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COMPANY PROFILE

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GEARWHEEL MANUFACTURING IN A 34-SECOND CYCLE

By using KAPP NILES gear grinding machines, Volkswagen is making strides in its gearbox production.

By MARTIN WITZSCH

PERFORMANCE AND PROPERTIES OF A NEW ALTERNATIVE GEAR STEEL

Hybrid steels show many interesting properties relevant to gear applications, somewhat depending on the area of application and the working conditions.

By LILY KAMJOU and JOAKIM FAGERLUND

TACKLING AGGRESSIVE GEAR-GRINDING APPLICATIONS

COMPANY PROFILE

With a history that dates back more than century, Weiler Abrasives has become a global market leader in abrasives, delivering innovative solutions to customers in targeted end markets.

By KENNETH CARTER
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MARK MICHAUD
CHANGES AHEAD IN THE ROUGHNESS STANDARDS
Just when you thought it was safe to calculate a tooth flank surface roughness measurement, think again.

BRIAN DENGEL
DETERMINING TOOTH THICKNESS OF VARIOUS GEAR TYPES – PART II
How to calculate the nominal values of span measurement of teeth various types of gearing.

D. SCOTT MACKENZIE
BACK TO BASICS: MECHANICAL TESTING – THE TENSILE TEST
Understanding that the basic tensile test is used for the design of components, and to validate proper processing.

Exact Metrology offers workplace tips for social distancing.

Global Innovative Products launches EDM wire online store.

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American Gear Manufacturers Association

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American Gear Manufacturers Association
In these challenging times, it’s important that we all try to maintain some sense of normalcy amid the social distancing and mask wearing.

That’s why we at Gear Solutions want to make sure you’re staying informed about what’s going on in the industry, even when you’re stuck at home in never-ending conference calls on Zoom.

With that in mind, take a look at what’s in our May issue:

Squeezing metal into a mold to forge a gear or pouring hot metal into a mold to cast one are often two sides of a very important coin when it comes to creating gears.

That’s why Gear Solutions’ May issue focuses on these important processes of gear manufacturing.

This month’s issue tackles that, as well as gear grinding — another vital part of making sure gears reach their final destination with the detailed specifications required of them.

In our Focus section, Martin Witzch with KAPP NILES takes a look at a new gear grinding machine used in gearwheel manufacturing with a 34-second cycle.

When forging and casting gears, the use of hybrid steel is showing interesting properties relevant to gear applications. With that in mind, Ovako AB’s Lily Kamjou and Joakim Fagerlund share their insights into the performance and properties of a new, alternative gear steel.

And an issue of Gear Solutions wouldn’t be complete without the expert advice from our knowledgeable columnists. Each of our contributors always offers interesting information often conveyed in a unique fashion.

Yes, May is finally here. And even though “normal” is on vacation for the time being, summer is still right around the corner.

So, grab our latest issue and take it to the deck. It may not keep you cool, but the gear information inside certainly is. And besides, haven’t you made it to the end of Netflix by now?

As always, thanks for reading!

Kenneth Carter, editor
editor@gearsolutions.com
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WE OWN WHAT WE SELL, AND WE KNOW WHAT WE’RE SELLING!
Exact Metrology offers workplace tips for social distancing

Exact Metrology, a comprehensive metrology service provider, shares helpful safety tips for metrology workers during the COVID-19 pandemic. These tips are courtesy of Jason Kleinhenz, Exact Metrology marketing and training manager.

With much of the workforce operating from home, keeping up with quality inspection and reverse engineering is difficult during this time. However, there are solutions to counteract this problem. Some companies employ several of these tactics daily, but in these trying times they are much more relevant to maintain effective production.

If you are in the workplace, follow all the stated guidelines. These include staying six feet away, washing/sanitizing touched surfaces, and washing your hands. Also remember to clean the objects you’re working with, such as data collection tools and computers.

- Only one person should collect the data from the object(s). That person is responsible for handling the objects and the data collection tools. Of course, the designated person also needs to clean and sanitize all objects, tools and surfaces.
- Workers must save and upload data sets (and/or workspaces) to the cloud. Due to security threats, a company’s IT team should use a virtual private network (VPN) and/or file transfer protocol (FTP). This reduces the chances of data being hacked or stolen.
- Have another person, or a team, work separately to download (receive) the data sets, or workspaces and process them. They will have their own safety procedures in place (essentially the same as the data collector). If possible, the processing person(s) should write programs at the same time the data is collected. This saves time and money as two operations are occurring at the same time. Most likely, this is not possible in reverse engineering projects. However, in quality inspection projects, this is a massive time-saving practice.

- Communicating between the collector and processor(s) can be done quickly, and virtually, with online services such as Skype and Zoom. The good old-fashioned phone works well for quick conversations, too. There are some software packages that allow seamless workspace sharing between different people and teams such as a package through PolyWorks® by InnovMetric.

These techniques and tools can help companies reach their quality and reverse engineering objectives during social distancing. Exact Metrology is available to answer any questions about how to maximize efficiency or help with projects.

Exact Metrology is ISO AS9100 certified along with being FFL and ITAR registered.

MORE INFO  www.exactmetrology.com

Global Innovative Products launches EDM wire online store

Global Innovative Products (GIP), a recognized leader in EDM wire technologies, has launched its EDM wire online store. High-performance EDM wire provided by GIP enhances EDM operations, efficiency, and performance for all types of EDM machines on the North American market today. As Ramesh Malhotra, owner of GIP, said, “We are taking some very bold steps with this venture, but we did so for a very practical reason. Namely, our customers were often telling us they needed faster response to their wire needs and the convenience of an online store seemed a natural next step for us.”

The new GIP online store promotes the company’s full line of EDM wire types, including many patented and proprietary technology EDM wires, manufactured globally and made exclusively for GIP. Products offered here are produced by Thermo Compact and Bedra, two of the largest manufacturers of EDM wire in the world. Available products
include brass wire (Bedra Boline Brass) and coated wires (Plasma, Kleen, Gamma, Blaze, and Epsilon). GIP Plasma™ is a hybrid-coated wire designed to improve cycle times and reduce operating costs. Customer testing has confirmed it is 20 percent to 30 percent faster vs. premium brass wire and is competitively priced.

All pricing is shown for the products in the GIP online store, something unique to the EDM industry, plus all major credit cards are accepted for fast, easy purchasing. In addition, GIP offers trial spools at discounted rates to all participants in the company’s GIP Wire Test Program, which can be engaged at the company’s website.

MORE INFO www.gip-edmwire.com

EXSYS Tool celebrates 25th anniversary as CNC tooling supplier

EXSYS Tool Inc., the exclusive importer of Eppinger tool holders, adapters, and specialty products, celebrates its 25th anniversary in June. For a quarter-century, EXSYS has served as an industry-leading supplier of CNC tooling and tool holders, including innovative products like the PRECI-FLEX® modular tool holding system and a wide range of high-precision live and fixed toolholders for turning centers.

EXSYS was established by President and CEO Stewart Bachmann, and Craig Campbell, who served as vice president of sales until 1998. Originally an acronym for “Expert Systems,” EXSYS began as a business launched by Walter Bachmann, Stewart Bachmann’s father, who had previously served as a director of manufacturing planning and had considerable experience with the production of special tooling.

“My father started his business out of our house in California, with boxes of tool holders stacked up on the washing machine,” Bachmann said. “But he did some significant volumes with that infrastructure — and his knowledge of working with Eppinger to develop specialized manufacturing solutions. So, when Craig and I moved out to the Eastern time zone to start our branch of EXSYS, I used what I learned from him to push our sales and applications expertise even further.”

Initially, the new branch of EXSYS remained focused on the sale of axial and radial toolholders, products the company has refined and optimized over the years. The company increased its capacity year after year, eventually forming an exclusive distribution partnership with Eppinger. Today, in addition to its headquarters in San Antonio, Florida, the company has Canadian and Mexican distribution centers in Ontario and Monterrey, respectively, as well as fac-
Kloeckner Metals names Andrea Moseley as new chief financial officer

Kloeckner Metals Corporation, one of the largest steel and metal service centers in North America, promoted Andrea Moseley to chief financial officer, effective April 1. Moseley assumed the role held by longtime Kloeckner Metals employee Kirk Johnson, who retired March 31. Kloeckner Metals’ management board unanimously agreed Moseley will be Johnson’s successor due to her wide-ranging experience, proven track record of accomplishing complex initiatives, and deep understanding of Kloeckner Metals’ North American and international business.

Moseley attained both her Bachelor and Master of Accountancy from the University of Mississippi. She began her career with Ernst & Young, LLP, in the audit and assurance practice.

Moseley joined Kloeckner Metals in 2002. Preceding her current role of executive vice president of finance at the company, she was head of governance and finance transformation for Kloeckner Metal’s parent company, Klöckner & Co SE, in Duisburg, Germany.

“Andrea brings with her passion, dedication, and a can-do attitude that will help further fuel Kloeckner Metals’ pursuit of commercial and operational success,” said John Ganem, chief executive officer of Kloeckner Metals. “We look forward to working closely with Andrea as she enters her new role as chief financial officer and quickly becomes an invaluable partner during Kloeckner Metals’ ongoing transformative journey.”

With the promotion comes Moseley’s appointment to Kloeckner Metal’s executive management team, where she will join Ganem and Bart Clifford, chief operating officer.

