently, Gleason has developed hydraulic workholding systems for applications ranging from hobbing automotive transmission gears in high volumes to power skiving large internal gears in lots of one or two, to high-precision hob sharpening operations. These systems are capable of performing as well or better than their mechanical counterparts. Most importantly, they offer a host of characteristics unique to hydraulic systems that are increasingly desirable across this wide application spectrum. For example:

MORE FLEXIBILITY

Hydraulic workholding solutions offer attractive benefits to manufacturers producing families of parts with various bore or shank diameters, and/or producing multiple parts in a stacked configuration. The new design Gleason hydraulic production expanding arbor is available for, but not limited to, the most common size range of automotive cylindrical gears from 12 mm to 100 mm in diameter. It delivers a powerful and consistent clamping force when hydraulic fluid pressure is applied to a thin-walled expansion sleeve, precision-machined out of tough tool steel. The sleeve expands as required by the application uniformly over its entire clamping length. This gives a single arbor the inherent flexibility to meet the requirements of, potentially, a variety of parts with different bore diameters.

The ability to produce uniform clamping force across the entire length of a gear’s bore also makes it an ideal solution for the machining of both thin-walled and multiple-stacked parts. In the case of multi-stacking applications, the sleeve can be designed with multiple expansion zones so that even parts with different diameters can be stacked together and clamped with great precision.

The hydraulic system is also a good alternative for parts with small bore diameters, since it eliminates the challenges that exist in producing small precision collets for mechanical systems.

Note that the automatic chucking system is designed with a pressure balance feature to prevent over-expansion. It can also be expanded without a workpiece with no risk of damage, since its maximum expansion range can’t be exceeded.

GREATER RELIABILITY

These hydraulic workholding systems apply clamping forces in a completely enclosed system that’s inherently impervious to the dirt and swarf contamination that can plague much more exposed mechanical systems. In high-volume, dry-cutting operations,
Hydraulic workholding solutions offer attractive benefits to manufacturers producing families of parts with various bore or shank diameters, and/or producing multiple parts in a stacked configuration.

The periodic downtime required for routine maintenance, cleaning, and lubrication can be an enormous burden on both productivity and manpower. The same problems exist in large-part production as well, and particularly so with internal gears where effective chip evacuation can prove more difficult.

Additionally, Gleason’s use of new FEA design tools, precision machining, and heat-treat resources, and our extensive workholding “know-how,” have enabled the company to manufacture hydraulic workholding for greater reliability and for applications requiring extreme accuracy. Gleason is now able to build longer service life into all the wear components of its latest hydraulic systems with these state-of-the-art, in-house manufacturing resources. Improvements in design and manufacturing have also resulted in particularly reliable, repeatable performance. Gleason’s standard hydraulic production expanding arbors, for example, deliver the standard accuracy and repeatability levels — 5 microns (0.0002”) TIR (Total Indicator Reading) — of their mechanical counterparts, but can also be designed for applications where the quality bar is even higher.

Gleason’s hydraulic hob sharpening arbor is one such example. This type of high accuracy production arbor typically has two expansion zones delivering an accuracy of 0.00005” (0.0013mm) or better. In the case of a typical shell-style hob with two location bores with a relief between them, the arbor expands into the hob bore to clamp, leaving zero clearance. A typical mechanical system would require a small clearance, thereby compromising accuracy. Additionally, a mechanical system requires an axial clamping element, whereas the hydraulic system’s very high bore clamping forces eliminate this need. The hydraulic arbor can also be used for hobs with different lengths as well, with no additional setup.

**FAST AND ECONOMICAL**

Finally, hydraulic workholding can offer attractive economies, both in terms of cost and delivery. Meeting on-going new-part clamping requirements often requires production of new, high-precision mechanical collets that are both expensive and typically require lead times of many weeks or months. This situation is exacerbated when it involves larger parts. In the case of the large-part power skiving application cited previously, Gleason’s hydraulic workholding system was the perfect solution to meet the needs of the customer’s ambitious multi-part family production requirements. Just two large chucks, with adapting sleeves, accommodate a range of workpiece diameters from 200 mm to 400 mm. They can operate with less maintenance required as well, sealed against all the considerable volumes of chips and swarf produced in this highly productive soft cutting/hard finishing power skiving environment.

**ABOUT THE AUTHOR**

Peter Harrison is a mechanical engineer for Tooling Products with The Gleason Works. For additional information on the Gleason hydraulic workholding and the complete array of Gleason workholding solutions, visit: www.gleason.com/workholding, or contact Peter Harrison at workholdingsolutions@gleason.com.
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STILL STUCK WITH HAND DEBURRING?
With hand deburring, consistent quality and steady volume are vital concerns.

By WAYNE MOORE

O blueprint ever revealed, nor engineer ever designed, a part with burrs. It is only after a process is selected for making a part that the burring issues become obvious. Veteran designers have learned that even when a deburring process is planned, chances are high that additional burr developments will come to light needing more attention. In most cases, unanticipated deburring is needed in a hurry. A temporary hand-deburring solution is usually the immediate fix until a better solution can be implemented.

HAND DEBURRING

If you are doing hand deburring as an ongoing solution, then poor quality, inconsistency, a high scrap rate, and employee turnover are likely significant issues for your business. For hand deburring to achieve the desired final results, considerable training must be given; and yet, these jobs are not highly skilled and/or highly-paid positions. And once you get an individual trained who can produce good parts on a regular basis, they develop on-the-job repetitive work injuries, they want to learn another skill and do something else, or they quit. Maintaining a reliable pool of hand deburring workers is tough, and you are always training someone new.

In the best of cases, producing consistent part quality, avoiding part scrapping, and achieving steady production volume are difficult results to maintain with a hand deburring approach. James Richards, founder of James Engineering, explained how manufacturers tend to accept hand deburring as a satisfactory fix despite the drawbacks. “I watched a demonstration of a company’s best hand-deburring specialist as they processed an airplane cylinder head. It was impressive to watch; 17 minutes later, the specialist was done. I said, ‘Great! Three cylinder heads an hour with a three-minute turn around and you can do 21-heads a day; Right?’ ‘Oh no,’ was his reply. ‘We do seven heads a day.’”

