

Power Transmission Engineering®

OCTOBER 2021

AEROSPACE AND DEFENSE

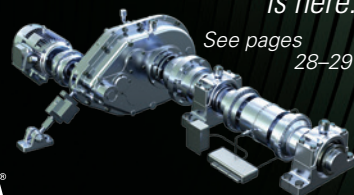
CLEAN SKY PROGRAM
LINEAR MOTION APPLICATIONS

IMPORTANCE OF
OIL ANALYSIS

COUPLING A
MOTOR TO A LOAD

*The promise
of end-to-end,
optimized
industrial powertrains
is here.*

*See pages
28-29*



REGAL®

Creating a better tomorrow™...

www.powertransmission.com



The best protection you may never need



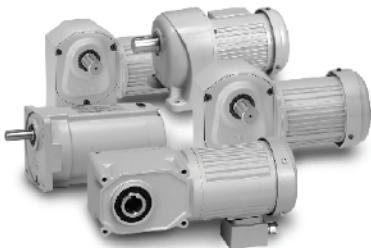
Brother Gearmotor makes such an outstanding product that they offer a 5-year limited warranty...we've never had to use the warranty.

RYAN MILLER,

Owner and Engineer Manager
Southeastern Technology Automation



Brother leads the way, by shielding its entire line of standard gearmotors with the industry's best warranty. No matter how far the journey or how rough the path, rest assured you've got the protection you need right "at your side."



Call us today for a sample gearmotor to try out.

brother
at your side

866.523.6283
BrotherGearmotors.com

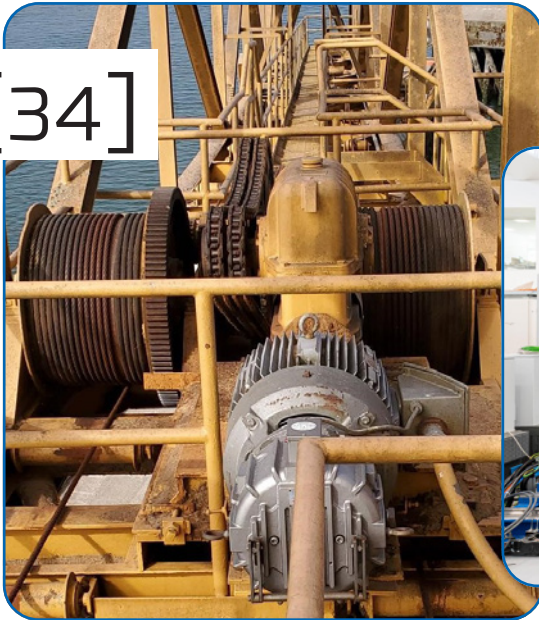
Power Transmission Engineering®

OCTOBER 2021



A Publication of
The American Gear
Manufacturers Association

[34]



[20]



FEATURE ARTICLES

- [20] **Bright Skies, Big Opportunities**
Clean Sky Project in Europe focuses on reimagining the aerospace ecosystem.
- [26] **The Importance of Oil Analysis**
Lubrication management is crucial to developing a successful preventive maintenance program.
- [34] **Oil Shear Brakes Speed Loading of Oceangoing Vessels**
While “applying the brakes” generally means slowing down, applying the right brakes can transform an equipment fix into a decade of reliable service and support.

TECHNICAL ARTICLES

- [40] **Coupling a motor to a load**
With so many load types and motor types, there are many ways to couple a motor to a load.
- [44] **In the Fast Lane with the FVA-Workbench**
Cutting-Edge gearbox design software.
- [46] **Linear Motion Components Take Flight in Aerospace and Defense Industry**
Key advantages of linear motion components in aerospace applications.

Stay Connected



Follow us on Twitter
twitter.com/#!/PowerTransMag



Connect with us on LinkedIn
www.linkedin.com/groups/Power-Transmission-Engineering-PTE-2950055



Subscribe Online
www.powertransmission.com/subscribe.htm

Vol. 15, No. 7. POWER TRANSMISSION ENGINEERING (ISSN 2331-2483) is published monthly except in January, May, July and November by The American Gear Manufacturers Association, 1840 Jarvis Ave., Elk Grove Village, IL 60007, (847) 437-6604. Cover price \$7.00. U.S. Periodicals Postage Paid at Elk Grove Village IL and at additional mailing offices. Send address changes to POWER TRANSMISSION ENGINEERING, 1840 Jarvis Ave., Elk Grove Village, IL 60007.

The American Gear Manufacturers Association makes every effort to ensure that the processes described in POWER TRANSMISSION ENGINEERING conform to sound engineering practice. Neither the authors nor the publisher can be held responsible for injuries sustained while following the procedures described. Postmaster: Send address changes to POWER TRANSMISSION ENGINEERING, 1840 Jarvis Avenue, Elk Grove Village, IL, 60007. ©2021 Contents copyrighted by THE AMERICAN GEAR MANUFACTURERS ASSOCIATION. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without permission in writing from the publisher. Contents of ads are subject to Publisher's approval.

FIND OUT MORE NOW AT:
WWW.NEUGART.COM/EN-US




POWERFUL SOLUTIONS FOR RACK AND PINION DRIVES.

Planetary gearboxes with mounted pinion

A gearbox/pinion combination developed from a single source is the guarantee of ideal technical coordination for your rack and pinion drive.

CONTACT:
Neugart USA Corp. | 14325 South Lakes Drive
Charlotte, NC 28273 | USA
Phone: +1 980 299-9800 | sales@neugartusa.com



BEYTA GEAR SERVICE 

PUTTING A LIFETIME OF GEAR DESIGN EXPERIENCE TO WORK FOR YOU



- Reverse engineering
- Gearbox upgrades
- Custom gearbox design
- Specification development
- Project management
- Vendor qualification
- Design reviews
- Bid evaluations
- Tooling design
- Customized gear training
- Equipment evaluation
- Custom machine design

Charles D. Schultz
chuck@beytagear.com
[630] 209-1652

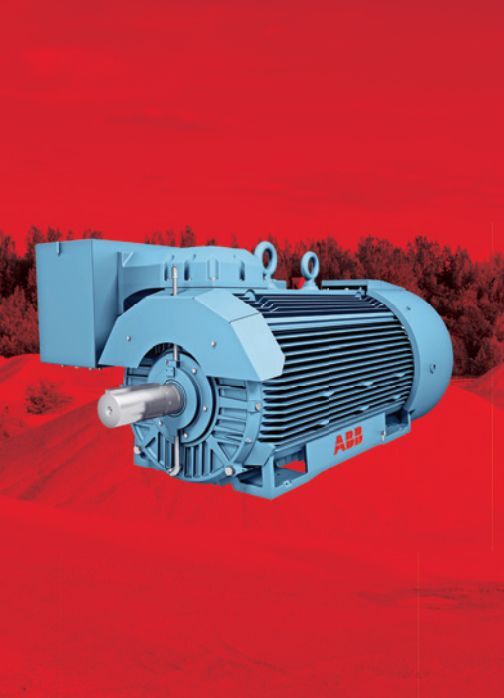
www.beytagear.com

Power Transmission Engineering

VOL. 15, NO. 7

- [04] **PTEExtras**
PTE Videos: SKF Condition Monitoring for Railways; Clean Sky Update; **Rexnord Aerospace** – Bearing Installation and Removal
- [06] **Publisher's Page**
Coming Together
- [08] **Voices**
Establishing MPT Expo as the platform of choice for both buyers and sellers
- [10] **Product News**
Romax Technology connects with VCollab System; **Miki Pulley** offers micro brakes; **NORD** offers drive solutions for intralogistics and warehousing; **Thomson Linear** ball screws drive optimization for 5G fiber optic filament production; **KISSsoft** examines gear strength calculation with load collectives; **Heidenhain** offers latest CNC control technology, and other news
- [30] **Engineering Showcase**
The inside stories from leading suppliers.
- [38] **Engineering sMART**
Products and services marketplace.
- [49] **Industry News**
Schaeffler Launches SHARE Program in North America; **Bonfiglioli** Celebrates 40 Years in the UK; **STLE** Announces Free Podcast Series; **Formic Technologies** Offers Robotics-as-a-Service, and more.
- [54] **Advertiser Index**
Contact information for every advertiser in this issue.
- [55] **Subscriptions**
Renew your free subscription today.
- [56] **Power Play**
Adapting Aerodynamics: Northwestern University Introduces Smallest





Designed in North America for use in North America

Buying low and medium voltage motors has never been easier.

ABB's NXR 5000 and 5800 frame general purpose motors, specifically designed for the North American market, combine cost-effective standardized designs and short lead times with safety, productivity, energy efficiency and reliability.

Our new modified-to-order capability in Athens, Georgia, allows stocked motors to be modified to meet your non-standard needs.

- Application-specific solutions
- More power per pound
- Easy to install

PTE Videos

SKF Condition Monitoring for Railways

Condition monitoring can help you reduce the number of unplanned stops, stretch your maintenance intervals, and lower maintenance costs.

But how does it work?

Condition monitoring of rotating parts is like monitoring of your heart.

Like a heart, every rotating part has its own unique heartbeat, expressed as a vibration pattern. By monitoring changes in that vibration pattern, it is possible to detect early symptoms of damage. Every

rotating component in a bogie system also has its own, unique vibration pattern: the traction motor, gearbox, wheels, and wheelset bearings.

www.powertransmission.com/videos/SKF-Condition-Monitoring-for-Railways/



Clean Sky Update

Executive Director Axel Krein discusses the current challenges facing the aviation sector and the ambitious goals of Clean Sky 2 and the upcoming European Clean Aviation partnership. Learn more about the Clean Sky Initiative on page 20 and listen to this recent program update from September 2021:

www.powertransmission.com/videos/Clean-Sky-Update/

Rexnord Aerospace - Bearing Installation and Removal

Learn about the company's complete installation, swaging and bearing removal offerings at the link below:

www.powertransmission.com/videos/Rexnord-Aerospace:-Bearing-Installation-and-Removal/



Power Transmission Engineering



AGMA MEDIA
1840 Jarvis Avenue
Elk Grove Village, IL 60007
Phone: (847) 437-6604
Fax: (847) 437-6618

EDITORIAL

Publisher & Editor-in-Chief

Randy Stott
stott@agma.org

Senior Editor

Jack McGuinn
mcguinn@agma.org

Senior Editor

Matthew Jaster
jaster@agma.org

ART

Art Director

David Ropinski
ropinski@agma.org

ADVERTISING

Advertising Sales Manager

& Associate Publisher
Dave Friedman
friedman@agma.org

Materials Coordinator

Dorothy Fiandaca
fiandaca@agma.org

CIRCULATION

Circulation Manager

Carol Tratar
tratar@agma.org

ACCOUNTING

Luann Harrold
harrold@agma.org

MANAGEMENT

President

Matthew Croson
croson@agma.org

FOUNDER

Michael Goldstein founded Gear Technology in 1984 and Power Transmission Engineering in 2007, and he served as Publisher and Editor-in-Chief from 1984 through 2019. Michael continues working with both magazines in a consulting role and can be reached via e-mail at michael@garttechnology.com.



*YOU USE IT TO ORDER
KUNG PAO SHRIMP.*



**Now your phone can do something
even more useful and awesome.**

Introducing the Make Power Smart app. All the tools you need to manage your drive systems are right at your fingertips. Check for proper tension. Take a pic. Data, analysis and performance. It's all here, making the app the smart way to replace manual work. That's food for thought.

Get the Power



Coming Together



The American Gear Manufacturers Association recently held our biennial trade show, the Motion+Power Technology Expo.

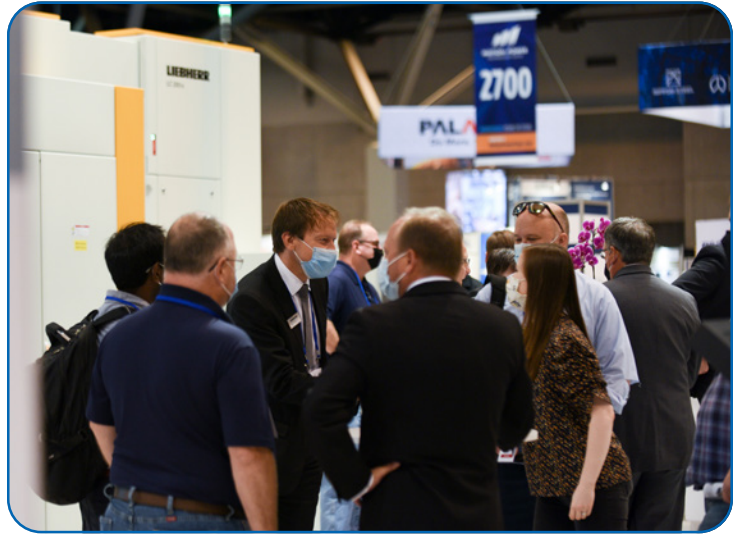
Although it was a smaller, quieter show than normal, it was well worthwhile for those who were able to make it.

And although you couldn't really say there were crowds at MPT Expo, there were times when certain booths were, in fact, crowded – particularly among some of the larger suppliers of gear manufacturing equipment.

We heard from many exhibitors who told us they'd gotten solid leads at the show. One gear manufacturing exhibitor told me about a visitor who walked up to his booth with a briefcase full of part prints and tales of his supply chain woes. He was looking for a new gear supplier. As it turned out, the parts were a perfect fit for this manufacturer, and the exhibitor was hopeful about the new business that might be coming.

That exhibitor wasn't alone, either. We heard similar tales from others at the show. Even though it was a small event, it was still worthwhile. If you're sitting at home thinking you missed out, you're probably right. You should have been there. You probably could have solved some of your own supply chain woes.

For those of you who couldn't make it, we're here to help. While at the show, we recorded a number of videos featuring the companies and technologies that were presented. You'll be able to experience some parts of the show by tuning in to *Gear Technology TV* and *Power Transmission Engineering TV* on our websites. You'll see video interviews with exhibitors and explanations of some of the latest technology.



The best way to make sure you see those videos is by going to www.powertransmission.com/tv/ or www.geartechnology.com/tv/. Of course, if you've subscribed to our newsletter, we'll be highlighting some of these videos over the coming months. If you haven't subscribed, you can sign up at www.powertransmission.com/subscribe.htm.

These days, everybody's supply chain is backed up, and everybody is looking for solutions. MPT Expo was just one place where you could have found them. Fortunately, there are others. One of those is the *Power Transmission Engineering Buyer's Guide*. Our annual printed directory comes out in December, so there's still time to get listed if your company is a supplier of gears, gear drives, bearings, motors, clutches, couplings or other mechanical power transmission components or related supplies and services. All you have to do is go to www.powertransmission.com/getlisted.php and fill out the form to be sure your company will be included in the printed Buyer's Guide. Plus, that way you're also automatically included in the *online* buyers guide that is the most comprehensive directory of suppliers in our industry.



Randy Stott



90 MISSILES

330 SAILORS

1,100 MILES OUT
TO SEA

**ZERO
ROOM
FOR GEAR
DRIVE
FAILURE.**



Whether it's the frontline combat fleet of the U.S. Navy or your own gear drive operation needs, Philadelphia Gear delivers mission-critical performance and reliable, responsive support.

With unmatched expertise that's on call 24/7, plus complete warranty coverage on workmanship and material for any gear drive we service, including those from other manufacturers, we've set the standard in dependability — on land and at sea — for more than 125 years.

Keep your mission moving.

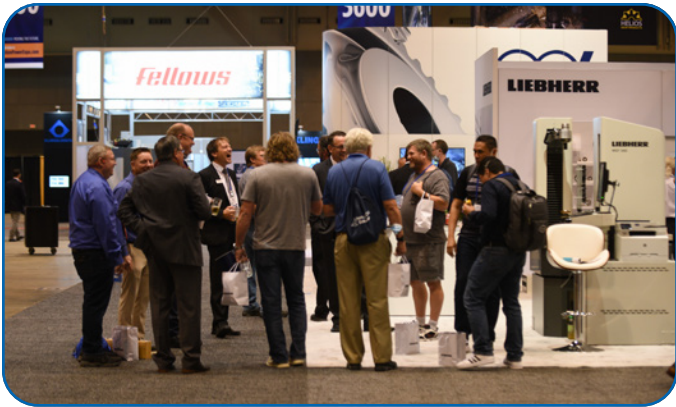
Visit [PhilaGear.com/MyMission](https://www.philagear.com/MyMission) to learn more.