“Johnson’s 37 years spent at Kloeckner Metals produced immeasurable contributions to the success of the company and its domestic and international partners,” said
Ganem. “We, at Kloeckner Metals, will miss his insight, guidance, and steady hand as we navigate our industry.”

MORE INFO  www.kloecknermetals.com

MC Machinery names South Texas regional sales representative

MC Machinery has named manufacturing industry veteran Scott Yurashek as the new South Texas regional sales representative handling laser, automation, and press brake products.

Yurashek, who is based in Houston, has more than 20 years of experience in manufacturing and printing industry sales along with a bachelor’s degree from the Rochester Institute of Technology.

“We are thrilled to have Scott join our team,” said MC Machinery Southeast Regional Sales Manager Bill Coleman. “His experience and knowledge are tremendous assets to our current and future customers.”

Headquartered in Elk Grove Village, Illinois, MC Machinery Systems is a premier manufacturer of laser, press brake, wire EDM, sinker EDM, milling, high-speed VMC, and consumable products.

MORE INFO  www.mcmachinery.com

Sky Hook has lifting solution for social distancing requirements

Maintaining efficiency with a limited or restricted workforce has never been more paramount. With the widespread impact of COVID-19, many companies have temporarily closed their doors or made changes for personal safety, including employees working from home to help reduce the spread of the novel coronavirus. However, essential businesses deemed critical to our current endeavors are rapidly ramping up production to meet the growing demands brought on by this new challenge that the nation faces.

Manufacturers all over the country are in full swing bringing medical supplies, equipment, and other necessities to market as quickly as possible to assist the growing number of individuals impacted by this pandemic. This does, however, create its own challenges as many companies have implemented social distancing policies to curb the potential spread of this virus. Maintaining a six-foot distance between employees can make some vital operations either challenging or impossible to perform safely.

Two-person lifts are currently prohibited due to the close quarters between employees. Additionally, implementing new overhead crane solutions are typically three to four months out before they can become operational. They can also be expensive and take additional time and training to integrate into operations. How do companies working with limited or restricted staff maintain operational efficiency, while meeting critical safety and ergonomic standards?

With this growing pandemic, companies all over the world are calling on their employ-
ees and vendors alike to innovate and develop new strategies and processes to maintain operations that deliver their vital products to the masses. The Sky Hook is the ergonomic lifting device many companies are reaching for as it provides a safe, single-operator lifting solution to meet today’s health and safety needs. As a customizable, lightweight lifting device, the Sky Hook can be an essential component in this endeavor that offers a much-needed solution to a variety of applications spanning countless industries.

Syclone ATTCO Service has been manufacturing the Sky Hook lifting device in the United States since 1969 and they have adapted their products to fill a variety of needs. Being both OSHA and ASME compliant, their equipment integrates easily into operations and provides a timely and effective solution to those in need.

“During this time of crisis, we’ve been contacted by many companies seeking lifting solutions to fill these lifting needs and Sky Hook has been proud to rise to the occasion,” says Dusty White, technical sales manager.

With the Sky Hook lifting device, employees are now able to safely work independently to perform critical lifts instead of team lifts, which would violate the proximity policies that many local governments and companies have now implemented.

“We are currently waiving our production expedite charges on both custom and standard units so customers can obtain the lifting solution that they need in a timely and efficient manner to keep up with their current production demand,” White said. “We also have cleanroom modifications available, allowing our products to adapt to a variety of work environments. Americans all across our nation are pulling together to meet this adversity head-on and Sky Hook is proud to do its part.”

### MORE INFO

www.skyhookmfr.com

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The Sky Hook is a customizable, lightweight lifting device, which can be an essential component in lifting safely while also practicing correct social distancing. (Courtesy: Sky Hook)

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**Basic powder metallurgy short course registration opens for August class**

The powder metallurgy (PM) industry’s leading short course returns to State College, Pennsylvania, this August to bring together new PM employees and those seeking to enhance their depth of knowledge and advance their careers in the industry. This intensive three-day course will run from August 10–12, 2020.

This year’s programming will focus on:

- History, current practice, and the future of the PM industry.
- Why PM is a leading method for producing metal parts.
The many applications that use PM parts.

The fine points in designing for PM.

How metal powders are produced.

Designs for compacting tools.

How sintering develops functional properties.

Various secondary operations.

The Metal Powder Industries Federation material and test standards.

Metal injection molding.

The latest high-tech PM technologies, including metal additive manufacturing (3D printing).

Attendees also receive hundreds of dollars in publications, including current MPIF standards.

“The Basic PM Short Course is nearing its 60-year mark of serving the PM industry,” said Bill Edwards, director of technical and member services, Metal Powder Industries Federation. “It provides concentrated knowledge from numerous industry experts over three days and is an invaluable tool to showcase PM technology to anyone who would like to enhance their knowledge.”

At press time, this event’s date had not changed.

MORE INFO  mpif.org

Olympus Scientific Cloud™ v. 3.0 eases corrosion inspection

Data handling can be heavy, disorganized, and complicated, but the Olympus Scientific Cloud (OSC) version 3.0 offers powerful new tools that simplify it, enabling users to leverage the Internet of Things and Industry 4.0 for their inspection and analytical applications. Accessed directly from the Olympus-IMS website, users will experience a streamlined UI, a new App Marketplace, instrument fleet and personnel management tools, cloud data storage and more.

The OSC 3.0 is a single-source platform for all connected Olympus industrial devices to provide continuously enhanced, comprehensive solutions. By signing up for a free OSC account, users with Olympus wireless-enabled devices — including the Vanta™ XRF analyzer, EPOCH™ 6LT flaw detector and 38DL PLUS™ thickness gage with a 38-Link™ adaptor — can expand their instrument’s capabilities with free features such as 10 GB of storage per tenant, wireless software updates, cloud access to manuals and calibration certificates, user registration, role management, and more. (Available features vary by instrument.)

Users can also browse free and paid applications designed to ease some of their most pressing pain points in the new App Marketplace. The first of these new apps, the Inspection Project Manager (IPM), was released with OSC 3.0.

The IPM app transforms thickness gage inspection workflows by making them more agile. For supervisors, it provides the tools they need to manage their projects efficiently. Projects can be broken down into as many jobs as required, with tasks and instruments assigned to specific inspectors. Managers maintain visibility throughout the inspection and can monitor the status of each project, job, and task. Inspectors in the field can download survey files that have been provisioned for them by a manager and share data with supervisors in the office as soon as it has been captured. Future updates will expand the capabilities of this app to work...
with other Olympus industrial products. The OSC provides a single location where administrators can control the users and devices associated with their cloud tenant. Admins can control users’ privileges and roles, add/remove members, manage their data, and manage subscriptions. For devices, users can add new devices and view previously registered instruments. Critical documentation associated with each instrument, such as calibration certificates and user manuals, can also be viewed and downloaded.

The OSC makes it easier to get the right information in front of the right people quickly and efficiently. Each OSC tenant receives 10 GB of free data storage, and you can upload any type of file that you want. If more than 10 GB of storage is required, users can add more by subscribing to a higher tier of service.

The OSC is protected by leading-edge security features and is built on the Microsoft Azure platform. Users maintain full ownership and control over their data, and Olympus does not access or share customer information.

MORE INFO Olympus-IMS.com

Wardwell continues refurbishing, upgrading programs

Wardwell Braiding Co., Rhode Island, a leading manufacturer of wire braiding equipment for more than 100 years, wants to extend its support to customers during this uncertain time and will continue to operate at full capacity. Wardwell understands that many companies have a hold on their budget for new equipment and will continue to offer its refurbishing and upgrading program on all Wardwell Braiding machines with original, new parts as a more cost-effective option.

As machinery ages, it begins to decline in performance and consume more replacement parts. Wardwell’s braiding machines are excellent candidates to be refurbished with new parts and updated features. Options can include high-efficiency motors, drives, broken wire detection, empty bobbin detection, core run-out sensors, and longitudinal taping systems. The advancements in mechanical and electronic components make retrofit a cost-effective option to improve performance on existing machines.

Retrofitting is a safer option than purchasing used equipment and offers the additional benefits of reduced machine downtime and increased output, often at a lower cost. Reconditioning is particularly suitable for Wardwell machines because wear is, generally, limited to the braiding head and rotating parts. These are easily removed, shipped to Wardwell for refurbishing, and re-installed when complete. The work is carried out by Wardwell’s trained technicians, who evaluate the machine’s mechanical components and advise customers on the condition and options available. Electrical and safety systems are replaced with factory-original parts and modernized to comply with current standards. Machine functions are tested and validated after completion.

Retrofitting reduces or eliminates the costs associated with acquiring and evaluating used equipment, purchasing of additional replacement parts to achieve the required performance, plus the training needed by operators and maintenance personnel.

MORE INFO www.wardwell.com

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Partnering with QualityReducer to provide Gearbox repair, rebuilding and reverse-engineering.

MORE INFO www.wardwell.com
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OVID-19 is not the first time in which AGMA and its members have risen to meet a crisis with solutions and resilience. Throughout the last 104 years — since AGMA began — gear manufacturers and suppliers have stepped up to help the world through the development of standards, the manufacturing of critical parts, and technological advancements to keep infrastructure moving.

In 1915, the U.S. Government, faced with WWI, asked gear manufacturers to develop standards to facilitate the manufacture of interchangeable parts for military vehicles. In 1916, the industry founded AGMA, which quickly developed the needed standards. After the war, AGMA's continued work contributed to technological advances across many industries including automotive, aviation, drilling, and mining. By 1921, AGMA had 94 members, and a tradition of spring- and fall-member meetings.

