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LEVERAGING THE COMPLEMENTARY STRENGTHS OF ORBITLESS AND PLANETARY DRIVES

The low-pitch and bearing velocities, fewer gear engagements, and uni-directional separation forces of an orbitless drive result in high-speed ratings and low NVH levels at the expense of decreased ratio and load capacity, making it particularly viable as a primary stage.

By LEO STOCCHI

THE BENEFITS OF SPLINES

Any device that transfers rotary motion from one point to another probably relies on a spline, so it’s a good bet that they are used on a near-daily basis.

By DAN SEGER

BRINGING FORGING EQUIPMENT ONLINE TO MEET EXPANDING PRODUCTION REQUIREMENTS

Forgers weigh options such as repair, rebuild, remanufacture, or new equipment when considering options to increase capacity.

By DEL WILLIAMS

CREATING STRESS-FREE PARTS WITH EXCELLENT METALLURGY

COMPANY PROFILE Wayland Additive’s NeuBeam technology combines the best features of existing AM technologies while overcoming their traditional limitations.

By KENNETH CARTER
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BRIAN DENGEL

ARE YOUR GEARS COMPLIANT?
What makes a gear RoHS or REACH compliant under U.S. and EU regulations?

MARC STRANDQUIST
President for the Americas at Optimas Solutions

To launch this series of articles, we illustrate the basic flow of an NDT examination and cover the basic terminology used.

American Gear Manufacturers Association

Gleason gear trainer webinars now streaming for remote learning.

Bourn & Koch offers details on IMTS-planned machines.

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.

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INTRODUCTION TO NONDESTRUCTIVE TESTING
To launch this series of articles, we illustrate the basic flow of an NDT examination and cover the basic terminology used.

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Q&A

MARC STRANDQUIST
President for the Americas at Optimas Solutions

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As we move into the fall of 2020, it finally looks like this insane year is waning, and, I think I speak for all of us — good riddance.

That doesn't mean a few good things haven’t come out of the year. If nothing else, it has forced us to challenge our norms and readjust our way of thinking about almost every aspect of what we do and how we do it.

That being said, a lot of our quarantine time here at Gear Solutions has been devoted to brainstorming new and innovative ways to ensure you're getting the best and latest information about the companies supplying all your gear-manufacturing needs.

We have quite a few irons in the fire, and we are hoping to be able to reveal them in the coming months. So, stay tuned.

With physical tradeshows on hold, please take time to see how Gear Solutions can also be your ally in getting your message to your customers. We offer many ways in which to remind the industry that your products and services are available.

That's good news for your audience in search of the very services and products that you can provide every day. And with the world trying to cope with economic and medical hardships, the deep reach Gear Solutions can provide is more important than ever.

And by thumbing through this issue of Gear Solutions, it’s easy to see the depth and breadth of information we are able to present to you on a monthly basis.

As I mentioned, tradeshows such as IMTS, which is headed for a mostly virtual format in lieu of the pandemic, are topics we like to highlight every year. In its absence, we adjusted our Focus topics for this month to take a closer look at planetary gear systems and splines.

In our cover article, Leo Stocco shares his insights on leveraging the complementary strengths of orbitless and planetary drives.

For a deep dive on the benefits of splines, Gear Solutions reconnected with contributor Dan Seger. In his article, he gives an informative essay on the diversity of splines and their various uses in the gear industry.

And, as always, you’ll find some expert and innovative advice from our columnists. I always appreciate the wisdom and time they volunteer for the magazine.

With all that in mind, a final reminder that Gear Solutions is here to serve you. If you have any suggestions or would like to contribute, please contact me. I’m always looking for exciting articles to share.

Stay safe and healthy out there, and, as always, thanks for reading!

Kenneth Carter, Editor
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Gleason's popular "Home Trainer" webinar series is now called "Gear Trainer Webinars" and is available for online viewing via the Gleason website.

In March 2020, Gleason launched its "Home Trainer Webinar Series" in order to support customers in their home offices during COVID-19 times. As the business environment slowly returns to normal, this very successful series has been renamed 'Gear Trainer Webinars' and will continue to deliver valuable content every week.

Gear Trainer Webinars provide a learning experience in response to design, manufacturing, and inspection challenges facing the gear manufacturing industry. Based on the popularity of the previous webinar sessions, and the interest expressed in making the webinars available on-demand, both the new Gear Trainer Webinars and previous Home Trainer Webinars are now streaming on the Gleason website. Every week, more recordings will be made available as the live webinar series continues to add new content.

To view Gear Trainer Webinars, registration on the website is fast and easy. Once registered, you can view any webinar as many times as you like.

While recorded webinars can now be streamed, the live Gear Trainer Webinars continue with new topics and presenters every week. The current webinar schedule can be found at www.gleason.com/geartrainer and is constantly updated with new webinars.

MORE INFO  www.gleason.com/webinars

Bourn & Koch offers details on IMTS-planned machines

Bourn & Koch planned to feature its two flagship gear manufacturing machines, the 400H & Fellows 10-4 retrofit, its newly redesigned and re-engineered Blanchard 22AD-42, and a brand-new multifunctional machine tool platform, the MT3 at IMTS 2020, but obviously didn't get that chance.

The Bourn & Koch 400H horizontal gear hobber provides high-quality gears in a compact foot print. The 400H can produce AGMA Class 10 gears on parts up to 406.4mm in diameter with a standard axial travel of 1930mm. A max 6.4mm module gear can be cut on the machine. In recent years, Bourn & Koch has focused on refining the programming software for its gear hobbing machines. The latest iteration of its gear hobbing human machine interface (HMI) allows for users to conversationally program the machine via 19.5" touch screen interface for entering all gear data and tool data. Up to six surfaces can be programmed on one gear with up to six cuts per surface, allowing for maximum control over the hobbing process. The HMI also features an Expert Mode, allowing for even more control over the process for well-experienced operators. The 400H has available 5:1 and 12:1 hob heads with six axes of CNC control.

The Fellows 10-4 Retrofit gear-shaping machine is an update to modern technology on a classic piece of American-Machine tool ingenuity. Bourn & Koch has had a long history of providing high-quality new and remanufactured models of Fellows gear shapers. This latest offering provides that same quality in a more compact, maintainable, and economical package. The 10-4 Retrofit features a Fanuc 35i CNC control making effective use of Macro Executor to provide a familiar programming interface for those who have been using Fellows gear shapers for decades. The machine's new guarding package and smaller hydraulic unit reduces the footprint by 16 square feet. The machine comes standard with a mechanical guide and t-slot worktable. The famous "Blanchard grind" is easy to spot as a mark of quality and accuracy. Bourn & Koch's newly redesigned Blanchard 22AD-42 takes the rugged, heavy-duty design of its rotary surface grinder and updates it to
today’s standards. The new machine comes with a full stainless-steel enclosure featuring an automatic roll-up door. The new enclosure design is leak proof, allows for easy mist collection, and has the potential for automation. One of the most exciting features of the new Blanchard 22AD-42 is the power dresser, which allows operators to dress the grinding wheel at a pre-programmed amount with the push of a button. Many other upgrades to the machine’s design were incorporated as well.

The newest addition to Bourn & Koch’s lineup of American-Made machine tools is the MT3, a multifunctional machine tool platform capable of performing grinding, milling, turning, and drilling/tapping machining operations on a workpiece in one set-up. The machine is primarily designed as a value engineered vertical cylindrical grinder, supplementing Bourn & Koch’s current VBG offering in that arena. The MT3 comes standard with a 42” diameter t-slot worktable and precision grinding spindle with an HSK-50A connection. The machine’s spindles are interchangeable via the innovative HBK-200 clamping system, allowing for the right spindle to be used for the application. The machine will be equipped with custom workholding from Advanced Machine & Engineering to manufacture a hob spindle cartridge from one of Bourn & Koch’s 400H hobbers in one setup. The machine is expandable from a vertical grinder to a “one and done” machine tool system, incorporating various spindles and tools into an added optional cell that are automatically changed via Fanuc R2000 robot and Bourn & Koch’s Alien Claw end-of-arm tooling, allowing for quick change of most tools and spindles. A spindle rack and disc style tool changer are incorporated to the cell to manage the various tools and spindles for the required operations. The machine is programmed via combination of Bourn & Koch’s grinding HMI and Fanuc Manual Guide-i, employing a Fanuc 0i CNC control for all machine functions. A virtual YAxis allows for the machine to perform standard milling functions. The MT3 spindle features a powerful Fanuc Beta-il 160M motor capable of producing 30kW from 2000-10000 RPM, providing ample power and range for a wide variety of grinding, milling, and drilling/tapping applications.

**Mazak’s inaugural All Axes LIVE event connects worldwide**

With the success of its inaugural All Axes LIVE online event, Mazak has reimagined how the industry connects with manufacturers and set a new standard for online events. Held on August 11, 2020 and streamed live from Mazak’s Midwest Technology Center, All Axes LIVE drew large crowds from across North America and worldwide.

The company’s All Axes LIVE online event series is part of a new, holistic digital customer experience designed to elevate their experience by providing unprecedented vir-
tual access to new Mazak manufacturing technology, as well as new opportunities to engage with experts and the larger manufacturing community. More than one thousand manufacturers registered to attend the first All Axes LIVE event.

Described as a paradigm shift for events in the manufacturing industry, All Axes LIVE was well received by the media, attendees, and Mazak’s industry partners.

“The response to our first All Axes LIVE event has been overwhelming,” said Dan Janka, president of Mazak Corporation. “From the moment the event began on Tuesday and in the hours that followed, I’ve received countless messages of support from customers, our supplier partners, and members of the press, all of which expressed excitement and enthusiasm about this new opportunity to engage with our customers on a new level.”

The format for All Axes LIVE includes both live and on-demand cutting demonstrations, technology presentations, and opportunities for customers to ask questions and interact with Mazak experts in real time. Participants can also use the event application to schedule meetings and visits to Mazak’s eight North American Technology Centers and be part of continued conversation in a variety of customized social media environments.

Upcoming All Axes LIVE events are already scheduled for September, October, and December of 2020, as well as January 2021. Additional details and registration for upcoming All Axes LIVE events are coming soon. In addition to All Axes LIVE, Mazak will release its new Virtual Technology Center and 360 Kentucky Campus Tour. Mazak’s network of North American Technology and Technical Centers are open, fully functional and welcoming visitors.

MORE INFO  www.mazakusa.com

High-speed SG-Series SCARA robots yield top production results

Yaskawa Motoman’s new SG-series SCARA robots enable extremely fast and precise operation for small part processing.

Ideal for a variety of applications that require short cycle times, these robots require minimal installation space and yield substantial results with little capital investment.

Now available in two compact models, the horizontally articulated SG400 and SG650 robots are well-suited for assembly and sortation, as well as multi-process systems requiring pick-and-place capability. Featuring a high work envelope to mounting surface ratio, each highly flexible model can be easily integrated with existing robotic automation and can readily be redeployed.

The SG400 robot features a 400 mm radial reach, a 200 mm long U-axis stroke and a 3 kg maximum payload, and the SG650 offers a 650 mm radial reach, 210 mm long U-axis stroke and a 6 kg payload capacity. Each model is highly repeatable and offers a wide variety of fieldbus connectivity options.

Easy-to-integrate vision functionality with MotoSight™ 2D, a Cognex In-Sight based vision system, provides feature-rich functionality and reduces the cost of expensive tooling for locating parts.

Installation is quick and efficient. A single cable is all that is needed to connect the manipulator to the controller, resulting in easy setup and reduced expenses for maintenance and spare parts inventory. Built-in air lines, user IO wiring and a hollow tool shaft simplify tool integration.

SG-series robots are controlled by the compact YRC 1000 micro controller; the same controller used on 6-axis Yaskawa robots. This controller uses a lightweight standard teach pendant with intuitive programming and can be installed in either a vertical or horizontal position, as well as within a 19-inch rack.

MORE INFO  www.motoman.com

Ideal for a variety of applications that require short cycle times, the SG400 (shown here) and SG650 robots require minimal installation space and yield substantial results with little capital investment. (Courtesy: Yaskawa)
Acu-Rite debuts TURNPWR control to program operations at machine

Offering lathe machinists a new, easy-to-use turning control with state-of-the-art features as standard, Heidenhain presents the Acu-Rite brand TURNPWR control. The new TURNPWR control is a workshop-oriented turning control that enables the user to program conventional machining operations right at the machine in an easy-to-use conversational programming language. It is designed for turning machine tools with up to two axes.

TURNPWR was developed to satisfy the needs of lathe machinists where manual and automated operation are both useful and needed. TURNPWR promises to enable the user to maximize throughput by significantly reducing set-up time, scrap, and other non-productive operations, thereby increasing efficiency, productivity and profitability.

The Acu-Rite conversational programming format for controls is a user-friendly method of writing part programs and included in the TURNPWR, however G-code (ISO) programming can also be used. Basic editing of G-code programs is also possible.

On the new TURNPWR, a 12.1” high-resolution display boasts a screen layout that is clearly arranged and user-friendly. Preview graphics in the editor illustrate the individual machining steps for programming the contour as well as corresponding tool path generated using only dimensions pulled from a production drawing. It also accepts DXF files. TURNPWR is a closed-loop system with positioning feedback provided by rotary encoders inside the motor assemblies.

When fitted with the (optional) Acu-Rite precision glass scales (1 µm/0.00005’’ resolution), TURNPWR also includes Position-Trac™, an advanced feature that enables the user to easily, quickly, and accurately re-establish work piece zero after shutting down or power loss.

Acu-Rite is a brand of Heidenhain consisting of digital readouts, linear scales and controls. Acu-Rite DROs and controls are manufactured in the U.S.

MORE INFO
www.heidenhain.us
www.acu-rite.com
Motion Industries announces two acquisitions

Motion Industries, Inc., a leading distributor of maintenance, repair, and operation replacement parts and a wholly owned subsidiary of Genuine Parts Company (GPC), announced two acquisitions. Motion has entered into agreements to acquire TRC Hydraulics, a Canadian-based supplier of hydraulic products and services, and F&L Industrial Solutions, Inc., a distributor of T-slotted aluminum extrusion components. Both transactions closed with an effective date of August 1, 2020.

In business since 1986, TRC Hydraulics has served the Atlantic Canada region with several full-service sales and repair facilities in Canada. In 2019, TRC Hydraulics expanded by opening a facility near Spartanburg, South Carolina.

Along with distributing many lines of hydraulic product, TRC designs, manufactures, and maintains hydraulic components and systems. TRC also engineers customized hydraulic and mechanical solutions, and offers the additional services of experienced fabricators, welders, machinists, and hydraulic technicians.

“This is a fantastic opportunity to grow our business with a leading company that shares the same core values as we do,” said TRC President and CEO Terry Coyle. “We look forward to leveraging the many resources that Motion Industries offers and enhancing our services to provide greater value to our customers.”