People are not machines; it’s very rare to find a person who can maintain production anywhere close to a theoretical or averaged cycle time. On the other hand, the positives of hand deburring are that you can always find a way — with files, sand paper, air-powered hand tools with carbide burrs, stones, coated abrasive flap wheels, and brushes with wire or abrasive-filled, nylon filaments — to get the deburring job done. Frequently it takes all of these tools being applied to a single part to get the job done. Hand deburring works; it’s not cost-effective, consistent, or timely, but it works.

MANUAL GEAR DEBURRING MACHINES

Gear deburring machines require an operator to manually set up each deburring tool. Early models used single tools, usually an air tool holding a 3-inch diameter grinding wheel on a weighted, hinged lever. As the gear, which was held to a rotating table, would turn under the tool, gravity would act as the work force that applied the grinding wheel to the outside or inside edges of the gear teeth. If the deburring of simple gears is your need, these early machines were, and still are, quite effective. However, since such machines generally use only one tool to chamfer gear teeth, the exit burrs need to be filed off using a manual lathe or similar method, before this deburring method can be used effectively.

By the 1980s, companies such as James Engineering came along and added up to four tools to these manual-machine designs, which enabled more tools to be used, either all concurrently or in a staggered sequence, for a faster, combined cycle time. Removing exit burrs using this new manual-machine design was no longer a separate operation. This multi-tool advancement changed everything. However, for one company, more was in store before they would be done with their multi-tool manual-machine deburring solution.

In the late ‘80s, James Engineering also added its automatic wheel-wear compensation control feature and a unique raised-gear holding capability to further distinguish its early manual-machine models. Together, these additions made the flipping of gears an unnecessary step in the manual-machine finishing process.

Gears could finally be taken right out of a gear cutter and put onto the James Engineering gear deburring manual-machine, either burrs facing up for a one-sided operation, or with the gear raised and held for both sides to be completed in a single cycle. Tool number one is manually set up to remove the exit burrs of the gear. Just a few degrees behind this operation, chamfer tools number two and three can be manually set up to put chamfers on both sides of the gear. Tool number four, an abrasive brush, can then be used to remove the micro-burrs of the chamfered gear teeth, completing four operations and producing a completely finished part in a single cycle.

As the early manual-machine deburring systems gained popularity, people found that each tool took about three to five minutes to set up, test run a part, adjust the setup and retest, and then run a batch of parts. These machines would run cycles of 15 to 30 seconds a side for gears measuring six inches in diameter or smaller. Larger gears might have a cycle time of a minute per side. These types of manual deburring machines are still used today with good success.
The down side to a manual-machine deburring system is that an operator with skill and knowledge of how to perform the manual setup for each gear type is required. Another drawback becomes clear if you are a job shop or production operation with a lot of short-run batches. In these cases, you will spend a significant amount of time each day setting up a manual machine for new parts.

A common scenario is that a business wants to set up six parts each day on a manual machine. Their operator spends 15 minutes setting up the machine, then 10 to 20 minutes getting the setup to produce the quality of part needed by tweaking the setup. On the surface, this timing doesn't seem bad; but losing three hours just to set up the machine out of an 8-hour shift means you've lost 37 percent of each day's production time.

Today, we are in a digital, computer-controlled world where operators just want to download a program and run parts. It has become very hard to find good manual operators who can turn around a manual machine from part to part in 10 minutes. Where have they gone?

Not all manual gear deburring machines are the same. Many use pivoting axes, which are significantly harder to set up to achieve the desired results. Moving a pivot point for multiple axes means you have shifted all the axes of the tool you are trying to set up along multiple planes at once — a complex visual and spatial problem for an operator to solve quickly. Other machines introduced small openings, which make it difficult to see what is going on during setup. If this old-school approach appeals to you, the best advice is to compare brand features, and do your homework.

MASS FINISHING

When deburring and finishing of part surfaces and edges is desired for more of an aesthetic or polished effect — like the old rock tumbler many of us had as kids — mass finishing systems are a reasonable alternative, as long as masking is not required. The mass finishing technique uses a synthetic aggregate mass, often plastic, steel, or ceramic; and applies this mass with either a vibratory motor or a moving container design (barrel tumbling), producing heat and frictional pressure through gravitational or centrifugal force over an extended period of time. As a deburring operation, mass finishing processes multiple parts per batch. Processing time per batch can be 30 minutes to hours long. The use of large mass finishing containers to process a high number of parts at once is a common means of making a longer cycle time more attractive, and for reducing the finishing cost per part.

A frequent complaint heard from users of mass finishing systems stems from the time and resources needed to find, apply, and routinely change out effective abrasives. It is a constant challenge to apply the right size, material, and quantity of abrasive to do a proper deburring job, given different parts’ unique dimensions. The incorrect sizing of abrasive materials can cause media to get stuck in holes, teeth, or crevices of varyingly designed parts. But the most common complaint of abrasive-compound finishing systems is that many parts require masking in order to prevent surface material from being removed from critical areas.

ROBOTIC DEBURRING

Robots have a lot of really good uses, and we need them; but there are some things they don’t do as well as purpose-built machines. Robots are very good at pick-and-place actions and are especially good at picking and placing items between multiple locations, thanks to computer control. Robots are also great at loading and unloading; however, precision locating of randomly sized and varying loads to different locations at different distances from the robot’s central mounting position often leads to inconsistent or imprecise positioning and placement. Both problems are improved by selecting a bigger robot, but then size and cost become issues.

As manufacturing industries expand the use of industrial robots to include deburring, chamfering, and controlled edge-finishing, some not-so-obvious handicaps affecting these skills have also become evident. To understand why, consider this basic issue: robotic units are roughly designed to replicate the functional nature of a human arm. A robot solution is built to a generalized design standard, including: range of motion, force and angle of tool movements, and maximum weight of a tool or part that can be manipulated with accurate control.

Integrators must work to adapt their product to a particular robot’s standard operating capabilities and limitations, which may or may not meet the cutting and deburring force, angle, and weight support requirements. For each part-processing activity that is within these standardized ranges, the robot’s motion and working skills must be fine-tuned and coordinated, if their programming allows it.