WWII was the next crisis, and again AGMA rose to the occasion. Members quickly shifted to manufacturing war material, including tank transmissions, armored vehicle tracks, gun turret gears, parts for the B-29 bomber, and much more. Wartime restrictions made travel difficult, but with the exception of fall 1945, AGMA continued its semi-annual meetings.

Today, AGMA boasts a worldwide membership of nearly 500 with 23 technical committees working to advance gear standards. COVID-19 travel restrictions canceled the 2020 Annual Meeting — only the second cancellation in 104 years — but AGMA members are still working. The gear industry is essential. A March 2020 survey shows AGMA members are busy, not only with their usual production, but they have ramped up to assist the food and beverage industry, the shipping industry, and, of course, the medical industry during this COVID-19 crisis. Gears move the trucks that deliver food and medical supplies. Behind much of the technology used throughout hospitals, are gears. Running the conveyor belts that are used in food and paper good packaging facilities are gear boxes. Essential businesses can't run without gears, and we are proud of our members for stepping up once again to be a part of the solution.

AGMA itself has also stepped up to make sure its members have the resources they need to stay informed and educated during this time. With the new travel restrictions and stay-at-home orders, many AGMA face-to-face events and classes have been postponed. AGMA has adapted to provide online education, digital marketing tools, and webinars from world-renowned experts to keep the industry up to date on the latest happenings in economics, politics and supply chain disruptions. AGMA is keeping to its mission and promises to its members, as it always has.

Gears have always, and will remain, a hidden necessity that most people don’t see or understand. They assume their favorite foods, cars, and household supplies come from a store, and how it got there is irrelevant. Lucky for the world, the humble and silent heroes that are gear manufacturers, and all those in their supply chain, step up for each and every challenge and crisis. AGMA is 104 years old because of our members and their incredible resilience during the hard times. We are not sure when things will get back to “normal,” but AGMA continues to operate and provide the same support we always have for our members and our industry. If you need anything during this time, please contact us: website@agma.org.
Upcoming Webinars

NAFTA 2.0: The New U.S.-Mexico-Canada Agreement (USMCA) and How it Impacts You
May 6, 2020 | 1–2 p.m. EDT | Free
This webinar will detail what you need to know to be prepared for the many changes coming later this year under USMCA, the replacement for the NAFTA trade agreement between the United States, Mexico, and Canada. From understanding the new rules of origin and certification requirements to labor and environmental provisions of the new agreement, companies engaged in cross-border trade in North America, as well as companies considering new investments in the region, should plan to attend this webinar.

Coronavirus, The Economy and Key Machinery Markets — Current Perspective
May 20, 2020 | 1–2 p.m. EDT | $149/nonmembers $99/members
Presenter: Jim Meil, Principal, ACT Research
Sponsor: McInnes Rolled Rings
The crisis triggered by the expanding footprint of the coronavirus globally and within North America has few precedents. Cross checks to prior recessions in 2008-09, 1981-82, and even the depression triggered by the Spanish flu of 1918-1919 serves to give some guidance, but crude. The economy and the outlook for key machinery and capital goods markets are fluid and changing daily. Jim Meil will give call participants an update on the current situation and scenarios for what may lie ahead for 2020 and beyond.

The Evolving U.S.-China Trade Relationship: The Phase One Trade Deal, the Phase Two Negotiations, and How U.S. Trade Policy on China Impacts You
June 3, 2020 | 1-2 p.m. EDT | Free
Despite the signing of a “phase one” trade agreement with China, the United States continues to levy Section 301 tariffs on hundreds of billions of dollars of imports from China, while China continues its own retaliatory tariffs. This webinar will discuss the prospects for the resolution of the U.S.-China trade dispute in 2020, the likely
scope and timing of a “phase two” deal, and what you need to do to prepare your own business to thrive despite the shifting landscape of U.S.-China trade relations.

2020 Political Outlook
June 17, 2020 | 11 a.m.-noon EDT
$149 / nonmembers; $99 / members
Presenter: A.B. Stoddard, RealClearPolitics

Nonpartisan A.B. Stoddard will cover the latest on the campaign trail. Frequently meeting with sources and politicians, Stoddard has her finger on the pulse of Washington, D.C., as she offers detailed and smart political and electoral analyses. Stoddard will cover the latest on the campaign trail, the most up-to-date happenings between Congress and the White House, ongoing budget battles, and the electoral prospects for the two parties.

Online Education
AGMA offers video training and an online workforce training series for members and non-members. These courses are a convenient way to keep your employees learning from the computer. Visit: www.AGMA.org/education/online/video-training/detailed-gear-design-beyond-simple-service-factors to see the course descriptions.

- Detailed Gear Design – Beyond Simple Factors
- Gear Failure Analysis
- Gearbox CSI: Gears Only
- Online Workforce Training: Parallel Gear Inspection
- Online Workforce Training: Hobbing
- Online Workforce Training: Fundamentals of Gearing

AGMA Welcomes New Board Members
The American Gear Manufacturers Association (AGMA) welcomes four new members to its Board of Directors. These Directors will serve a three-year term (2020-2022). The new Board Members were elected by AGMA Corporate Members in the first quarter of 2020 and were to be announced at the recently canceled AGMA/ABMA Annual Meeting.

The newly elected Board members are:
- Michael Cinquemani, CEO & President, Master Power Transmission.
- Greg Estell, Founding Principal, The Estell Group LLC.
- Eric Van Rens, CEO, Schafer Industries.
- Robert Rye, President & Owner, Cincinnati Gear Co.

AGMA Foundation Welcomes New Board Members
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May 21 — Wormgearing Committee Meeting — WebEx
May 28 — Plastics Committee Meeting — WebEx

JUNE

June 2 — Nomenclature Committee Meeting — WebEx
June 3 — Aerospace Committee Meeting — WebEx
June 3 — U.S./China Trade Relationship Webinar — www.agma.org/education/online/ (free)
June 4 — Bevel Gearing Committee Meeting — WebEx
June 5 — Metallurgy and Materials Committee Meeting — WebEx
June 10 — Lubrication Committee Meeting — WebEx
June 16 — Fine Pitch Gearing Committee Meeting — WebEx
June 16 — Fine Pitch Gearing Committee Meeting — WebEx
June 17 — 2020 Political Outlook Webinar with A.B. Stoddard — www.agma.org/education/online/
June 23 — Gear Accuracy Committee Meeting — WebEx

JULY

July 1 — Section 232 Tariffs Webinar — www.agma.org/education/online/ (free)
July 9 — Bevel Gearing Committee Meeting — WebEx
July 30 — Metallurgy and Materials Committee Meeting — WebEx

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Changes ahead in the roughness standards

Just when you thought it was safe to calculate a tooth flank surface roughness measurement, think again. I have written numerous articles on tooth flank surface roughness measurement. This is such a page-turner of a subject! Actually, I was thinking I was done with this topic. After all, I occasionally get a comment that “such and such” gear shop now has a profilometer. In addition, several AGMA or ISO gear standards now have sections on tooth flank roughness measurement. Mission accomplished.

What more could I possibly write about on flank roughness and its measurement, right?

Time for a mea culpa. I have sort of misguided you. My quest to get repeatable and reproducible tooth flank roughness measurement was based on four key ISO standards:

- ISO 4287: the definitions of the roughness parameters $Ra$, $Rq$ etc.
- ISO 4288: the process of roughness measurement, the filter, cut-off length, etc.
- ISO 3274: the requirements of a contact stylus profilometer.
- ISO 1302: the roughness diagram, the checkmark.

Unfortunately, I recently found out these and several related ISO Standards are about to be withdrawn and replaced with different standards. So, time for one last article on surface roughness.

THE ISO STANDARDS

The four ISO standards listed above are part of a family of GPS (Geometrical Product Specifications) standards related to two-dimensional (2D) surface texture analysis. There are many more 2D GPS standards, such as ISO 16610-21 (the Gaussian profile filter) or ISO 12179 (calibration of a contact stylus profilometer). Most of these standards were published in the late 1990s and have been regularly reaffirmed but without significant updating.

Between 2012 — 2016, a new GPS family of standards was published — the ISO 25178 family. These establish a new universal basis for surface texture analysis by first defining areal (3D) surface texture. Concurrently, ISO TC213, WG16 (TC = Technical Committee, WG = Working Group) began a project to update the family of 2D GPS profilometry standards.

In the fall of 2012, WG16 started revising the 2D standards to align them with the planned structure of the new ISO 25178, 3D surface texture family. In August 2016, the project was officially registered under the reference code ISO 21920.

To date, three new ISO 21920 standards have been drafted and are classified as ISO/DIS (Draft Standard). These three new GPS standards will consolidate the majority of the previous 2D surface texture standards. They are currently undergoing the twelve-week balloting process that began on February 19, 2020, and will end on May 13, 2020. Once the balloting process for these three draft standards is complete, and assuming they are accepted, it will take an additional eight weeks to publish the official ISO standards. By my mathematics, the new 2D surface texture standards will become official around July 8, 2020.

THE NEW STANDARDS

The new 2D surface texture standards are:


Part 1 will incorporate all of ISO 1302 and some additions from other ISO GPS standards such as ISO 1101.