Based near San Diego, California, F&L Industrial Solutions has served the southwest U.S. with full-service aluminum extrusion components since 2002. F&L offers local inventory including the 80/20 brand of aluminum, an experienced staff of CAD designers, in-house machining, digital panel cutting, full assembly/manufacturing, on-site delivery, and installation. Custom-designed products include a wide array of enclosures, clean rooms, walls, platforms, cabinets, racks, sneeze guards, tool holders, electrical connections, robotics, specialized carts, and more.

“It’s a perfect fit of our analogous visions and business cultures,” said F&L Industrial owner, Mike Fanolla, who co-founded F&L. “We look forward to the growth opportunities, and with us joining Motion Industries, our customers can anticipate even greater high-quality service they’ve come to know from our company.”

“We are pleased to welcome these outstanding organizations, TRC Hydraulics and F&L Industrial, to the Motion family,” said Motion Industries President Randy Breaux. “TRC gives us the opportunity to expand our hydraulics business in the Atlantic Canada markets. And with its aluminum extrusion niche, F&L will nicely supplement our Mi Automation Solutions Group. We look forward to working with the talented people of both companies to grow our market footprint and build on our industry-leading position, creating even more value for our customers in the coming years.”

MI Automation Solutions Group offerings to customers include control panels, conveyors, machine vision, motion control, network connectivity, pneumatics, robotics, sensing I/O, and other automation-related solutions.

MORE INFO www.motionindustries.com
Big Kaiser celebrates 30 years in precision tooling business

Big Kaiser Precision Tooling Inc., a global leader in premium high-precision tooling systems and solutions for the metalworking industries, is celebrating its 30th anniversary.

On August 1, 1990, KPT Kaiser opened its doors and began its mission to make Kaiser CKB modular boring tools, developed in Switzerland, the leader in the North American market.

When the company began in 1990, most shops used boring-tool technology from the 1950s, where tool changes were a costly and a time-consuming process. Labeling themselves “The Tooling Problem Solvers,” the sales team set out to take on the industry’s toughest problems and prove the efficiency and time savings of modular boring tools. Today, the modular connections are still the same, meaning a tool built in 1969 can still be used on a machine today.

“I started the company out of necessity,” said Big Kaiser President and CEO, Chris Kaiser. “I knew we needed to change how we were selling the boring tools manufactured by my father’s company in Switzerland, Heinz Kaiser AG.”

Now a member of the Big Daishowa Group of companies, Big Kaiser plays an integral role in the company’s worldwide R&D and manufacturing strategy. Big Kaiser develops and provides high-performance tool holders, boring heads, workholding, measuring instruments, and custom engineering support for machining companies.

MORE INFO  www.us.bigkaiser.com

Glebar launches Glebar Customer Care as part of service update

Glebar Company, a leader in precision grinding solutions since 1952, has reorganized investing in its service department. Strong recent growth fueled by retiring expert talent, aging legacy machines, and the acquisitions of Tridex Technology and Everite, created the growing need to support the expansive Glebar install base. In preparing for the future, the service department was expanded and transformed into Glebar Customer Care.

“We want to allow our customers to focus on what they do best: manufacturing quality products and delivering on time in support of their customers. This reorganization bolsters our ability to be our customers’ end-to-end, full-service provider for everything related to operating their equipment and maintaining a healthy supply chain,” said Mark Scanel, vice president and general manager of Glebar Customer Care.

The Glebar Customer Care team will work with customers to minimize downtime and maximize the capabilities of their machines to increase production efficiencies. As customer’s needs grow and technology advances, machine upgrades help to meet these changes while improving efficiencies. The acquisitions of Tridex Technology and Everite allow the service teams to combine resources and technology, finding the best solutions for customers. Glebar’s global distribution network and the dedicated parts and consumables sales team, can deliver parts the next business day, minimizing downtime.
“The investment in our Customer Care organization will ensure our ability to continue to be a full-service provider for our customers as their needs continue to evolve,” said Glebar CEO Robert Baker.

To enable the Customer Care group, Glebar hired Christopher DeFiori as the vice president of operations to drive stability and scalability to Glebar’s operational platform. DeFiori comes to Glebar from Stryker, where he held numerous roles of increasing responsibility across supply chain and commercial operations. Prior to Stryker, he served as an infantry officer in the U.S. Army, deploying multiple times in support of Operation Iraqi Freedom and Operation New Dawn. DeFiori is an alumnus of the United States Military Academy at West Point where he graduated with a BS in systems engineering.

“This is an exciting time to be joining the Glebar team,” said DeFiori. “I look forward to helping the team drive continued growth.”

6D Laser offers high-performance planar processing

6D Laser LLC is an affiliate of leading nanometer-level motion control specialist ALIO Industries, its mission being the integration of ultrafast laser processing with precision multi-axis motion systems.

6D Laser’s central mission addresses limitations of existing laser processing systems which are largely due to sub-optimal positioning systems used by many system integrators. 6-D Laser tackles this problem by integrating ultra-fast laser material processing with the 6-D nanometer-level precision motion control solutions in which ALIO Industries specializes.

6D Laser vertically integrates all of the sub-systems required for precision laser micro-processing, and it does this by forming strategic partnerships with key component and subsystem suppliers that are required to achieve the goals of demanding precision applications.

In addition to its association with ALIO, 6-D Laser has also partnered with SCANLAB GmbH, which, together with ACS Motion Control, has developed an unlimited field-of-view (UFOV™) solution combines the precision galvo scanning of SCANLAB’s XLSCAN system with ALIO’s precision monolithic XY stages for superior UFOV™ accuracy. As customers’ requirements of laser micro-processing applications become more demanding, the performance of legacy systems do not meet the specifications for accuracy, repeatability, and precision.

Conventional unlimited field of view systems that control a scan head and XY stage typically use the high-speed galvo scanners to compensate the slower stage’s following error. A tracking error is induced by the mass inertia and the design of each system’s servo control loop.

This means the real position of the target position. Therefore, the real laser spot position is correct only after a certain amount of time — and the system momentarily oscillates. Because of this, any imperfections in the stage error mapping, or galvo field correction, will affect the overall precision due to the time lag in the servo loop cycle.

In practice, attempts are made to extrapolate the slower stage’s behavior using estimated values, but that approach only works reliably at slow speeds and for non-abrupt motions. Especially at corners and sharp features with high acceleration or deceleration rates, this strategy can produce significant position errors.

The XLSCAN control solution used by 6D Laser applies intelligent filters to control the scan head and stages such that physical limitations of each system are taken into account prior to processing, in an integrated trajectory plan. The positions of both systems are coordinated with each other to sub-micron level precision within micro-second cycle time.

XLSCAN synchronizes the motion of the galvo scanhead and linear stages to increase the total field size without stitching or “tiling.” It has higher accuracy than competitive systems through intelligent trajectory planning. Its precision is only limited by the image field calibration and stage error mapping.

Automatic laser control can correct the spot distance relative to the velocity and the laser power across the scan field, and for increased throughput four scanheads can be controlled with a single XLSCAN controller.

In addition, the laser signal can be raised or attenuated in accordance with application requirements. This applies to straight as well as rounded laser markings, and multiple parameter changes and jumps for individual vectors are also possible.
AME releases white paper on revitalizing manufacturing economy

To help manufacturers successfully navigate the post-pandemic economy, the Association for Manufacturing Excellence (AME) has released a recently published white paper titled, “A Manufacturing Marshall Plan.” This paper maps out exactly how today’s companies can prevent post-pandemic supply chain disruptions, advance their manufacturing productivity, and reskill workforces.

A Manufacturing Marshall Plan advocates for reshoring, nearshoring, and LeanShoring™ together with an increased focus on Industry 4.0 innovations and enhance educational and training offerings to create a stronger workforce. These three actions will provide companies and their communities with a distinct competitive advantage while also boosting productivity and improving sustainable resilience in a fast-changing competitive manufacturing world.

According to the white paper, the coronavirus pandemic is taxing the efficiency and cost benefits of a globalized supply chain system. It recommends that a switch to a more robust domestic supply chain and advanced manufacturing base could reduce the dependence on the increasingly fractured global supply system.

Offshored supply chains cause long-distance transportation, increased communications obstacles, unpredictable delivery times resulting in the loss of manufacturing capacities, and increased environmental pollution. Consequently, a trend known as reshoring or nearshoring — moving supply chain production to domestic or nearly domestic facilities — is gaining acceptance.

In response to current and future demands, and to avoid future supply chain disruptions and takeovers from global competitors, today’s companies must consider undergoing a supply chain renaissance, according to the white paper. To do this, they will have to implement new operational strategies and technologies, and the white paper discusses several resources for the establishment of these redeveloped domestic supply chains.

The establishment of these new domestic supply chains, however, means that manufacturers must increase productivity, efficiency, speed, and quality to maintain competitiveness — all of which requires the digitalization of production.

Unfortunately, the Industry 4.0 and this Digital Revolution creates additional demands for millions of new skilled jobs. As the current workforce undergoes generational changes precipitated by retiring baby boomers, factories are evolving from the pre-automation plants of the past to the smart factories of the future. Workers in smart factories, according to A Manufacturing Marshall Plan, require digital fluency, technological savviness and data analytics know-how — skills that previous generations did not require and that future generations often lack.

The white paper states that the development of a skilled workforce begins with motivating a higher quantity and quality of recruits and that the demise of vocational education at the high school level has bred a skills shortage in manufacturing today. To close the growing skills gap, groups of employers, community colleges, workforce agencies, intermediaries, youth programs, labor organizations, policy experts and others across the country are advancing apprenticeship and work-based learning.
strategies—outlined in the white paper—as workforce development and talent solutions for American businesses.

MORE INFO  www.ame.org

Haas Multigrind LLC announces office move to North Carolina

Haas Multigrind®, LLC, a market-leading provider of CNC grinding centers, relocated its U.S. office from Indiana to Charlotte, North Carolina, effective August 1, 2020.

The 6,500-square-foot facility includes office, classroom, and conference space, a machine demonstration area, and spare parts warehouse.

“This move represents an exciting development for Haas Multigrind, and it demonstrates our strong commitment to existing and prospective customers and strategic partners in the Americas,” said Harry Schorner, general manager of Haas Multigrind LLC. “We are pleased that the new location will enable us to better serve our customers, with better proximity to a major airport and better access to talent to fill key positions within the organization.”

The new address is: Haas Multigrind LLC; 2205-E Distribution Center Drive; Charlotte, NC 28269.

MORE INFO  www.multigrind.com/en

IMAGINiT Technologies earns Autodesk CAM specialization

With Autodesk’s CAM Specialized Partner designation, IMAGINiT Technologies now offers manufacturers a complete CAD/CAM solution that connects and automates the entire design and manufacturing process. Dedicated CAD and CAM experts make IMAGINiT a good choice to support manufacturing companies who are looking to leverage advanced CAD and CAM software solutions to generate toolpaths that increase the productivity of their computer numerical control (CNC) machines.

“As an Autodesk Platinum Partner and Premier Service Provider, we’re excited that IMAGINiT has demonstrated proficient knowledge in CAM to earn the Autodesk CAM Specialization,” said Joe Bailey, sales manager, Advanced Manufacturing Division, Autodesk. “With this designation, manufacturers will be in good hands with IMAGINiT regardless if they’re looking to improve their CNC mill-and-lathe-programming, create complex mold and die components, or focus on optimizing and automating their overall workflow.”

“Our CAM specialists have undergone rigorous training from Autodesk experts and are ready to bring their skills into the shops of our customers to help them modernize their complete tooling and machining workflows,” said Scott Hale, vice president consulting solutions, IMAGINiT Technologies. “Through the use of Autodesk’s CAM solutions, our customers can now generate high-speed machine toolpaths that reduce cycle times and create less tool and machine wear, resulting in faster and more accurate production of parts.”

MORE INFO  www.rand.com

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16  gearsolutions.com
Trends, information, and technology for precision cleaning

In times of contact restrictions, travel constraints, and trade fair cancellations, the virtual customer day scheduled by the Swiss company UCM AG offers customers and interested parties a safe way of keeping up to date with the latest developments in the field of precision and ultrafine cleaning. Presentations in German and English will inform about current trends and demands, as well as about solutions and innovative processes for meeting the requirements set by many industries for ever-cleaner parts. The innovative UCMSmartLine, which can be individually configured from standard modules, will also be showcased for the first time at the digital exhibition booth on September 29, 2020.

Companies from sectors such as the medical engineering, optics, automotive and supplier industries, precision engineering and microtechnology, and also high-purity processing are confronted with ever-increasing cleanliness requirements related to particulate and film-type/chemical contamination. Solutions to these issues are often discussed during a visit to a trade fair, but since that is not possible this year, the Swiss company UCM AG — a division of the SBS Ecoclean Group specializing in precision and ultrafine cleaning — is staging a digital customer day with a virtual exhibition booth.

One of the program highlights of the online event on September 29 will be the Trends, information, efficient solutions and the innovative and highly-adaptable UCMSmartLine for efficient precision and ultrafine cleaning are the focus of the first virtual customer day. (Courtesy: UCM AG)
first-time presentation of the novel smart solution for efficient precision and fine cleaning, UCMSmartLine. The innovative and cost-efficient ultrasonic cleaning series is based on standardized modules, including not only integrated electrical and control technologies for the process steps of cleaning, rinsing, drying, loading, and unloading but also a versatile transport system. The modules are used to configure customized systems for pre-cleaning, intermediate, and final cleaning, and can be adapted to changing requirements and market conditions at any time.

The presentations with subsequent question and answer rounds also address the different and growing demands of the various branches of industry. Topics include “Customized Solutions for Precision Cleaning,” “UCMSmartLine — Modular Solutions For Ultrafine Cleaning,” “Solvent-Based Processes For Ultrafine Cleaning,” and “Innovative Processes For Highest Cleanliness Requirements.”

The customer day is free of charge. The virtual exhibition booth can still be visited after the online event.

MORE INFO
www.ucm-ag.com
www.ecoclean-group.net

Accutek introduces AccuKool coolant port holes to shrink fit tool holder. (Courtesy: Accutek)

Accutek offers new AccuKool coolant port holes to shrink fit tool holder. Accutek Inc. is expanding its AccuGrip Shrink Fit tool holder product offering with the new AccuKool coolant port holes through the body of the shrink fit holder. Specially designed coolant holes target the “vortex” intersection for maximum coolant flow to and through the cutting flutes. Their hole size, design, and angle are critical to the exact placement of coolant into the centrifugal “vortex” created by rotational RPM of cutting tools to minimize the negative impact of centrifugal air flow created by the spinning tool. Improved coolant flow improves tool life, part finish, and overall productivity.

MORE INFO
www.accutekusa.com

Schunk names VP of toolholding and workholding sales

Schunk has promoted Allan Logan to vice president of sales, toolholding, and workholding.

Logan has more than 20 years of territory sales and team management experience in the metalworking industry. He started his career in account management for cutting tools and abrasives before holding various roles as sales engineer, aerospace industry specialist, and regional sales manager.