MPT EXPO 2021: Moving Industry Forward in Tough Times

Steve Janke, Chair, AGMA Trade Show Advisory Committee
President, Brellie Gear Company Inc.

On behalf of the AGMA Board of Directors, Show Committee and our 123 exhibiting companies—thank you for supporting Motion + Power Technology Expo 2021 (MPT Expo).

We all know this event was not the show we expected, in terms of attendance. There will not be any glowing press release about crowded aisles, overly busy booths, and long days and nights spent with customers. Combined, Heat Treat and MPT Expo drew over 2,000 total attendees—down from our normal 6,500. Those are the facts.



On the other hand—what has always made our show stand apart from other larger shows is attendee quality. One major benefit of MPT Expo is that no one comes to this show by accident. If you aren't focused on gear technology—you don't show up and roam the hall, kicking tires or looking for free food and giveaways.

Even with the decrease in attendance, it was important to hold MPT Expo this year to begin to get back to normal even in the face of the ongoing pandemic, supply chain challenges and other factors making 2021 an abnormal year. I am proud to see the resiliency of our industry and I know that it really only takes one or two QUALITY leads to make MPT Expo a success for most of our exhibitors—and even this year, MPT Expo was able to provide that connection between buyers and sellers.

As a long-time supporter of Gear Expo, and as the Chair of AGMA's Show Committee, I can live with that fact—furthermore, that's the way I like it! Small, 100% focused on power transmission innovation, and affordable for both the big multinationals, and small family-owned open gear shops, like mine—Brellie Gear.

I know many companies managed their expectations, rationalized their spend—and of course, many cancelled due to COVID. But for the leaders that showed up, spent their money wisely, and focused their time on delivering value to

their customers—I am confident the show will have a strong return on investment.

That is AGMA's goal—always has been, and always will be.

- For MPT EXPO 2023 - we have already started to deliver on that goal through the following ways:
- For MPT Expo 2021 Exhibitors - we offered a \$21 for 2021 special per square foot rate if you signed up during the show. I am pleased to report that we had a 99% renewal rate for the show and are already larger than the 2021 event.
- For MPT Expo 2021 Exhibitors - who signed up, then cancelled due to COVID, we will be offering a special early bird registration through November 30.



We are expanding our Solutions Center offerings in 2023, and will work with speakers who sign up to ensure their on-site presence also includes a digital presence on *geartechnology.com*, *powertransmission.com* or both websites.

AGMA and the Trade Show Committee are also spending the next six months considering how MPT Expo supports the industry. We will be focusing on all aspects of the show—what's working and what isn't along with location, exhibitor make up, partnerships, and what changes to marketing have occurred post-COVID—such that MPT Expo needs to adjust.

AGMA will also spend time discussing how to bring the next generation of buyers to MPT Expo.

None of these challenges is easy to solve, nor will there be a silver bullet to “fix” anything that needs fixing. I am certain not every direction we take will be supported by 100% of our industry. That is also why it is so important to be involved at the committee level. AGMA makes a difference in bringing the industry together, and if you want a say in the direction the show is headed, I encourage you to support the efforts and join in and grab a seat at the table. Share your opinion, your expert knowledge and join your peers to mold the future of MPT Expo.

My message to the entire industry—our machine tool innovators, our materials suppliers, our open and closed gear system providers—EVERYONE—is this: AGMA and its members drive power transmission innovation—and we want MPT Expo to be the platform of choice for both buyers and sellers.

Again—thank you for your support of MPT Expo—I look forward to seeing you in Detroit in 2023. **PTE**

We deliver precision gears, high-quality machined parts, and molded components for thousands of applications.

- Prototype
- High-Volume Production
- Custom Design
- Engineering Support
- Precision Manufacturing
- Assembly



ISO 9001:2015 | AS9100D
ITAR Compliant - DDTC Registered
DFARS Compliant
NIST SP 800-171 Compliant

CNC Swiss Turning | CNC Milling & Turning | Gear Cutting | Bevel Gear Cutting
Rapid Tooth Cutting Only Capability



As an online engineering resource, SDP/SI provides:
Engineered Mechanical Solutions
Design Tools and Calculations
Product Specifications
3D CAD Models

Shop with us 24/7
87,000 Component Choices
Gears, Timing Belts, Pulleys, Couplings, and More

SDP/SI looks forward to working with you!
Send an RFQ – we can quote from a
3D model or drawing

For Metric Gears or Bearings, Check into our sister companies:



Supplying North America
with Metric Gears

<https://qtcgears.com>



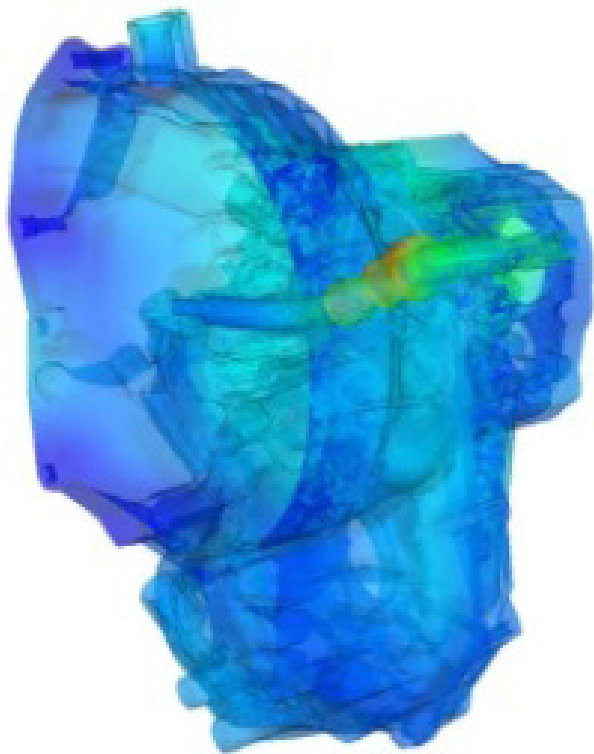
The Bearing Marketplace

<https://qbcbearings.com>

Romax Technology

CONNECTS WITH VCOLLAB SYSTEM

The Romax product suite now connects with the VCollab Computer Aided Engineering (CAE) reporting system to capture multi-physics product engineering analyses in 3D Digital Reports, helping transmission and powertrain engineering teams collaborate efficiently with any team member, supplier or customer through a web browser.



Electrification is driving the need for increased use of simulation earlier in the transmission design lifecycle, bringing together all the physics areas that can improve power density. The Romax product suite combines more than 30 years of experience in electromechanical simulation in an integrated, cloud-enabled MBSE (model-based systems engineering) workflow so engineering teams can design, simulate and deliver energy efficient power transmission systems for eMobility, renewable energy and aerospace. But since bringing a new transmission to market always requires the use of several simulation tools, an ability to integrate these different applications together, and in particular to share and present results from the various tools, is essential.

The Romax ecosystem is the result of more than 100 partnerships with high quality software tools that help customers break down barriers and achieve better results, faster. One recent addition is VCollab, a partnership which will help Romax users to share actionable simulation insights with business and technical stakeholders across the enterprise to aid in the review and understanding of CAE results while simultaneously improving the productivity of their analysts. It does this by automating the processing and reporting of

analysis results through 3D Digital CAE Reports.

VCollab can now process key NVH results directly from the Romax product suite, presenting information in its 3D Digital Reports so that the results can be easily shared with team members that don't have access to a given tool. The interactive reports can be shared in a portable html-based format that any supplier or customer can open and review, reducing bottlenecks and helping more collaborative and engaging product development workflows from concept to sourcing and engineering project delivery.

Chris Baker, head of system dynamics, Hexagon's Manufacturing Intelligence division commented: "As development timescales are compressed and efficient cross-functional engineering and supply chain collaboration becomes critical, we are always looking for ways to improve our customers' processes and maximize their return on their Romax investments. VCollab provides one such solution. It can be deployed quickly and easily and can be used as a unifying post-processor to present multiple physics, calculated with multiple tools, in one report. Democratizing this information with VCollab's 3D digital reports can help transform traditional 2D collaborative workflows to bring better and more innovative products to market faster."

Prasad Mandava, CEO, VCollab commented: "VCollab is excited to announce our new support of the Romax product suite. By combining the power of Romax with many other solvers, VCollab's unique 3D digital CAE reporting is helping companies to streamline the way they process and share simulation results with product design stakeholders."

This collaboration is the first step for VCollab with Romax products, with further functionality planned in the near future.

www.romaxtech.com

Miki Pulley

OFFERS MICRO BRAKES

Fast braking response in small, precision torque applications are the primary benefit of Miki Pulley Micro Brakes. Where high performance braking for small motion control applications are required, these Micro Brakes provide the solution.

Miki Pulley's ultra-compact brake design features a stator with integrated mounting flange, proprietary composite



**WE'VE BEEN SOLVING
INDUSTRY'S TOUGHEST
LUBRICATION PROBLEMS
FOR OVER 150 YEARS...**

Roger Thostenson
Lubriplate District Manager
OK, AR, Northern TX & MS



**WHAT CAN WE
DO FOR YOU?**

Lubriplate®

WE ARE HERE TO HELP

Lubriplate has been helping industry meet its lubrication needs for more than 150 years. In that time, we have learned what works and what doesn't. Put our experience and knowledge to work for you.

WE HAVE THE PRODUCTS

Lubriplate offers a full range of ultra high-performance synthetic and petroleum-based lubricants that have been engineered from the ground up to provide a number of cost saving benefits including; extended lubrication intervals, reduced friction, multiple application capability and lubricant inventory consolidation.

WE HAVE THE SERVICES

Lubriplate offers its Complimentary ESP Extra Services Package to all of its customers at no additional charge. Services include; Complete Plant Surveys to help determine your exact lubrication needs, Color Coded Lube Charts and Machinery Tags which simplify maintenance procedures, Lubrication Training Programs and Follow-Up Oil Analysis.

Call 800-733-4755 to get started.



**Lubriplate®
Lubricants**

INCLUDED AT NO ADDITIONAL CHARGE



Complimentary Extra Services Package

**COLOR CODED LUBE CHARTS & MACHINERY TAGS
PLANT SURVEYS / TECH SUPPORT / TRAINING
LUBRICATION SOFTWARE / FOLLOW-UP OIL ANALYSIS**

Newark, NJ 07105 / Toledo, OH 43605 / 800-733-4755
To learn more visit us at: www.lubriplate.com



friction liner and armature complete with ring plate spring and hub. Field proven, these Miki Pulley Micro Brakes halt rotation mechanically by utilizing an electro-magnetic field to connect friction surfaces, thus creating mechanical resistance. With fast response, the brake's armature engages the stator when the coil is energized. A constant-force plate spring transfers torque to the rotating brake body halting all motion.

Additional features include: quiet operation, high holding torque for its size, space saving design configuration, long service life, stable and reliable braking power. Easily installed, these Miki Pulley Micro Brakes require no maintenance. They are available in three armature assembly options depending on application requirements.

Typical applications include: ATM's, office copiers, weighing and packaging equipment, optical mechanisms, paper binding mechanisms and many others.

www.mikipulley-us.com

NORD

OFFERS DRIVE SOLUTIONS FOR INTRALOGISTICS AND WAREHOUSING

NORD's innovative drive solutions are designed to meet the demands of the intralogistics and warehousing industries. Their high efficiency gear units, motors, and VFDs work in unison to transport items quickly with precise control and lower energy consumption. Regardless of the application, all



NORD solutions focus on three core areas: energy efficiency, reliability, and safety. They are engineered to lower Total Cost of Ownership, reduce the number of system variants, and reduce overall maintenance time and costs.

Conveyors are essential to intralogistics and supply chain operations. NORD components assist in transporting from start to finish and can handle anything from light packing units to heavy loads and industrial containers. Their full-featured drive solutions are based on a modular concept that allows incredible flexibility without the need for costly custom components and each gear unit is selected to integrate into the specific system requirements provided by the customer.

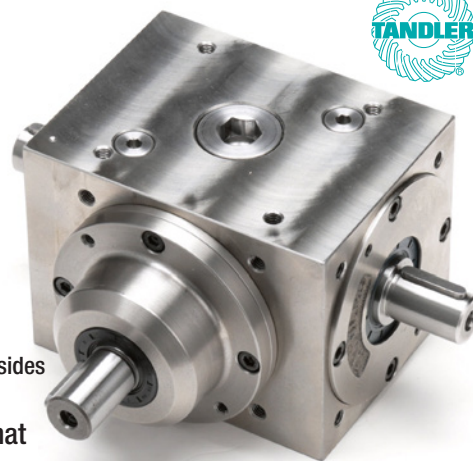
Did you mean: **DieQua Corporation?**

The search is over!

For quality spiral bevel gearboxes that provide improved performance, high reliability and easy maintenance, look no further than DieQua.



- 9 sizes
- 15 ratios
- Power capacities from 1-300 HP
- Low Backlash
- Customizable
- Mounting on all 6 sides



To finally find what you're looking for, check us out on the web, or give us a call.

diequa.com/pte 800-363-2145

DIEQUA
Corporation

NORD offers over 20,000,000 standard drive configurations that have multiple mounting and shaft designs, extensive input options, environmental protection options, and more.

NORD's primary products for Intralogistics include:

LogiDrive Complete Drive Solution—LogiDrive is an energy-efficient, maintenance-friendly solution consisting of an efficient gearbox, IE4/IE5+ permanent magnet synchronous motor (PMSM), and a decentralized variable frequency drive. Gear unit standardization and spare part reduction are easily achieved without sacrificing your ability to obtain modular replacements. Variable frequency drives and IE4/IE5+ motors provide constant torque over large speed ranges through a single gear unit/motor combination. In addition, Plug-&Play decentralized technology makes installation and maintenance a breeze. The LogiDrive system also maintains operational efficiency at partial load and low speeds, making it the ideal solution for the ever-changing demands of intralogistics systems.

Condition Monitoring for Predictive Maintenance—The Industrial Internet of Things (IIoT) is ushering in a new era that focuses on the acquisition and accessibility of data from intelligent, connected devices to increase operational efficiency, reduce costs, and accelerate processes. With condition monitoring, drive and status data are recorded periodically or continuously to optimize the operational safety and efficiency of machines and plants. Condition monitoring provides valuable information for predictive maintenance to proactively maintain machines and plant facilities, reduce

downtime, and increase the efficiency of the entire plant.