Part 2 will incorporate all the existing profile parameters (i.e. ISO 4287, 4288, ISO 12085, and ISO 13565). It will also include some new parameters, such as $P_{vv}$ (void volume of the valleys on the primary profile) which is adapted from ISO 25178’s $S_{vv}$ parameter. Note: This might become an interesting parameter for tooth flanks since it is a measure of retained lubricant volume on a surface. Finally, Part 3 will specify additional default values and units of the parameters.
related to surface texture. Once published, the following standards will be withdrawn: ISO 1302, 4287, 4288, 12085, 13565-2, and 13565-3.

Regarding contact stylus profilometers, I do not know of any plans to write new standards describing the minimum characteristics of these instruments or their calibration.

Contact stylus profilometers are well-defined already and incorporated in ISO 25178 Parts 6 and 7. I expect ISO 3274 will also eventually be withdrawn.

THE ROUGHNESS CHANGES

The new ISO 21920 standards have a few important changes that relate to gear specifications.

First is that certain roughness parameters such as Ra and Rq are now defined on the entire evaluation length. Remember, Ra and Rq are used to predict tooth fatigue or durability. Previously, ISO 4288 divided the evaluation length into five sampling lengths where parameters were calculated and then averaged together. The new ISO 21920 will calculate Ra and Rq only once on the entire evaluation length. However, Rz will still be calculated by the averaging of five sample lengths to reduce the influence of large outliers.

In addition, the old 16 percent rule will no longer be the default rule in surface roughness measurement. In ISO 4288, the 16 percent rule is the default procedure. It is quite complex and often misunderstood. It allows for multiple roughness measurements to meet a specification. I liken it to hunting around on a surface until you find the number you need. In ISO 21920, the 16 percent rule is replaced with specifying a specific number of measurements on a surface and setting an allowable tolerance range based on a statistical parameter. Alternatively, ISO 21920 states a single maximum or minimum roughness limit shall be specified. Any roughness measurement outside of the limit will result in a rejection.

CONCLUSION

The new ISO 21920 GPS standards can affect the gear industry. The different values of Ra or Rq could be significant when measuring tooth flank roughness using the newer method compared to the old ISO 4288 method. Also, this can be particularly true if the roughness limits are specified to a maximum or minimum, rather than incorporating the old 16 percent rule. Gear designers and manufacturers will need to review and update their tooth flank roughness specifications based on the new ISO 21920 GPS family of standards. These standards should be published in July 2020.

ABOUT THE AUTHOR

Mark Michaud, REM Technical Fellow of REM Surface Engineering, is the inventor and pioneer of REM Surface Engineering’s chemically accelerated finishing technology. He has authored numerous patents and technical papers and served a term on the AGMA Board of Directors. He continues to serve as vice chair of the AGMA Aerospace Committee, as a member of the AGMA Wind Turbine Committee and as a shadow delegate on the ISO 61400-4 Wind Turbine Committee. He can be reached at mmichaud@remchem.com.
Determining tooth thickness of various gear types – Part II

How to calculate the nominal values of span measurement of teeth various types of gearing.

In order to determine the tooth size of a gear after taking into account the backlash allowance, you first must determine what the nominal tooth thickness should be. There are three methods for determining this value. They are chordal tooth thickness measurement, span measurement, and over pin or ball measurement. For this article, we will discuss span measurement.

The span measurement of teeth, \( W \), is a measure over a number of teeth, \( k \), made by means of a special tooth thickness micrometer. The value measured is the sum of normal tooth thickness on the base circle, \( sbn \), and normal pitch, \( Pb \texttt{in}(k −1) \). (See Figure 1).

Figure 1 details the span measurement of a spur gear. As such, the span measurement is on the outside of the teeth. For internal gears, the tooth profile is opposite to that of the external spur gear. As such, the measurement for an internal gear is between the inside of the tooth profiles. The calculations for both an external spur gear and an internal ring gear are detailed in Table 1.

Measuring helical gears can be done in either the normal plane or the transverse plane dependent on how the gears are cut. The formulas for measurements in the normal plane are detailed in Table 2, and those for measurements in the transverse plane are detailed in Table 3.

There is a requirement of a minimum face width to make a helical gear span measurement. Let \( b_{\text{min}} \) be the minimum value for face width. See Figure 2.

Then \( b_{\text{min}} = W \sin \beta_b + \Delta b \)

Where \( \beta_b \) is the helix angle at the base cylinder,

\[
\beta_b = \tan^{-1}(\tan \beta \cos \alpha_t)
\]

\[
\beta_b = \sin^{-1}(\sin \beta \cos \alpha_n)
\]

These calculations resolve to show that a minimum value of \( \Delta b > 3 \text{mm} \) is required in order to have a valid value for \( W \).

Due to the tooth form of a bevel gear, whether it is a straight or spiral tooth, this span measurement technique cannot be used. The span measurement technique is also not employed for a worm wheel or a worm.

Using the above tables and formulas, you will be able to determine the proper span measurement for your spur gear, helical gear or internal ring gear. From these values and the measured values, you can determine the tooth thinning or backlash allowance cut into the gear.

**Table 1: Span measurement calculations for spur and internal gear teeth.**

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Span number of teeth</td>
<td>( k = zK(f) + 0.5 ) \texttt{NOTE 1 Select the nearest natural number of} ( k_{lb} ) \texttt{as} ( k )</td>
</tr>
<tr>
<td>2</td>
<td>Span measurement over ( k ) teeth</td>
<td>( m \cos \alpha \left( x \left( k-0.5 \right) + x \sin \alpha \right) + 2x \cos \alpha )</td>
</tr>
</tbody>
</table>

\( K(f) = \frac{1}{\pi} \left( \sec \alpha \sqrt{\left( \frac{x z}{2} \right)^2 + \cos^2 \alpha} - \sin \alpha - 2f \tan \alpha \right) \)

\( f = \frac{x}{2z} \)

**Figure 1:** Span measurement over \( k \) teeth (spur gear).
Table 2: Equations for the span measurement of normal system helical gears.

\[
K(f, \beta) = \frac{1}{\pi} \left\{ \left[ 1 + \frac{\sin^2 \beta}{\cos^2 \beta + \tan^2 \alpha_n} \right] \sqrt{\cos^2 \beta + \tan^2 \alpha_n} \left( \sec \beta + 2f \right)^2 - 1 - \tan \alpha_n - 2f \tan \alpha_n \right\}
\]

where \( f = \frac{x_n}{z} \)

Table 3: Equations for span measurement of transverse system helical gears.

\[
K(f, \beta) = \frac{1}{\pi} \left\{ \left[ 1 + \frac{\sin^2 \beta}{\cos^2 \beta + \tan^2 \alpha_n} \right] \sqrt{\cos^2 \beta + \tan^2 \alpha_n} \left( \sec \beta + 2f \right)^2 - 1 - \tan \alpha_n - 2f \tan \alpha_n \right\}
\]

where \( f = \frac{x_1}{z \cos \beta} \)

Figure 2: Face width of helical gear.
Back to basics: Mechanical testing – the tensile test

Understanding that the basic tensile test is used for the design of components, and to validate proper processing.

In the previous article, we discussed hardness testing, and the various methods of hardness testing were illustrated. In this article we discuss the tensile testing. In tensile testing, a specially prepared specimen is readied and tested to destruction. In hardness testing, only a small indentation is made that generally does not affect the function of the part.

TENSILE TESTING

Tensile testing (ASTM E8/E8M [1]) is probably the most useful of all mechanical tests. The strength of a material and a measure of ductility are obtained. This data can then be directly used in the design of a part. In this test, a specially designed specimen is axial loaded continuously until failure occurs. The load and elongation are plotted during testing, and then converted to engineering stress and strain:

\[ \sigma = \frac{P}{A_0} \]

\[ \varepsilon = \frac{\delta}{L_0} \]

where \( \sigma \) is the stress; \( \varepsilon \) is the engineering strain; \( P \) is the load applied; \( A_0 \) is the original cross-sectional area; \( \delta \) is the measured elongation; and \( L_0 \) is the original length. The obtained data is plotted as engineering stress and strain (Figure 1). A detailed mathematical treatment of the tensile test is provided by Nadai [2].

At the beginning of the test, there is a linear region where Hooke’s law is followed. The slope of this linear region is the elastic modulus \( E \) (for steels, the elastic modulus is about 30 x 10^6 psi). The yield stress, \( \sigma_{y} \), which is the limit of elastic behavior, is defined as the point at which a small amount of permanent deformation occurs. This deformation is defined in the United States as a strain of 0.002 in./in. or 0.2% strain [1]. Loading past this point causes plastic deformation. As the plastic deformation increases, strain hardening occurs, making the material stronger. Eventually, the load reaches a maximum value and failure occurs. The ultimate tensile strength (\( \sigma_{UTS} \)) is determined by taking the maximum load experienced and dividing it by the original area:

\[ \sigma = \frac{P_{MAX}}{A_0} \]

In ductile materials, the strain may increase after the maximum load is reached and the applied load is decreased. This point is the onset of necking (Figure 2). Necking progresses until the point of failure, giving rise to a “cup and cone” fracture (Figure 3). The ultimate strength is the most quoted property but is the least useful of all the properties determined from the tensile test. In ductile materials, ultimate strength is a measure of the maximum load...
that the material can experience in uniaxial loading. However, in brittle materials, the UTS is valid design information. The UTS used to be the basis for many designs and design codes (with a margin of safety), but now design codes rely on the yield strength instead. Because of its reproducibility, the UTS is often used for procurement, specifications, and quality documents. The yield strength, $\sigma_{ys}$, is the stress required to obtain a small (0.2%) permanent strain. In other words, if the specimen were unloaded at the yield stress, it would be 0.2% longer than the original length. The yield strength is now the basis for many design codes and is used extensively in the determination of many other properties such as fracture toughness and fatigue strength.