But because robot manufacturers only make the robot; grippers, tool holders, and tooling are designed by third-party companies, and integrators combine these in their offerings. Usually an integrator company is the overall designer and manufacturer of a robotic work cell. Integrators select the robot, tooling, tool holders, and then design and build a cell that manufacturers purchase as a unit; it is then built on the buyer’s production floor. If it doesn’t work or work right, the delays, changes, and risk of not working at all happen on the buyer’s shop floor.

For a wide range of part designs, a standardized robot with an integrator’s tooling may not do the job. For example, reach and access...
limitations may result from the robot’s anchoring to a floor or base. The nature of robotic solution handicaps stem from this critical robot-tool integration. Several factors limit a robot’s ability to add deburring and finishing tasks to its operations: the available manufacturing workspace, the range of part sizes and weights, the need for wet containment, and the environmental or operator safeguards that must be taken into account. The ability to manage the dynamic, rigidly-controlled motion of a deburring tool using a robot is elusive.

As one engineering author explained: “Conventional industrial robots can be used for milling but are no match for machine tools when it comes to precision.” The inability of robots to apply adequate and steady stiffness behind a tool’s grinding or finishing force leads to increased tool deflection. And as the writer concludes, “Robot milling is unsuitable for applications that demand tight production tolerances.”

**CNC MILLING MACHINES**

As the CNC machine market matures, providers are looking for ways to add functions to their machines, which are not normally included in their manufacturing operations — functions such as deburring, chamfering, and finishing. A common CNC machining approach has been to offer a cutting tool, usually a coated carbide end mill with a small diameter and a 45-degree angled point, which is programmed to follow the gear tooth contour. A program is written using a CAM system and is then downloaded into the CNC machine. Next, the part is mounted to a timed fixture, and the gear-profile program is then run. All of this is routine stuff. The ever-present problem starts with the cutting tools. (See Figure 1 – Manual-Machine Deburring: Precision vs Inconsistency.)

Aerospace parts cannot have burrs of any kind; the chamfers created need to be smooth with no stress risers and be micro-burr free. New cutting tools start in razor-sharp condition and create a chamfered edge with two sharp corners. These sharp corners need brushing to finish the part to aerospace standards. As the cutting tool continues processing the second, third, and fourth parts, the two sharp chamfered edges are now getting much rougher with each cut. The small portion of the tool's cutting point, which engages and chamfers the high-quality, steel alloy gear edge, wears down very quickly. The edges continue to degrade at an increasing rate until it is necessary to change out the tool. This degrading process creates chamfered edges that begin sharp and can be brush finished; however, as the chamfered edges of later parts become rougher and rougher, brush finishing can no longer evenly smooth the rough chamfer surface or edges, and may also fail to remove micro burrs created by the degrading tool point and stress risers.

In addition, the whole cutting tool chamfering process is extremely slow, compared to a gear deburring machine doing the same job. The tooling cost is considerably higher than that conducted with a simple grinding wheel used by a gear deburring machine. But the fact that the mill bit tool gets worse and worse with each part is a real show stopper.

On the other hand, a grinding wheel has a unique characteristic: as it wears away, its cutting surface keeps renewing. Every part processed by a properly controlled grinding wheel tool receives the same, consistent, high-quality chamfer finish, just as the first part did. The wheel just gets smaller until it cannot be used anymore. The machine line from James Engineering applies grinding tools using its automatic wheel-wear compensation control feature. On these systems, grinding wheels wear down to their smallest, depleted state without requiring a single setup change. The entire chamfering effort of a single wheel takes place with no discernible change in chamfer angle and size. Factor in the couple of bucks grinding wheels cost for processing hundreds of parts versus the higher cost of cutting tools, which can process at most one or more dozen parts.

What about edge finishing? Brush manufacturers are quick to say, “Just put them in; your CNC will work fine.” There are two issues that add significant qualifications to that advice. The first issue: A predictive programming formula created to compensate for brush-wear does not work. Grinding wheels and brushes have an unpredictable wear rate, and since the predictive programming formula CNC machines use to predict wear rates does not accurately measure wear rate, these systems either over-engage or under-engage. This problem really manifests in either too much working pressure, or not enough. Abrasives at times will also get slightly glazed on a brush or wheel as they wear, and will then stop wearing, or they will cut with an “open” rate, wearing very quickly. This glazing doesn’t have a negative finishing effect on the part being chamfered or brushed, but it plays havoc with predicting each brush or wheel's wear pattern or rate. This unpredictability ensures that a consistent chamfer is impossible to guarantee with computer predictive wear software.

The second issue involves the nanoparticles produced by abrasives as they break down (e.g., aluminum oxide, silicon carbide, CBN, and diamond). These nanoparticles flow with gravity through CNC X- and Y-axes screws and linear slides, finding their way into the ball screws and linear slides or bearings, eating them up with considerable speed. Confirm this for yourself by taking a look at your existing CNC warranties; most do not allow abrasives in their machines or it voids their warranty. The reality is that CNCs offer one advantage: you can download a program into the machine, so your first processed part

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**Every part processed by a properly controlled grinding wheel tool receives the same, consistent, high-quality chamfer finish, just as the first part did.**
FOCUSED DEBURRING™, CHAMFERING, AND FINISHING

It was the introduction of the MAX System™ by James Engineering that gave birth to the phrase, Focused Deburring™. The MAX System totally makes obsolete the need for skilled operators to manually change setups from one part to another. All the machine operator needs to do is select the correct recipe from the inventory of recipes; press enter; load the part into the machine; then press cycle start. Run one part or 100 parts; select-enter-cycle start and run another one or 100 parts. (See Figure 2 – Focused Deburring of a Life-Critical Aerospace Part.)

To run six different part types during an 8-hour shift, for example, takes less than 30 seconds to set up all six parts. Remember the manual-machine scenario that took 37 percent of a production shift to set up and tune the setups each time? The MAX can run six or 60 different parts in the course of one 8-hour shift and only lose a couple minutes total time to select-enter-cycle start as needed.