NORCON APP with NORDAC ACCESS BT—The NORCON APP and corresponding Bluetooth stick “NORDAC ACCESS BT” is a mobile commissioning and service solution for all NORD drives. The app and Bluetooth stick work together to offer a wireless solution that assists with commissioning, drive optimization, and service requests, including management of extension units. With this system, maintenance can be simplified, enabling issues to be resolved quickly to reduce costly downtime. The NORCON app also has a dashboard-style interface that is useful for drive monitoring and fault diagnosis. Parametrization of drives is easy via a Help function and rapid access to parameters. The app also offers other convenient functions such as backup, recovery, and an oscilloscope function for drive analysis.

www.nord.com

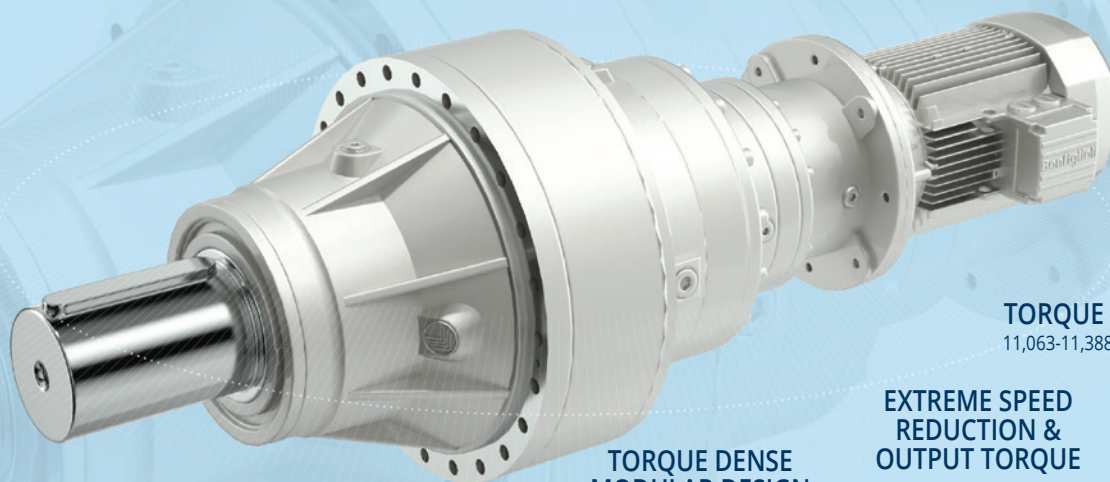
Thomson Linear

BALL SCREWS DRIVE OPTIMIZATION FOR 5G FIBER OPTIC FILAMENT PRODUCTION

Fundamental ball screw technology hasn't changed much since 1929 when Rudolph G. Boehm patented what he called an “anti-friction” nut. The ability to move heavy loads smoothly and precisely is a key process which continues to enable engineering innovation today. Nowhere is this more evident than in the production of fiber optic filaments, where ball screws are helping manufacturers meet the growing de-

INDUSTRIAL PLANETARY GEARMOTORS

Discover the 300 Series



TORQUE RANGE
11,063-11,388,254 in-lbs

EXTREME SPEED
REDUCTION &
OUTPUT TORQUE

TORQUE DENSE
MODULAR DESIGN



 **Bonfiglioli**

Buy Now at Shop.Bonfiglioli.com

mand for fiber optic cables generated by 5G communications.

Delivering Fiber Optic Strands for 5G Communications

Wireless carriers are just beginning to roll out 5G communications, but expectations with even the most conservative estimates are projecting at least a 10-fold speed increase over 4G. This will impact everything from cell phones and laptops to driverless cars. The realization of 5G communications is boosting the demand for high-bandwidth fiber optic cable, which requires continuous improvement in the fiber optic manufacturing process. This begins with the creation of highly treated, multilayered silicon rods called preforms. These provide the silicon that will eventually be drawn into filaments approximately the width of a human hair and joined with hundreds of similar strands to produce the fiber optic transmission cables that will carry the 5G signals.

To start the conversion of the

preform into a single strand, a technician climbs to the top of a drawing tower and loads it into a feed mechanism that will lower it into a high-temperature furnace. Once the preform

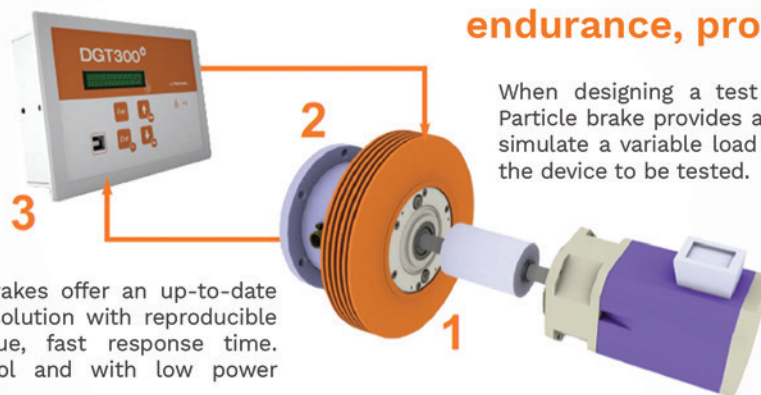


arrives at the heating element, gravity takes over, and the molten silicon drips and narrows to its intended diameter. As it cools and hardens, the filament passes through a laser micrometer to assure 99 percent width consistency. It is then pulled onto a take-up spool that will gather as much as 10 kilometers of filament before transfer to a fabricator for incorporation into the final cable.

Critical to the success of the process is the control over the speed with which the system feeds the preform. Due to the thin nature of the fiber, slow and steady movement of the feed unit (one meter per hour) ensures that the production is stable. Any faster than that, and the furnace will be unable to melt the preform fast enough. Anything slower will break the continuity of the stream. Many of the world's leading fiber optic wire producers accomplish this with ball screw technology, which provides high stability and smooth movement at such low speeds.

LOAD SIMULATION FOR TEST BENCHES

Characterization, design validation, endurance, production, etc.



When designing a test bench, the Merobel® Particle brake provides an excellent solution to simulate a variable load (resistance torque) on the device to be tested.

Merobel® Particle brakes offer an up-to-date and cost effective solution with reproducible and accurate torque, fast response time. Easy remote control and with low power consumption.

Feel free to contact us to learn more about our comprehensive solutions for test bench applications.

ANDANTEX USA Inc.

andantex.com
info@andantex.com
Phone: 732-493-2812

Selecting Ball Screws for Fiber Optic Drawing Towers

In a typical ball screw configuration, the feed mechanism anchors to the ball screw nut with a rod. The nut rides down the vertically oriented ball screw, carrying the preform feed mechanism with it toward the heating unit. Requisite travel distance from the top of the drawing tower to the furnace is 6-8 meters, which requires a long screw.

To optimize production of fiber optic cable, three important factors must be taken into account:

Pitch diameter. Speed control and efficiency are impacted by pitch. Standard dimensions such as 50 x 10 mm, 63 x 10 mm and 80 x 10 mm are ideal to ensure slow and steady fiber optic filament production.

Long strokes. Travel length of the preform from insertion to heating the element is about six meters. It is best to do this with only a ball screw, which requires shafts of up to eight meters long.

Diameter. The diameter of the screw is also a factor in the robustness, operation, stability and durability of the motion. Diameters of 50, 63 and 80 mm are best to avoid screw bend due to the long stroke.

Driving Next-Generation Communications

Automated production of fiber optic cable is just one way that ball screws are enabling a new generation of communications technology. Thomson Industries, for example, has customers using ball screws on the doors of furnaces used to process sapphire for mobile phone screen protectors and feeding electrodes to winding machines for lithium batteries that will be used in electric cars.

Although the fundamentals are the same, ball screw technology continues to advance in flexibility and applicability. Companies such as Thomson are supporting even more advanced innovation in other industries by consistently pushing the envelope in heavy load handling, stroke lengths, compactness and onboard intelligence, which will provide the motion control needed to support the emergence of 5G and future generations as well.

www.thomsonlinear.com

KISSsoft

EXAMINES GEAR STRENGTH CALCULATION WITH LOAD COLLECTIVES

Load spectra can be derived from time series - a measured time-torque-speed curve or one derived from simulations. For time series with only positive torque, the "Simple Count" method is used to obtain a load spectrum with torque-speed bins. The refinement of the resolution in load spectrum bins (grid) can be specified.

The procedure is more complicated

for time series with positive and negative torques since the tooth root is then subjected to alternating loads. First, the "Rainflow" method is used to find all significant torque changes over time. A load spectrum, which also contains alternating bending factors YM, is then derived from the resulting Rainflow triangular matrix. In addition to extended reports on the calculation



YOU CAN DEPEND ON WORLDWIDE ELECTRIC

Quality, Affordable Motors, Controls, and Gear Reducers
for Demanding Industries and Applications



WorldWide Electric is a leading manufacturer of quality, affordable electric motors, motor controls, and gear reducers and an exclusive master distributor of **Hyundai Electric** low-voltage motors and drives. Offering fast, often same-day, shipping from 6 regional warehouses, WorldWide Electric is committed to exceeding your expectations on product availability, value, and speed & quality of service.

Call us or visit us online!

(800) 808-2131 / worldwideelectric.net



Superior Customer Support

Driven to provide the best possible customer experience



Proven Quality & Affordability

Premium motors, controls, & gear reducers at competitive prices



In Stock When You Need It

\$50M in inventory stocked at 6 regional warehouses

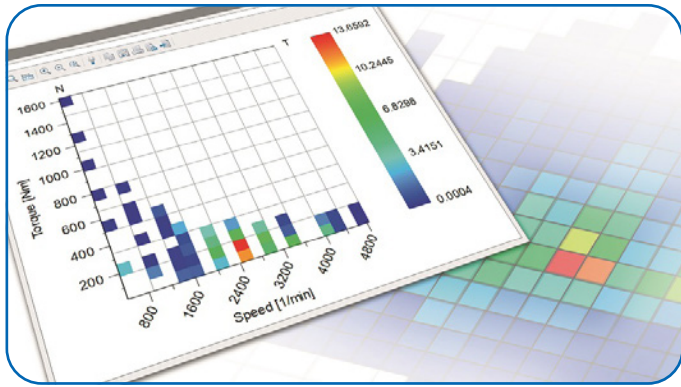


Same-Day Shipping Available

Most orders placed before 2PM local warehouse time can ship same-day

WorldWide Electric Corporation | 3540 Winton Place, Rochester, NY 14623

Distribution Centers located in Allentown, PA | Atlanta, GA | Dallas, TX | Indianapolis, IN | Los Angeles, CA | Seattle, WA



details, graphical displays are now available in matrix form for torque and speed distribution with frequency. The same display can also be used for the direct input of load spectra. The evaluation and control of the collective are thus much clearer.

Dr. Ulrich Kissling will give an (online) presentation (in English) on “Use of duty cycles or measured torque-time data with AGMA ratings” at this year’s AGMA [Fall Technical Meeting](#) (Nov 1–3, 2021) in the United States.

www.kissoft.com

KHK

ANNOUNCES LINE OF METRIC HELICAL GEARS

KHK USA Inc., distributor of the market leading KHK brand of metric gears, announces its extensive line of helical gears, manufactured to the highest quality standards by Kohara Gear Industry Co., of Japan. KHK’s large selection of stock helical gears are suitable wherever high-speed rotation is required, including in machine tools, speed reducers and other industrial machinery.

Helical gears are cylindrical disks which have involute-shaped teeth cut into their face at a helix angle. By slanting the teeth, helical gears can obtain a large contact ratio and



the gradual change to the contact surface load which give helical gears their characteristic of smooth transmission of rotation. Consequently, compared to spur gears, helical gears generate less vibration and noise and perform better in high-speed rotation and high-load applications.

Two categories of KHK helical gears are available. Ground Helical Gears (KHG) feature exceptional strength and wear resistance that allow designs to be more compact. KHG ground helical gears use a “transverse” module. The assembly distance is the same as spur gear pairs with the same module and number of teeth, and therefore KHG ground helical gears are often used as drop-in replacements for spur gears to achieve all of the advantages of helical gears without the need to change the rest of the gear train.

KHK also offers Helical Gears (SH) that feature larger contact ratios compared to stainless steel spur gears. SH helical gears are very effective in reducing noise and vibration.

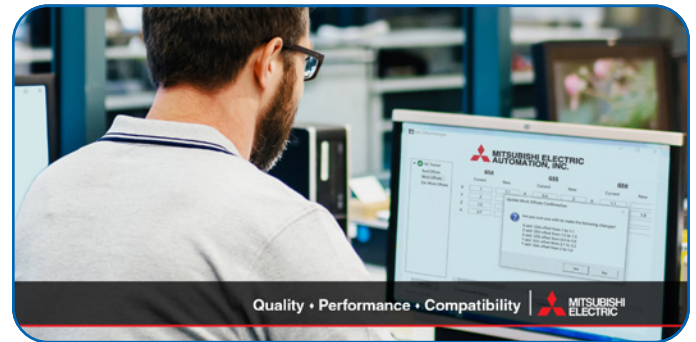
KHK helical gears are offered in alloy steel and carbon steel, with many configurations of modules and numbers of teeth.

www.khkgears.us/products/internal-gears/

Mitsubishi Electric

RELEASES CNC OFFSET MANAGER SOFTWARE

Mitsubishi Electric is announcing the release of its CNC Offset Manager software for remote modification of computerized numerical control (CNC) tool and work offsets. With the push towards automation and central control, machining facilities are searching for more efficient ways to manage their CNC machines. The software can introduce increased

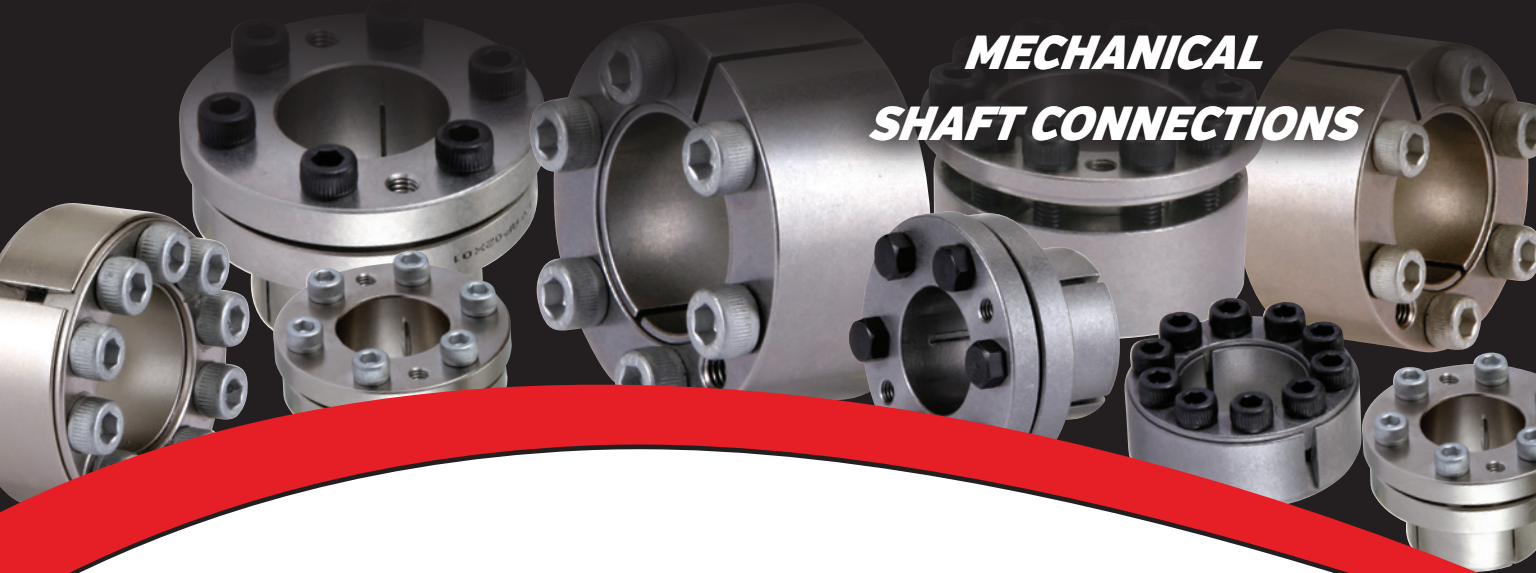


efficiency in multiple ways: for instance, it allows one operator to manage more machines, speeding up machine setup and tool wear changes, or adjusts for parts out of tolerance, as well as centralizing this work so operators don’t need to move between machines or into robot cells. CNC Offset Manager is thus geared towards production managers and supervisors on factory floors across various industries, as well as towards CNC automation software companies. CNC Offset Manager runs on Windows and is networked to the Mitsubishi Electric CNC via Ethernet. It also has a feature that allows other automation software or systems to interface with the CNC to fully automate the offset management process, or make the changes from a central cell-management software. This allows software companies to interface

HYDRAULIC SHAFT CONNECTIONS



MECHANICAL SHAFT CONNECTIONS



PRECISE. ROBUST. AVAILABLE.