Logan quickly rose to the challenge of exceeding sales goals and leading focused sales teams in the field of manufacturing.
and machining solutions. Since joining Schunk in 2018 as the director of sales for Eastern US, Logan has managed a group of regional sales managers across 20 states. His team has been responsible for incremental sales growth in the last two years.

“Allan has shown tremendous leadership capability in his time here at Schunk. With his focus on helping the customer succeed and his dedication to the manufacturing industry, Allan is a natural fit to lead our tooling and workholding teams,” said Milton Guerry, president, Schunk USA.

“I am proud to work closely with my colleagues to achieve the growth of Schunk products in the toolholding and workholding space, keeping our customers' interests a priority. I hope to continue fostering collaborative partnerships with our channel and end user customers while building the Schunk brand,” Logan said.

MORE INFO www.us.schunk.com

Machine tool orders fell in the second quarter 2020

As expected, there was again a decrease in the index of the orders collected by the Italian machine tool manufacturers in the second quarter 2020. In particular, according to the data processed by the Economic Studies Department & Business Culture of UCIMU-SISTEMI PER PRODURRE, in the period April-June, the index registered a 39.1 percent downturn compared with the same period of 2019.

The outcome was due both to the reduction in the orders collected by Italian manufacturers on the domestic market (–44.7 percent) and to the fall reported on the foreign market (–37.8 percent).

“In the month of April,” said Massimo Carboniero, president of UCIMU-SISTEMI PER PRODURRE, “the machine tool manufacturing enterprises, as well as a good part of their customers, remained closed, stopping both their production and trade activities. All this has strongly affected the overall performance of the quarter, which shows a difficult situation for the operators of the manufacturing industry.”

“The uncertainty generated by the pandemic and its asynchronous spread in the different areas of the world complicates matters and, undoubtedly, slows down investments in production systems, but we, the Italian manufacturers, are receiving some small signs of recovery, especially from the domestic market,” said Carboniero. “After all, according to the data processed by UCIMU, based on the econometric survey of the renowned Oxford Institute of Economics, after the slowdown of the current year, in 2021, investments in new production technologies should rise again. The demand for new machine tools in Italy is thus expected to grow by 31.5 percent versus 2020, exceeding 3.5 billion euro. Even Europe should be more dynamic, increasing consumption by 19.5 percent to nearly 18 billion euros. Asia, with China in front, should have new impetus, registering a 35.3 percent demand growth, corresponding to 34 billion euro, and so should America, expected to invest 11 billion euros in new production systems, i.e. 31 percent more than in 2020.”

“With these indications,” said Carboniero, “we really hope that the worst is over and that the next months can be characterized...
by a trend reversal, preceding the recovery expected in 2021. Also owing to this, UCIMU is working intensely on the organization of the 32nd BI-MU, scheduled to take place from October 14–17. It will be the first exhibition of the year for the operators of the sector and, considering the time positioning, it can still benefit from the incentive measures provided for in the Transition Plan 4.0 until the end of the year.

MORE INFO www.ucimu.it

Olympus, Metal Analysis Group to deliver API RP 578 training

Olympus and Metal Analysis Group have teamed to offer API RP 578 training courses for alloy verification and positive material identification (PMI) experts who want to sharpen their skills, advance their careers, or earn their certificate of completion.

Using the right alloy in the right component is critical to help prevent accelerated corrosion or even part failure. API RP 578 is a recommended practice from the American Petroleum Institute that provides guidelines for a material and quality assurance system to verify the composition of alloy components in new and existing piping systems. Olympus’ Vanta™ handheld X-ray fluorescence (XRF) analyzers assist with the compliance of API RP 578 for alloy verification in piping systems and API RP 939-C for detecting sulfidation corrosion susceptibility.

Metal Analysis Group provides expert training for comprehensive testing solutions to organizations that rely on PMI, material verification, and metal testing. Their consultation-based approach and experience in a variety of industries and applications will help users better understand how to use their Vanta analyzers to follow API RP 578 and 939-C recommended practices.

Vanta analyzers provide fast, accurate chemistry and alloy identification in PMI applications, including piping, valves, welds, components, and pressure vessels. The analyzers are durable for maximum uptime in harsh environments and high temperature applications, provide traceability to the field to meet API RP 578 guidelines, and offer excellent performance in low silicon (Si) applications to help prevent sulfidation corrosion.

“Metal Analysis Group is known for their strength in the inspection market, and this partnership offers strong support for our business,” said Randy Wertz, executive director, global sales at Olympus Scientific Solutions.

Troy Robertson, cofounder of Metal Analysis Group, said, “It’s an honor to collaborate with one of the world leaders in metal inspection and join a select group of training partners who support Olympus in their mission to ensure safety, quality, and security in the industrial community. We are excited to leverage our expertise with Olympus XRF analyzers and hope to inspire more businesses to make a conscious effort to monitor the impact they have on the environment.”

Together, Olympus and Metal Analysis Group combine their strengths in XRF and testing solutions to help inspectors comply with piping codes and meet safety standards.

MORE INFO olympus-ims.com/training-members

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MORE INFO olympus-ims.com/training-members
The Fall Technical Meeting gets a virtual overhaul

The Fall Technical Meeting (FTM) has long been a staple in the mechanical engineering community as it relates to the gear industry. Although the actual conference did not take its name until the ’80s, the concept has been around for more than 100 years. AGMA’s core foundation is built upon the quality and relevance of our standards, and the FTM is the pipeline of innovation that feeds into the overall promise of what we do as an association.

Due to the COVID-19 pandemic, the traditional format of the FTM has been altered to provide a safe and travel-free option — the conference is virtual for this year. Due to the change, the normal format for the event has been altered. Ten papers were chosen by our expert engineers and committee members, and the researchers behind them will record their presentation to distribute to attendees for viewing from October 5–19. Directly following, on October 20, the 10 presenters will conduct a live Q&A session where you can have your pre-submitted questions answered in real time. Although we know that an online event can never replace the handshake you get in an in-person event, there will be networking, and the latest research will be shared.

This year’s presenters are Europeans and Americans who represent both academia and industry. Their presentations cover the latest research on gear-testing methods, case studies with comparisons to existing standards, efficiency calculations, computer modeling, and gear-formula development.

Because every registrant gets access to every paper and presentation, there are not specific categories or “sessions” planned out. Instead, registrants are free to make their own schedule and watch the pre-recorded presentations at their leisure. This allows for viewers to write down questions, go back and look at something they might have missed, and, most importantly, they are able to choose when it is convenient for them to watch. For example, watching presentations on rating could be broken up by watching presentations on test methods and so forth. What we miss in regards to a live presentation, attendees gain in flexibility and viewing from their own computer.

The diverse topics covered by the 10 presentations this year span from design to manufacture, include electric vehicles and wind-turbine case studies, and cover thermal rating, high-speed gearing, tribology, and failure analysis. As always, each paper maintains the quality assurance, as the double-blind peer review remained a priority. Each paper will be published in SCOPUS and will be available for purchase separately from the FTM. AGMA recognizes that this year has been challenging for so many in the gearing industry, and that changing the format for the FTM, to keep our attendees safe, was necessary. We look forward to hopefully seeing you all again next year, but in the meantime, we will see you online.

For more information, go to: www.agma.org/2020-fall-technical-meeting.
**Fall Technical Meeting abstracts and presenters**

October 5-19 (online content available), October 20 (live Q&A and networking)

**AITOR ARANA**  
Mechanical and Industrial Production of Mondragon University, Spain

*Abstract Title:* Quasi-static transmission error behavior under the composite effects of temperature and load  
*Abstract:* Current demands for enhanced rotational speed in geared transmissions affect the thermal behavior of mechanical parts by increasing their steady-state temperature. Lubricating film thickness is reduced, increasing the failure probability, and if temperature levels are sufficiently high, thermal distortion can affect mesh behavior. In this work, a custom back-to-back test rig is used to experimentally analyze the composite effect of temperature and load in terms of backlash, mean level of transmission error and its peak-to-peak value. The experimental results are then compared to analytical predictions.

**DOMINIK KRATZER**  
FZG Gear Research Centre, Technical University of Munich, Germany

*Abstract Title:* Effects of different shot peening treatments in combination with a superfinishing process on the surface durability of case-hardened gears  
*Abstract:* There have been extensive scientific studies in the past on the positive effects of shot peening and superfinishing, however a detailed quantification of a calculation model of these two effects has not been subject to in-depth investigation yet. To address this gap in knowledge, a study was carried out to examine and evaluate different peening processes and the resulting residual stress profiles in combination with a superfinishing process. By correlating the pitting durability from the experimental investigations with existing calculation methods, it was possible to extend the surface factor ZR from ISO 6336 to a wider range of roughness values as well as to introduce a new factor ZS for different shot peening treatments.

**ANDREAS BEINSTINGEL**  
Renk AG, Technical University of Munich, Germany

*Abstract Title:* Thermal lead correction for high speed gears  
*Abstract:* Temperature distribution in high-speed gears of large dimension and high-power density is much different in operation as compared to manufacturing. Therefore, the influence of non-uniform thermal growth should be accounted for with suitable lead modification, as it is demanded by the latest version of API 613. For many years, REIK has been using empiric methods for thermal lead correction based on measurements and experience. This paper compares a complex finite element calculation to the original method and develops a simplified approach for quick and reliable heat analyses for thermal lead correction of high-speed gears.

**YI GUO**  
National Renewable Energy Laboratory, United States

*Abstract Title:* Validation of a generalized formulation for load-sharing behavior in epicyclic gears for wind turbines  
*Abstract:* In an ideal epicyclic gear set, every parallel gear path transmits the same amount of torque. However, it is well known that certain manufacturing variations result in unequal load sharing between the parallel gear paths. Previous works have developed and validated a general closed-form analytical model of this phenomenon. In this paper, the analytical model has been reformulated to include the effects of gravity, carrier bearing clearance, and external applied moments. The model is compared to load measurements collected from two similar wind-turbine gearboxes with three-planet epicyclic gear sets, and also compared to the mesh load factor requirements in the ANSI/AGMA 6006 and IEC 61400-4 wind turbine gearbox design standards.

**DR. PARVIZ MERATI**  
Western Michigan University, United States

*Abstract Title:* Gear sliding losses  
*Abstract:* Accurately predicting frictional losses is critical for increasing overall gearbox efficiency. This paper documents an approach used to incorporate the effect of lubrication characteristics, gear geometry, surface finish, and operating conditions into an algorithm that accurately predicts sliding losses over a range of operating conditions for a standard set of gears. The methodology developed for simple contacts is used to predict gear sliding losses for much more complicated cases of spur and helical gears, where load and rolling and sliding speed of the contact patch varies at each roll angle during the mesh cycle.

**PHILIPP NORGAUER**  
Gear Research Centre, Technical University of Munich, Germany
The current calculation status for worm shaft deflection is discussed, and a new approach for the worm shaft deflection calculation is developed. The new method allows calculation of the bending stiffness of overhung worm shafts as well as worms of reduced tooth thickness, which are usually used in crossed helical gear boxes.

ROBIN OLSON
Rexnord Industries, United States

Abstract Title: Case study of ISO 6336-22 method
Abstract: ISO/TS 6336-22 specifies a method to calculate the risk of micropitting in gear sets through the use of a safety factor. The safety factor is calculated as the minimum specific film thickness in the contact zone divided by a permissible specific film thickness. The permissible specific film thickness is best determined through experience or testing, but there is an option to estimate it based on the lubricant’s failure load stage in FZG testing. In this paper, real cases of micropitting have been identified in gear sets operating in high speed, low speed, and intermediate speed applications. The ISO/TS 6336-22 method has been applied to these cases in order to determine whether the method reliably predicts that micropitting will occur.

DANIEL VIETZE
Institute of Machine Elements, Technical University of Munich, Germany

Abstract Title: Service life of cylindrical and bevel gears under variable load and stresses
Abstract: Transmissions are usually loaded by variable external loads under real operating conditions. Variable loads can be considered in the calculation of the load carrying capacity by using application factors, overload factors, or more complex standards such as ISO 6336-6. This paper gives a brief overview of currently applied methods to consider variable loads in the design process of cylindrical, bevel, and hypoid gears. The scope of application of these methods is shown and critically analyzed for the damage mechanism pitting, tooth root breakage, and tooth flank fracture. Furthermore, the influence of locally changing stresses on the pitting load carrying capacity is explained on bevel and hypoid gears. A method to assess such influence is shown for constant external loads.

MATTHEW WAGNER
Applied Research Lab, Penn State, United States

Abstract Title: Single tooth bending fatigue testing at any R ratio
Abstract: This paper outlines Single Tooth Reversible Bending Fatigue (STRBF) testing, which overcomes previous test limitations by allowing compressive loads to be applied to the test tooth root in any magnitude in conjunction with the typical tensile loads. This test setup involves three teeth of the test gear, with the upper and lower teeth providing the reactions in the up-and-down load directions, and the test tooth being subject to test loads in both directions. Any R-ratio applicable to gear-bending fatigue testing up to and including fully reversed loading (1 > R ≥ -1) is possible. Non-dimensional examples of fatigue data from a recently completed fully reversed testing program are shown.

CHRISTIAN WESTPHAL
Laboratory for Machine Tools and Production Engineering, RWTH Aachen University, Germany

Abstract Title: Analysis of the operational behavior of a high-speed planetary gear stage for electric heavy-duty trucks in multi-body simulation
Abstract: In this paper, the operational behavior of a high-speed planetary gear stage for electric heavy-duty trucks is analyzed in dynamic multi-body simulation MBS. The tooth contact analysis method developed is extended by the simulation of planetary gears in the MBS. Different bearing strategies for planetary gears are compared, and the effects on the operational behavior are evaluated. In addition to the dynamic transmission error, the dynamic tooth flank pressures are analyzed both in their amplitude and their distribution on the tooth flank. Furthermore, bearing forces are evaluated in dynamic operating points. In the simulation, the misalignment of the gears is directly taken into account by means of a penetration calculation in every time step.

PRICING

- Member Price for individual attendee: $349
- Non-member Price for individual attendee: $499
- Student Rate (with proof of scanned ID and student email): $75*

*Students must fill out the form at www.agma.org/2020-fall-technical-meeting and send a scanned copy of ID.

Please note that each individual person should have their own registration even if you share a work space with a colleague. If your company would like to discuss a group discount, please email lewis@AGMA.org.
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.