Once a part has a recipe, you never need to create another one; and every time you run a recipe, the part that is produced is exactly the same. To create a recipe is no big deal either. A simple spur gear only requires five minutes to create a recipe, and anyone can be trained to do it. No CAM Software or even CAD model is required. Everything is done from the MAX System Machine Interface. This is what deburring, chamfering, and now controlled-edge and surface-finishing have become — simple.

Today’s MAX System is composed of tool towers attached to the machine’s roof. Each model comes standard with one to four towers, and each can use up to six axes of fully synchronized motion. Each tower can have up to three tools. These towers are capable of 1,000-ipm rapid travel, which makes quick work of complex motions. Additionally, the machines can be fitted with a 1,000-rpm rotary table. This nets an impressive system where all axes and rotary tables are fully synchronized, and interpolation, threading, and repeating are all a breeze to manage. This configuration enables the maximum amount of work to be performed at the same time (concurrent processing) by each tower system and delivers a maximum amount of output in very short cycle times.

These upgraded axes give each MAX machine a wide, three-dimensional tooling range and ability to deburr and finish surfaces no other multi-axes machines can match. In this patented design, all electric servos, ball screws, and linear motions are out of the work area, so toxic nanoparticles cannot come into contact with, or affect these components’ day-to-day operations.

The patented tool-head design of the MAX delivers precision, computer-controlled working forces behind its perishable tooling media and produces consistent, ultra-precise edge and surface finishes. Active axes, along with automatic wheel-wear compensation control, allow a wide range of media to be applied with different, precise forces to every part as each tool head moves over different surfaces, performing multiple, distinct deburring and surface finishing processes. In addition, the technology can create different sized chamfers and edge radii to distinct areas of the same part, and apply these combined functions within a single cycle for precise quality and consistency, at extremely high throughput rates.

Along with its Focused Deburring skills, the MAX System delivers selective and focused surface finishing for only the part surfaces manufacturers deliberately choose to finish. (See Figure 3 – Focused Deburring, Chamfering, and Finishing.) It is a simple programming task to avoid surfaces, like bearing diameters and gear teeth contact surfaces, for example. The MAX’s selective finishing abilities — to quickly process some part features and completely avoid others, without requiring part masking or special setup adjustments — is a new and game-changing option for this industry, especially for those who have leaned heavily on abrasive finishing.

Perhaps the biggest misconception of the MAX is price. But let’s go back to the 1960s and 1970s when everyone thought CNC machines would never replace manual mills and lathes for the same reason. How did that turn out? Today, manual shops are all but nonexistent. The MAX, axis for axis, is less expensive than most CNC machines with comparable axes numbers. The MAX, just like CNCs did in the ‘60s and ‘70s, has begun to take deburring, chamfering, and selective surface finishing by storm, because it does the job faster, better, at lower cost, and without requiring skilled operators.

Combining focused deburring, chamfering, and finishing allows the MAX to work specific part-features, as needed, when needed, and nowhere else. The advantages realized from Focused Deburring, Chamfering, and Finishing are three-fold: 1) reduced cost-per-part, 2) least amount of energy consumed per part, and 3) greatest number of parts produced per perishable tool use. By precisely deburring and finishing only surfaces you want processed, the MAX saves you time, consumables cost, and energy, for MAX(imum) Efficiency.

ABOUT THE AUTHOR

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The profile gear-grinding wheel here grinds two teeth simultaneously and is made to exceptionally tight tolerances. (Courtesy: Weiler Abrasives)
With a history that dates back more than a century, Weiler Abrasives has become a global market leader in abrasives, delivering innovative solutions to customers in targeted end markets.

By KENNETH CARTER, Gear Solutions editor

Weiler Abrasives has worn many hats dating back to its original roots in 1898, but gear grinding has become one of the company’s key initiatives.

“We chose gear grinding for several reasons,” said TJ Boudreau, category manager with Weiler Abrasives. “Our unique vitrified technology gives our gear-grinding products significant advantages. Additionally, it complements our technical deburring business. Deburring is a critical aspect of gear manufacturing, and we’re the leader in gear-deburring technology.”

Weiler Abrasives manufactures high-performance vitrified grinding wheels for all of the major machine manufacturers, including Reishauer, Liebherr, and Gleason, according to Boudreau.

“We make all shapes and sizes of gear-grinding and honing products,” he said. “We also manufacture specialized vitrified products for hob-sharpening machines and high-performance type 1 OD wheels that are sometimes utilized after hardening. In addition to our industrial grinding products, we manufacture wire and Nylox brush products for gear-deburring applications. Our deburring offerings include standard-size brushes used on common machines such as a CDMC Model 1100 as well as custom-engineered brushes designed for a specific customer application. We can make just about any size and shape brush that you can dream up.”

TIGHTER TOLERANCES
Weiler Abrasives uses CNC finishing equipment for all of its precision abrasive products, according to Boudreau.

“This was a great insight by our company seeing the future need for tighter and tighter tolerances,” he said. “We hold very tight tolerances on specialty profiled wheels, including our worm-gear wheels and our single-profile wheels. This is valuable to our customers because it reduces the amount of fine dressing that our customers have to face once they get the wheel and put it on the machine. “When you take out 45 minutes of dressing for the customer, all that time goes back to their production. It can be a tremendous savings for them.”

GRAIN TECHNOLOGY
Boudreau points out that Weiler Abrasives has relationships with some of the best grain technology companies in the world, which also presents a special advantage.

“You got your big guys, and they all have their own grain divisions, and they’re obligated to the technology that those grain divisions develop,” he said. “We don’t have those types of restrictions, so we’re able to partner with grain producers to develop technology that’s specifically designed for the markets and applications that we are focused on. We also don’t try to service every single industry. We have a lot of varying capabilities, but our primary focus is what we call our initiative markets. We put our resources into developing top-tier products for the applications within those industries.”

CUSTOMER SERVICE
With grinding becoming more of the norm in gear manufacturing, Boudreau said customer service is a top priority at Weiler Abrasives.