Keyless Shaft Bushings

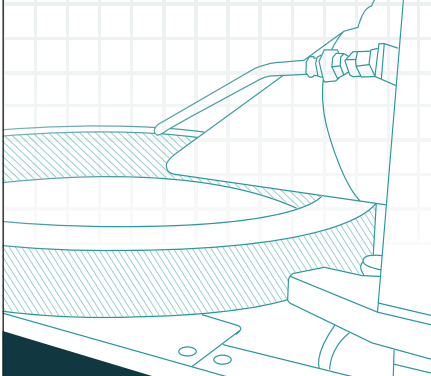
- Precise & Reliable Shaft Component Mounting
- Single-Screw Models for Fast & Frequent Use
- Steel, Nickel-Plated, and Stainless-Steel
- Variety of Mounting Styles Available
- English & Metric Sizes in Stock
- Engineering Assistance / **Fast** Delivery



www.zero-max.com 800.533.1731

ZERO-MAX

FORGING AHEAD OF THE PACK



MADE IN THE
USA

**Fast.
No Fine Print.
No Premium.**

At McInnes Rolled Rings, we provide quality products, shipped fast. And we partner that with exceptional customer service to forge the perfect partnership with our customers.

**McINNES
ROLLED RINGS**

1.877.736.4409

www.McInnesRolledRings.com

their software with Mitsubishi Electric CNC for automation and remote offset management, and allows manufacturers with CNC equipment to automate their machine-tending CNC cells and testing or measuring equipment, or centralize the offset management operation so operators and floor workers can work more efficiently.

“The release of CNC Offset Manager

is coming at a good time,” said Rob Brodecki, services product manager at Mitsubishi Electric Automation. “The ability to remotely modify CNC offsets will help our CNC end-users increase their productivity. We see its use becoming commonplace in factories that use our CNC equipment.”

us.mitsubishielectric.com/fa/en

Heidenhain

OFFERS LATEST CNC CONTROL TECHNOLOGY AT EASTEC AND SOUTHTEC

Heidenhain recently took part in both the EASTEC and SOUTHTEC machine tool trade shows. Heidenhain hosted booths to showcase CNC controls and more from multiple motion control component brands—including both ACU-RITE and Heidenhain.

The ACU-RITE MILLPWRG2 control is today’s easiest-to-operate CNC for vertical knee and bed mills. It is available with an optional AMI (auxiliary machine interface) offering users the ability to interface as well as control its host machine tool’s spindle. Full 3-D contouring is part of the MILLPWRG2’s capabilities. It is available as a complete retrofit package

for two- or three-axis knee or bed mills or on a new mill from a machine builder. It continues to provide machinists the convenience of straightforward 2½-axis conversational shop floor programming as well as powerful calculators, eliminating the need for time-consuming manual calculations and to learn complicated programs.

Heidenhain’s TNC 640 high performance mill-turn control is popular with users thanks to its workshop-oriented operational design. Its milling-turning, HSC and capability to do 5-axis machining on machines with up to 18 axes also makes it a popular control. The TNC 640 also utilizes



a groundbreaking touch technology that supplements its field-proven cycles and functions, allowing the user to operate the control screen with gestures, similar to smartphones or tablets.

www.acu-rite.com, www.heidenhain.us

GAM

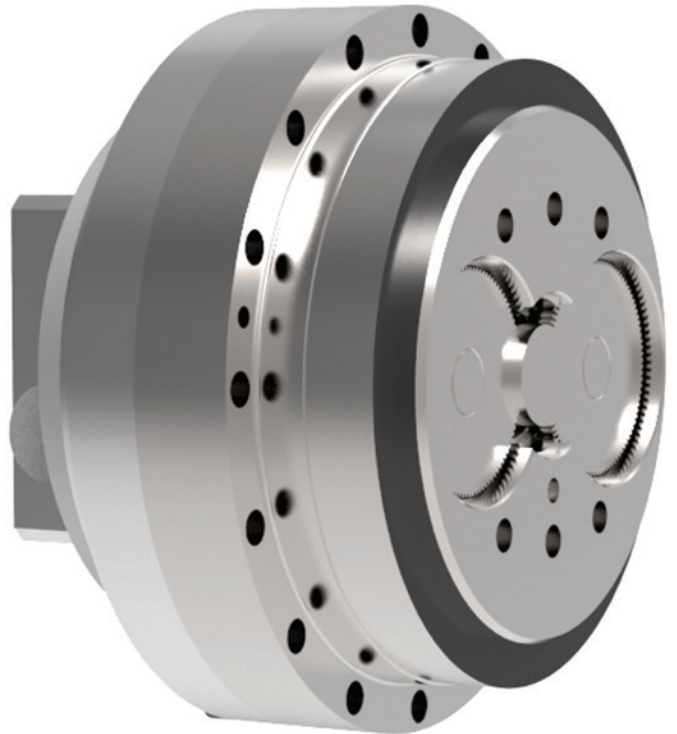
INTRODUCES ROBOTIC CYCLOIDAL GEARBOX

GAM recently announced the release of the new GCL cycloidal gearboxes. The new gearboxes provide high precision and rigidity for horizontal and vertical robotic and motion control applications.

The GCL is designed to withstand the frequent start-stop impact loads of industrial robots and other motion control applications with impact resistance five times nominal torque. The GCL series is available in a wide range of sizes with ratios from 36:1 to 192:1.

Output options for the GCL series include component boxes with a solid flanged output (GCLC F) or a hollow shaft flanged output (GCLC-H). In addition, the solid flanged output gearbox is available with a cover and motor mount (GCL-F). The GCL series can be used in a variety of applications, from robotics and automation to medical equipment, where zero-backlash and high tilting and torsional rigidity are required.

www.electromate.com



We answer EVERY CALL, EVERY TIME, within TWO RINGS.

It is at the core of who we are.

- ✓ NADCAP
CHEMICAL PROCESSING
- ✓ AS9100
CERTIFIED
- ✓ ISO9001
CERTIFIED

REVISION	REV	NAME	DATE
A	A	AKE	09/12/2019

NES Bearing Company has been providing American-made custom bearing products, inspection and testing to customers in diverse industries for over 24 years.

- ▣ Corrosion resistance
- ▣ Temperature extremes
- ▣ High fatigue life
- ▣ SQI and Edurance Testing

NES Bearing Co., Inc.

nesbearings.com
sales@nesbearings.com
 877-870-3200

- ▣ Short lead times
- ▣ Unique Materials
- ▣ Custom or Made to Print
- ▣ Failure Analysis

Bright Skies, Big Opportunities

Clean Sky Project in Europe Focuses on Reimagining the Aerospace Ecosystem

Matthew Jaster, Senior Editor

It's all there for the taking. Clean, sustainable aviation technologies from the cockpit and control systems to advances in propulsion and aerodynamics. This is the EU's journey toward climate-neutral aviation that began back in 2008 with a couple of modest proposals.

As of September 2021, the Clean Sky 2 program includes 34 flagship demonstrators, 106 contributing demonstrators and more than 1,000 new technologies on everything from energy efficiency and electrical solutions to battery and fuel cell propulsion systems.

But the biggest takeaway from Clean Sky 2 is that *only 30 percent* of these advanced technologies will be completed by the end of 2021. I'm no math wizard, but that means 70 percent of Clean Sky's initiatives are coming by 2022-2023. This represents an amazing opportunity for companies currently providing bearings, gearboxes and motors to the aerospace industry. Thousands of aircraft fleets will need to be replaced in the coming years to meet global sustainability goals in the skies.

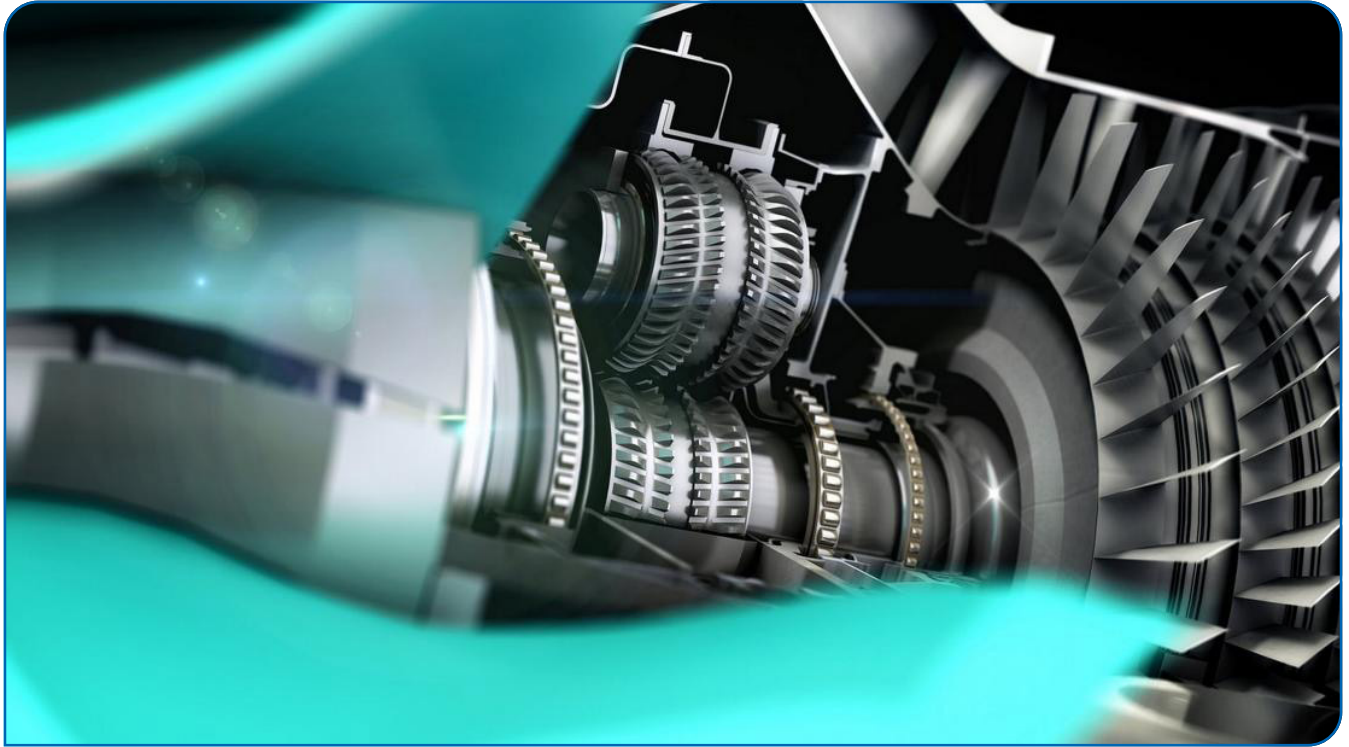
"The scale of the challenge is tremendous," said Axel Krien, executive director and the head of the Clean Sky program in Europe. "We're talking about a worldwide fleet of over 50,000 aircraft by 2035 that will need to be replaced. But the business case is there. The opportunity is huge. This journey needs to start yesterday."

"Clearly, we are heading towards a very busy and exciting time for Clean Sky, for Clean Aviation and the entire aviation sector as a whole. There's no time to spare. Bold, rapid investment is needed in sustainable aviation. Although the challenge ahead is tremendous, I firmly believe we have the competence and the capacity to succeed. The future of sustainable aviation looks bright," he added during a recent speech at the 32nd Congress of the International Council of the Aeronautical Sciences in Shanghai, China.

Here's a small sample of some of the aerospace work taking place in Europe for the Clean Sky program:



The UltraFan uses a power gearbox—introduced between the fan and intermediate pressure compressor—to ensure that the fan, compressors and turbines all continue to run at their optimum speed.



The PowerGearbox consists of five planetary gears.

Rolls-Royce UltraFan Targets Fuel Efficiency and Performance

The UltraFan engine is an innovative geared turbofan engine demonstrator, as well as a major showcase within Clean Sky's Engines program. The demonstrator targets fuel-efficient and more environment-friendly engine performance and achieves this by incorporating a raft of technologies and innovative high-temperature materials, as well as new geared architecture (using a power gearbox introduced between the fan and intermediate pressure compressor) to ensure that the fan, compressors and turbines all continue to run at their optimum speed.

"The beauty of the UltraFan engine is its modular design, so you can cover a wide range of tasks from 25,000 to 100,000 pounds of thrust," said Clean Sky Engines project officer Andrzej Podsadowski.

"Clean Sky and Rolls-Royce are working together on the key enabling features for the UltraFan, such as different fans, solutions for transmission systems, solutions for bearings, and many other technologies, and these are progressing well," he adds. "The demonstrator program encompasses over 30 different organizations across eight different countries via Clean Sky 2."

"Years of preparation and planning are coming together to create our first real working piece of equipment, the start of something that has the capability to transform into an entire family of UltraFan engines — with a power range

from 25,000 lb. to more than 100,000 lb., that can power both the narrow body and widebody aircraft of the future."

The build is taking place at Rolls-Royce's DemoWorks facility in Derby, UK, and the company is creating all the build kits that are needed to get the demonstrator build up and running. Concurrently, associated milestones are being reached on all the key technologies going into UltraFan, so all the large pieces of technology are now in the build phase.

These include the carbon composite blades that will make the demonstrator the largest in the world at 140 inches in diameter (encased in a composite fan-case that is big enough to drive a London tube train through) are already in production at Rolls-Royce's new composites facility in Bristol, UK.

And meanwhile, the UF001 PowerGearbox, the most powerful in the aerospace industry capable of delivering 50 MW, is now on build at the company's facility in Dahlewitz, Germany.

"It's all coming together, and it gives me a real sense of pride to know that this program is about to deliver something tangible and something that will make a real difference in reducing emissions at a time when people are preparing to connect again, travel again and want to do so sustainably," says Charmain Cordo, chief project engineer, Rolls-Royce.

VOLTAYRE'S Oil Valve Improves Gearbox Performance

A key innovation in the UHPE engine is the introduction of a gearbox (a gear train between the blower and the rotor), which enables the engine input blower to run at a different speed to the main rotor. This allows an increase in the secondary air flow provided by the blower while improving the efficiency of the different compression stages.

That's where the Clean Sky VOLTAYRE (valves for oil regulation with high accuracy and reliability) project comes in. With the support of the European Commission's Horizon 2020 funding, VOLTAYRE is focused on the design and manufacture of an innovative high flow direct drive oil valve, which will be qualified to TRL 5 level. The valve will be able to meter accurately and split the flows coming from the pump to the gearbox and to the engine, allowing the excess oil flow to return to the tank. The valve will also communicate a visualization of the delivered oil flows with the FADEC (full authority digital engine control).

The VOLTAYRE concept is based on the upsizing of a patented electronic free low energy limited angle torque motor developed by FACT (Fluid Actuation & Control Toulouse), an SME based in L'Union, France. The company has developed a torque motor which provides high torque, high displacement, high ageing stability, and without dynamic seals which is able to directly drive a spool that can meter and split an oil flow.