### SEPTEMBER
- **September 15** — Powder Metallurgy Committee Meeting — WebEx
- **September 22** — Metallurgy and Materials Committee Meeting — WebEx
- **September 24** — Bevel Gearing Committee Meeting — WebEx
- **September 25** — 3D Printing Committee Meeting — WebEx
- **September 29** — Wormgearing Committee Meeting — WebEx

### OCTOBER
- **October 2** — Electric Drive Committee Meeting — WebEx
- **October 6** — Nomenclature Committee Meeting — WebEx
- **October 7** — Aerospace Committee Meeting — WebEx
- **October 8** — Gear Accuracy Committee — WebEx
- **October 9** — Lubrication Committee Meeting — WebEx
- **October 13** — Electric Drive Committee Meeting — WebEx
- **October 13-15** — Gearbox Systems Design — Virtual
- **October 16** — Electric Drive Committee Meeting — WebEx
- **October 20** — Fall Technical Meeting Live Q&A Session — Virtual Platform
- **October 21** — Powder Metallurgy Committee Meeting — WebEx
- **October 23** — Metallurgy and Materials Committee Meeting — WebEx
- **October 27** — Wormgearing Committee Meeting — WebEx
- **October 29** — Bevel Gearing Committee Meeting — WebEx

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Are your gears compliant?

What makes a gear RoHS or REACH compliant under U.S. and EU regulations?

The concept of clean living has been around for a long time, but it wasn’t until recently that it became the movement that it is today. Where once you needed to travel out to the countryside to find a local farm stand that sold farm-fresh produce, today we have complete marketplaces that sell only certified-organic produce. Many consumer products are quick to tout that they are free from this additive or free from that ingredient. These consumer-first initiatives, in response to the desire to not pollute our bodies or our environment, have extended into the industrial world as well.

It was 1948 when the United States federal government passed the Federal Water Pollution Control Act. Before this point, these were no laws that prohibited the use of our rivers and oceans as repositories for industrial waste. The Act was rewritten in 1972 and granted the newly created Environment Protection Agency (EPA) broad authority to protect all surface waterways including wetlands, rivers, streams, lakes, and the oceans.

In 1963, the United States federal government passed the first Clean Air Act. Its initial purpose was to research methods for monitoring and controlling air pollution. However, it was quickly realized that the booming automobile population was a major source of toxins polluting the air. To address these emissions, the government passed the Motor Vehicle Air Pollution Control Act in 1965. In 1970, additional legislation was passed which mandated limits be placed on industrial sources of air pollution as well.

In 1974, the United States federal government passed the Safe Drinking Water Act. This legislation mandates that all public drinking water systems are free from microorganisms, disinfectants and their byproducts, certain organic and inorganic chemicals, and radioactive particulates.

In 1990, legislation was passed that further improved both the air and the water by addressing the issues of acid rain, ozone depletion, and toxic air pollution. Although these legislative actions helped to improve the air and water quality, none of them address the end-of-life disposal of products and their possible leaching of toxic chemicals to the environment.

The idea of toxic chemicals leaching into the ground and eventually finding their way into our waterways and food sources led the European Union (EU) to develop Directive 2002/95/EC, commonly known as the Restriction of Hazardous Substances (RoHS). This directive was enacted in 2002 and compliance was mandatory on July 1, 2006. The directive placed strict limits on the use of lead (Pb), mercury (Hg), cadmium (Cd), hexavalent chromium (CrVI), polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE) in electronics and electrical products. It also applied some restrictions to coatings and plating of components in these devices.

Since the introduction of the initial directive, the EU has upgraded the restrictions two times. The first upgrade Directive 2011/65/EU, also known as RoHS2, added the requirement that all products bearing the CE designation mark also be RoHS compliant.

The most recent upgrade is EU Directive 2015/863, which is also known as RoHS3. This directive expands the list of restricted substances to ten from the original six. Here is the full list and the maximum allowable concentrations:

- Cadmium (0.01%)
- Lead (0.1%)
- Mercury (0.1%)
- Hexavalent chromium (0.1%)
- Polybrominated biphenyls (PBB) (0.1%)
- Polybrominated diphenyl ethers (PBDE) (0.1%)
- Bis(2-ethylhexyl) phthalate (DEHP) (0.1%)
- Butyl benzyl phthalate (BBP) (0.1%)
- Dibutyl phthalate (DBP) (0.1%)
- Diisobutyl phthalate (DIBP) (0.1%)

### About the Author

Brian Dengel is general manager of KHK-USA, which is based in Mineola, New York. Go online to www.khkgears.us
In addition to the RoHS regulations, there is another regulation that exists for chemical usage within the EU. This regulation is the Registration, Evaluation, Authorization, Restriction of Chemicals (REACH). This regulation is administered by the European Chemicals Agency (ECHA). The ECHA currently identifies 197 substances made from 71 base chemicals which it has identified as hazardous to humans and the environment. Specifically, these substances have been found to be carcinogenic, mutagenic, reprotoxic, bio-accumulative and toxic, or as endocrine disruptors. The most current list of restricted chemicals can be viewed at: https://echa.europa.eu/substances-restricted-under-reach

Unique to REACH is that it applies to all applications of the restricted chemical substances. It is not restricted to electronic or electrical products in the way RoHS is; nor is it restricted to the industrial use of these chemicals. REACH regulations apply to the paint you use on your home, it applies to the solvents that you use to remove tar from your carpet, and it even applies to the stain release treatment applied to your favorite sofa.

All of the above regulations restricting the inclusion of these hazardous substances and hazardous chemicals in our products and processes are an excellent way to help prevent the leaching of toxic substances into our environment. However, none of these substances or chemicals are commonly found in gearing. The most common gearing material is carbon steel. The make-up of AISI 1045 steel is outlined in Table 1.

As such, the request to certify that a carbon steel gear is RoHS3 compliant is an example of bureaucratic hubris. In addition to being free of the REACH and RoHS substances, all steel gears are also soy-free, gluten-free, non-GMO, BPA-free, sugar-free, salt-free, caffeine-free, phthalate-free, paraben-free, and are not manufactured on shared equipment with peanuts, tree nuts, wheat, soy, milk, eggs or shellfish.

Clean air and clean water are excellent ideas, and everyone should do their part. We should all recycle our plastics, paper, glass and metal. We should properly dispose of refuse and no trash should ever be discarded as litter. We can all contribute to keeping the environment clean. Let’s start by eliminating all of the hubris.

ARE YOU MAXIMIZING YOUR EXPOSURE?

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Dave Gomez – national sales manager
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Introduction to nondestructive testing

Nondestructive testing (NDT) is an interdisciplinary science that uses many different methods to evaluate the properties of metals, parts, or assemblies without causing damage to the tested part or assembly. Because no damage results from these testing techniques, it is often done as part of the manufacturing process to determine if any flaws are present or created. It is also often used for product evaluation or during failure analysis.

Nondestructive testing relies on a variety of different signals to examine different materials. The most common method, visual inspection, compares the appearance of an object, such as a circuit board or part, against a known standard. This method can be augmented beyond simple visual inspection by an operator by using computerized vision systems, borescopes, microscopes, or other methods to detect any changes in a product. This method can also be used to examine processes, such as welding for proper bead, or weld undercut.

Other methods use sound waves or magnetic fields to determine if any discontinuities exist, still others use X-rays or neutrons to examine for flaws or defects. Some methods use dyes and a carrier to detect leaks or cracks.

There are many applications of NDT in manufacturing and the medical field, as well as in everyday life. For instance, the dyes your mechanic would use in your automotive air conditioning circuit to detect leaks is an example of a simple non-destructive technique. Tapping a watermelon to see if it is ripe is another simple everyday application of an NDT method using sound.

In manufacturing, NDT is used to examine parts to meet specifications such as weld soundness or the presence of overheating due to grinding. NDT can be used to detect the presence of laps or seams, or the presence of inclusions. The soundness of adhesive joints in aerospace is examined using non-destructive testing.

There are numerous different types of NDT techniques used in manufacturing. The most common methods include:

- Magnetic particle inspection.
- Ultrasonic inspection.
- X-ray.
- Dye penetrant.
- Eddy current.

However, there are many more NDT methods that are particular to different applications. Each of these methods has its own advantages and limitations. These methods will be discussed in more detail in subsequent articles.

**NOMENCLATURE**

In the United States, the standard terminology is established by ASTM E-1316 [1][2]. Some typical [3] terms used in the industry are:

- **Discontinuity:** “A lack of continuity or cohesion; an intentional or unintentional interruption in the physical structure of the material.” This could be a sharp radius or columnar grain structure in a weld. It could also be porosity or a fatigue crack.
- **Indication:** “The response or evidence from a nondestructive evaluation.” This is the response from the NDT method. In could be an agglomeration of particles in magnetic particle testing, or evidence of dye from dye penetrant testing. Indications are further broken down into two categories: a relevant indication and a non-relevant indication.

A non-relevant indication is “an NDT indication that is caused by a condition or type of discontinuity that is not rejectable.” This could be noise due to the geometry of the component being examined.

A relevant indication is “an NDT indication that is caused by a condition or type of discontinuity that requires evaluation.” This
could be the response due to a large inclusion or the presence of a lap or seam in a forging.

- **Interpretation:** “The determination of whether indications are relevant or non-relevant.” This is really the crux of the matter and the hardest part of NDT. This is where training is very important. It is not cost effective to call too many false positives or false negatives.

- **Flaw:** An imperfection or discontinuity that may be detected by NDT but is not necessarily rejectable. This can be naturally occurring or created by the fabrication or manufacturing method.

- **Evaluation:** “Determination of whether a relevant indication is cause to accept or reject a material or component.”

The hierarchy of these terms is shown in Figure 1.

**CERTIFICATION AND TRAINING**

NDT methods rely heavily on the skill of the inspector. Operators are often certified either internally through their employers or externally through an outside agency such as the American Society of Nondestructive Testing [1]. Depending on the application, a certification program certified by an outside agency is required.

There are different levels of certification. Using the nomenclature of ASNT, these are classified as Levels I, II, and III skill levels.

In Level I, technicians are qualified to only perform certain duties, under close supervision. They follow specific work instructions and procedures. They do not do any interpretation of the data, but only report findings.

Level II technicians or engineers are experienced personnel who can inspect to various standards and codes. They can establish written methods for Level I technicians. Level II personnel can report and interpret results as well as train Level I technicians. Level II technicians or engineers possess a broader and deeper understanding of the testing requirements to the many different standards and have a deeper understanding of the specific test method.

Level III technicians or engineers have a deep knowledge of the method and have many years of experience in the method. These technicians can certify lower level personnel according to accepted standards. These are the technicians who develop and establish methods for Level I technicians to follow.

Many employers use an Employer Based Certification. In this method, each employer specifies the qualifications and requirements for each of the various NDT methods. Typically, the written plan would establish criteria for testing and minimum skill/knowledge required for each level of testing.

**CONCLUSIONS**

In this short article, the basic flow of an NDT examination is illustrated, and the basic terminology used is shown. In future articles, an examination of different NDT methods will be discussed.

Should there be any comments regarding this article, or any suggestions for new articles, please contact the author or the editor.

**REFERENCES**


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LEVERAGING THE COMPLEMENTARY STRENGTHS OF ORBITLESS AND PLANETARY DRIVES
The low-pitch and bearing velocities, fewer gear engagements, and uni-directional separation forces of an orbitless drive result in high-speed ratings and low NVH levels at the expense of decreased ratio and load capacity, making it particularly viable as a primary stage.

By LEO STOCCO

An orbitless drive is a novel, fixed-ratio, epi-cyclic drive that includes a second carrier in place of a ring gear. It has been shown to have superior efficiency to a planetary drive and is shown here to produce less vibration and noise at the expense of reduced torque capacity and ratio. A prototype 16mm orbitless drive is constructed and compared to an off-the-shelf planetary drive. Vibrations that occur at the planetary tooth engagement frequency are absent from the orbitless drive. A higher-quality, 32mm orbitless prototype is evaluated in a multi-stage environment in both a stand-alone and multi-stage configuration. It is shown that sound levels are reduced; sound quality is improved, and it is concluded that an orbitless primary stage may be mated with conventional technologies to minimize NVH levels in multi-stage gear drives.

1 INTRODUCTION
Parallel-axis and planetary drives are centuries-old technologies that form the foundation of the gearing industry. The orbitless drive [1, 2] is a newly patented gear technology [3, 4] that is co-axial and epicyclic, similar to a planetary drive, but lacks idler gears, similar to a parallel-axis drive. Orbitless planets circulate but do not rotate, resulting in reduced friction losses, as reported in [5, 6].

Although all three technologies may be configured in a variety of ways to achieve reduction, over-drive, low, high, positive and negative ratios, this paper only considers the most fundamental, low-ratio configuration where the input and output are the pinion and bull-gear respectively (parallel-axis), or the sun and carrier respectively (epicyclic). Parallel-axis drives are the simplest and most common, with non-coaxial drive shafts that rotate in opposite directions. Planetary drives have higher-power density and coaxial drive shafts that rotate in a common direction. Orbitless drives may be configured for either coaxial or offset drive shafts that rotate in a common direction.

In Section 2, the relative strengths of planetary and orbitless drives [5, 6] are identified and SimulationXTM [7] is used to demonstrate reduced orbitless planet vibration. It is proposed that a high-speed, low-noise orbitless primary stage may be mated with one or more compact, high-torque planetary downstream stages to minimize noise without sacrificing torque capacity or compactness. In Section 3, a prototype orbitless microdrive is constructed and compared to an off-the-shelf planetary drive using sound measurements to corroborate the simulated results. In Section 4, a high-quality Maxon MotorTM [8] orbitless/planetary multi-stage drive is developed, and noise is recorded and analyzed to support the proposal made in Section 2. Finally, a summary and conclusion are presented in Section 5.

2 RELATIVE STRENGTHS
An orbitless gear-head resembles a planetary gear-head in that a high-speed (input) shaft drives a sun pinion that is surrounded by a collection of planet pinions that ride on an output carrier that drives a low-speed (output) shaft, as illustrated in Figure 1. Instead of an orbit (ring) gear, an orbitless gear-head includes a second reaction carrier that engages each planet on a second planet axis. Although the two planet axes must not coincide, they may otherwise reside anywhere on the planet. Orbitless planets do not rotate. They circulate the sun at a fixed orientation, so it is not necessary for either axis to intersect the planet center (see Figure 1, right).

Figure 1: Conceptual coaxial and non-coaxial orbitless gear-heads.
In Figure 1, the coaxial version (left) has its drive carrier planet axes intersecting the center of each planet, which results in coaxial input (high-speed) and output (low-speed) shafts. The non-coaxial version (right) has symmetrically eccentric planet axes, which accommodate large planet bearings for greater durability. It has non-coaxial input and output shafts with a shaft distance that is equal to the distance between the planet’s central and drive axes.