“Over the last decade, grinding has become a much larger part of the gear-manufacturing process,” he said. “People are grinding from solid, and gear-grinding applications are becoming more challenging every year. In order to tackle these very aggressive gear-grinding applications, customers need high-performance gear-grinding technology. These types of wheels have traditionally been available only from very large domestic and European players, limiting the choice customers have. I’ve spent a lot of time with customers over the last year, and many of them are frustrated by the service and delivery that they are getting today.”

To that end, Weiler Abrasives is extremely customer focused, according to Boudreau.

“We focus on solving end-user problems, and we focus on innovation,” he said. “We’re not afraid to look at one end user and say, ‘How can we solve this guy’s problems?’ And we’ll design something specifically for his application. It doesn’t matter to us if we can sell that to somebody else or not. Our job is to solve this customer’s problem. We really want to be technical consultants for our customers. We want to be able to leverage our technical expertise to help our customers succeed. In doing so, our customers will grow, and we’ll grow with them. That’s kind of our philosophy.”

A part of what helps Weiler focus on its customers’ needs is the company’s approach to delivery, according to Boudreau.

“Everyone’s challenged on delivery,” he said. “Our
model’s a little bit different, because we have some different logistical challenges. We’re manufacturing in Europe, which other people are doing, so it’s not impossible. But some of these companies, if you order a wheel out of Europe, they’ll be glad to sell it to you in 20 to 24 weeks. It’s a little hard for customers to plan production around those kinds of lead times.”

FAST-TRACK PROGRAM
To help combat that issue and help customers avoid carrying massive amounts of inventory, Weiler Abrasives has a fast-track program, according to Boudreau.

“If we go to Customer A, and they have an issue, or we think we can help them optimize a process, we will get the technical details, design a wheel, and the fast-track program will make that wheel within 30 days,” he said. “We can be back at the customer, testing and making sure that it’s the right solution for them very quickly. Once we establish a right solution, we work directly with the end user to understand their needs. We then work with our distribution partners to ensure we have a stocking and logistics plan that supports the customer’s needs. Even with strong local support and stock, something can happen or needs can change so we add another layer of support that I like to call Flex Stock. We will build inventory in our Pennsylvania facility where we can deliver basically anywhere in the U.S. within a couple of days. We stay ahead of that customer’s production and allow for demand swings.”

Whereas many manufacturers will carry inventory for big million-dollar customers, Boudreau noted Weiler Abrasives is willing to do that for any customer that it is working with.

“Weiler’s core business is metal-fabrication products,” he said. “And the expectation in that industry is: We can have it tomorrow. Our logistics capabilities and the standard we hold ourselves to are much higher than someone who can deliver in 20 to 24 weeks. Because we have this logistics expertise and capabilities already in-house, we’re leveraging that to be the best service provider in the gear industry.”

GERMAN BEGINNINGS
Weiler Abrasives actually began life back in 1898 in Germany where founder Joseph E. Weiler began manufacturing polishing brushes for the jewelry industry. In 1944, Karl E. Weiler, Joseph Weiler’s oldest son, started manufacturing these brushes in a chicken coop in Franklin Square in Long Island, New York.

As the company grew, it moved to Cresco, Pennsylvania, in 1957. The founders were fond of this section of the Pocono Mountains, which reminded them of the Black Forest. Since they were ready to build a bigger operation, it became the company’s new headquarters. The location has expanded many times since then, according to Boudreau.

In 1971, Karl Weiler, who is currently the chairman of the Board, became the president and began the expansion of Weiler Brush Company into Weiler Abrasives.

“We first got into coated abrasives,” Boudreau said. “We were the first company to manufacture flap discs in the United States. The Weiler Tiger Abrasives brand is very well known in the metal
fabrication and MRO businesses and continues to be a great product that we manufacture today.”

In 2015, the company acquired SwatyComet, one of the largest producers of thin wheel products in the world. SwatyComet had an industrial grinding division. That industrial grinding technology is what pushed Weiler Abrasives into the gear industry.

LIGHTNING GROWTH
That business jump has sparked many changes within Weiler Abrasives, according to Boudreau.

“You wouldn’t recognize it from a year ago,” he said. “Just a few years ago, there was no industrial grinding expertise within the organization on the Americas side, and we built a sales team and sales organization to support that. That’s a big change for us. We’ve always had an application engineering team, but they really focused on the deburring end of the business. Now our application engineering team includes guys with expertise specific to the gear industry.”

With all that infrastructure in place, Weiler Abrasives is set to grow along with the gear industry, according to Boudreau.

“I see the gear industry continuing to innovate and evolve,” he said. “There is nobody making equipment anymore that does just one operation or one feature. New equipment is evolving to the point where they’re doing multiple features in a single process step. We need to continue to evolve along with the industry and develop technology that is able to maximize the performance of the new equipment technology coming out. We want to stay out in front of the industry and partner with OEMs to make sure that the technology we’re putting in the marketplace is out front.”

To that end, Weiler Abrasives’ goal is to be the No. 1 name in the gear industry in terms of abrasive and deburring technology, according to Boudreau.

“We have an OEM program where we’re working with different OEMs,” he said. “We work together with them to design grinding wheels that maximize the output of their machines. If we can develop technology that makes their machines more useful and more valuable, it’s a win-win for everybody.”

Boudreau said Weiler Abrasives will be at the Motion + Power Technology Expo in October and expects a positive response at the show.

“We’re really excited about that,” he said. “We’ll be unveiling some new wheel technology at that time. We’ll be featuring not only our grinding products but our deburring products as well. I suspect we’ll be the only manufacturer there that can service the customer’s needs from front to back.”

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Helios introduces

Hera 90 CNC

gear-hobbing machine

Helios Gear Products (formerly Koepfer America) now exclusively offers the Helios Hera 90 CNC gear-hobbing machine from YG Tech for the North American market. This gear-cutting solution provides high technology features such as FANUC 0i-MF control and servo motors, direct drive hob and work spindles, Heidenhain linear scale on X-axis for precise repeatable control of size, and more. Gear manufacturers will appreciate this hobbing machine for its unique combination of technical capabilities, market-beating price, and proven domestic support.