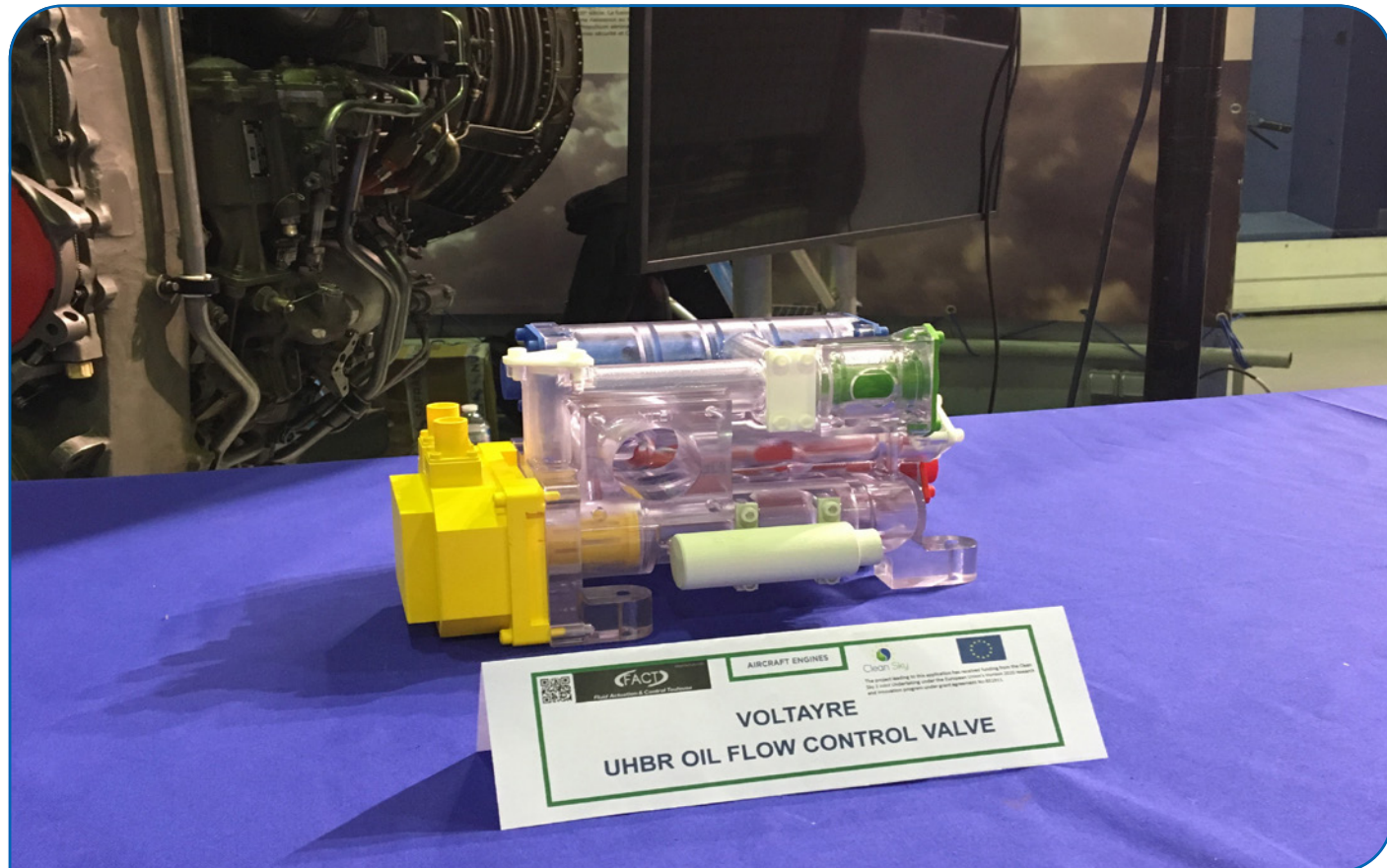
"Due to the large range of power, we need to reach a large range of oil flow," says Sébastien Oriol, topic manager at Safran for the VOLTAYRE project. "It's quite a new component because we have never done an oil flow measuring unit before."

Clean Sky's Integrated Intelligent Bearing Systems

Real-time monitoring of aero-engine bearings means that overhauls and repairs can be safely scheduled when they're needed, as opposed to at fixed intervals determined by time or operation cycles. Clean Sky's Integrated Intelligent Bearing Systems (I²BS) for the Ultra High Propulsive Efficiency (UHPE) Ground Test Demonstrator project is bringing a smarter approach to bearing health monitoring which will make European aero-engines more cost effective to operate while raising safety standards.

The idea of the Integrated Intelligent Bearing Systems (I²BS) for UHPE Ground Test Demo project is to design, develop, evaluate and test interchangeable conventional and smart bearings for the Ultra High Propulsive Efficiency (UHPE) Ground Test Demonstrator. The project kicked off in July 2016 and runs until December 2021.

Smart bearings will be able to deliver information related to their functional characteristics—their health, including temperature, axial and radial load, ball or roller or cage speed, lubrication quality, and radial clearance on each part



VOLTAYRE is focused on the design and manufacture of an innovative high flow direct drive oil valve, which will be qualified to TRL 5 level. The valve will be able to meter accurately and split the flows coming from the pump to the gearbox and to the engine.



of the bearing. And all of this information will be in real time, similar to Formula 1 racing cars, to see how they are working within the system.

Dr. Jean-François Brouckaert, team leader for Clean Sky's Engine ITDs, references the context of the project by noting that "Safran's UHPE demonstrator has a completely different engine architecture in terms of shaft support, bearing locations and shaft dynamics, because the weight balance along the shaft for an engine like this is very different from a classic direct drive turbofan, so there's limited experience of what the bearings will have to endure in this new architecture. So, the concept is to have instrumented bearings to monitor it during the first test and to validate this with respect to the models, and the dynamics of the behavior of the engine in the longer term. If these smart bearings prove to be reliable, they could be used eventually for in-service health monitoring. But the project's first goal is to understand the dynamics of the shaft on this concept."

Patrick Merring, head of product development aerospace at Schaeffler Aerospace (formerly FAG Aerospace) and coordinator of the project added, "In ideal conditions bearings last thousands of hours without problems, but that's not the case inside an aircraft engine. For example, you could have contamination in the oil system, or oil interruption — if the oil pump isn't supplying enough oil for the lubrication, you get friction which will lead to degradation of the bearing and eventually bearing failure."

He continued, "With a smart bearing you will be able to detect any initial damage, so you'll know exactly which component — whether it's the outer ring or the inner ring or if it's a rolling element — has suffered initial damage and consequently you'll also have a prediction of the spall propagation behavior so that you'll know the bearing's remaining lifetime. And with this knowledge it will be possible to extend the overhaul interval."

Currently the industry uses fixed overhaul inspections based on hours and/or cycles, but with smart bearings, by knowing how many hours of lifetime are left, it becomes possible to extend the inspection intervals and the maintenance intervals, potentially reducing overhaul costs. The project team is also carrying out estimations and calculations regarding the loading and speeding which are applied to the bearings.

"We don't yet know how often overloading situations occur and therefore it could be that some of the bearings are over-engineered. With instrumentation on the bearings, we would get actual data from an engine to know what the maximum load applied is, how often it occurs and so on, and you can take this into consideration to design the bearing according to the real loading and speeding situation and therefore also downsize the bearings," he added.

Clean, Green and Energy Efficient

Both the Clean Sky 1 and Clean Sky 2 projects came together in Europe to reduce emissions targets, significantly lower noise pollution and provide unparalleled fuel savings for the aerospace industry. R&D projects like this must start at the component level where bearings, gears, motors and drives can be 'reimagined' to provide a cleaner, more efficient roadmap to future aircraft production. These technologies can then be utilized in other areas such as automotive, industrial machinery, agriculture, mining, packaging, and marine applications. We look forward to the results of this research project across the globe. **PTE**

www.cleansky.eu

Decarbonizing the Airport

Airports are at the forefront of leading the transition towards climate-neutral operations across the entire value chain. For example, the Airbus' "Hydrogen Hub at Airports" concept brings together key airport ecosystem players to better understand hydrogen infrastructure needs for future aircraft and to develop a stepped approach to decarbonizing all airport-associated infrastructure using hydrogen.

The use of hydrogen to power future aircraft is not only expected to significantly reduce aircraft emissions in the air: it could also help decarbonize air transport activities on the ground. And the need to do so is certainly there. In fact, airport-controlled activities account for around 2-3% of the aviation industry's total emissions. This represents approximately 15-20 megatons of CO₂ emissions per year globally.

For this reason, airports are now beginning to rethink how their infrastructures could be designed and operated to reduce their overall environmental footprint. One promising option is to build a unique airport ecosystem with hydrogen at the core of operations.

In 2020, Airbus launched "Hydrogen Hub at Airports" to help airports reflect on how to do just that. The concept aims to jumpstart research into infrastructure requirements for future hydrogen aircraft, as well as low-carbon airport operations, across the entire value chain. And a variety of airport authorities, airlines and energy providers are already signing on to get involved.

Airports are complex infrastructure assets that rely on deep interdependencies between multiple systems, structures and stakeholders. For example, ground transport at airports includes not only passenger transport to and from aircraft via buses, but also heavy-duty vehicles — such as aircraft tugs and cargo trucks — for logistics. Traditionally, these vehicles have been powered by fossil fuels, which contribute to airports' overall emissions. But hydrogen could drastically cut the emissions of airport ground transport. In addition, airports require vast amounts of energy for cooling and heating, the environmental footprint of which could be mitigated through hydrogen.

The on-site production (and liquefaction) of hydrogen could also be a promising option for airports to meet their individual energy needs. This solution would eliminate the need for transport to and from off-site hydrogen production facilities, which would further reduce emissions. In doing so, airports could also become future energy ecosystems with liquid hydrogen production at their core.

"Airports have a key role to play to enable the transition to a climate-neutral air transport ecosystem," says Lionel Cousseins, Airbus ZEROe Market Development and Airline Relations Manager. "Hydrogen Hub at Airports enables us to collaborate with partners to define needs today, so we can pave the way for hydrogen adoption by 2035."

Partnerships across the airport ecosystem

To date, Airbus has activated Memorandums of Understanding (MoUs) with two airline customers to assess hydrogen infrastructure needs at airports. For example, an MoU with SAS Airlines is currently investigating airport infrastructure requirements for future hybrid, electric and hydrogen aircraft. A similar collaboration agreement was also signed with easyJet. The results of both studies are expected to be released later this year.

But airline partnerships are only just the beginning.



For hydrogen to meet its full potential, the entire airport ecosystem — airport authorities, energy suppliers, regulatory authorities — needs to come together to collaborate. To this end, Airbus has signed a joint-partnership with ADP (Paris Airports) and Air Liquide to better understand hydrogen infrastructure needs at Paris Charles-de-Gaulle Airport (CDG) and Paris Orly Airport (ORY).

"At Airbus, we see ourselves as a facilitator," Lionel explains. "This means we want to bring together all the key players around the same table to ensure we have the necessary infrastructure in place to bring our zero-emission aircraft to market by 2035."

Airbus expects to announce additional strategic partnerships with key players across the aviation ecosystem in markets worldwide throughout 2021. **PTE**

www.airbus.com

cti symposium

 AUTOMOTIVE DRIVETRAINS
INTELLIGENT
ELECTRIFIED

30 November – 1 December 2021 | Estrel Hotel, Berlin, Germany

**LIVE
IN BERLIN**

Discuss the road to carbon neutral power- and drivetrains with key market experts



Dr Karsten Bennewitz
Head of Powertrain and Energy System Development, Volkswagen AG, Germany



Hildegard Müller
President, Verband der Automobilindustrie e.V. (VDA), Germany



Mansukh Nakrani
Vice President, Electrification, Hydrogen and Mobility Services, BP Plc, UK



Stephan von Schuckmann
Member of the Board of Management, ZF Friedrichshafen AG, Germany



Martin Zeilinger
Executive Vice President, Head of Commercial Vehicle Development Division, Hyundai Motor Company, South Korea



Prof. Dr Tong Zhang
Director, National Fuel Cell Vehicle and Powertrain System Engineering Center, Clean Energy Automotive Engineering Center, Tongji University, China

Main Partners



Detailed programme at
www.drivetrain-symposium.world/de

The Importance of Oil Analysis

Ian Miller, Business Development Manager, Motion

Lubrication management is crucial to developing a successful preventive maintenance program. Like with most preventive measures, information is key. The better your information and ability to interpret that data, the better your results will be. This is why the best lubrication management programs also include proper sampling, testing and analysis of in-service lubricants. When properly executed, a robust sampling program can give vital insights into equipment condition.

The insights gleaned from analysis can, in turn, help evaluate the predicted life for that equipment and further the

proper scheduling of service. This ultimately translates into savings for the equipment owner. These savings are delivered by preventing expensive overhaul/replacement costs, maximizing lubricant life, and minimizing or completely avoiding unexpected downtime or even catastrophic failure.

A good analogy to consider is taking a blood sample during your annual physical. Such tests analyze platelet count, cholesterol, iron levels, glucose, etc. This information gives a doctor key indication of a patient's physical health. The same is true for mechanical equipment. Similar mechanical health inferences can be made by reviewing

things like particle count, element analysis, viscosity, water content, TAN (total acid number) rating, etc.

Common Testing Methods

- Visual Patch:** ISO 4406 is a visual inspection of the oil through a microscope. The patch test identifies the types and quantity of contamination present in an oil sample. It usually comes with a picture on the report for you to view the results.
- Particle Count:** ISO 11500/4406 uses a laser to count and measure particulate size and quantity in an oil sample. The typical format is # of particles > 4 μm /# of particles > 6 μm /# of particles > 16 μm . These numbers correlate to a look-up table that indicates the quantity range for that particle size within a 1 ml volume of the fluid. For example, a rating of 22/18/13 indicates the ranges below.
 - 22 Between 20,000 to 40,000 of particles greater than 4 μm
 - 18 Between 1,300 to 2,500 of particles greater than 6 μm
 - 13 Between 40 to 80 of particles greater than 14 μm
- Karl Fischer Water Content:** ASTM D6304 will provide the water content in oil in ppm (parts per million). Typically, your report will give an acceptable range in addition to the specific value that was determined. Water content can be of particular interest for some, as its symptoms can be more difficult to identify in low-to-moderate quantities. This is because added water will reduce lubricity and can look like standard (albeit premature) wear.
- Conductivity:** ASTM D2624 will provide a measure of conductivity in pS/m. This test is particularly important for systems with very high flows and are at risk of electrostatic discharge.
- Common Element ICP Analysis:** The ICP (inductively coupled plasma) analysis is used to identify the elemental breakdown of contaminants in ppm. This information can help to identify components that are currently subject to excessive wear. By establishing a baseline and looking



This hydraulic power unit is equipped with a clean fill/sample adapter. This adapter enables maintenance personnel to fill or sample the oil through a closed coupled connection. Image courtesy of Motion.

for step changes in elemental contamination, you can predict problems before they become catastrophic failures. Below are two examples.

- » Elevated levels of Cu (copper) in a hydraulic system that can indicate a worn piston pump, side loading of a cylinder
- » Elevated levels of FE (iron) that can point to gearing, bearings, shafts or cylinder/liners
- **Viscosity:** Tracking oil viscosity is essential to ensure that your equipment is within its prescribed operating parameters. Decreases in viscosity can lead to premature failure and increases can lead to heat (further degrading the fluid) and other issues for systems that are hydraulically driven. A good rule of thumb is to operate within +/- 10% of what is outlined in the material data sheet (or your established baseline). Some systems will require a tighter window.
- **MPC (Membrane Patch Colorimetry):** This is often used to determine the susceptibility of your oil to insoluble particles suspended in your lubricant (more commonly referred to as varnish). These contaminants can be difficult to remove and often discolor system components before building up to levels that can harm your equipment. Equipment running in extreme temperatures (or large temperature variations), or where water egress is a problem, is particularly susceptible to “varnishing” issues.
- **TAN (Total Acid Number):** This number tracks acidity levels in lubricants. As they break down and age, this number will often go up due



The sampling port (center view of the black adapter) is fed from a downtube that is positioned for samples to be taken from the working fluid, which is the optimal place. Image courtesy of Motion.

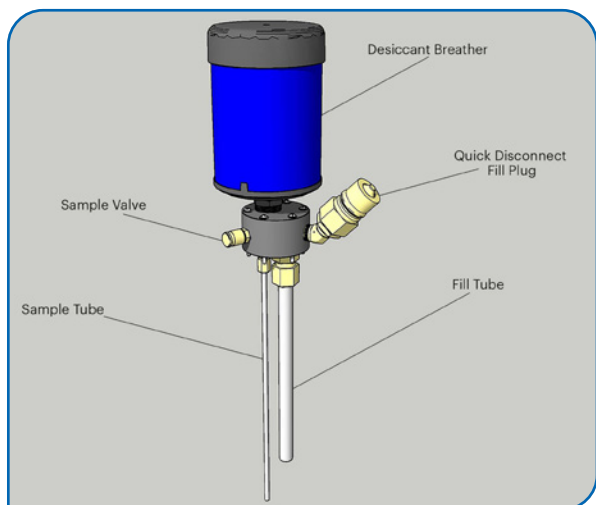
to oxidation. As the levels increase, your system becomes more at risk of damage from corrosion and buildup of oxidized materials. This test is particularly important for the ester-based fluids that are susceptible to this breakdown over time. For mineral fluids, caution limits are usually set at the baseline +0.6, and the critical limits are often set at the baseline +1.