The reduction ratio $i$, and pitch line velocity $V_{PL}$ of a planetary and orbitless drive are derived in [1] and shown in Equations 1-4 where $Z_S$ and $Z_P$ are the teeth on the sun and planet, $\omega_S$ is the angular velocity of the sun (high-speed shaft), $\omega_C$ is the angular velocity of the carrier (low-speed shaft), and $M$ is the tooth module.

$$i = \frac{\omega_S}{\omega_C} = 1 + \frac{Z_P}{Z_S}$$  

\begin{equation}
V_{PL} = \frac{Z_S Z_P}{2(Z_S + Z_P)} M \omega_S
\end{equation}

$$i = \frac{\omega_S}{\omega_C} = 2 \left( 1 + \frac{Z_P}{Z_S} \right)$$  

\begin{equation}
V_{PL} = \frac{Z_S (Z_S + 2Z_P)}{4(Z_S + Z_P)} M \omega_S
\end{equation}

Equations 2 and 4 are plotted against $Z_S$ in Figure 2 with $M=1$, $\omega_S=1$, and $Z_S+Z_P=36$. The assembly criteria are always satisfied when the number of planets $N=3$ and all drives have a similar outer diameter. In Figure 2, the corresponding reduction ratios and sketches of the associated drive topologies are superimposed for $Z_S=\{9, 18, 24\}$, and the curve is re-plotted with ratio on the x-axis.

In Figure 2, the planetary curve has both a higher value and a steeper slope over the entire range of practical sun geometries. For geometrically similar drives, the orbitless pitch velocity is from 20% ($Z_S=9$) to 50% ($Z_S=24$) lower, and for functionally similar drives ($i=3:1$ to $4:1$), the orbitless pitch velocity is about 50% lower throughout. These are sufficiently significant to indicate meaningful improvements in efficiency, NVH, and speed rating.

To compare performance characteristics, geometrically equivalent planetary and orbitless drives are simulated side-by-side in a common SimulationX Multi-Body System (MBS) environment. SimulationX Version 3.9.2 is used to develop a planetary drive model, which is then duplicated, the ring gear is erased, an offset bore is added to each planet, and an offset carrier is added and connected to the planets with rotary joints. In doing so, it is assured that all other parameters are identical between the two models.

The parameters are shown in Table 1 and the 2-model environment is shown in Figure 3. PA is the gear tooth pressure angle; physical units are absent for all parameters that are pure; two ratios are specified because uniform geometry results in a higher planetary drive ratio, and the outer diameter (OD) neglects housing thickness. From Equations 2 and 4, the orbitless pitch velocity is 22% lower for a common input speed.

To verify the implementation, an XY plot of radial-tangential planet force is plotted and compared against a Matlab plot of the theoretical equivalent, which neglects load sharing error and centrifugal forces but includes separation forces resulting from a 20° pressure angle. In the Matlab plot, the tooth force is represented by the red vector with its tip at the origin and its tail tracing the red circle for carrier angles varying from 0 to 360°, and where $F_t$ is its maximum amplitude. Similarly, the blue vector ($F_d$) represents

<table>
<thead>
<tr>
<th>$Z_S$</th>
<th>$Z_P$</th>
<th>$M$ (mm)</th>
<th>PA (deg)</th>
<th>FW (mm)</th>
<th>N</th>
<th>$i$</th>
<th>OD (mm)</th>
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<td>5</td>
<td>3</td>
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Table 1: Parameters of SimulationX MBS gear-heads.
the drive carrier pin force, and the green vector (Fr) represents the reaction carrier pin force. As shown in Figure 4, the two results are equivalent for the drive pin carrier force once the SimulationX model has reached steady-state (i.e., full torque).

Although SimulationX MBS Version 3.9.2 does not simulate gear tooth friction, a new “gearLosses” block (beta version) computes the friction of gear meshes associated with a rotary joint and applies an equivalent amount of friction to that joint.

The orbitless load consists of a 117 µNms/rad damper applied to its output joint. Since the ratio of the planetary drive is 2x as high, its load damper should be 4x larger, but to compensate for non-uniform tooth friction, it is 3.7x larger to keep the input speed, torque, and power as consistent as possible. The input shafts are accelerated to 7,000 RPM at which point approximately 8.5 W of power flows. The associated total system power loss and corresponding efficiency are plotted in Figure 5. As expected, the planetary drive has approximately twice the losses due to its higher pitch velocity and additional gear meshes.

Noise is not explicitly measured by SimulationX but may be estimated by planet vibration. In Figure 6, the planetary radial separation forces show cancellation of opposing sun and ring forces, with a high-frequency and DC component remaining. Orbitless separation forces are uni-directional and predominantly DC. The associated FFTs show a spike centered at the planetary toothing frequency but a consistently decaying orbitless frequency spectrum.

Phase differences between radially opposing separation forces induce vibrations that are transmitted into, and possibly amplified, by the planetary housing (see Figure 7). Orbitless separation forces are uni-directional, so the planets vibrate less and do not contact the housing, so sound transmission is impeded. The complementary advantages of orbitless and planetary configurations are summarized in Table 2.

The above properties motivate the use of an orbitless drive as a primary stage. The conceptual multi-stage drive shown in Figure 8 combines an orbitless primary stage with two planetary downstream stages. The low pitch and bearing velocities of the orbitless primary stage maximize speed rating where internal velocities are highest, and superior NVH properties combined with plastic planets minimize noise where most of it is generated. Compact, high-ratio, metal planetary downstream stages maximize output torque capacity and reduction ratio for long service life and a small footprint.

### 3 SINGLE-STAGE ORBITLESS PROTOTYPE

A single-stage orbitless prototype is constructed to validate the simulated planet vibrations shown in Figure 6. The prototype is co-axial with plastic planets that are supported on both sides by the central carrier and is mounted to a Maxon DCX16 motor, as shown in Figure 9. It is too small for planet bearings, so planet and carrier bores are given tolerance for a sliding fit, and polished shafts are used wherever possible. The 2-sided central carrier is male on the left and female on the right, and the offset carrier is male. The 2-sided central carrier provides stability to prevent planet yaw as described in [5, 6], and offset bores in the planets are contained entirely within the large male members to avoid weakening adjacent tooth roots. The toothed
The planet body has only a central bore to maximize wall thickness.

The technical specifications are shown in Table 3, many of which are chosen to satisfy the challenging manufacturing constraints, such as 3D-printing resolution, standard tooth modules, and minimum available bearing and shaft diameters, of a 16mm micro-gear-head.

The sun has a collar with a 2mm D-shaft given tolerance to slip fit onto the motor shaft. Roller bearings are used between the carriers, and the housing is constructed from 3D-printed plastic adapter plates, and aluminum tube stock is fixed on each side by 3 set-screws for easy disassembly. The multi-part housing is a source of gear misalignment, which increases sound volume.

A variety of 3D-printing technologies are used to construct the components, with multiple technologies used for the carriers and gears for the purpose of experimentation. Figure 10 shows a version using metal planets and plastic carriers. The prototype 2.77:1 orbitless gear-head is compared with a Maxon Low-Noise 3.9:1 GPX16 planetary drive, factory assembled with the same Maxon DCX16 motor. The prototype orbitless gear-head has a high-resolution metal sun and carriers, high-resolution plastic planets, and a light coating of WD40™ for lubrication. Both gear-motors are connected by a flexible coupling to a DC motor with a load resistor across its terminals. Due to variations in reduction ratio, load resistor values are chosen so that equal power is delivered at 7,000 RPM (input). Both motors draw the same current and rotate at the same speed during the comparison.

Uncalibrated loaded and unloaded sound measurements are recorded with a microphone placed 5cm away from the front face of the gear head to minimize the sound contribution of the motor. FFTs of the recordings are shown in Figure 11. The maximum loaded and unloaded amplitudes are similar, in spite of the inferior manufacturing quality of the 3D-printed, hand-assembled, unlubricated orbitless prototype.

The commercial planetary drive produces frequency spikes near the tooth engagement frequency of 1.7 KHz, which amplifies under heavier loads. The orbitless drive has a flatter spectrum, regardless of load, with no distinct spikes (tooth engagement frequency = 1 KHz). It is assumed that a comparable manufacturing quality would result in reduced sound amplitude, improved sound quality (mellower tone), and minimal high-frequency gear whine.

4 MULTI-STAGE ORBITLESS PLANETARY PROTOTYPE

To evaluate its performance with a more comparable manufacturing quality and in a multi-stage environment, a prototype orbitless gear head is constructed by the Maxon Motor research and development department. It is interchangeable with a Maxon GPX32 planetary gear head so it may be used stand-alone or in series with an off-the-shelf GPX32.

All male joint members are machined into steel planets with
cubic offset shafts pressed in for added strength. Plain bearings are pressed into a 2-sided central and 1-sided offset carrier. The technical specifications are shown in Table 4 and photos of an assembled gear-motor, a disassembled gear head, and a close-up of a planet are shown in Figure 12.

Ball bearings are used between the carriers and housing, brass bushings are used to support the two smaller planet shafts on the central and offset carriers, and two different types of high-performance plastic plain bearing (V1 & V2) are used to support the large planet shaft on the central carrier. Each version is operated as a 1-stage and a 3-stage drive, where a 2-stage 16:1 GPX32 planetary gear head is mounted to the output for a combined reduction ratio of 32:1. Each gear head is mounted to a Maxon DCX32 motor and is spun at 6,000 RPM in a noise chamber with a microphone placed 10cm from the gear head. The resulting FFTs of the audible frequency range for 1-stage orbitless and 3-stage orbitless/planetary drives are shown in Figure 13.

In all cases, the spectrum is flat with no perceptible spikes (tooth engagement frequency = 900 Hz). There is no significant difference between V1, V2, single, or multi-stage drives. These results are consistent with predicted values and the presumption that the primary stage is the dominant sound source in a multi-stage drive.

5 CONCLUSION

In multi-stage drives, each sequential stage rotates slower and delivers more torque. The low pitch and bearing velocities, fewer gear engagements, and uni-directional separation forces of an orbitless drive result in high-speed ratings and low NVH levels at the expense of decreased ratio and load capacity, making it particularly viable as a primary stage.

A SimulationX MBS model demonstrates a vibration spike at the tooth engagement frequency for a planetary drive but not for an equivalent orbitless drive. A prototype single-stage 16mm orbitless gear head demonstrates these predicted noise characteristics. A high quality 32mm orbitless primary stage is integrated with a 2-stage planetary to achieve a compact, high-ratio, high-torque, multi-stage drive that emits a low-noise volume with a flat-frequency spectrum across the entire audible range.

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THE BENEFITS OF SPLINES
Any device that transfers rotary motion from one point to another probably relies on a spline, so it’s a good bet that they are used on a near-daily basis.

By DAN SEGER

What is a spline? According to the American Heritage Dictionary of the English Language, a spline is defined as: Noun: 1a) Any of a series of projections on a shaft that fit into slots on a corresponding shaft, enabling both to rotate together. 1b) The groove or slot for such a projection. 2) A flexible piece of wood, hard rubber, or metal used in drawing curves. 3) A wooden or metal strip; a slat.

The origin of the word may be derived from the word “splinter,” but in today’s world, a spline had better not splinter or the consequences could be grave.

For purposes of this article, splines are used in mechanical drive systems. They are found in the rotating mechanisms that we all see daily. Any device that transfers rotary motion from an input to an output most likely uses a spline of some sort. Splines transfer the rotary motion of an input to an output through a mechanical connection, or splined shaft. A splined shaft is one that (usually) has equally spaced teeth around the circumference, which are most often parallel to the shaft’s axis of rotation. These teeth can be straight sided, including angle forms (serrations) or involute form. The externally splined shaft mates with an internal spline that has slots, or spaces, formed in the reverse of the shaft’s teeth. The rotation of the splined shaft is transferred to the internally splined member, such as a gear or other rotary device. The transfer of this rotation is at a ratio of 1:1.

The benefits of using a splined shaft in the place of a keyed shaft are many: The spline connection provides an equally distributed load along the sides of the teeth. This shared load provides a longer fatigue life vs. a keyway drive. Different types of spline tooth forms allow for stronger drives, the ability to slide, transfer of rotational concentricity, allowance for misalignment, and, in the case of helical spline drives, the transfer of axial and rotary motion at the same time.

SPLINE TYPES

Parallel key spline: This type has equally spaced teeth that are straight sided. The teeth on the shaft have an equal tooth thickness at any point measured radially out from the axis of rotation. Conversely, the internal parallel spline has corresponding straight-sided spaces. This type of spline is similar to a keyway drive, with the exception that the keys are integral to the shaft and equally spaced around the circumference. The piloting feature can be the outside diameter of the shaft and major diameter of the internal spline or the inside diameter of the internal spline and the minor diameter of the shaft. Types of fit are 1) permanent; 2) to slide when not under load; 3) to slide when under load. Types of fits and tolerances are described in the SAE handbook.

Involute spline: Again, this type has equally spaced teeth, but they are not straight sided. The teeth have an involute form, just like a gear tooth. The teeth do not have the same proportions as a gear tooth; they are shorter in height. This truncated height combined with the involute form sides provides greater strength. There are no sharp inside corners at the base of the teeth as found in parallel key spline drives. Instead, there is a smooth transition through a fillet radius. This decreases the possibility of fatigue cracking in these areas. Involute splines come in several varieties: flat root side fit, fillet root side fit, and major diameter fit.

The flat root side fit has a slightly larger minor diameter (male) and smaller major diameter (female) than the fillet root spline. The transition area between the side of the tooth (male) or space (female), and the corresponding minor diameter (male) or major diameter (female) exhibits a smaller fillet radius than in the fillet root spline. These splines may be used when strength is needed and fatigue is not of great concern.

The fillet root side fit spline exhibits a full radius in the trochoid area between the teeth, providing maximum strength. The major diameter fit spline has a tightly controlled outside diameter (male) and major diameter (female). The close fit at the major diameters provide for transference of concentricity from the shaft to the female spline. The tips of the male spline teeth are typically chamfered to allow clearance with the fillet radii in the transition area between the sides of the teeth.
and the major diameter in the space of the female spline. These spline types are specified in metric and English through ANSI and DIN design manuals, and these specifications also provide for classes of fit.

**Crowned spline:** These splines are typically involute. They can be flat root, fillet root, or major diameter fit. The purpose of this type of spline is to allow for angular misalignment between the shaft and mating detail. This is accomplished by “crowning” the male tooth. The tooth (usually) has a symmetrical crown about the centerline of the spline face-width. At this centerline, the tooth thickness is at its maximum. Moving toward the ends, the tooth thickness gradually decreases with the thinnest sections occurring at each end face. The tooth thickness is measured at the pitch diameter. Usually the outside diameter of the spline is also crowned, with the largest diameter occurring at the same location as the thickest tooth thickness, and decreasing proportionally to the designed misalignment toward each end face. The female spline is usually not crowned.

The effect of this is to allow the male spline to “tilt” slightly to the maximum designed angular misalignment. This “tilt” occurs about the centerline established by the intersection of the shaft axis of rotation and the centerline of the spline face-width. The thinner shaft tooth thickness at each end of the face width — combined with the radius, or crowned outside diameter — allows opposite ends of the spline to penetrate deeper into the female spline space as it tilts. This deeper penetration into the spaces effectively allows the shaft to “roll” about the previously described axis intersection, providing for the angular misalignment. Splines of this type are usually designed in conjunction with ANSI or DIN tolerances.