The ductility of a tensile specimen is measured by the percent of elongation of the tensile specimen, and by the reduction of area after fracture:

$$\%E = \frac{L_f - L_0}{L_0} \times 100$$

$$\%RA = \frac{A_f - A_0}{A_0} \times 100$$

where $L_f$ is the final gauge length after fracture, $L_0$ is the original gauge length, $A_0$ is the original cross-sectional area, and $A_f$ is the final cross-sectional area after fracture. Whenever reporting elongation, the gauge length is always reported, since the amount of elongation will vary with the gauge length.

The shapes of tensile specimens are standardized by ASTM. A wide variety of specimen shapes are permissible. Some examples are shown in Figure 4. Care in fabricating the tensile specimen is necessary to preclude faulty or inaccurate results. Heating and cold working of the specimens must be minimized during fabrication, or inaccurate yield and ultimate stress values may result. The
specimens must be straight and flat; otherwise, a distortion of the elastic region and an inaccurate yield strength may result. During machining, the tensile specimens must be symmetrical about the load axis. If not, bending may occur, leading to erroneous results because of the combined stresses of tension and bending.

Testing machines used for tensile are generally simple. Either screw-type or hydraulic machines are used (Figure 5). The load is measured by a load cell, composed of strain gauges or a linear velocity displacement transducer (LVDT). This is recorded by a chart recorder as a plot of load versus strain.

The strain is measured by extensometers (Figure 6), which measure in situ the strain experienced by the tensile specimen. Modern extensometers use strain gauges to provide strain measurements. This is an advantage because it sends an electric signal proportional to the experienced strain to the chart recorder.

The tensile specimen is held during testing by either hydraulic or mechanical grips. Both methods grip the specimen by wedges with serrated surfaces. In mechanical grips, the load applied to the specimen forces the wedges tighter against the specimen by inclined surfaces inside the grip. With hydraulic wedges, hydraulic pressure is used to force the wedges against the specimen and hold it in place. For high-strength steels or steels that have hard or highly polished surfaces, hydraulic grips are preferred to prevent the specimen from slipping in the grip.

CONCLUSIONS
In this short article, the methodology of tensile testing was described. A brief discussion of the test, and test data, was conducted. Finally, a short description of the types of tensile specimens available, and the tensile testing equipment was discussed. It is hoped that this article will help you understand the basic tensile test used for the design of components, and to validate proper processing.

Should you have any comments, or suggestions for additional comments, please contact myself, or the editor.

REFERENCES

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GEARWHEEL MANUFACTURING IN A 34-SECOND CYCLE

Gearwheel manufacture in 34-second cycle. (Courtesy: Martin Witzsch)
By using KAPP NILES gear grinding machines, Volkswagen is making strides in its gearbox production.

By MARTIN WITZSCH

Minimizing production times to ensure competitiveness is one of the most important challenges in the automotive industry — Henry Ford already recognized this over a century ago. After decades of optimization, it is difficult to reduce machining times even further while maintaining the same level of quality. Nevertheless, the company Volkswagen (VW), near the German town of Kassel, has managed to achieve this in gearbox production using KAPP NILES gear grinding machines.

The Volkswagen plant in the small town of Baunatal is one of the larger German locations of the enterprise with a workforce of about 17,000. Its production focuses mainly on passenger car gearboxes in 10 different series at present. Gearing centers of KAPP NILES are being deployed on 50 percent of the manufacturing lines. The company, based in Coburg, Bavaria, is primarily known as a specialist for hob grinding with dressable tools — a process combining productivity and quality.

880 GEARBOXES PER DAY

KAPP NILES machines are also applied in the production of the DL 382 dual clutch gearbox for Audi. A total of 16 gearings is required to shift the seven gears with this type of gearbox — 10 ground and six honed. The production unit runs 24 hours a day, five to six days per week, depending on demand. VW strives to achieve an EPEI value of one day in the production unit. EPEI stands for “every part, every interval,” meaning that all components can be produced on each day for the aforementioned gearbox. This type of streamlined production requires seamless processes and a high degree of flexibility. Technical clerk, Christian Hahn, is in charge of the production process of the DL 382 dual clutch gearbox (Figure 1).

“We have five gearing centers by KAPP NILES in the wheel production unit and two more in the shaft production unit,” he said, describing the production process. “In order to achieve an EPEI value of one day, we change over the machine in the wheel production unit twice a day. This way, we can produce 10 different wheels per day.”

The challenge with flexible production was the short cycle times. With an output of 880 gearboxes per day, one machine in wheel production must produce 1,760 parts per day. Including all set-up times and failures, this yields a line cycle time of 34 seconds. An average line cycle time is about 39 to 40 seconds.

“Saving five to six seconds per cycle does not sound like a lot at first, but together it can be up to a 15 percent reduction,” said Bernd Kümpel, application technician at KAPP NILES. “If I consider that at least 40 percent of segments cannot be influenced, I have to reduce the actual process time by 30 to 40 percent. Seen in this way, 34 seconds is a real challenge.”

SAVING PRECIOUS SECONDS DURING CHANGEOVER, DRESSING, AND MEASURING

A total of seven KAPP NILES machines are being deployed, which, with their low space requirement, are ideally suited for the highly automated production at Volkswagen.

These include: Three KX 100 DYNAMIC (Figure 2), two KX 260 TWIN in wheel production, and two KX 160 TWIN in shaft production (Figure 3).

Hahn and Kümpel agreed from the beginning that the desired cycle time could only be achieved with a combination of several measures. In order to minimize the daily set-up effort, Hahn makes sure the wheels that are to be produced on one machine have bore holes of the same size. Thus, he has to changeover the machine, but not the clamping tools. The remaining set-up time is minimized by the intelligent set-up concept of the KX 100 DYNAMIC. For one machine, he needs just 20 to 25 minutes.

“The semi-automatic set-up makes the KX 100...
DYNAMIC extremely user-friendly,” Kümpel said. “All you need is an Allen key for the entire set-up operation. With it, you operate the hydro-expansion clamping chuck of the dresser roll. Everything else is connected without any screws via HSK interfaces (HSK = hollow shaft cone).”

An additional visual aid is available in the form of a menu-guided and easy-to-understand cycle on the machine controller. By completing the step-by-step process and the acknowledgement screen, the operator ensures no work steps are executed incorrectly or, in fact, forgotten. High-cost failures are prevented in this way.

The tools are dressed using full profile rolls, allowing all threads of the cylindrical worm to be approached and molded simultaneously. Thus, with a 5-pass full profile roll, the dressing time can be reduced by more than half without compromising on quality (Figure 4). The integrated measurement system is another important timesaver.

“After each changeover, a quality measurement has to be made outside the machine,” Hahn said. “In fact, we continue to require this, but I can already check the basic, quality-related parameters with the integrated measurement sensor in the machine itself. It saves a lot of time since we can start production before the results of the external measurement are available.”

The integrated measurement system of the KAPP NILES machines thus accelerates the restart process considerably. The external measurement merely checks more teeth and generates the measurement report to monitor the gear.

**OPEN FOR NEW MACHINE TOOL TECHNOLOGY**

The search for optimization potential also includes the actual grinding process. Cubitron™ II machine tools by 3M™ show a highly promising approach, with geometrically specific — triangular shaped — cutter heads, compared to conventionally dressable grinding wheels.

“With these, you can step it up a notch, to say it plainly,” Hahn said. “That is, remove more material in one thread, and remove it faster.”

For this purpose, KAPP NILES provided relevant preparatory work with a large number of grinding tests in-house to be able to use the benefits of this machine tool with the DL 382 components.

“With CII, you can remove a considerable amount of shavings without any thermal damage to the component,” Kümpel said. “This way, we reduce time consumption by a solid 30 percent compared to other grinders, depending on the component.”

**SAVING SPACE AND MONEY**

Production is characterized by a belt chaining (or linkage), which goes through the entire hall (Figure 5). Among the employees, it has gained the nickname “highway.” The available space is limited. Hence, the highly compact KX 100 DYNAMIC machines are the preferred choice. This machine type has two separate rotatable mounted columns, each with vertically movable pick-up axes with one workpiece spindle. While a workpiece is being machined, the other pick-up axis places the machined workpiece and loads a non-machined part.
onto the workpiece spindle. The workpiece is aligned outside the work area. This allows the workpiece spindle, already accelerated to machining speed, to be swiveled in the work area. Non-production times are thus reduced to a minimum.

A transfer unit (Figure 6) does the loading to and unloading from the conveyor belt.

“We usually move with the belt directly below the machine,” Kümpel said. “However, this was not possible here. With the transfer unit, we compensate for height and distance from the belt to the machine.”

This solution is not only compact, but also cost-effective.

“An integrated automation solution would have been significantly more expensive, at about 25 percent of the price of the machine,” Kümpel said. “A simple transfer unit costs less than 10 percent of the machine price.”

PLANNED SUCCESS

The time for conversions and commissioning is, in most cases, very limited. But the highly ambitious goals have been achieved.