Gaining knowledge during testing (along with knowing which tests to request) is just one part of the process. Using that information to fine-tune preventive maintenance schedules is how you can realize the cost savings. A maintenance team can more effectively schedule tasks like filter/oil changes, follow-up inspections, targeting equipment for inspection, and preemptive removal and maintenance of equipment. While allowing for risk evaluation, this enhances the ability to weigh the potential of an unexpected outage against production schedules and targets.

Catastrophic failures can have far-reaching implications past the mere cost of replacement. Lost production, labor costs, safety concerns and damage to other equipment are all considerations. By establishing a baseline through regular oil analysis and monitoring for increased iron, chromium, nickel, molybdenum, aluminum, copper, tin, lead, silver, sodium and particle count, etc., you can build a predictive model for component failure, and thus avoid it. **PTE**

For more information, visit Motion.com/pte or Motion’s Fluid Power Knowledge Link (motionind.biz/3mXrsRa).

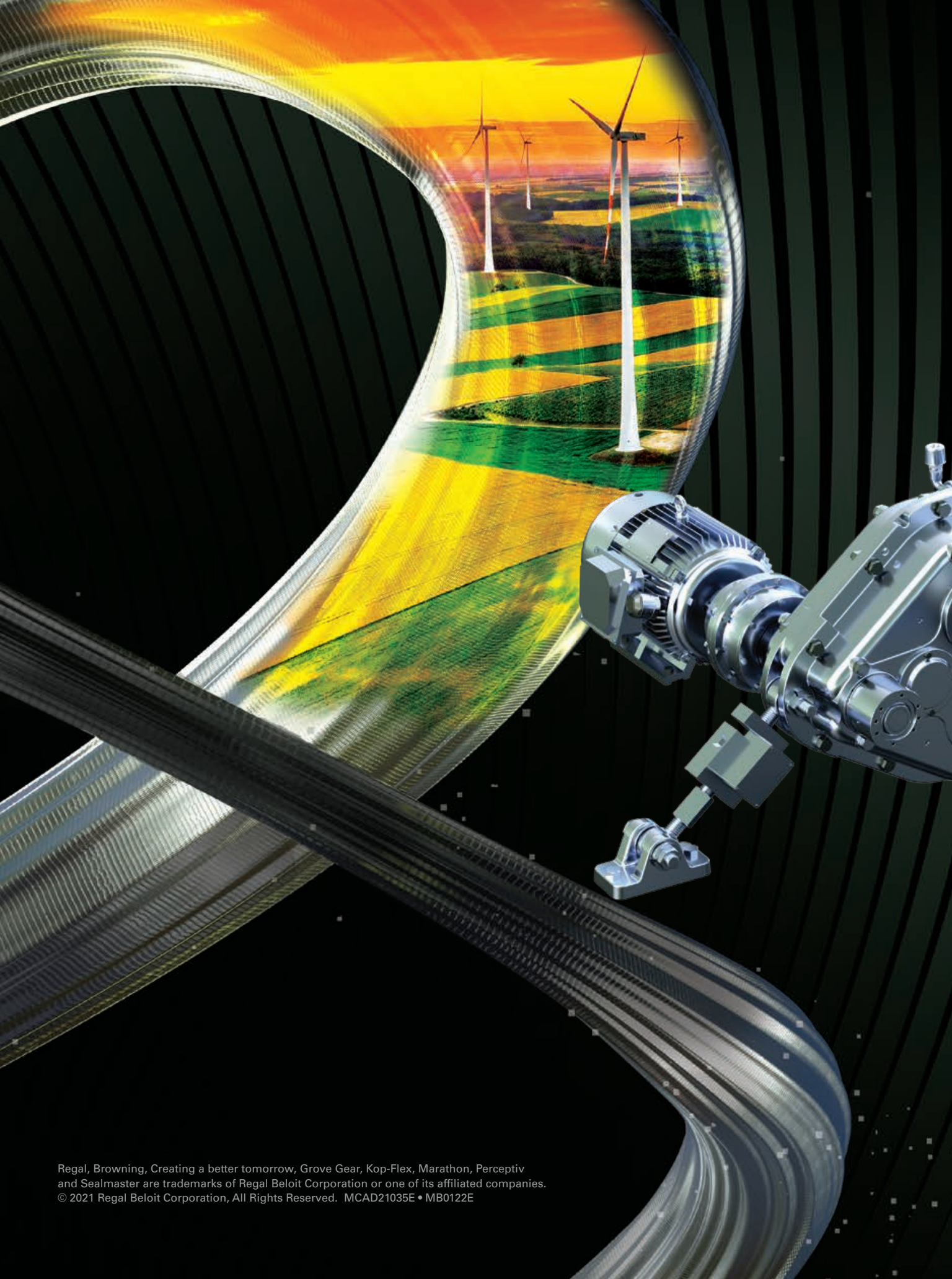
motionindustries.com



Hydraulic adapter kit detail. Image courtesy of Des-Case.

Based out of Calgary, **Ian Miller P. Eng.** is a National Services Business Development Manager at Motion. He has over a decade of hydraulic and electrical experience in the field, including system design, troubleshooting, on-site installations and technical training/support.





Regal, Browning, Creating a better tomorrow, Grove Gear, Kop-Flex, Marathon, Perceptiv and Sealmaster are trademarks of Regal Beloit Corporation or one of its affiliated companies.
© 2021 Regal Beloit Corporation, All Rights Reserved. MCAD21035E • MB0122E

The *industrial powertrains* that drive endless potential.

The promise of end-to-end optimized powertrains is here.

Regal components designed and configured to work flawlessly as complete, right-sized systems delivering energy-efficient power.

Regal-optimized electromechanical powertrains open the door to new ideas and unlimited potential for converting power into motion.

Visit us at regalbeloit.com/powertrain to learn more.



SEALMASTER[®]

KOP-FLEX

GROVE GEAR[®]

marathon[®]

Perceptiv[™]

Browning[®]

REGAL[®]

Creating a better tomorrow[™] ...

Napoleon Engineering Services NES Bearing Co., Inc.

Empowering Our Customers To Support Theirs

At NES our goal is to empower you with specialized bearing solutions related to custom bearing manufacturing, inspection, and testing. We accomplish this as the largest independent bearing inspection and testing facility in North America and always keeping our customers' needs at the forefront of all NES processes. With over 100 years of generational bearing knowledge and experience NES is the one-stop shop you need to make your bearing projects streamlined and efficient.

Diverse Industries & Applications

- Aerospace
- Aviation & Vertical Flight
- Defense & Military
- Oil & Gas
- Power Generation
- Marine
- Industrial
- Transportation
- Gear Drives
- Medical
- Agriculture & Lumber
- Pumps & Turbines
- Generators
- Off-Highway
- OEM's
- MRO stations

Custom Ball Bearings:

- Deep groove
- Deep-groove fractured race
- Angular contact
- Two-piece inner ring Gothic arch
- Double-row
- Thrust
- Hybrid
- Magnetic back-up

Custom Roller Bearings:

- Needle
- Cylindrical
- Thrust
- Ceramic

NES is THE Solution:

- Corrosion Resistance
- Temperature Extremes
- Load Extremes
- High Fatigue Life
- High Life Materials
- Cost Effective Solutions
- Bearing Size Range 20–350 mm
- Shorter Lead Times
- Small Production Runs
- High Precision Capabilities
- Advanced Design Technologies
- Precision Modifications



Custom Bearing Manufacturing

NES's design engineering and manufacturing capabilities provide you with custom bearings without the long lead times of other bearing manufacturers. Our knowledge and expertise allow us to analyze your application conditions and develop an advanced product that will meet or exceed your needs.

Bearing Inspection & Testing

NES is the creator of inspection & testing programs that support global bearing sourcing & bearing qualification. We have been leading OEMs through the global bearing qualification process for 24 years. We provide technical information through bearing inspection, modeling and testing programs to evaluate bearing design, manufacturing capability, overall quality of workmanship, and the relationship these attributes have on bearing life. No other source has the experience, capacity, or capability to expertly service your bearing qualification needs.



www.nesbearings.com

FOR MORE INFORMATION

1601 Johnson Street, Olean, NY 14760

Phone: 877-870-3200

Fax: 716-372-1448

Email: sales@nesbearings.com

www.nesbearings.com

Regal Beloit Corporation

Optimizing Industrial Powertrain Performance

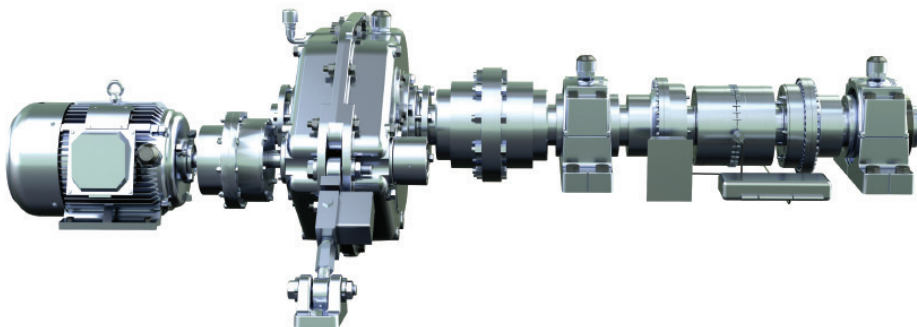
Virtually no complete turnkey powertrain solutions have been widely available off the shelf. So engineers and operations managers adapt and force-fit motors, controls and other assorted components sold by a variety of brands from multiple manufacturers.

By using parts not optimized to work together, companies can keep their equipment running. But the powertrains often function with less-than-optimal efficiency, reliability and/or profitability. Additionally, sourcing their bills of material becomes an extensive, complex and expensive problem.

For many companies, that conventional approach no longer is sufficient. They need new equipment or ways to upgrade existing equipment that enhance performance while reducing energy consumption and other operational costs. To meet business objectives, they must be able to maximize the uptime of their power transmission systems.

Maximize powertrain performance with the integrated system experts

Regal recommends a better approach. Count on us to design, assemble and commission complete, end-to-end optimized electromechanical powertrains for a wide range of applications and industries.

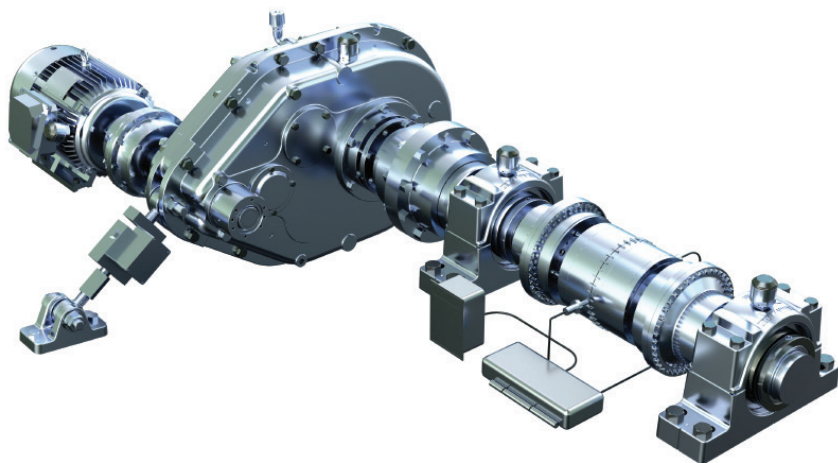


We enable you to fully meet your company's unique applications and requirements by incorporating off-the-shelf componentry such as:

- Bearings
- Belt and chain drives
- Clutches and backstops
- Disc and gear couplings
- Motors
- Speed reducers and gearboxes

We can also enhance your powertrain performance with IoT monitoring via our Perceptiv™ intelligence platform.

Regal fine-tunes and tests industrial powertrains to ensure the components fit and function together. Your company can significantly improve its powertrain performance and reduce total cost of ownership (TCO).



LEARN MORE



REGAL®

FOR MORE INFORMATION

7120 New Buffington Rd., Florence, KY 41042

Phone: Application Engineering: 800-626-2093

Email: PTSApEng@regalbeloit.com

www.regalbeloit.com/powertrain

Stock Drive Products/ Sterling Instrument

Precision CNC Machined Components

Stock Drive Products/Sterling Instrument (SDP/SI) creates precision gears, superior mechanical components, and custom engineered solutions for the most highly-regarded names in the aerospace, precision medical, and defense industries. Our in-house design, precision manufacturing, and assembly capabilities let us meet the critical tolerances and functionality needs our customers require.

As a full service provider, OEMs around the world rely on us for innovative solutions. Providing engineering support from beginning to end, we offer valuable insights during the early design stage of a project. Drawing from 70 years of problem solving capabilities and manufacturing experience, customers benefit from our expertise, resulting in design improvements and optimum manufacturability.

SDP/SI specializes in miniature to small mechanical components as well as subassemblies for integration into larger systems fully supporting our customers from prototype to high-volume production. Our small power transmission and motion control components can be found in thousands of applications in a wide assortment of industries.

Partnering with medical device manufacturers we deliver the high-quality components required for precision medical applications including surgical robotics, blood analyzers, drug delivery systems, and COVID testing equipment.

As a manufacturer in the aerospace gearbox industry, our custom gearbox assemblies provide the means to position wings, open doors, fuel control, instrumentation, loading and steering mechanisms. A wide variety of SDP/SI precision gears and custom gear assemblies can be



found on commercial and military aircraft, missiles and satellites around the world.

Standard components are a cost-effective option and with over 87,000 machined and molded parts offered, we are a preferred source. Product specifications, 3D CAD models and the ability to shop 24/7 are all offered at our E-Store.

- Timing Belts and Pulleys
- Precision Gears
- Precision Gearboxes
- Motors
- Gearheads
- Motion Control Products
- Speed Reducers / Increases
- Bearings
- Couplings
- Clutches and Brakes
- Hardware

SDP/SI provides solutions that fit your needs; mechanical, electromechanical, molded, machined, assembly, our engineers look forward to working with you!

Certifications

ISO 9001:2015 + AS9100D Certified
 ITAR Compliant – DDTC Registered
 RoHS & REACH Compliant
 DFARS compliant



SDP/SI

STOCK DRIVE PRODUCTS/STERLING INSTRUMENT

FOR MORE INFORMATION
 250 Duffy Avenue, Hicksville, New York 11801

Phone: 516-328-3300
 Toll Free: 800-819-8900
 Fax: 516-326-8827

Email: sdp-sisupport@sdp-si.com

www.sdp-si.com

Hungry for More



Everything you need if you buy gears, bearings, motors, couplings and clutches.

Power Transmission Engineering

- Product and Industry News Updated Daily
- Directory of Mechanical Power Transmission Suppliers
- Exclusive online content in our e-mail newsletters
- Back Issues and Article Archive
- Calendar of Upcoming Events for power transmission professionals

FREE SUBSCRIPTION!

www.powertransmission.com

Oil Shear Brakes Speed Loading of Oceangoing Vessels

Force Control Industries

For Paul Revere it was one if by land, two if by sea.

But for the team at Roseburg Forest Products, they primarily focus their sights on land, taking wood chips from truck or train before loading them onto sea-going vessels at their Coos Bay Shipping Terminal. The facility, located at the port of Coos Bay in Oregon, uses pneumatic conveyers to intake chips around the clock and load vessels upwards of 19 hours a day during peak season. To produce around the clock, Roseburg Forest Products relies on a handful of brakes that power their mission critical systems. These brakes not only keep operations running smoothly but they enable the Coos Bay Shipping Terminal to be one of the most efficient bulk cargo handling terminals in North America. Gregg Harvey, Maintenance

Coordinator, and Richard Dybevik, Coos Bay Terminal Manager, would be the first to tell you that their brakes are the machinery that's speeding up their business success.