**Serration:** This type of spline has a tooth form that is non-involute. The teeth of the male detail are in the form of an included angle with the female serration having spaces of the same included angle. Serrations are generally used on smaller diameter drives where an involute form would not add strength. Because the teeth are a simple included-angle form, more teeth can be used on a small circumfer-ence providing a greater contact area. Serrations are used in instrument drives, valve shafts, and the like. Standards are found in SAE, JIS, and DIN

**Helical spline:** These can be either parallel or involute tooth form. The helical spline has a specific lead and helix angle. These splines are used for several applications.

In drives where the spline shaft may become torsionally “wound up” (in applications of high torque), a straight spline might lead to drive shaft breakage in areas other than the spline. This is because the load along the straight spline is equal and the stresses are concentrated in areas other than the spline. Introducing a slight helix to the male spline allows an equal “wind” along the entire length of the spline, resulting in full contact along the drive side of the tooth. This load sharing distributes the rotational torque along a greater length of the shaft, which now includes the spline.

In some applications it is desired to combine rotation with axial motion. The use of a helical male and mating helical female spline accomplishes this. When sudden rotation of the axially fixed member is introduced, the helical teeth of the splines slide against each other. This thrusts the axially floating detail forward, or backward, depending upon rotational direction. This type of spline can be used for engagement or disengagement of face couplings through the use of rotary motion.

**METHODS OF MACHINING SPLINES**

**Milling:** Serrations and parallel or involute splines can be milled. A double angle milling cutter designed to produce the space of a serration or parallel key splined shaft is used to machine the spaces between the teeth. For involute splines, a milling cutter that has the reverse form of the involute for that specific diametral pitch, pressure angle, and number of teeth would be used to machine these spaces. The use of an index, dividing head, or CNC rotary table provides the index between teeth.

**Hobbing:** All types of external splines can be produced with the hobbing method. A cylindrical hob with the mating rack form of the spline to be produced is the cutting tool. The number of starts of the hob and the number of teeth in the spline determine the ratio that the hobbing machine is geared or programmed to produce. The hob then “rolls” with the spline, as a gear would roll with a rack, while the hob traverses the work along the work axis of rotation. The cutting teeth of the hob remove material from the spaces between the spline teeth.

**Shaping:** This method can be used to produce both internal and external splines. A shaper cutter — a disc with a given number of teeth, diametral pitch, and pressure angle — has a cutting edge at one face. The ratio of the number of teeth in the cutter and the number of teeth in the work determine the differential gear train or programmed ratio for the shaping machine. This determines the specific rotational ratio between the cutter and work. The cutter is then reciprocated along a parallel axis to the work while both cutter and work are rotating. The cutter and work roll together (as a gear and pinion would) while the cutter removes material from the work during the down stroking action. The resulting teeth on the work have generated involute sides.

**Broaching:** This method is used to produce female splines of all types. The broach tool is specific to the internal spline it is designed for. The tool has the correct number of teeth and form for the female spline it is to produce. It has multiple cutting edges, arranged along the length of a cutting tool. The starting end of the broach is a smooth diameter that fits in the smooth bore of the work. Progressing from this end to the opposite end of the tool, cutting edges at predetermined equal axial
distances are found. Each cutting edge has a progressively increasing form of the final spline. This allows a specific chip load on each cutting edge as it is pulled or pushed through the blank. Upon exiting, the last rows of cutting edges produce the final spline size.

**Slotting:** This method can be used to produce internal splines, typically parallel key splines. A tool designed to mirror the space of the spline is used in a slotting or shaping machine. The tool is reciprocated along a parallel axis to the work and is in-fed between each stroke. The cutting action occurs on the downward stroke. Upon reaching full depth the tool is retracted to the original starting position, the work is indexed, and the process begins again until all spaces are machined. This method can also be used for external splines, but other methods are usually more efficient.

**INVOLUTE SPLINE INSPECTION**

**Gage pin measurements:** One, two, or three-gage pins of a specific diameter placed in the spaces of the spline can be used to obtain a measurement over or between pins. A gage pin of a specific size will contact the involute sides of the spline teeth. The calculated dimension for the over or under pin measurement, depending upon whether it is an external or internal spline, determines the actual tooth thickness or space width. This actual measurement of the tooth or space width does not take into account any other elements of a spline. Because of this, the actual thickness or space-width tolerance band begins at the minimum material condition to ensure fit between details.

This method is used in the absence of full composite go and full composite or sector no-go spline gages. Tolerance ranges for differing fit types can be found in the respective ANSI or DIN standards to which the spline conforms.

**Spline gage:** Ring or plug gages, depending upon whether you are inspecting internal or external splines, come in several types:

**Composite:** Composite go and no-go gage sets check the spline to the effective tooth or space width. The effective fit is one that is “tighter” than the actual fit measured by the pin method. The effective fit is intolerant of spacing, involute, or lead error. Both go and no-go gages are made with a full complement of teeth. The gages are “perfect” in all elements: spacing, lead, and involute. Splines machined to these standards are machined to the effective tooth and space widths. This tolerance band is taken from the maximum material condition and will slightly overlap the actual tooth thickness dimension. It is possible to produce a spline that “takes” the go gage but is still out of tolerance to the actual tooth or space width as measured over or between pins. This is an acceptable condition as the go gage ensures a fit with the mating part.

Were this same part machined to the maximum (internal) or minimum (external) pin measurement calculated from the actual tooth or space width, the composite no-go gage would be accepted by the part. If the requirement were that the acceptance be made by composite gages, this part would not be acceptable.

**Sector no-go:** Use of this gage allows the whole range of tooth thickness tolerance, from minimum or maximum effective to minimum or maximum actual tooth or space width. In this case a full composite go gage and a sector no-go gage would be used.

The sector no-go gage has two groups of two or more diametrically opposite teeth. These teeth (or spaces on a ring gage) are produced to the maximum actual space width (plug) or minimum actual tooth thickness (ring) part allowance. In effect, if this gage goes, the part would measure out of tolerance using the pin measurement: oversize for an internal and undersize for an external. Gage-design parameters can be found in the respective ANSI or DIN standards to which the spline conforms.

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An external involute spline shaft. (Courtesy: Perry Technology Corporation)
BRINGING FORGING EQUIPMENT ONLINE TO MEET EXPANDING PRODUCTION REQUIREMENTS
Forgers weigh options such as repair, rebuild, remanufacture, or new equipment when considering options to increase capacity.

By DEL WILLIAMS

When forging operations need to expand production to meet increased demand for existing parts or to add new product lines, selecting from the available options to bring new equipment online can be challenging. Ultimately, the decision involves striking a delicate balance between fitting within budget constraints and accepting what can often be very long lead times.

Forging machines, by design, are massive pieces of equipment that weigh between 25 and 300 tons and rise 10 to 25 feet above the production floor. Despite the violent nature of the forging process, the equipment is designed and built to last decades, and it is not uncommon to find equipment from 50 or more years ago still in use.

Unfortunately, this can be both a blessing and a curse when it comes to purchasing new equipment. The sheer size and complexity of the machine means that even items such as the massive cast steel frame can take six to eight months for delivery — not including the four to six months to install all the internal parts and components.

Given the longevity of the equipment, the other option is to purchase used forging equipment and have it rebuilt or remanufactured. This can speed delivery by as much as six months and reduces the impact on the budget, but the dwindling worldwide supply of used equipment is increasingly taking this option off the table.

The only other alternative is to simply repair out-of-commission units and/or to squeeze additional production by incorporating more automation in existing forging equipment.

Regardless of the choice, one thing is clear: Those in the industry are taking a closer look at each of the four options available — repair, rebuild, remanufacture, or new — as well as each option’s advantages and challenges.

REPAIR

The most immediate option to bring forging equipment online is simply to repair existing equipment or out-of-commission units. This often comes down to locating adequate replacement parts, which can be quite difficult.

The tremendous longevity of horizontal and vertical forging equipment can create unique challenges for a forging operation when a part they need to replace was built decades ago. Is the original equipment manufacturer (OEM) still in business? Does a drawing of the part still exist? Can a local machine shop replicate it?

“Sourcing spare parts can be an ongoing problem,” says Wade Ferguson, maintenance manager at Modern Forge Companies, LLC, a hot steel forging company in Blue Island, Illinois that operates five manufacturing facilities with more than 25 production forge units. “We probably run hammers tighter than what would ever be specified. And together with our high volume of forging, at times we are scrambling to make or find spare parts.”

To produce engine valves and other motorcycle parts for customers such as Harley Davidson, Modern Forge uses Chambersburg (CECO) die forgers that date back to the 1980s and weigh between 20 and 50 tons.

So, when Ferguson heard that Chambersburg was in bankruptcy many years ago, his first reaction was “what the heck are we going to do for parts?” Fortunately, he had some replacement parts in inventory and was able to salvage parts from two offline units. Like other forging operations, he also sent some parts out to be reverse-engineered and machined.

This comes with some unintended risk, however. Machine shops often do not have access to critical
specifications about high-wear parts, including the material grade of the steel, the heat-treating process used, and tolerances that all were engineered specifically for that piece of equipment. The result can be parts that fail prematurely or wear much faster.

So, when Ferguson learned the Park-Ohio Company had acquired the intellectual property rights to all Chambersburg and Ajax Manufacturing equipment in 2005, he contacted them. Ajax-CECO, as the company is now known, is one of the oldest manufacturers of forging equipment, having begun operations in 1875. In its more than 140 years, the company has built and put into production more than 6,000 horizontal and vertical units of forging equipment.

Fortunately, the provenance of forging equipment for both Ajax and Chambersburg equipment has been well maintained, including the original drawings, bill of materials, and service manuals.

“They have very good, detailed information that Ajax-CECO carried over from Chambersburg, which is really advantageous for us,” Ferguson said.

Most OEMs today also stock replacement parts using MRP systems that monitor inventory levels and track historical trends for common wear items such as friction plates, driving plates, piston heads, piston rods, rings, and packings.

In addition, some OEMs such as Ajax-CECO offer stocking programs for long lead time items such as main gears, centric shafts, rams, frames, and anvils that most customers will not stock due to the cost. In this type of program, the part is held in inventory for the customer. The customer pays a percentage of the cost and then the balance when they take possession of the part — even if years later.

“Ajax-CECO is good about putting a spare part on the shelf for me and not charging (the full price) for it,” Ferguson said. “It is in their inventory until we need it, and then we pay the balance. I’m talking about expensive parts, too.”

**REBUILD**

A step-up in order of magnitude from a repair is a rebuild of the forging equipment. In a rebuild, all high-wear items such as bearings, bushings, seals, and liners are replaced to get the machine in good working condition. The frame is inspected and repaired, if necessary.

Given the extent of the work involved, however, this approach represents a significant investment in time. Rebuilds can take six months, depending on the number of components involved in the project. While this is a significant amount of time, a rebuild can save an operator six months or more in comparison to purchasing new equipment. This approach also reduces the overall cost to bring the equipment online.
Rebuilds can be approached several different ways. The forging equipment can be sent to the OEM for rebuilding; the OEM can send repair personnel to the manufacturer’s facility to rebuild equipment on-site; or the OEM can supervise a rebuild by maintenance staff. This allows the in-house staff to ask questions and better understand the operation of the equipment they are maintaining.

Rebuilds can be approached several different ways. The forging equipment can be sent to the OEM for rebuilding; the OEM can send repair personnel to the manufacturer’s facility to rebuild equipment on-site; or the OEM can supervise a rebuild by maintenance staff. This allows the in-house staff to ask questions and better understand the operation of the equipment they are maintaining.

At the Eaton Corporation forging operation in Kearney, Nebraska, the company operates 26 Ajax-CECO 100-ton to 1,300-ton forging presses. Eaton remains one of the top producers of engine valves and precision gears in North America.

Although some Eaton plants purchase rebuilt equipment from companies like Ajax-CECO, the lead maintenance manager at Eaton, Randy Kreutzer, sees the value in rebuilding the equipment in house with components sourced from the OEM.

“I like the experience the maintenance staff gets from rebuilding the equipment,” Kreutzer said. “That way, when future repairs are required, the time frame to complete them is much shorter.”

In addition, Eaton often incorporates automation upgrades that speed production in rebuilt equipment. Today, many of these manual tasks are instead being replaced with the mechanical “hand” of a robot or by integrating servos that can lift, insert, and deposit materials. Even tasks such as automated tooling changes can be completed with the push of a button.

By doing so, tasks that were once performed manually — such as moving heavy steel rods, pipe, and other stock in and out of equipment — are now automated to improve worker safety. Not only does this create a safer environment for forging operators, but productivity is increased.

REMANUFACTURE

Sometimes only the cast steel frame of the forging equipment is salvageable, in which case all the internal components can be replaced in a full remanufacture of the equipment. Given the extent of the work required, a remanufactured forging unit can still cost 85 to 90 percent of new equipment, but delivery time is reduced by about six months. However, when it is finished, a remanufactured machine comes with a new machine warranty.

In essence, a remanufacture saves the cost and the time of acquiring a new cast frame. The frame on a 3-inch upsetter press weighing 55,000 pounds, for example, could take six months, plus another month for shipping from overseas.

“With a remanufacture, all the internal parts are built to factory specs,” Kreutzer said. “With a remanufactured unit, you don’t need the man-hours to rebuild it. It can just be set in place, hooked up, and is ready for forging.”

As with a rebuild, a remanufactured forging unit can include a variety of automation option upgrades.

NEW

While the “buy new” option may offer a forging operator the most confidence in long-term performance and the most tailored solution to their forging needs, it also has the longest lead times. Moreover, a manufacturer will need to plan on approximately one year to take delivery of a new piece of forging equipment.

However, if the new equipment option is affordable, the decades of value that will be generated from the new equipment mean the return on investment will be significant.

When it comes to new forging presses, Kreutzer cautions quality can sometimes be an issue when sourcing from overseas sources.

“We like Ajax-CECO presses for their quality, and even prefer to rebuild that equipment instead of pursuing some other options out there that will not perform or last as long,” he said.

New equipment also gives forgers the opportunity to take advantage of the most advanced automation options available today. For example, entire forging line “cells” can be created that include sophisticated communications that report production rates and machine performance back to company networks.

CONCLUSION

Some forging operations even hedge their bets by using more than one strategy. Given the shortage of available used equipment and the lead times, some customers order a new machine while another is being remanufactured. Others get quotes on new equipment while continuing to seek out used equipment opportunities as they arise.

Regardless of the approach, forging operations have a lot to consider when attempting to meet increasing production demands. Whether repair, rebuild, remanufacture, or new, bringing forging equipment online requires careful consideration and foresight, as well as a more complete understanding of the options.

“You have to constantly keep a look-out for equipment, worldwide, and do your price comparisons to ensure you stay within the budget,” Kreutzer said. “Usually, when we are acquiring in new equipment, it is well into the future, so we have adequate time. But there are always timelines that must be met. So, as a company, we have to consider all the available options.”