“Throughout the process, I have been very satisfied with the on-site support and the local service,” Hahn said. “We were convinced by the machine concept and managed to overcome any obstacles together. The cycle time, in particular, was a critical aspect. But, we did it.”

And for this, they faced a lot of time constraints. The commissioning that included the machine capability analysis, where 100 components of each type are produced and measured a 100 percent, took place in the summer of 2016. Production commenced right in the first week of September.

Apart from the cycle time, other difficulties were overcome in the shaft production (Figure 7).

“The shafts are hollow and thus, comparatively unstable,” Hahn said. “This called for a special clamping technique and a machine that can absorb the unavoidable vibrations in the grinding process. The KX 160 TWIN can do this due to its solid design and construction, which in turn helps to achieve better grinding quality.”

Should immediate service be required, KAPP NILES has stationed an employee in Kassel who only provides support to the Volkswagen plant.

“Our highest priority is to ensure production, regardless of the problems that occur,” Kümpel said.

“Saving five to six seconds per cycle does not sound like a lot at first, but together it can be up to a 15 percent reduction. If I consider that at least 40 percent of segments cannot be influenced, I have to reduce the actual process time by 30 to 40 percent.”

ABOUT THE AUTHOR

Martin Witzsch is a freelance journalist for KAPP NILES.
PERFORMANCE AND PROPERTIES OF A NEW ALTERNATIVE GEAR STEEL
Hybrid steels show many interesting properties relevant to gear applications, somewhat depending on the area of application and the working conditions.

By LILY KAMJOU and JOAKIM FAGERLUND

In the ongoing strive for light weighting or power densification, high-performance clean steels are showing a significant improvement. As a next step, gear steels that combine several properties, are now proving an interesting alternative. Traditional gear steels achieve their maximum hardness after carburizing and a fast quench. A fast quench usually results in distortion as the part is unavoidably unsymmetrically cooled/quenched. For many gear applications, distortion during heat treatment of final component, can add cost and unwanted hard machining operations. With many components being more sensitive to distortion, especially within electrical vehicles, where NVH becomes even more important, the potential to reduce distortion from heat treatment can be essential. With a new steel composition that hardens by precipitation hardening (aging around 500°C/950°F), low distortion can be attained as a fast quench such as an oil quench is not necessary. This type of steel can be both nitried and carburized. Costly hard machining can therefore be reduced due to the low distortion. Other interesting properties of this new steel that will be presented in this paper are: good mechanical properties at elevated temperatures and good corrosion and oxidation properties compared to traditional gear steels.

1 BACKGROUND AND INTRODUCTION

Increased demands on mechanical properties at elevated temperature set the starting point for the development of hybrid steel.

The objectives were:
- A possibility to reach a high hardness ~58-60 HRC.
- Improved mechanical properties at elevated temperatures.
- Material can be produced cost-effectively (in current process with Electric Arc Furnace EAF, Ladle Furnace & Ingot casting-route).

The strength and hardness of steels are dependent on particles that stop dislocation movement. In order to achieve good strength/hardness at elevated temperatures, these particles need to be stable at those temperatures. In a low alloyed steel (Fe-C), the hardness is dramatically reduced by increased tempering temperature. In tool steels, secondary carbide particles precipitate at about 500°C and contribute to increased strength. Another example of high-temperature precipitates are the precipitates in maraging steels (examples of precipitates: Fe-Ni-Al and Fe-Ni-Ti).

To illustrate how these types of steel respond to tempering, the Ovako Heat Treatment Guide [1] has been used (Figure 1). There it can be seen how the material strength is affected by the tempering temperature; the strength of the “engineering” steel, Fe-0.7C, drops with increasing tempering temperature. The maraging steel as well as the tool steel, both exhibit secondary hardening properties, resulting in improved elevated temperature properties.

The negative aspects of tool steel, are that the high carbon content (which is needed to achieve the desired hardness/strength) in combination with the carbide formers (e.g., Cr, Mo, V) will have a strong tendency to form large carbides during the solidification of the steel. These carbides will have a detrimental effect of the fatigue performance of the steel. The tendency to form large carbides can be reduced by fast solidification (small ingots) or by alternative steel making methods such as ESR or VIM-VAR, but this will have a large negative influence on the cost to produce the steel. Maraging steels have many attractive properties, but the very high alloying content (e.g., Ni and Co) makes it too expensive to be attractive for many applications, and also, the very low carbon content does not make it suitable for an EAF-route.
Hybrid steels require a very slow cooling rate for the martensite transformation and to reach full hardness.

2 MATERIAL PROPERTIES
To avoid the negatives of tool and maraging steels, the aim was to keep the carbon content low, avoiding formation of large carbides and at the same time keep the alloying content, and therefore the cost, at a reasonable amount. Figure 2 shows the steel's low tendency toward segregation, which is important for the fatigue performance of the steel. As can be seen, all elements show an even distribution.

The development has resulted in two steels so far, hybrid steel 1 and hybrid steel 2. The name “hybrid” comes from the fact that the hardness is achieved from both secondary carbides and precipitated intermetallic particles. The chemical composition for the two grades is presented in Table 1; the carbide forming elements are Cr, Mo and V and the elements that form intermetallic phases are nickel and aluminum. Oxygen, nitrogen, and sulphur in these grades are low; approximately 3ppm O, 20ppm N, and < 10ppm S.

The fact that the steel composition comprises 2 percent aluminum affects the density of the material. Common engineering steels such as the AISI 8620 have a density of approximately 7,800 kg/m³, whereas the hybrid steels' density is 7,582 kg/m³, i.e. almost 3 percent lower. For the automotive industry, among others, where weight reduction is in focus, lighter materials can make an impact.

Figure 3 shows the intermetallic Ni-Al precipitates (green and blue) that form at aging of the material. The average precipitate size is 5nm, which means that in 1µm³ of the material there are approximately 500,000 of these precipitates, adding to the strengthening of the material.

The hardness after austenitization and cooling is 430 Hv for hybrid steel 1 and 550 Hv for hybrid steel 2, and it is after tempering at 500-550°C (aging) that the hybrid steel reaches its hardness; 55 HRC for hybrid steel 1 and 60 HRC for hybrid steel 2, see Figure 4.

2.1 SOFT ANNEALING
Hybrid steels can be soft annealed; with a slow cooling from 800 to 600°C, <20°C per minute, the resulting hardness is approximately 260 HV for hybrid steel 1 and 300 HV for hybrid steel 2.

2.2 HARDENABILITY
Due to the alloying strategy, the material has very high hardenability and can therefore be cooled slowly; no need for a fast quench to reach required properties. As can be seen in Figure 5, the hardness is the same for a bar with a diameter of 10 mm as a large bar with a diameter of 250 mm when air cooled.

2.3 MECHANICAL PROPERTIES AT ELEVATED TEMPERATURE
One objective with the present steels is to increase the mechanical properties at elevated temperatures compared to engineering steels. In Figure 6, the yield strength of hybrid steel 1, hybrid steel 2, tool steel, and a bearing steel (100Cr6/52100) are compared. All steels have been hardened and tempered at 550°C (1,022°F). As can be seen, the elevated temperature properties are comparable with a tool steel and significantly improved compared to an engineering steel.

2.4 DISTORTION
Component distortion after heat treatment is quite a common issue in
gear manufacturing and tends to result in cost-intense hard-machining processes such as grinding. This does, of course, depend on the type of gear, gear material, and heat-treatment process, but with standard gas carburizing and quenching processes, it is difficult to avoid entirely. Choosing a material with high hardenability and a slow enough quenching operation will reduce the distortion significantly.

The hybrid steels require a very slow cooling rate for the martensite transformation and to reach full hardness; the steels are aged/tempered (where no quenching is needed). These facts make it possible to harden the hybrid steels with significantly lower distortion, compared to traditional gear steels, where the propensity to distortion is low, offer an interesting alternative to currently used common grades.

2.5 NITRIDING

The maximum hardness achieved by nitriding is strongly correlated to the amount of nitriding forming elements (e.g., Cr, V, Mo, Al); therefore, it is no surprise that the hybrid steels exhibit a high surface hardness after nitriding. As an example, hybrid steel 1 was plasma nitrided at 520°C (968°F) for 20 hours; see Figure 8. The surface hardness reached, was approximately 1,200 Hv. The nitriding resulted in a high compressive residual stress. Unlike many engineering steels, the nitriding temperature does not reduce the core hardness since it is performed in the same temperature range as where the precipitation of intermetallic particles occurs. This can be used in different ways; one possibility is that the nitriding process time can be shortened.

2.6 OXIDATION/CORROSION PROPERTIES

In some applications, the materials’ oxidation and corrosive properties are important. Although those properties for normal engineering gear steels are normally not discussed much since they are poor and sometimes not needed. Due to the content of nickel and aluminum, the hybrid steels have an increased resistance to oxidation or
corrosion compared to normal, low-alloyed engineering steels. In Figure 9, the oxidation behavior of the hybrid steel is compared to a carburizing grade (16CrMoV8-5F) and a quench and tempering grade (AISI 4140/42CrMo4). The test was performed at 700°C (1292°F) and in air. As can be seen, the oxidation resistance is significantly improved for the hybrid steel, which shows very little mass increase.

To evaluate the corrosive properties, a standardized test was performed (ISO 15158, [2]), where the pitting potential is measured. A high value means less sensitivity to corrosion. The result (Figure 10) showed the hybrid steel was comparable to AISI 440C (martensitic stainless steel with 17%Cr and 1%C). According to ASTM, the 440C steel is “characterized by good corrosion resistance in mild domestic and industrial environments, including fresh water, organic materials, mild acids, various petroleum products” [3].