Adam Gimpert, Helios’ business manager, said, "The Hera 90 is the first of the Hera series to meet the demanding needs of our customers, and this includes not only a globally competitive price point but also a complete hobbing solution backed by industry experts for technical support."

The Hera 90 offers key features, such as 8.5 DP (3 mm) pitch rating, 6,000 rpm maximum hob speed, and up to 8 CNC axes. When equipped with the optional gantry loading and unloading system, the Hera 90 capably and productively hobs a variety of gear types. Workpieces up to 12.600” (320 mm) in length can be manually loaded, or 7.874” (200 mm) length automatically loaded. Centerline distance between cutter and work spindles moves between 0.394” (10 mm) and 3.937” (100 mm), providing the capacity for a wide range of gear sizes. With a 6.300” (160 mm) hob shift, job shops and end-product gear manufacturers should consider this machine’s productive mix of flexibility and capability in a small footprint.

Several standard capabilities are available via the Hera 90’s dialogue programming: one and multiple gears on a single workpiece; multiple-cut cycles; any combination of radial, axial, climb, or conventional hobbing; crowning (lead modification); automatic shifting over a broken hob section; CNC hob shifting; and burr-free hobbing using two equal hobs. Straight bevel gears can also be cut by index milling or generating cutting via the Conikron method.

"In today’s globally competitive market, gear manufacturers need a cost-effective, highly capable, yet versatile hobbing solution for fine-pitch gearing. The Helios Hera 90 fills this role like nothing else on that market," said David Harroun, sales manager of Helios Gear Products.

Construction features of the Hera 90 prove strong fundamentals of engineering and design. The machine uses direct-drive torque motors. A cast-iron machine base provides optimum stability and dampening of cutting forces. The machine’s slant bed design uses gravity to efficiently remove chips during the cutting process. Automatic X-axis (radial hob head position) retract at power failure ensures the safety of tooling during electrical loss. Total machine enclosure includes world-standard safety equipment such as electro-mechanical interlock and front splashguard doors.

The Hera brand is owned by YG Tech Co., Ltd., who has been building hobbing machines for more than 50 years. The Hera series began development in 2004 and today comprises hundreds of installations worldwide including North America, the European Union, Asia, and South America. Helios is the new North American sales and technical support organization for the Hera line. The Helios company offers more than 30 years of expertise in supplying machines, tools, and engineering solutions to gear manufacturers and brings a proven sales record with technical support.

MORE INFO  www.heliosgearproducts.com

EMAG’s HLC 150 H is an all-around gear-cutting solution

More than ever, planners in the automotive industry are faced with the crucial challenge of flexibility in production technology. Manufacturers continually need to cope with modified ranges of components. For instance, the geometry can change very quickly. For gear cutting in particular, this development can reach new extremes.

Take the example of steering components: Production planners are looking for extremely flexible machines that can efficiently cut the gears of steering pinions, worm gears, and screws. This is how an EPS steering gear can be produced on a single machine. Innovative machine builders are able to accomplish this task, as demonstrated by EMAG Koepfer with their horizontal gear cutting machine...
HLC 150 H – an all-around solution in every way. This high-performance machine is able to process a very wide range of workpieces – transmission and anchor shafts, pinions, and planetary gears with a length of up to 500 millimeters. It features all relevant gear-cutting technologies such as gear hobbing, skiving, screw milling, worm skiving, and chamfering. Workpieces up to module 3 can be finished without burrs, meeting high-quality requirements.

Huge output quantities, a wide variety of demands on the workpieces, and materials ranging from high-strength steel to relatively soft plastics: Automotive gear production is a large and challenging field. In view of hybrid drives and various assistance systems, the wide array of gearing in cars tends to increase even further. The big question is, therefore, more than ever: Which production solutions allow the efficient and comprehensive gearing of the largest possible number of different workpieces?

“This was exactly the question to start the development of the HLC 150 H machine,” said Jörg Lohmann, sales director of EMAG Koepfer in Schwenningen, Germany. “Our answer was to develop a universal solution with high-performance components. We are using all relevant machining technologies including chamfering. We have a large axis center distance of up to 130 millimeters, and a powerful 28 kW cutter head. As a result, we can efficiently cut gears on a wide range of workpieces up to module 3 with a maximum crown circle diameter of 150 millimeters, and up to 500 millimeters in length. The customer benefits from lower costs and higher workpiece quality.”

Transmission shafts are a good example to illustrate this approach – the HLC 150 H guarantees hobbing and chamfering completely free of secondary burrs. After rough-machining the gears in a first step, the gearing is deburred. The finish is applied during the second hobbing step. The result is an entirely burr-free chamfered gear. In addition, the HLC 150 H has many cost-reducing features – for instance, the highly energy-efficient frequency-controlled hydraulic units, and the fact that the media supply is only activated when required. Furthermore, the counter bearing with its quick-clamping system and the good accessibility of the machine allow changing of all tools within a very short time. Unproductive downtimes, such as for changing batches, are thus reduced to a minimum.

“Regarding the cost aspect, we must emphasize that the customer will benefit from excellent value for money from the day of his initial investment,” Lohmann said. “This is made possible by the highly efficient EMAG production facilities in Zerbst, Germany, and in Jintan, China. This is where the basic machine structure is created by means of highly efficient processes.”

There are several technical details that contribute to the workpiece quality and process reliability on the HLC 150 H. During the milling operation, for instance, the cutter head with its very rigid suspension always moves in its entirety. The shift axis is based on...
PRODUCT SHOWCASE

the interpolation of two axes. This results in a large swivel angle for the cutter head, and a large shift path at the same time. As a result, the milling process is very smooth and precise. The quality of the cut gears (also in view of absolute measuring systems) is at the very highest level. A similarly important feature is the chip disposal concept by EMAG Koepfer. Users benefit from free downward chip flow without any chip build-up. That is why the machine is also perfect for dry machining. Additionally, different solutions are available, including scraper-belt or permanent-magnet-conveyors – with the option of a deep-bed filter with magnetic preseparator drum for ferromagnetic materials, non-ferrous metals, and plastic.