Del Williams is a technical writer based in Torrance, California. He writes about health, business, technology, and educational issues, and has an M.A. in English from C.S.U. Dominguez Hills. For more information about Ajax-CECO, call 440-295-0244, email info-sales@ajax-ceco.com, or go to www.ajax-ceco.com.
CREATING STRESS-FREE PARTS WITH EXCELLENT METALLURGY

An impeller part in a powderbed. (Courtesy: Wayland Additive)
Wayland Additive’s NeuBeam technology combines the best features of existing additive manufacturing technologies while overcoming their traditional limitations.

By KENNETH CARTER, Gear Solutions editor

Metal additive manufacturing (AM) is still a technology that, for all intents and purposes, could still be considered in its infancy.

Great strides have been made over the last 10 to 15 years in this arena, and Wayland Additive is building on this technology with its own unique innovations.

Wayland’s team of engineers and physicists has developed and built a metal AM system from the ground up and is rewriting the rulebook on what a metal AM machine is capable of, according to Peter Hansford, director of business development for Wayland Additive.

INTRODUCING NEUBEAM

The Wayland process is an electron-beam (e-beam) powder-bed fusion process, which offers significant advantages over laser-based processes to create components. Wayland has dubbed that process NeuBeam.

“Because we come from an e-beam background — meaning the core of the technology is e-beam — we decided to build everything in house,” Hansford said. “We are not buying off-the-shelf components; we designed our own electron-beam column; we designed our own feed system. We designed our own in-process monitoring equipment. Because we started with a blank piece of paper, we needed to build a system from scratch, and we needed to decide what was going in there. We looked at it from a customer’s perspective. We built the system based around that, which included solving the problems of existing e-beam AM systems.”

Traditionally, one of the biggest problems with existing electron-beam processes is the charge from the beam can attach itself to all the particles in the powder bed, causing them to repel each other, so they scatter, according to Hansford.

“The traditional way of resolving that would be to sinter those particles together and to conduct the charge away,” he said. “The problem with doing that is you’re working at an elevated temperature, and you end up with this cake of sintered powder, and the parts get stuck inside the cake, which is hard — and time-consuming — to remove with the necessary and arduous post-processing requirement. What we’ve done is develop a system where we are able to fully neutralize the charge — hence the name NeuBeam or neutral beam.”

KEEPING TEMPERATURES DOWN

The NeuBeam process has the advantage of being able to keep the powder loose while also keeping part temperatures high, according to Hansford.

“We can work at the right temperature for the part/material,” he said. “Fundamentally, I guess in a nutshell, we sit between a laser-based system and a traditional e-beam AM system. We’re in the middle. We have advantages of both. We have all the power of e-beam and its ability to move the beam around fast and to melt material with a lot of power. But you have the usability of the laser system. The parts are not stressed; they’re never under stress, because they’re always above that temperature. And then on the other side, we have loose powder, but we have no support structures to remove, and we don’t have to heat-treat the parts afterwards; they’re already stable; they’re already above the temperature they need to be.”

LASER-ONLY PROBLEMS

The problem with laser AM systems is the laser beam can create a plasma effect on the powder, according to Hansford.

“That plasma effect is very, very hot, but it’s immediately cold, because it’s in a cold process,” he said. “So, the parts are going hot, cold, hot, cold, hot, cold, all the time.”

This causes the parts to be unnecessarily stressed during the manufacturing process, so they have to be nailed down with supports to a build platform, and, the bigger the parts, the greater the risk of stresses, according to Hansford.

“And, obviously, the bigger the part, the bigger the start plates needed, the stronger the supports needed, and it’s just a difficult thing to do,” he said. “When the plasma’s on top of the powder, you’ll see it’s like a little mini volcano, and it creates ejections. They call it spatter. Then, you need a gas flow going across the top to get rid of the spatter, or else it’ll drop back down into your powder bed and contaminate it.”

Wayland’s NeuBeam process works under a vacuum, which avoids spatter issues, according to Hansford.

AEROSPACE APPLICATIONS

Wayland originally worked on an aerospace project based on titanium gear blanks.

“What they were looking at was production pro-
cesses and trying to increase the lifetime of the gears,” Hansford said. “And that’s all about microstructure, and it’s also about weight savings, too. These two criteria are what we were working on. We found that we could print parts in a certain orientation, and it gave us much stronger parts, but you need to design for AM, too.”

Once Wayland developed the NeuBeam technology, the next challenge was making it marketable, according to Hansford.

“The technology is applicable when using original materials,” he said. “What’s happened in AM, in a lot of cases, and certainly with laser-based processes, is that there are so many compromises made on material choices. Because of the nature of the processes, they can’t process what would be the natural material to use for certain applications. You find people trying to find ways around that, and that invariably means: Let’s try and make an alloy of whatever. Let’s try this, so we can still process it. And what we’re finding, because an e-beam has so much power, we can process the original material. And then, for the end user, the only quandary is: Is a new process but a familiar material much better than a new process and a new material? It really takes that question away from the materials side.”

MORE APPLICATIONS
Since the technology is brand new, Wayland is continually discovering ways in which it is applicable, according to Hansford.

“Our technology really gives us an advantage when we’re talking about large parts, about bulky parts, and that’s exactly where we are effective,” he said. “And then in terms of materials — like tungsten, for instance — we can process tungsten and give you good, fully dense, crack-free tungsten parts that you couldn’t easily produce on a laser system. Then with materials like CM247, materials that are notoriously difficult to weld, or to connect; NeuBeam has enough power to be able to do that. So that’s really where we’re seeing the technology today; that’s where it’s got an advantage. Also, materials like copper. Copper on a laser system typically has to change the laser from a red laser to a green laser, but if you really need a pure copper, we can do pure copper.”

For industries that include aerospace and automotive, the process would be particularly useful in making gear blanks, according to Hansford.

“NeuBeam is a great way to create gear blanks. Because of the geometry — one axis is long, and one is short — they get stressed via a laser system,” he said. “We found that with the laser parts, they continued to move even after heat treating them, so trying to machine them was very difficult and a waste of time. Having NeuBeam, which is different to traditional electron beam AM, you’ve just got a very stable process. And that means you can control the temperature. If you are looking at microstructure and strength, for instance, we can tailor that to what you want to get or to the maximum you can get from the material. And that’s the difference. You’ve just got a lot more control.”

SCANNING ABILITIES
Another advantage to the technology is it includes scanning technology — for in-process monitoring — allowing a look at the topology of a build, according to Hansford.

“That can tell us things like porosity and swelling,” he said. “It can tell us about the amount of material we’re dispensing. The high-speed infrared cameras can give us very accurate temperature measurements, allowing us to witness the process and see far more detail during the build. And then we have back-scatter detection from the electron beam, so we’ve got three monitoring systems in there giving us an awful lot of information. And what that gives us is three things: One is rapid development of material properties, so if we’re dealing with a new material, we can develop the parameters rapidly, because we can see exactly what’s going on. Two, it gives us traceability, and a history of the complete build. And three, it gives us a chance to alter the cooling curve. If we alter the cooling curve of the parts, we can change the microstructure of the metal. If we cool fast, we get smaller dendrites, smaller crystals. If we slow the cooling cycle, we get larger dendrites. Therefore, we can change the properties of the parts through that cooling cycle.”

The technology is also useful for prototyping, according to Hansford.

“If you want to do something quickly, and you want to test a theory out, then it’s perfect for that,” he said. “But invariably, we designed this system as a production system, rather than a prototyping system.”

Hansford and the experts at Wayland Additive hope to present
the NeuBeam technology as simply another tool in a manufacturer's potential arsenal.

“It’s just different to subtractive: it’s just a different way of getting there,” he said. “And it’s only applicable where the cost makes sense, where the speed is correct, and the volume of parts are correct. You have to choose the right technology for the right job. And that’s no different with AM.”

FOUR-YEAR HISTORY, DECADES OF EXPERIENCE
Wayland is made up of people who have decades of combined experience, but the company itself has only been around since 2016.

“Wayland started in 2016, under the radar, within a high precision engineering firm in the U.K.,” Hansford said. “The company had been in operation for around a hundred years, and it was working within numerous sectors, including the semi-conductor, medical, and aerospace industries. When considering a metal AM system, the team was looking at laser systems and e-beam systems that were on the market. And they got some gear blanks built on a laser system. They’d been heat treated, and despite the laser parts being heat treated, they continually moved. Every time they attempted to do something, there was some slight movement in the blanks on the laser-based systems because they were still stressed.”

Wayland’s now CTO — Ian Laidler — decided e-beam was the way to go, but while looking at systems on the market, he found fundamental flaws within the system that he thought he could resolve, according to Hansford.

“Initially they undertook an internal project,” he said. “This was able to generate some government funding, which enabled Laidler to bring his team of people — experts in e-beam and hardware development — back together who had the capability to build a machine from scratch. That’s how they started, and they started with a project to build gear blanks.”

By using e-beam technology, the team was able to create stress-free blanks that not only started out as light weight, but Wayland was able to change some of the features to make them even lighter, according to Hansford.

READY FOR CHALLENGES
From those origins, the NeuBeam process was developed, and Hansford stressed that Wayland stands ready to use the technology to solve any challenge thrown at them.

“If they’re coming to us with a challenge, it means they have a problem,” he said. “And it means that they haven’t found a solution. If we can help, and if we think we’ve got a solution to that, then we would explore it together, and work on a project, or we’d work on finding the right materials.”

With that in mind, Hansford hopes to have the NeuBeam technology launched to the market by January.

“The NeuBeam system, with electron beam, means you can move it around very fast, so you can produce parts very quickly,” he said. “But I think there are a number of things that have to happen before it’s applicable to multiple industries. And that will come down to material costs, surface finish, and accuracy. But the biggest advantage with the technology is the freedom you have; you can adapt the parameters, and you can change the geometry, and stop thinking about old methods of production.”

MORE INFO
www.waylandadditive.com

The new Calibur 3 system concept that incorporates the NeuBeam process. (Courtesy: Wayland Additive)
Helios introduces Hera 200 CNC gear hobbing machine

Helios Gear Products exclusively offers the Helios Hera 200 CNC gear hobbing machine. This machine, manufactured by YG Tech, provides gear manufacturers a vertical hobbing solution with its siblings, the models 150, 350, and 500. The model 200 completes the fine- to medium-pitch range of the Hera series with the same standard of proven technology.

“We are excited to bring the new Helios Hera 200 to North American gear manufacturers who need an updated, cost-effective, profitable hobbing platform for gears up to about 8 inches — all with 30+ years of domestic support expertise,” said Adam Gimpert, president of Helios.

The Hera 200 offers 6 axes (7 with automation) of Fanuc CNC, a 4 module (6.35 DP) pitch rating, and 1,200 rpm maximum hob speed. (Courtesy: Helios)

With the new KISSsoft release and the installation of the 2020 version, customers are provided with new useful example models in KISSsys (module SYS).

The added gearbox models come from a wide variety of applications:

- **Automotive:** EV transmission with bevel gear differential and tractor transmission (18 gears).
- **Industry:** Crane transmissions and an integral compressor transmission.
- **Planetary gear:** Complete compound planetary gearbox.
- **Wind power:** Yaw drive model.
- **Aviation:** Aircraft flap actuator.
- **Shipping:** Model with ship propeller gearbox.

The models can be used as templates when building similar gearbox models. All models are stored in such a way that after opening them in the system, the strength calculations can be performed. In addition, they serve as a basis for further system calculations, which would include e.g. the programming and flexible capabilities to produce globally competitive gears, and for demanding production, the Hera 200 also offers unified automation options to suit pre- and post-operations as well as a variety of part types.

MORE INFO  heliosgearproducts.com

New example models now in KISSsys module of software update

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definition of a load spectrum, the analysis of the efficiency or the determination of the
eigenfrequencies.

By reading in a reduced stiffness matrix
of the housing, it is also possible to take the
housing deformation into account in the sys-
tem’s strength calculations.

MORE INFO www.kisssoft.com

GWJ offers extended
calculation of planetary
gear stages

GWJ Technology, Germany, is a leading
manufacturer and provider of calculation
software for mechanical engineering. An
updated version of the planetary gear mod-
ule within the software eAssistant has been
released.

The calculation module for planetary
gear trains allows a fast design and optimi-
sation of simple planetary gear stages includ-
ing the load capacity according to various
accepted calculation methods, such as DIN
3990 Method B, ISO 6336 Method B, or ANSI/
AGMA 2101. The calculation of load spectra
is also supported. There are several new
options for the profile shift sum as well as for
the distribution of the profile shift coeffi-
cients.

Another new feature is that the profile
shift coefficients or profile shift sum can be
specified and used to determine the center
distance, similarly to the functionality in the
eAssistant cylindrical gear module.

A function for disconnecting the center
distance and the sum of the profile shift coeffi-
cients was added. This allows a calcu-
lation with a “wrong center distance.”

In addition to “Own Input” and balanced
specific sliding, new options for the distribu-
tion of the profile shift were also integrated:

minimum sliding speed, maximum root
safety, maximum flank safety, and maxi-
mum scuffing safety (integral).

The user can choose to dimension either
sun/planet or planet/annulus pairing.

MORE INFO www.gwh.de

Dillon special top jaws
allow choice of base
material for best grip

Special Top Jaws from Dillon Manufacturing
can be manufactured from copper, brass,
Delrin®, tool steel, 1018, 1045, 4140, 8620, A2,
6061 aluminum, and stainless steel.

The jaws are available in configurations
to grip a component’s ID, OD, or a combina-
tion of both, to suit any workholding appli-
cation and available in soft or hard jaws, or
full grip jaws, for virtually any chuck manu-
ufacturer. A comprehensive website provides
complete details and includes an ‘easy quote’
format with fill-in-the-blanks convenience:
dillonmfg.com/special-jaws/. Dillon standard
and custom chuck jaws and collet pads
and jaws are ideal for high-speed machining,
as well as precision boring, tapping, drilling,
and finishing across virtually all industrial
markets.

Dillon custom, special, or modified hard,
soft, or full grip top jaws are manufactured
with industry-best turnaround time, which
saves time and money by reducing down-
time.

Dillon Manufacturing, Inc. manufactures
a complete line of standard and custom
workholding solutions including chuck jaws,
chucks, vise jaws, soft jaws, hard jaws, col-
let pad jaw systems, chuck lubrication, and
more. All products are made in the USA and
Dillon is ISO 9001:2015 registered.

MORE INFO www.dillonmfg.com

New version of “Planetary gear train” module.
(Courtesy: GWJ)
Brüel & Kjær Vibro offers portable vibration analyzer

Brüel & Kjær Vibro, one of the leading worldwide independent suppliers of condition monitoring solutions for rotating machinery, has launched the Vibroport 8000 (VP-8000) portable vibration analyzer for rotating and reciprocating equipment.