2.7 WELDING
Hybrid steels are suitable for welding, but require a different approach compared to a typical engineering steel, which reaches its maximum hardness through a fast cooling from the austenitization temperature. In Figure 11, an example where hybrid steel has been friction welded is shown. The hardness before welding was approximately 450 Hv. After welding, the hardness outside the weld increased due to aging/tempering whereas the welded zone is more or less unaffected. After aging/tempering, the hardness increased to approximately 600 Hv. In a typical engineering steel, welding would result in a hard-center portion, and the surrounding material would be tempered to a lower hardness.

2.8 INDUCTION HEAT TREATMENT
When progressively induction hardening a ring/gear, there is a large risk of overlapping heating of the already heat-treated part, which can result in a soft part (tempering of the already hardened steel). Tests have been performed by induction heat treating the hybrid steel and by intentionally doing an overlap.

The hardness results show minimal effect of the overlap.

2.9 INFLUENCE OF HYDROGEN ON FATIGUE
The fatigue properties of steels can be severely influenced by hydrogen, observed in both bending fatigue and in rolling contact fatigue. This can affect the component and system lifetime for many different applications, from wind power to electric vehicles, where hydrogen can be an issue and where the choice of material can be crucial. Hydrogen can be an issue in gear applications, as sliding contact, together with the lubricant can introduce hydrogen into the gear (depending on lubricant, temperature, and leak currents).

Tests of hybrid steel compared to bearing steel (100Cr6/52100) indicate it is less prone to lose its fatigue strength due to hydrogen. Tests were carried out on rotating bending fatigue specimens charged with hydrogen. As can be seen in Figure 12, the hybrid steel performed better than the bearing steel, indicating it might be less sensitive to hydrogen (top two diagrams without hydrogen charging, bottom two diagrams with hydrogen charging).

3 GEAR MANUFACTURING
There are many factors that influence the total cost of a component, see Figure 13 where an example of a bearing is shown. Generally, and as seen in the example, raw material cost is a small amount compared to other process steps. By reducing, for example, hard machining/grinding there is an opportunity to allow for a more expensive steel, also in gear applications.
To make full use of the potential of hybrid steel, machining after hardening, at a hardness around 450 HV should be done, since that enables cost-efficient production. There are, however, several possible manufacturing routes from which gears can be produced using hybrid steel.

- Through hardened gears, which are solution treated and aged, resulting in a hardness of 55 HRC or 60 HRC respectively for hybrid steel 1 and hybrid steel 2.
- Solution treated, aged and nitried (alternatively solution treated and nitried, with aging taking place simultaneously as nitriding), resulting in high surface hardness around 1,200 HV and a bulk hardness of 55 or 60 HRC respectively.
- Soft annealed and solution treated by induction in the surface region of the gear with additional aging, resulting in a surface hardness of 55 or 60 HRC respectively combined with a core hardness of ≥260 or ≥300 HV respectively (depending on hardening parameters).

Hybrid steels show good results in bar rolling, tube- and ring-manufacturing as well as for forgings, indicating that normal production routes for these types of steels should be very similar to standard engineering steels.

4 SUMMARY AND OUTLOOK

Hybrid steels show many interesting properties relevant to gear applications, somewhat depending on the area of application and the working conditions. Distortion and the reduction thereof, is often one of the main concerns for gears, due to cost implications or challenges in the final machining steps. Finding ways of reducing distortion through the choice of material usage as well as heat-treatment processes might facilitate the manufacturing. For applications where a higher core strength is required, as well as a high surface hardness, both hybrid steel 1 and hybrid steel 2 could be an alternative.

Some properties of hybrid steels include:
- Low microstructural segregation.
- High-volume, cost-efficient production.
- High strength, especially at elevated temperatures.
- Ultra-high strength with good weldability.
- High hardenability enabling low distortion.
- Excellent surface treatment possibilities.
- Good corrosion resistance.

In a currently ongoing project, nitried gears will be tested for bending fatigue performance in a pulsator test rig and further on, carburizing tests on gears are also planned. To understand the machinability of the steel better, and possible production routes, there is also more gear manufacturing planned in the near future.

BIBLIOGRAPHY


ABOUT THE AUTHOR

Lily Kamjou and Joakim Fagerlund are with Ovako AB.
COMPANY PROFILE

WEILER ABRASIVES

TACKLING AGGRESSIVE GEAR-GRINDING APPLICATIONS

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

By KENNETH CARTER, Gear Solutions editor

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

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

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

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

TIGHTER TOLERANCES

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

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

GRAIN TECHNOLOGY

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

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

CUSTOMER SERVICE

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

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

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

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

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

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

**FAST-TRACK PROGRAM**

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

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

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

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

**GERMAN BEGINNINGS**

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

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

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

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

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

**LIGHTNING GROWTH**

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

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

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

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

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

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

This article first appeared in the April 2019 issue of Gear Solutions.
Exact Metrology offers
Leica RTC360 3D laser scanner

Exact Metrology, a comprehensive metrology service provider, announces the immediate availability of the Leica RTC360 3D laser scanner. Manufactured by Leica Geosystems and distributed by Exact Metrology, these portable coordinate measuring machines are designed to measure large-scale objects. This laser scanner uses 3D reality capture.

3D reality capture is a process of scanning and capturing any site, for example, factories, buildings, crashes, and crime scenes, in a 3D digital model, combining measurements and imagery. The model can be used for design and comparison purposes in various situations, capturing every detail with to-the-millimeter accuracy. This technology combines one-touch operation with portability and speed to deliver high levels of accuracy, automation and the ability to create 3D environments in a matter of minutes.

Many industrial sites present inhospitable environments, where the health and safety of the employees and visitors are at risk due to temperature, corrosive materials, moving machinery, and heavy objects. In addition, sites often have networks of pipes, tunnels, storage vessels, and other structures that need to be examined. 3D reality capture permits complete site visualization for safety training. Site visibility also greatly improves plant management efficiency. Accurate measurements help designers create extensions without needing to visit the site and enhanced planning of workflow avoids disruptions.

Thanks to 3D reality capture, Building Information Modeling (BIM) experts save time and money as BIM processes become more efficient, from the accuracy of construction documentation to design and build quality assurance. The latest laser scanning technological developments improve understanding and documentation of the build environment through the use of millimeter-accurate laser scanning and High-Dynamic Range (HDR) imagery. By using 3D reality capture, previews of data and imagery are viewable onsite directly from a tablet, enabling scans to be checked and verified before going to the office.

The RTC360 3D laser scanner is ideal for professionals managing project complexities with accurate and reliable 3D representations. This scanner effectively combines a high-performance 3D laser scanner with Leica Cyclone Field 360, a mobile device app for edge computing that automatically registers scans in real time and Leica Cyclone REGISTER 360, an office software that integrates the 3D model into the workflow.

Using 3D technology is useful when a crash or crime scene requires quick analysis of the scene. Scanning creates a 3D environment that can be explored and analyzed, as well as documents the entire scene in detail. Furthermore, fast scanning minimizes disruption and delays and removes scene degradation, thus providing jurors with credible evidence.

With a measuring rate up to 2 million points per second, automated targetless field registration (based on VIS technology) and automated transfer of data from site to office, the device and software greatly reduce time spent in the field and maximize productivity.

As part of the RTC360 solution, the Cyclone FIELD 360 links the 3D data acquisition in the field with the laser scanner and data registration in the office with Cyclone REGISTER 360.

MORE INFO
www.exactmetrology.com

Web-based software supports virtual teaching for training purposes

It has always been important to GWJ to support and promote teaching and learning. Therefore, GWJ provides the web-based software eAssistant free to universities and other educational institutions for training purposes as well as to students for private use. This gives students the opportunity to work from home without any problems.

Now that the universities have moved from face-to-face classes to online teaching, the web-based application can help ensure continuous learning during the current situation. With the eAssistant, the software application for the calculation, design and optimization of machine elements such as shafts, bearings, shaft-hub connections, bolted joints, or gears, users learn practical skills
they can apply immediately and deepen. Integrated functions such as redo/undo or the automatic recalculation after entering values help to explain certain contexts in a way that can be easily understood. A recalculation occurs after every data input. Any changes that are made to the user interface take effect immediately.

This is possible not only for number values, but also for the representation of the tooth form. The effect of the profile shift on the gear tooth form can be quickly understood.

**MORE INFO** [www.gwj.de](http://www.gwj.de)

### Norton Xtrimium™ adds range of solutions for gear grinding issues

Saint-Gobain Abrasives’ Norton Xtrimium™ products provide an expansive range of solutions for challenging gear grinding applications. The Norton Xtrimium™ range of gear solutions is designed for high-performance gear grinding in extreme, tight-tolerance environments. The structured portfolio of gear-grinding products is specifically designed by category to provide higher profile accuracy, supreme form holding, and burn-free grinding in worm, profile, and bevel applications. Highlighting the range is an innovative dual-worm wheel design that enables two operations in one grinding wheel, substantially saving time and cost.

Norton Xtrimium dual-worm grinding wheels feature a design with a high-performance vitrified bond section for grinding and a fine-grit resin section for polishing the gear teeth, enabling one wheel to perform what traditionally required two wheels. Substantial savings in wheel costs and productivity via the elimination of wheel swapping can be achieved with the Norton design. In addition, improved surface finishes of Rz = 1.0mm and Rpk = 0.05mm, and reduced harmonics (noise) are realized.