“In each case we ensure that the discharge process runs very smoothly, guaranteeing high process reliability,” Lohmann said. “Especially in large-scale production at high performance, this is vitally important.”

Lastly, a modular automation concept is available for this machine, providing for short chip-to-chip times. The HLC 150 H can be loaded both manually and by automation system. As a second option, lighter components up to 3 kilograms are handled by an integrated high-speed gantry loader with rotating twin gripper. However, for heavier workpieces up to 10 kilograms, a V-shaped linear gripper is available. Integration into complete EMAG production lines is equally simple.

“In summary, we are confident to say that this machine sets a new benchmark for the flexible machining of workpieces up to 500 millimeters in length. Many steering components such as steering pinions, worm gears, screws and transmission shafts fall into this category,” Lohmann said.

MORE INFO www.emag.com

Quality Tool and Gear makes most of new lathe with workholding solution

With more than 40 years of experience, Quality Tool and Gear in Redford, Michigan, has become known as a leader in the gear industry. It recently purchased a new Mazak QTU-350 CNC lathe to turn its small family of input gears. The new machine made the company more efficient. However, their current method of holding the parts nullified the benefits of the new machine.

Fred Pelle, vice president, contacted John Kaczmarek of Marathon Industrial Sales. Pelle is the representative for Speedgrip Chuck Company for eastern Michigan. He gathered the necessary data for the Speedgrip engineering staff to design a solution. The result was Speedgrip design B-39461. With it mounted directly to the machine’s A2-8” spindle and connected to the drawtube, operating the assembly was simple and efficient. This special external diaphragm chuck incorporates several interchangeable pin and ring assemblies that are designed to locate on the pitch diameter of each gear. The original chuck was designed to hold five different parts. Quality Tool and Gear has since added three more pin and ring assemblies.

Vice President Angelo Berlasi said, “The biggest improvements this new chuck produced is the reduction in cycle time and the overall quality of the parts. With the chuck located on the pitch diameter of the gear, it eliminates the need for the operator to indicate the part. This reduced the run time per part by 30 to 60 seconds or more, based on the operator’s ability to indicate. The quality
of the part improved with the variance in the indicating being eliminated. The chuck also ensures that the spline is within specification. Overall, a more consistent part is provided to the next operation of grinding the gear teeth. Another benefit realized is the ability to reduce the amount of stock left for gear grinding during the honing operation. This has reduced the gear grinding cycle time, the grinding wheel wear, and the frequency of dressing the grinding wheel.”

**KISSsoft.AG beta release 2019 gets preview at Hannover Fair**

At the Hannover Messe in early April, attendees took a first look at the latest developments in KISSsoft and KISSsys. The beta version of KISSsoft was scheduled for release for testing on April 12.

KISSsoft has announced some of the new highlights of the next KISSsoft Release 2019, which will be available at the end of June.

- Concept design on system level.
- Rolling bearing calculation with connection to SKF cloud.
- Contact pattern analysis of asymmetrical gears.
- Crossed helical gear calculation with rack.
- Feasibility assessment for “Power Skiving.”

Those interested in knowing more about the KISSsoft Release 2019 should note the KISSsoft User Meeting KUM International 2019 will take place on October 23–25, 2019. More details to come.

**Exact Metrology introduces multifunction Artec LEO 3D scanner**

With its ability to scan both expansive areas and fine details, Artec LEO can scan a variety of objects, from small mechanical parts to the human body, cars, boats, or crime scenes.

Exact Metrology announces the availability of its Artec LEO 3D scanner, the first scanner to offer onboard automatic processing with an integrated touch panel viewer. This frees users from being tied to a computer for data capture.

The scanner has a 3D reconstruction rate of 80 frames per second, making it the fastest professional scanner on the market. With its large field of view, Artec LEO can scan and process large objects and scenes quickly and accurately.

It features data acquisition up to 4 million points/second, with a working range of 0.35-1.2 meters. The 3D resolution on this scanner

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** MORE INFO **

www.qualitytoolandgear.com

** MORE INFO **

www.kisssoft.ch

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www.qualitytoolandgear.com
LEO has the ability to scan in sunlight, as well as capture dark and shiny objects. As with all Artec scanners, LEO uses advanced hybrid technology and texture tracking. Therefore, users can point at an object and shoot. There is no need to stick targets and remove them. The texture resolution is 2.3 mp.

This handheld scanner is equipped with a 4” LCD screen to capture images of the data. The 3D light source is provided by state-of-the-art VCSEL (Vertical-Cavity Surface-Emitting Laser) technology. With no need to connect to a computer or to plug in to a main power source, users can hold the scanner and walk around freely, scanning without worrying about wires or additional equipment. Artec LEO’s battery pack allows users to scan for 3.5 to 4 hours. Supplementary battery modules permit unlimited 3D scanning on expeditions or in remote areas. There are two cameras on this scanner. One is a range camera for 3D geometry and another is a color camera. The color camera captures color texture data. Besides built-in battery and wireless connectivity, Artec LEO can stream to a second device and upload the data.

Exact Metrology, with facilities in Cincinnati and Milwaukee and affiliated offices throughout the Midwest, is a comprehensive metrology services provider, offering customers 3D scanning, reverse engineering, quality inspection, product development and 2D drawings. The company also provides turnkey metrology solutions, including equipment sales and lease/rental arrangements.

MORE INFO www.exactmetrology.com

Emuge adds new Softsynchro® tap holder to tooling lineup

The Softsynchro® tap holder with minimal length compensation technology is available with a new adjustable length feature called Softsynchro Xtension. The Xtension holder allows for quick length adjustments up to 50 mm and eliminates the need for specially made holders or extra length taps.
A slim design allows for deep pocket reach in difficult to tap applications. The holder is available in HSK 63 and HSK 100 versions.

Emuge has created other ways to improve manufacturing. Almost every hole that is tapped requires some type of countersink operation to improve the functionality of the threaded feature. Emuge offers the industry's most extensive offering of stocked standard coolant fed carbide chamfering step drills with the exact tapped hole diameters. The EF Drill-C program has more than 900 diameter/step length variations for cut and form taps. These drills are made with a double margin, high penetration rate design with a 90° chamfer angle. The program is great for customers who want to reduce cycle time without having to purchase large quantities of special drills. If a step size is not available from stock, it is quickly manufactured in less than three weeks.