The new VP-8000 is a specially configured and packaged version of Brüel & Kjær Vibro’s VC-8000, which is an internationally renowned machinery protection system. The VP-8000 features the same universal measurement modules (UMMs) and the rugged and field-proven design as the VC-8000, but is optimized for portable dynamic data collection and diagnostics.

There is a wide range of applications for VP-8000 for both plant operators and service providers. It is ideal for verifying the condition of machines after a turnaround and those repaired prior to service start-up. It is also used for steady state and transient condition monitoring (i.e. during a run up and coast down) for observation and trending of machines following an event (e.g. operational process changes or machine fault detection). VP-8000 can also be used as a mobile platform for monitoring a number of machines within the plant that are not instrumented or that only have protection systems.

VP-8000 can be used both as a portable data collector and as an analyzer. Advanced diagnostics offered by Bruel & Kjaer Vibro’s best-in-class Setpoint® condition monitoring software (CMS) include:
- Shaft/bearing – Orbits, full spectra, shaft centerline plots, Bode plots, polar plots, etc.
- Reciprocating compressor – PV plots, rod load, rod reversal, impact monitoring, etc.
- Two-plane balancing.

The VP-8000 connects to rotating machines and captures real-time vibration and process data for immediate monitoring and diagnosis of equipment health, or via the VP-8000 flight recorder for storing data for remote analysis. The VP-8000 can be connected to the buffered outputs of most machine protection systems with BNC outputs, or it can be used with temporarily mounted sensors on machines where there is no monitoring system. Data can also be exported to the OSIsoft PI data historian.

KISSsoft SKRIPT designed for tailor-made calculations

For customized calculations, the integrated programming language SKRIPT (module CC3) has been extended and better integrated into the KISSsoft user interface through a separate tab.

Scripts can now be directly loaded and executed from files or automatically called at certain points in the calculation process (after file loading, before saving, before or after calculation, before report generation).

THK introduces new Telescopic Type ATG utility slider

THK’s new Telescopic Type ATG utility slider combines proven smooth-motion technology with fully hardened raceways to enable high load capacity and ensure a long service life.

The Type ATG uses THK Circular-Arc Raceway Technology for equal to or higher permissible load capacities than Gothic Arch Raceway designs. Circular-Arc Technology achieves less differential slip between the ball and the raceway, resulting in reduced cage displacement, as well as decreased friction and wear. Full stroke reliability is achieved due to the shape of the grooves.

The solid construction of the Type ATG further contributes to its increased load capacity and rigidity. The Type ATG consists of high carbon steel outer and inner profiles, high carbon chrome bearing steel balls, a steel stopper, a cold rolled steel ball retainer, and Trivalent chromate coating on all surfaces with the exception of the balls.

The Type ATG is offered in three configurations: the ATG-S Single Type, the ATG-D Double Type, and the ATG-P Parallel Type. Rail lengths range from 130 to 770 mm and stroke lengths range from 79 to 399.6 mm. The Type ATG is compatible with competitor dimensions.

Applications for the Type ATG include...
automated warehouse equipment, train doors, seat sliders, and under floor equipment sliders.

The Type ATG features patented THK caged technology for smooth and quiet motion. Caged technology employs a synthetic resin cage with a patented curvature that cradles each ball and separates it from the next. The spaces between the rolling elements retain grease and act as a lubrication system for long-term maintenance-free operation. Other caged technology benefits include increased speed and accuracy, decreased noise levels, low dust generation, and long life.

THK manufactures the widest range of linear motion products, including LM guides, ball screws, mechanical actuators and ball splines, and more. All THK products have been designed and manufactured to meet the strictest requirements. THK’s experienced global engineering team can provide customized linear motion solutions from their standard linear motion products as well as from mechatronics products for the most demanding applications.

MORE INFO  www.thk.com

Twin booster bending machine processes 90-meter-long tubes

Russian boiler manufacturer Krasny Kotelshchik bends 90-meter-long tubes into bending membrane walls consisting of numerous 180° single bends. Modern power plant construction requires powerful machines that can bend challenging materials according to strict specifications. The large dimensions require particular structures in the bending process. Germany-based tube bending machine manufacturer Schwarze-Robitec designed the CNC 60 DB Twin booster bending machine for the Russian company complete with a 90-meter-long tube magazine and a supporting table with a 10-meter radius. The machine was
recently put into operation.

Modern power plants continuously supply the exact amount of electricity required in the grid. The higher the process temperatures are, the higher the level of efficiency. Constantly starting up and shutting down the power plants leads to extreme fluctuations in temperature. This is something that the pipe lines made of high-strength or resistant materials must be able to withstand. In addition, there are high-pressure conditions inside to contend with. Boiler and power plant manufacturers aim to maximize the surface area to ensure the highest level of heat transfer. Tubes, therefore, need to be bent in narrow radii and must fulfill strict tolerance specifications in terms of wall thinning and ovality.

Tube bending machine manufacturer Schwarze-Robitec was able to fulfill these requirements for its Russian client Krasny Kotelshchik. As one of the leading Russian companies for boiler and thermal power plant construction, Krasny Kotelshchik manufactures fired steam boilers and waste-heat boilers in Taganrog, southern Russia. More than 80 percent of power plants in Russia and the CIS countries are equipped with heat-exchange equipment from Krasny Kotelshchik.

A sophisticated design for a sophisticated bending task, the CNC 60 DB Twin from Schwarze-Robitec bends tubes with an outside diameter of up to 63.5mm and with a wall thickness of up to 5mm. The booster bending machine is designed for continuous year-round use.

Suhner EconoMaster® drilling units work on multiple materials

Suhner introduces the EconoMaster® line of drilling units, affordably priced at less than $3,000 for the basic unit, in stock for immediate delivery or customizable to suit the particular operation. This economical solution is ideal for multiple materials such as light metal, wood, composite, plastic and foam. Because these units are entirely produced at the Suhner factory in Rome, Georgia, response times for delivery and customized construction are fast.

“We recognized the need to bring our global technology to a local level, here in America, and the EconoMaster is a key step in that process,” said sales manager Lee Coleman.

Suhner is based in Brugg, Switzerland, with plants and distribution centers worldwide.

The EconoMaster drilling unit features low power and air consumption, adjustable motor housing, adjustable total stroke up to 4", hydraulic feed control cylinder, J33 taper spindle end, 0-1/2" drill chuck, electric front and rear position limit switches, belt tensioner, and chrome-plated quill. Basic unit weight is 45 pounds.

EconoMaster drilling units can be supplied with an adjustable stand, inline vertical configuration and multiple spindle heads for medium-duty production drilling, with many other spindle options and toolholders available.

Platinum Tooling releases updated catalog with new features


The catalog offers an updated look and features the company’s high-quality machine tool accessory lines, including heimatec GmbH’s live tools and machining center angle heads; Tecnicrafts Industries’ collets and guide bushings for Swiss-type CNC lathes; Henninger GmbH u. Co. KG’s mechanical, air, and motor speeders, plus custom machining center angle heads; and
Andreas Maier GmbH & Co. KG’s (AMF) cleaning and marking tools.

Preben Hansen, president of Platinum Tooling, is well known for his expertise and experience in the tooling industry. Hansen will continue to offer advice and welcomes the opportunity to discuss customers’ applications.

Platinum Tooling Technologies, Inc., is in Prospect Heights, Illinois (near Chicago). It recently expanded its facility to provide increased inventory to better serve the marketplace.

MORE INFO  www.platinumtooling.com

Starrett introduces newly designed electronic digital micrometers

The L.S. Starrett Company has introduced more than a hundred electronic digital micrometers with new features for improved ergonomics, functionality, and productivity.

The company is a leading global manufacturer of precision hand tools and gages, metrology systems, and more. The new electronic micrometers range from the No. 733.1 outside micrometers to a wide array of application-specific models.

To withstand the harshest shop elements including coolant, water, chips, dust, and dirt while retaining tool integrity, the new micrometers include an IP67 level of protection on sizes 0 – 4” (0 - 100mm) and on various application-specific models. A modern, ergonomic, insulated frame design on the new No. 733.1 0-1” outside micrometer is designed for comfort and ease of use, providing an optimal user measuring experience. In addition, the new electronic micrometers offer upgraded electronics, a longer battery life, an advanced locking mechanism, and a large, easy-to-read LCD display. Industry 4.0 ready, Starrett Electronic micrometers are equipped with RS232 output, ideal for use with data collection systems such as Starrett DataSure®.

“We are very pleased to offer our newly designed electronic micrometers that preserve many of the precision quality features our micrometers are well known for, with added functionality, ergonomics, and efficiency, and new competitive pricing. Starrett Electronic Micrometers guarantee a precise measurement at every position each and every time,” said Tim Cucchi, precision hand tools product manager at Starrett.

The Starrett 733.1 electronic micrometers are available in a 0-1” (25mm) model, up to 24” (600mm) and in 0-6” (152mm) and 0-12” (304 mm) sets of individual micrometers. Starrett electronic micrometers are accurate to +/- 0.0001” (0.002mm) with a resolution of 0.00005” (0.001mm). Micrometers have a knurled and graduated satin chrome finish thimble, and are offered with carbide measuring faces or with 52100 steel measuring faces on some application-specific models.

MORE INFO  www.starrett.com

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AWEA Wind Project Siting and Environmental Compliance Conference  
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AWEA CLEANPOWER Strategy Summit  
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“We’re going to always be there for our customers and give them the benefit of being a good partner and help them generate higher profits.”

What did you see coming that helped you map out the future of Optimas Solutions Americas’ market?
There were a lot of unfinished projects, but there was a really good base with excellent resources and great people. We put together a plan to challenge everybody to be best in class in the marketplace. We wanted to be able to offer a full range of products and services.

Tell us about Optimas Solutions’ renewed strategy for the Americas market.
Our strategy is to really focus on innovation and technology, because we have a variety of things we can and will offer in addition to fasteners. For example, we went from focusing on simple VMI programs to offering sophisticated programs like RFID.

Internally, we installed demand planning tools to help manage the ebbs and flow in our distribution business. That is a dynamic change for us, and that’s something that we think is best-in-class in the marketplace. We’ve really focused on our manufacturing side, too. We installed a new ERP system in our Wood Dale, Illinois, facility. Those are the types of innovation that we’re working on in order to separate us from the competition.

How can your Manufacturing Solution strategy apply to gear manufacturing?
There are three things that we enhanced that would be of great use to your audience:

One, we have an eCommerce platform that is at the top of the industry. It offers customers convenient and quick access to manufacturing consumables.

If customers want standard fasteners or MRO products for their facility, they can log-in as a customer and order those items from their production floor. Hand sanitizer and safety products, as well as other PPE items, are available as well. In this coronavirus atmosphere where contactless interaction is preferred, there is no better solution. A few clicks and orders arrive at the dock however the customer wants them shipped. We’re able to source ample supplies of quality products and quickly provide them from our mobile-friendly site, so customers don’t have to go to a distribution warehouse or retail outlet.

The second thing is our unique, cold-form, manufacturing plant. We offer an integrated solution — engineering, rapid prototyping, cold-form production, and quality testing — from a single location near Chicago. Our capabilities include six-die machines. That allows us to produce 16 mm and below. And, what’s unique about this is when you are looking for a near net shape form or a blank that a gear manufacturer would screw-machine the rest of the way to their tight tolerances, we can save them money.

Typically, today, they would get rod or bar, and let’s say it’s one inch in diameter. They would cut off a piece and machine it down. There’s a lot of steel that’s wasted by that machining process. But with Optimas Manufacturing, we can produce multiple diameters, so there is much less cost on the steel side. We can do a near net shape of a gear that they can finish off. We can give them all sorts of high-volume opportunities to make blanks with tremendous cost savings.

The third thing is, if a gear manufacturer has a higher volume product that they’re making, whether it’s a gear assembly or another offering, sometimes it comes with a high-quality fastener that has to be a grade eight, super-strong part because of its application. We can provide an individual part number for a male-threaded fastener they might need to be part of the component they are making.

What have you done at Optimas Solutions to help combat the economic impact of COVID-19?
I asked everybody to stay focused. So, in the second quarter, which was a disaster, we did not hide in our offices. Everybody was working hard making the kind of improvements that would help Optimas be ready for the next generation of doing business. We were perfectly suited for the old way, but now, customers do not see you at their locations. We’re doing Teams and Zoom meetings, all sorts of new things in order to communicate with audiences.

We have to make sure we present our products and services in innovative ways that attract and engage audiences — wherever they are located — as opposed to the classic outside salesperson showing up with a box of doughnuts. It’s just not going to be that way anymore.

We want to make sure we’re able to present solutions and support customers with the technology we have.

We’re going to always be there for our customers and give them the benefit of being a good partner and help them generate higher profits, more cashflow with their inventory, as well as help them manage their inventory, so they can focus on their own demand, innovation, and production.

Looking forward, how do you see using this strategy to handle future challenges in a post-COVID-19 world?
I’m not so sure there is a post-COVID-19 world; I think there’s a post-crisis world. I think, 50 years from now, this virus is still going to be out there. I think we’ll have controls in place, but we never got rid of the common cold or the flu.

It’s going to be another thing that we have to deal with globally, but I still think business will thrive. Hopefully, people are going to start going back to the office. If not, I think Optimas is well on its way to adapting to this new environment.

And I think there’s going to be, in terms of manufacturing, which — and this is just an educated guess — has been 80 percent direct selling and 20 percent direct marketing. We’ll see it go 50/50, or it might even go 60 percent direct marketing. And that’ll just be the reality of life. No matter what, Optimas will continue to innovate and serve its customers.
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2007 Samputensili S-750 Gear Hobber

2001 Gleason Pfauter P800G Gear Grinder

2005 Gleason Pfauter Model GP-1505 CNC Gear Shaper

2007 Liebherr Model LFS-380 6 Axis CNC Gear Shaper

2004 Gleason Model 600 HTL CNC Turbo Lapper Fanuc 160i-M Controller

Bourn & Koch Model 25H 4 Axis CNC Horizontal Gear Hobber

2006 Gleason M&M System Sigma 3

2001 Hofler Model Helix 700 CNC Gear Grinder

2006 Mitsubishi Model SE25A CNC Gear Shaper with Autoloading

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Maximize Production and Profits With Mitsubishi’s Multiple Process Capabilities Machines.

When you reduce steps you reduce costs. With that in mind Mitsubishi developed its Process Integration platform. It allows various operations, such as chamferring, deburring, inspection, timing and meshing, to be incorporated into our existing gear machines. The advantage is clear. It’s simply more efficient to have one machine completing two or more processes. With numerous options and configurations available you can customize our shaping, grinding or hobbing machines to incorporate the additional services that precisely meet your needs—and maximize your efficiencies, production and profits. To learn how you can leverage all the possibilities of Process Integration visit www.mitsubishigearcenter.com or contact sales at 248-669-6136.