A day in the life of a wood chip

Whether it's from customers or Roseburg-owned sawmills and private facilities, wood chips are brought in via trucks and rail cars 24/7. No matter their route to Coos Bay, the chips are weighed on arrival and their now-empty containers are weighed again on their way out to ascertain how much material has entered the facility. Next, the chips that were trucked in are dumped into a larger pit which they are eventually taken out of with box chains into a conveyance. For rail car wood chips, which have three times

the volume of trucked containers, they are dumped into a separate pit before two sets of dry chains feed them into the same conveyance as the trucked materials.

Once the wood chips are in the conveyance system, they pass through a 52-inch airlock feeder and into a pneumatic system where six 700-horsepower blowers are used in pairs of two to stock wood chips by species to storage. Then, after the chips are placed in storage, they await their lucky day to be loaded onto a vessel.

The process then reverses itself when vessels dock at the Coos Bay Shipping Terminal. Stored chips travel via conveyance up to a 210-foot tower with a 72-inch airlock feeder and a loading boom that swings out over the vessel. The loading boom has a loading head



with a telescopic pneumatic pipe that can extend, retract, and rotate a full 360 degrees to allow the longshoremen to distribute chips evenly in the vessel holds. This loading head uses a Force Control MagnaShear MSB6 motor brake coupled to a 15 HP motor to start and stop the position of the loading head to optimize the vessel loading process.

Because of their success with the loading head operation, when the time came to upgrade old and failing PE brake shoes elsewhere in their process, Harvey and Dybevik decided to call up Force Control once again. The main reason? Reliability. "Now we have good reliability with our brakes, which is key," Harvey explained. After the loading head brake, Roseburg installed MagnaShear motor brakes into their railcar unloader and load out telescope operations.

A chip off the old block

Roseburg's railcar unloader uses Force Control's MagnaShear MSB9 500 lb. 1,800 rpm motor brake as a holding brake on a 50-horsepower motor. The motor allows an operator to start to rotate the railcar until it reaches its desired angle before engaging the brake to lock the pistons down and secure the railcar at its current spot. This brake usually sees four to eight cycles before a vessel is totally emptied. Up to 15% of the wood chips that come into the Coos Bay Shipping Terminal come by rail so the brake's role in unloading 10 railcars a week is critical to the overall operation of the plant.

The facility also uses a MagnaShear MSB6 brake on a 60-horsepower motor for their telescope boom. The telescopic pneumatic pipe can extend or retract their loading head onto vessels to distribute wood chips, a process that typically takes 31 to 33 hours to load a 3.6 million cubic foot vessel. Both brakes are activated frequently to evenly distribute the wood chips throughout the six cargo holds in a vessel. The telescopic brake engages 750 to 1,000 cycles per hold and the rotating loading head is activated 2,000 to 2,500 cycles per hold.

"If we had a failure on either one of those, if we were out a spare, it would

keep us from vessel loading," Harvey said. "Primarily, that's what we're here for...that's our end goal."

Before switching to MagnaShear brakes, the holding and telescope brakes used PE brakes which started to have mechanical issues after they got past their life expectancy. "The brake started to have some failures and being so obsolete, trying to get parts for it was difficult," said Harvey. Ten years later and Harvey is singing a different tune. The rollover and telescope

MagnaShear brakes are still in use and haven't experienced any mechanical issues, even though the brakes have been in use outdoors in the dust and debris of wood chips, and subject to sea air for over a decade. And while the loading brake doesn't have as clean of a maintenance record as its peers, the Roseburg and Force Control teams have collaborated to adjust their program accordingly.

"On the loading head, it seemed like for a little while there we were going

ustsubaki.com

YOUR SIDEKICK FOR PINPOINTING SPROCKET WEAR.

Optimize your operations and avoid unscheduled downtime with patented Smart Tooth® Sprockets. Strategically-placed Wear Indicator technology provides a visual indication when your sprocket needs to be replaced, eliminating the guesswork associated with worn sprockets. Now you have the ability to identify and schedule drive system maintenance before critical component failure occurs, extending chain life and reducing the overall cost of equipment ownership. Smart Tooth® Wear Indicator Sprockets — only from your reliable sidekick, Tsubaki.

THERE'S NO ROOM FOR WEAK LINKS WITH...

SMART TOOTH® SPROCKETS

- › Extend chain life with right-on-time, proactive maintenance
- › Prevent catastrophic failure and unexpected downtime
- › Eliminate the guesswork associated with worn sprockets
- › Reduce your equipment costs
- › Just look for the BLUE

Want us to optimize your operations? That's what we do. Call us today to schedule an on-site visit 800-323-7790

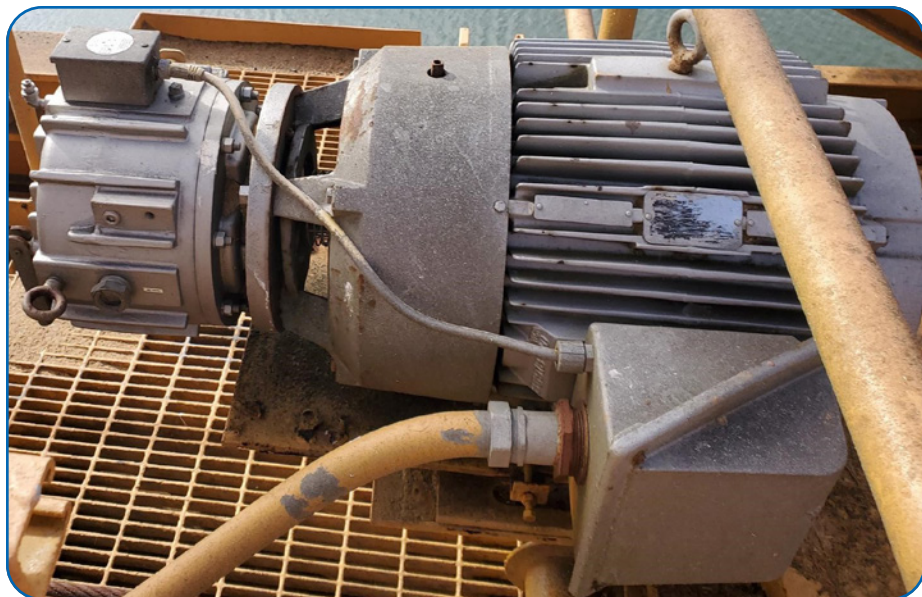
©2019 U.S. Tsubaki Power Transmission, LLC. All Rights Reserved.

LEADING THE MOVEMENT

through brakes, burning them up, and having problems with those,” Harvey explained. Since a motor insulation issue came to light, Force Control and Coos Bays’ electricians created and implemented a preventative maintenance program of changing fluid every four to six vessel loads, which extended the brake life to nine to ten months. To Dybevik this was just another example of the power of a good industry partner. “Force Control has been awesome to work with as far as research, development, and figuring out what our preventative maintenance program should be,” he said.

How it works

Unlike dry brakes, MagnaShear oil brakes use oil shear technology, which includes a film of transmission fluid between the brake disc and the drive plate. As the fluid is compressed, the fluid molecules are put in shear— thus imparting torque to the other side. This torque transmission causes the rotating surface to come to a stop. Since most of the work is done by the fluid particles in shear, wear is virtually eliminated. Elimination of wear enables oil shear brakes to last significantly longer, while also eliminating the need for maintenance and adjustments which are common for dry braking systems.



In addition to transmitting torque, a patented fluid recirculation system helps to dissipate heat which causes friction disc wear and eventual failure in traditional dry brakes. Along with heat removal and torque transmission, the fluid serves to continually lubricate all components of the oil shear brake, increasing their service life.

Force Control MagnaShear motor brakes have a “quick mount” feature that allows them to easily be mounted to drive motors in NEMA frame sizes from 56 to 449 or some IEC frame motors. These brakes are shipped ready to install, with no assembly or

adjustments required. These proven motor brakes are totally enclosed from outside contaminants, with seal integrity for harsh and washdown environments. A modular design /assembly allows for ease of servicing and maintenance.

While “applying the brakes” generally means slowing down, for Harvey, Dybevik, and the entire team at the Coos Bay Shipping Terminal, applying the right brakes transformed an equipment fix into a decade of reliable service and support. New brakes meant there was no stopping the flow of wood chips for Roseburg Forest Products. **PTE**

www.forcecontrol.com



JIE DRIVE

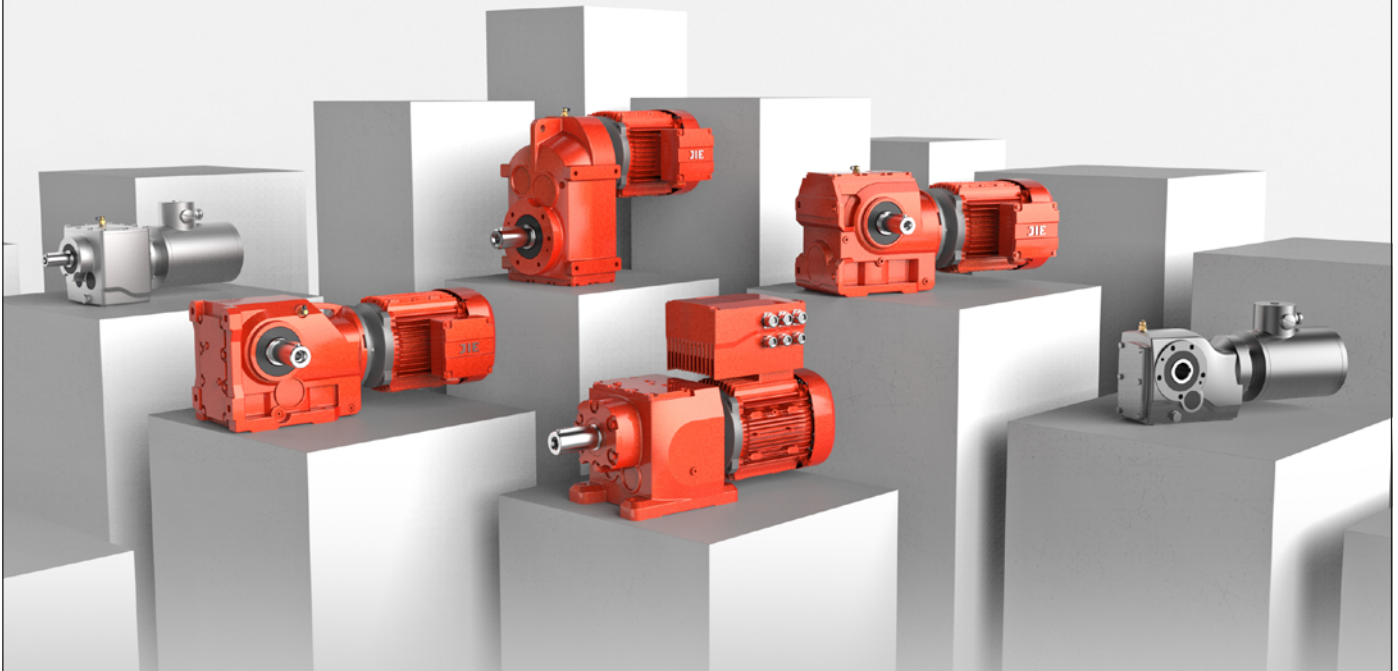


PTDA
Channeling the
Power of Industry

CE C **RU** US IP69K



- *Local Inventory*
- *Quick Delivery*
- *Great Service*
- *Top Quality*



*Options are Helical Inline, Parallel Shaft, Helical Bevel and Helical Worm;
Available in both cast iron and stainless steel housing.*

www.jie-drives.com

Info@jie-drives.com

+1 630 580 9986

Precision Mechanical Components & Assemblies

Standard Industrial Components | Made To Print Parts



Gears, Pulleys, Shafts, Bearings, Couplings, Fasteners, Custom Gear Boxes
Value Added Features and Services

Engineering, Refurbishing & Design
Custom Made To Print Parts
Modified Standard Parts
Assemblies & Sub-Assemblies
Custom Mounts For Shafts
Build Sub-Assemblies And Complete Assemblies
Prototype Work

- ▶ Press bearings into pulleys
- ▶ Assemble bearings to shafts
- ▶ Set backlash on gears
- ▶ Assemble drive boxes
- ▶ Straightening
- ▶ Welding
- ▶ Kitting
- ▶ Plating / Custom Coating
- ▶ Heat treat

ADD

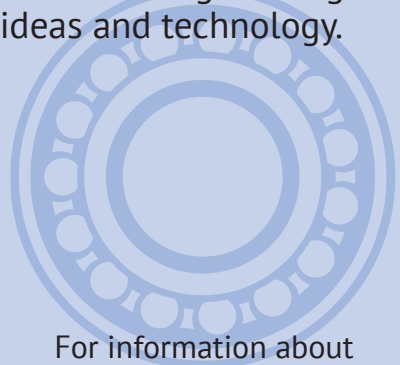
- Grooves • Flats • Keyways • Pins
- Threads • Staking • Pressing
- Testing



Nordex.com Sales@nordex.com Eng@nordex.com
Phone: (800) 243-0986 or Call: (203) 775-4877

Engineering sMart

is your resource for the latest in great ideas from our advertisers. Check this section every issue for sMart Engineering ideas and technology.



For information about advertising, contact

Dave Friedman
at

(847) 437-6604

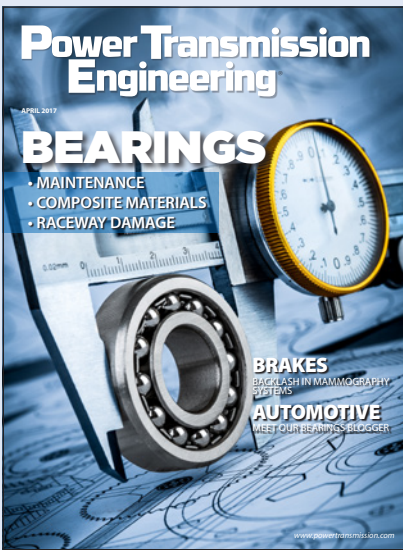
or

dave@powertransmission.com.

B&R
MACHINE AND GEAR CORP

BRGEAR.COM

Subscribe TODAY



IT'S FAST. IT'S EASY.
IT keeps YOU in the KNOW.

[www.powertransmission.com/
subscribe.htm](http://www.powertransmission.com/subscribe.htm)

Screw Jacks

The NEW Zimm ZE screw jack series offers all the connecting, drive and safety components from a single source.



ZIMM USA
by **DIEQUA**
screwjacks.com 800-459-5845

Aluminum Worm Speed Reducers

Our aluminum worm speed reducers provide improved performance, high reliability and easy maintenance.



- 7 sizes, 28-110 mm CD
- 12 ratios from 5:1 to 100:1
- Flexible coupling input
- Aluminum housings
- NEMA, IEC, or Servo Motor Adapters

DIEQUA
Corporation
diequa.com/pte 800-269-4715

Power Transmission Engineering online!

It's like your own professional superpower.

Stronger, faster and smarter than your average website, www.powertransmission.com offers everything you need to supercharge your engineering-oriented organization.

- Complete archive of articles on engineered components
- Directory of suppliers of gears, bearings, motors and other mechanical power transmission components
- Product and Industry News updated daily
- Exclusive online content in our e-mail newsletters
- The Bearings Blog
- Calendar of upcoming events
- Comprehensive search feature helps you find what you're looking for — *faster than a speeding bullet!*

www.powertransmission.com

Coupling a Motor to a Load

Don Labriola

It should not be surprising that with so many load types and motor types, there are many ways to couple a motor to a load! The rotary motors are more common, but linear and even planar motors are available. Although the linear motors are more specialized and would rarely be used to move a rotary load, converting rotary motors to linear motion is very common. The subject is very broad, so this article will focus more on servo applicable gear heads.

Rotary Motion Direct Drive

Let's start with a very common operation — a rotary motion. The simplest configuration is when you can direct drive the load from the motor. This requires the motor to have sufficient torque to accelerate the load, as well as sufficient shaft and bearing capabilities. As there is no gearing down, this solution may require specialized motors and higher resolution encoders than if a pulley or gear reducer were used. The control loop of the controller may also need to be higher-bandwidth to handle the high inertia mismatch ratios between the motor and the load. Finally, with power being torque times velocity ($W = N \cdot m \times \text{radians/sec}$) low speed operation translates into significant torques being required to produce significant mechanical output power.