Emuge Z-Taps are designed with an advanced chamfer geometry and rake/flute form that produces consistent, controllable chip formation that is released smoothly for fast and efficient chip removal. This series of high-performance taps enables higher cutting speeds while reducing tap breakage and is now available in a powdered metal PM substrate for increased wear resistance. Expanded offering with 2B and 3B class of fit tolerance tools as stocked standards.

Users can often increase the life of Emuge taps. The reconditioning of end mills and drills is a common practice. Regrinding tools is a great return on investment and can produce instant cost savings for manufacturers looking to maximize productivity. Emuge operates a state-of-the-art reconditioning facility in W. Boylston, Massachusetts, that reconditions not only carbide drills and end mills but also high performance Emuge taps in sizes over 1/2” or M10. Some restrictions apply.

MORE INFO www.emuge.com

Jergens announces additions to OK Vise®
low-profile edge clamps

Jergens Inc. announces three key additions to the company’s range of OK Vise® compact, low-profile edge clamps. Among them are Multi-Rail (MR), Knife Grip and Hydraulic Kits.

Multi-Rail is the new general-purpose, multi-configurable, modular workholding system capable of holding challenging workpieces, small and large, and often multiple in the same location. Multi-Rail is also compatible to mount to the Jergens QLS Grid System, a lightweight 2-piece aluminum column that opens up further machining opportunities including connections with both Fixture Pro® and Ball Lock®.

Knife Grip are also compact, low-profile edge clamps that improve production and provide solutions for difficult applications. What’s unique about OK Vise Knife Grip are the jaws that feature serrated teeth to penetrate into softer materials and prevent part movement due to the load imposed by machining forces.

Hydraulic actuation kits pair the OK Vise clamping system with the advantages of hydraulic workholding. Repeatable clamping forces and improved ergonomics are two key benefits for high-production applications. OK Vise clamps are small in size yet provide excellent clamping force, up to 150 kN.

MORE INFO www.jergensinc.com

KISSsoft Highlights

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MARKET PLACE

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“The design and craftsmanship of our offering in the marketplace is unparalleled.”

How long have you been involved with Emuge precision workholding products?
I have worked at Emuge Corp. in the precision workholding group since 1997 and have been the manager of the group since 1999.

Over the years, what changes have you seen in terms of what gear manufacturers need for clamping solutions?
Surely, there have been many changes over the years, but in large part these changes have revolved around the need to cut cost while maintaining workpiece quality. Workholding can play a large role in these aspects of a manufacturing process.

Perhaps a quick-change solution for a part family could be the answer for reducing cost. Alternatively, even holding the workpiece in a different location, which may not be a datum on the workpiece, but would add rigidity to the process is the right solution. Rigidity generally results in better surface finish and extended tooling life, etc. Sometimes it’s not one thing that provides the required cost reduction, but many things combined which add up to an ideal solution. To that end, manufacturers should look at the big picture including what the desired end result is, as compared with a quick fix that might not attain the ultimate goal.

What are the most common workholding challenges you see from gear manufacturers?
Many times, a manufacturer has a scripted plan for the production of their workpiece, and in this script, there are certain expectations within the manufacturing process. Expectations may include machining time, scrap rates, and final workpiece quality, to name a few. The challenge has been how to consistently get to that quality finished product while reducing the machining time, scrap rates, etc. What is sometimes missed along the way is that this workpiece needs to be manufactured on several different machines with varying operations, resulting in different workholding requirements for each operation.

This is really an engineering function, and workholding locations/datum placement on the workpiece are key during the design phase of the workpiece and should not be an afterthought when chips are hitting the floor. Sometimes putting extra planning into the initial design and machining operations for a workpiece or even investing a little more money into the blank can translate into a better result. The more carefully thought-out workholding setup can add more accuracy and rigidity to the system and have a positive effect on machining time, scrap rates, and final workpiece quality.

When evaluating a workholding solution, what are some tips for determining whether a custom, precision workholding solution will be more suitable than an off-the-shelf workholding product?
This decision is often based on things like workpiece geometry, datum location/s on the workpiece, workpiece material, the complexity of the operations being performed, and which machine/s are being used. The volume of workpieces to be manufactured is also a factor.

Let’s say you want to hob and shave an average pinion gear with a 1” (25mm) bore, and a 1.38” (35mm) face width, and you are only going to produce 200 workpieces a year. The shop may be able to use some existing, or off-the-shelf workholding to get by with manufacturing this smaller run of workpieces. That is unless the accuracy requirements are too stringent for an off-the-shelf solution or the volume level demands a dedicated workholding device. Now let’s say we have the same average pinion gear, but one of the faces doesn’t run to the bore as the other face does, or if the production volume is high with very stringent cut-to-cut time tables, then you would more likely be looking at a dedicated design and build type of workholding, which is specifically designed for your machine, your workpiece, your operations, and your tooling.

What should gear manufacturers expect from their workholding solution manufacturer/supplier?
For a design and build offering like Emuge brings to market, you can expect more questions up front, including prior to receiving a quotation. We want to dig a little deeper into the manufacturer’s plan, including understanding fully the manufacturer’s processes, so we can determine more comprehensively the best solution for the application.

What sets Emuge apart from its competitors?
There are many aspects of our organization that set us apart from the competition. The design and craftsmanship of our offering in the marketplace is unparalleled, and there are also other elements we add that make an overall difference: Things such as raw materials. We specifically source our material for best quality and not just purchase it from whomever is more cost friendly this week. We not only use state-of-the-art manufacturing and inspection equipment, but we also rely on some tried-and-true equipment that still gets the job done today.

Also, many of our team graduate from our in-house apprenticeship program. This allows us the opportunity to ensure the best-of-the-best for a trained workforce now and in the future. Several of our employees, including from the apprenticeship program, have worked for Emuge for many years. Ultimately, it’s the experience these people bring to the table that keeps us ahead of the curve and a leader in the industry.

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