The Norton Xtrimium Dual-Worm grinding wheels can also be adapted to existing machines.

The Norton Xtrimium Gear Grinding Platform also covers the whole range of gear grinding processes, and leverages the whole spectrum of Norton grains and bond technologies to match each customer’s requirements, whether with:

- Worm Grinding Wheels featuring micro-structured ceramic grain and providing free cutting action and wheel homogeneity, allowing constant performance throughout the wheel thickness for the life of the wheel.

### Siemens offers Sinumerik 828D CNC through new program

To offer a fast solution to US-based machine tool builders, system integrators, and retrofitters, Siemens is stocking typical system packages that include the most frequently used Sinumerik 828D CNC, Sinamics drive, Simotics motor, and accessories such as cables in their Elk Grove Village, Illinois, facility to ensure fast and efficient delivery.

Additional benefits of ordering the pre-defined packages include a price discount, a simplified ordering process, and a shortened lead-time. The program is subject to availability and delivery time will depend upon the stock available in Elk Grove Village. Only customers in the United States with a physical mailing and delivery address are eligible for this program.

“Siemens is bringing the Sinumerik 828D to a highly competitive price point in the U.S. market. The 828D is a compact, panel-based CNC that offers machine tool builders very flexible machine design integration,” said John Meyer, marketing communications manager, Siemens Industry, Inc. “End-
customers will benefit from our highly intuitive and easy-to-use ShopMill and ShopTurn graphical programming interfaces, which increase machine tool usability and shop-floor productivity.”

There are seven pre-defined Sinumerik 828D packages covering the most typical standard milling and turning machines. They include:

* 3+1 Milling with 6.5 Nm feed axes + 10 kW spindle.
* 3+1 Milling with 12 Nm feed axes + 22 kW flange mount spindle.
* 3+1 Milling with 12 Nm feed axes + 22 kW foot mount spindle.
* Milling with three 12 Nm feed axes, no spindle with S120 Combi drive.
* Milling with three 12 Nm feed axes, no spindle with S120 Booksize drive.
* Turning with 3 6.5 Nm feed axes, no spindle with S120 Booksize drive.
* Turning 2+1, 12 Nm feed axes, 10 kW spindle.

The beta version of KISSsoft is now available for testing. It presents numerous innovations and new features of our software. This year’s highlights include:

* Rainflow method for load data analysis.
* Reliability evaluation with AGMA 6006, VDMA 23904, and Bertsche.
* Revised tooth root and flank rating according to ISO 6336:2019.
* Scripting language for automation and extension of calculations.
* Gearbox data exchange with REXS.

Apply as a beta tester and define the next release, which will be available June 26, 2020.

The new Helitronic Raptor offers both automation-ready flexibility and an economical, universal design for all-around tool grinding excellence. (Courtesy: United Grinding)
kW) spindle and a work envelope that can accommodate tools up to 12.6” (320 mm) in diameter and 11.0” (280 mm) in length, including end face operations. For the utmost in tool grinding efficiency, from tool design to part production, as well as re-sharpening, the machine uses Walter Helitronic tool studio.

In addition to its low-vibration gray cast iron frame and gantry-type construction, the Helitronic Raptor is designed to accommodate a range of options, including top loaders with up to 500-tool capacities integrated in the working area. Other options include glass scales, A-axis torque drive, a grinding wheel measuring probe and a manual support steady rest.

MORE INFO  www.grinding.com

Suhner offers POLYDrill range of multi-spindle drills

Suhner features several options in its popular multi-spindle lines. Among them is the POLYDrill family, offering a huge selection of multi-spindle heads from the standard range. Fixed and adjustable hole pitches and compact models allow the tool to be used in a variety of situations. In addition, Suhner can supply tool holders from all stock for all popular brands of machining centers.

Drilling capacity is available standard between 0.06-1” (1.5-25 mm). Minimum hole spacing is 0.27” (7 mm), while maximum hole spacing is virtually limitless. Optional tool holders include ER, ST, JT33, Weldon, and customized styles. Additional options are axial and radial compensation and custom layout and spacing.

The POLYDrill range includes various multi-spindle heads such as: MH 20/5, MH 20/7, MH 20/10, and MH 20/13 plus multiple spindle heads with two adjustable spindles for the utmost in flexibility. The MH 20/5, 20/7, and MH 20/10 have maximum speed of 4,000 RPM. Maximum drilling capacities are 5 mm, 7 mm and 10 mm, respectively. MH 20/13 has a maximum drilling capacity of 13 mm and a maximum permissible speed of 3,000 RPM.

The MHF has up to 10 spindles, a custom-made pattern, and a fixed spindle distance. Maximum drilling capacity is between 5-13 mm and the speed range is 2,500-4,000 RPM. MHFP is equipped with eight spindles with preloaded angular contact bearings for use of carbide tools and fixed spindle distance. Maximum drilling capacity is 7-20 and the speed range is 0-8,000 RPM.

The drive system VG 4-8 allows the user to power up to eight machining units with a single motor with flex shaft power delivery. The speed range for this drive system is 46-9,320 RPM. Flexible drive shafts NA 7/10/12 have a speed range of 12,000-20,000 RPM.

MORE INFO  www.suhner.com

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> Contact pattern of asymmetrical gears
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> Feasibility assessment for “Power Skiving”

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“The NGV gearbox is dedicated to the AGV; it’s very important for space-saving on the vehicle, because space is always limited.”

What's a typical day like for you at Neugart?
I'm product manager here at Neugart. In total, we have four product managers on the team. We are responsible for all the products and market research, and we have two other colleagues who take care of training and software tools. I am responsible for product and the NGV.

Tell us about the NGV gearbox.
It’s a gearbox dedicated to AGVs. It’s a little bit different than what we normally do. Our standard gearbox can be used in many different applications. But the NGV is a gearbox dedicated to one specific application, which is AGVs. We offer the gearbox in three sizes with different load capacities. The smallest size gearbox can take 350 kilograms up to 1,075 kilograms, which is the biggest size gearbox.

The NGV gearbox is dedicated to the AGV. It’s very important for space-saving on the vehicle, because space is always limited. You have batteries; you have controls; you have all this navigation and security and scanner devices on AGVs, so we tried to be as small as possible, and we deal with that with a special wheel. The gearbox is placed more or less completely outside the vehicle and inside the wheel, saving a lot of space inside the vehicle.

The NGV is very easy to assemble. We make it with a special design and recessed mounting flange, so it’s not positioned where it is normally on our standard gearboxes, which are made more for machine applications. We have recessed it, so it can be mounted directly to the chassis of the AGV without using any adapters.

The inside is well-tested and reliable with a two-stage economic gearing that we also use in many other of our gearboxes. We already make millions of the parts used in the NGV, so that makes the NGV gearbox cost efficient and reliable.

What makes the NGV gearbox unique to the gear industry?
The NGV is very important for AGVs. In addition to the space saving design is its high load capacity. That means the high radial load that the gearbox — or the output shaft and output gearing — needs to take because normally the wheel is not supported by additional bearings. The gearbox is responsible for taking the radial load, and to solve that, we chose a special output bearing concept that are double-inclined roller bearings. These special bearings in that position allow for very high radial force, especially in combination with the wheels that we offer. The rim shape of that wheel is something we developed that helps increase the load capacity of the gearbox.

The reason for that is because, with that wheel, the load application point is moving in the middle between both of these inclined roller bearings, and then you have almost no tilting moment on the bearing, and if you don’t have tilting moment on the bearing, you can put maximum radial load on it. In other words, we have that wheel, but it’s not mandatory to use that wheel.

Another unique selling point is that we offer dedicated gearboxes from batch size one. All our gearboxes are available in batch size one within a two-week delivery time. That helps smaller companies to do business with us.

But, if they need prototypes just for tests, we can deliver them pretty easy. But if a company makes very special AGVs with smaller quantities or for other companies who need to order, say 100 or 200 gearboxes, then we can offer that from batch size one and in a very short period of time.

Are there any other points you’d like to make about the AGV market using this particular gearbox?
The AGV market is an interesting market because it is growing rapidly. All logistics are growing with the internet sales and getting more efficient. This also fires up the re-order demand to AGVs for easy, fast, and very flexible logistics solutions. In the past, we had a lot of requests from AGV manufacturers already, and we solved them; we delivered them; we served them with customized gearboxes, which is still a huge business for us. We learned a lot from that. So we went from that to making a standard gearbox, which, as I mentioned, we can now offer from batch size one.

In addition, we also offer the market drawings, technical data, and 3D data within a couple of minutes. We have a helpful digital tool that helps to specify the gearbox. It’s not only about size, but it’s also about getting the motor connected. Often you need a special motor adapter, and we have a database for that tool. It is called “Tec Data Finder.” You can see it on our homepage. It’s free for everybody, and we have about 15,000 different motors in that database. You can choose whatever motor you want and specify the gearbox, and then within a couple of minutes, you get 3D technical data and drawings of the gearbox. It is for the AGV manufacturer or the engineers who design AGVs. It’s a very comfortable and fast way to get information.

What overall makes the NGV gearbox ideal for this AGV vehicle?
It’s compact and space-saving. It has, for its size, a really high load capacity because we use a well-known, well-proven technology. It is very reliable and maintenance free over its lifetime and it is available in a short period of time.
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