Pulleys

Tooth belt pulleys can handle up to 6:1 or even 8:1 in a single stage, and couplers are often not needed, simplifying assembly. The curvilinear tooth profiles carry more power with less error (slop) in the motion. Belts tend to add damping to a mechanical system, allowing for control loop gains without encountering resonance issues. The friction between the belt and the pulleys helps keep the error between forward and reverse motions from causing oscillations in the control system that is seen when geared systems have backlash (more on that under gears). A single stage tooth belt reduction is a very low cost and effective method to reduce reflected load inertia as seen by the motor. The load inertia — as seen at the motor shaft — goes down by the square of the pulley ratio: a

5:1 pulley reduces the load inertia seen by the motor by a factor of 25 times. The belt width and tension elements need to be selected for the needed stiffness in the system. A significant stiffness improvement can be made by going from glass or nylon reinforcement to aramid fibers, for instance. Wider belts can also provide greater stiffness.

If multiple stages of pulley reduction are used, it is necessary to size the belts according to the location in the pulley chain. For example, a 64:1 reduction with two 8:1 reduction stages, the lower speed belt would need to be significantly stiffer than the high speed belt. The forces seen in the low speed belt are 8× higher than for the high speed (input) belt, while a belt stretch that causes .1 degree of motion at the load is seen as 6.4 degrees at the motor! Larger diameter pulleys help reduce the forces on the belt for a given torque and also reduce the resulting angular deviation — the same stretch results in a lower angle deviation.

Pulleys generally tolerate some shaft angular misalignment, typically removing the need or couplers.

Gearheads

There are a very diverse range of gearheads. Here are a few of the more popular, but there are new design coming out on a regular basis. Gears provide a wide range of ratios, and are available in multiple gearing ratios. Gears do not tend to provide as much damping as belts, but can be extremely stiff, according to design. If the gear is driven by a shaft mounted spur gear, couplers are sometimes eliminated; if the drive gear has its own bearings, then a coupler is needed to provide compliance between the motor shaft alignment to its two bearings and the attached gear shaft with its own two bearings, as it is difficult to guarantee that all 4 bearings would be in a perfect line if these two shafts were rigidly coupled.

Efficiency, stiffness, backlash, and allowable shaft alignment vary with the various designs.

Simple gearing can use two gears coupled to their respective shafts. The spacing and alignment of the two shafts determines wear and backlash. The radial forces of the gears interacting puts loads on the shafts, which can be considerable. The desire for stiffer gearing and reduced loading has given rise to many options.

Planetary Gearheads

Planetary gear boxes (also called epicyclic gear trains) are frequently used to reduce the speed of a motor. They use multiple “planet gears” around a central “sun gear” which is driven by the motor. There is an outer “crown gear” which engages the various planet gears. The crown gear is typically (but not always) fixed to the case of the gearhead and provides a reaction force for the output pinion which is connected a plate supporting the bearings at the center of each of the planets. The rotation of the sun gear causes the planets to precess around the crown gear at a lower rotational velocity

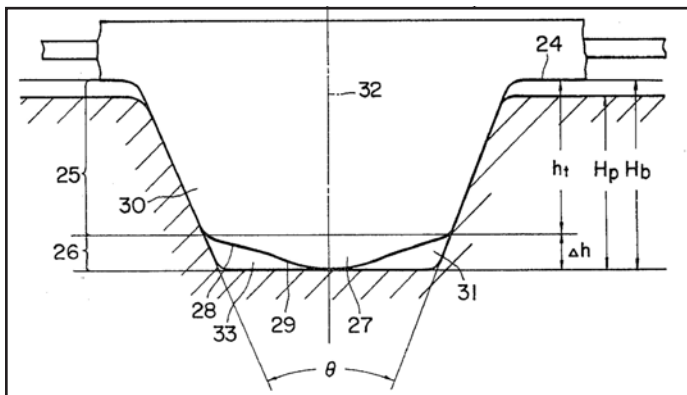


Figure 1 Tooth Belt and Pulley.

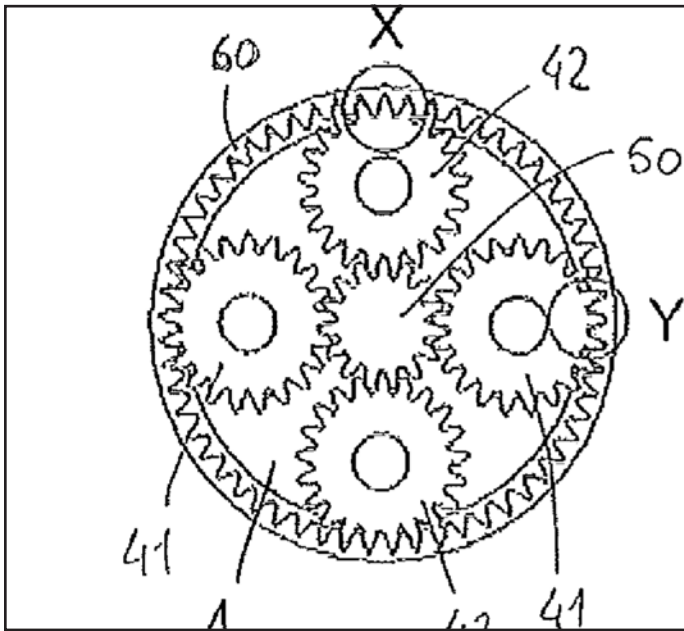


Figure 2 Planetary Gearhead.

than the sun gear input, rotating the output pinion. Note that the output pinion of one stage can (and often does) drive the sun gear of the next stage, often with the crown gear shared between multiple stages for a higher divide ratio. The planetary design balances the side load forces of the multiple planets such that the input sun gear does not cause a large radial load on the motor shaft driving the sun gear. Multiple planets also divide the forces on the teeth to increase both stiffness and torque rating. These gears typically have a fairly high efficiency with up to approximately 10:1 gear ratio per stage. Planetary gearheads have the input and output shafts inline.

Harmonic Gearheads

Harmonic drive (or strain-wave) gearheads use a rigid circular spline and thin flexible spline (flexspline) with an elliptical wave generator which is normally the driven input surrounded by a flexible bearing which presses on the flexspline, causing the flexspline to be stretched so that teeth of the flexspline engage with the rigid circular spline around the region of the two stretched portions of the flex spline. The teeth are carefully designed to allow as much contact area as possible while also allowing them to pass each other without (with minimal) rubbing. A cup structure is generally attached to the flexible spline. The output is the difference in position between the two splines, with one generally fixed and the other used as the output (although these can have both rotating and the input adjusted to produce a phasing adjustment, such as are used on large printers). One rotation of the elliptical input causes the flexspline to advance by one tooth on each half of the rigid spline. The large contact diameters and the multiple engaged teeth allow for very stiff gearheads,

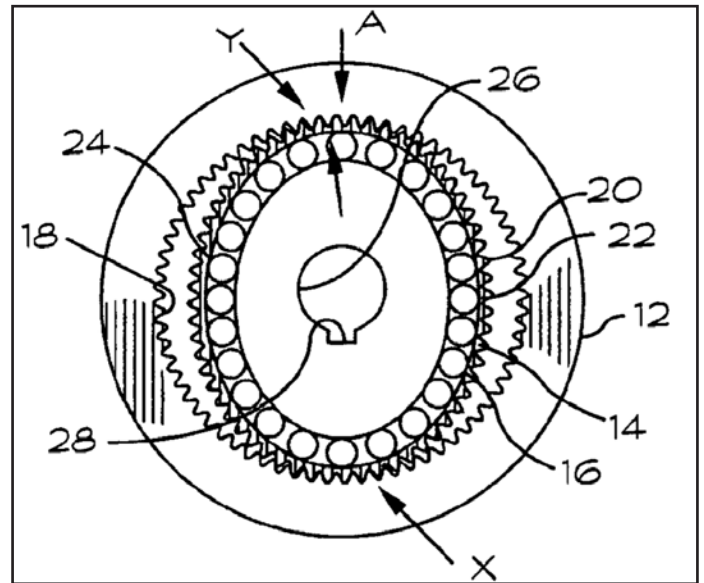


Figure 3 Harmonic Gearhead.

with a single stage gear ratio of capability of approximately 50 to several hundred with a typical efficiency of around 60%. Harmonic drives can also be designed with zero backlash. The contact and the flexure does limit the life of the gearhead, but with proper lubrication life expectancy is good. The high stiffness and zero backlash and high gear ratios makes these popular with robotic arms.

Cycloidal Gearhead

Cycloidal gearheads use an eccentric mechanism to walk one (or more) cycloidal gears around a series of pins. A rotation

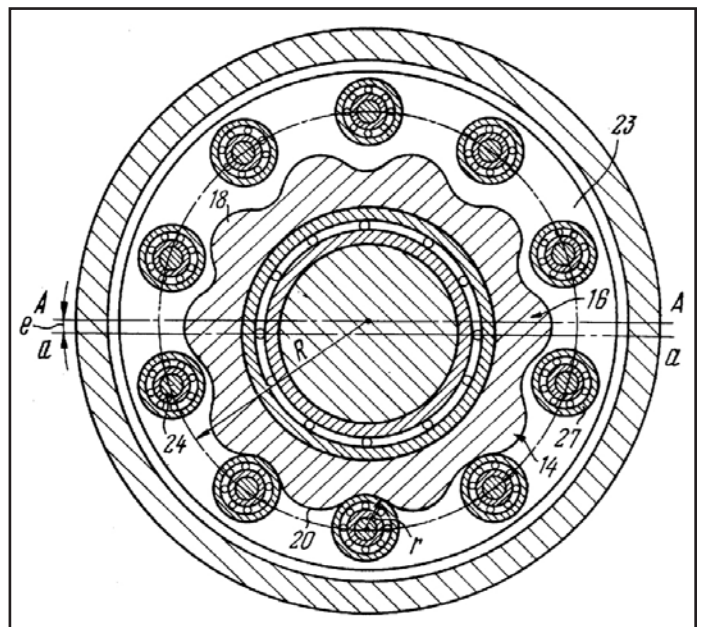


Figure 4 Cycloidal Gearhead.

of the eccentric moves the cycloidal gear in a small circular motion that moves the point of engagement with the outer ring forward by one pin for each revolution of the eccentric. The output shaft is normally driven from the outer ring (into which the pins are mounted). Other arrangements may use alternatives to replace the pins, but pins with rollers help reduce the contact friction. The large number of pins in contact with the cycloidal gear produce a gear design with low backlash and very high impact rating and high continuous torque rating. The contacts are all rolling so efficiency is fairly high (90–95% per stage) and wear is low. The use of two (or more) cycloidal gears operating in opposition helps reduce vibration from these moving masses while also increasing the number of pins in contact to increase the torque rating and stiffness. The gear ratio for a single cycloidal stage can go up to approximately 119:1 per stage. These are also used in robotic applications for their high stiffness and high gear ratio.

Combined Stages

It is very common to combine different gearhead styles. For example, to use a planetary gearhead followed by one of the higher torque rated harmonic or cycloidal gear head stage, taking advantage of the best of each.

Rotary to Linear

A large percentage of motors are rotary while many of the applications require linear motion. Here are a few of the common choices to use a rotary motor to make a linear motion.

Lead Screws

Lead screws have a wide range of pitches producing a wide range of effective “gearing”. Leadscrews with a higher pitch can be back driven and those with a very tight pitch can be locking (not able to be backdriven). Tight pitches can be used with a single stage to move quite heavy loads. The effective

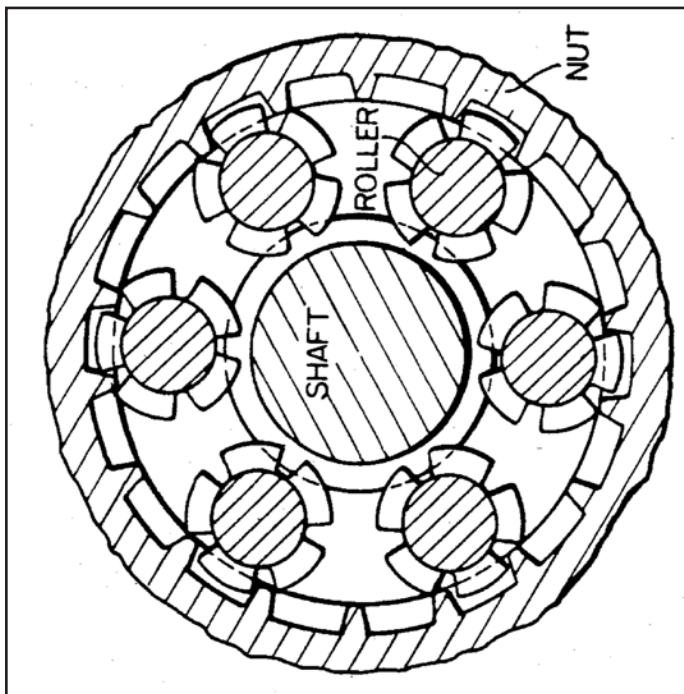


Figure 5 Planetary Roller Leadscrew.

“lever arm” when calculating reflected inertia to the motor rotary inertia is the pitch per revolution divided by $2 \times \pi$. A 2 mm pitch leadscrew has an effective “arm” radius length of 318 μm — that is moving a 1 kg load would reflect an inertia of $1 \text{ kg} \times (318 \text{e-}6 \text{ m})^2 = 1 \text{e-}7 \text{ kg-m}^2$ making a easy inertial match for even a fairly small motor. The trade off is the maximum speed is limited by the motor speed allowable for the bearing and by the maximum speed of the leadscrew to avoid whipping of the leadscrew (critical speed). Higher pitches can significantly speed the motion. Leadscrews are well applied to heavier loads with lower speeds. Multi-start lead screws can produce fast motion while still having a smaller thread spacing on the leadscrew. A 2 mm pitch 6 start lead screw advances 12 mm per revolution. This is an effective arm radius of $12 \text{ mm} / (2 \times \pi) = 1.91 \text{ mm}$; a 1 kg mass would be reflected as $3.6 \text{e-}6 \text{ kg-m}^2$. For reference a typical short stack NEMA 23 step motor has an inertia of $1.5 \text{e-}5 \text{ kg-m}^2$ so a 1 kg payload still is 4 \times less inertia than this size of motor.

Variants include brass and plastic lead nuts, and ball lead screws, that trade speed, noise levels, and life expectancy. There are also planetary roller lead screws that use other counter-rotating leads instead of nuts. These have very high force capability with much less wear as the sliding friction has been replaced with rolling motions.

Rotary motors are available with leadscrew shafts to reduce the size of the assembly and to eliminate couplers and bearings. Alternatively, there are also hollow motors that have a lead nut which is rotated by the motor for use with a stationary lead screw, which eliminates whipping of the leadscrew.

Belt Drives

Belt drives, helical belt drives, and wire drives convert the rotary motion of a pulley into a linear motion. Typically tooth belt is passed around a matching tooth pulley to avoid slippage. Wire drives can secure both ends of the wire to a bobbin with sufficient wraps to cover the required distance, while a helical belt drive typically uses a flat typically stainless steel belt wound in similar method to the wire drive.

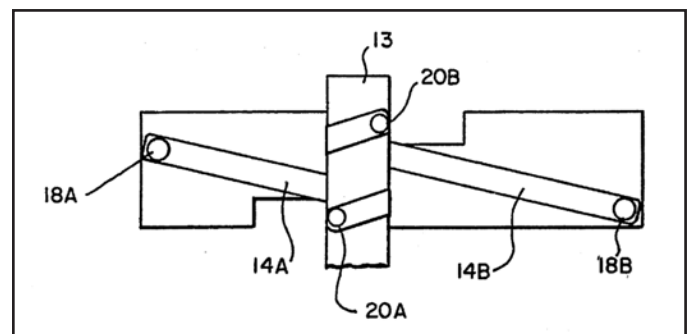


Figure 6 Helical Belt Drive.

The effective lever arm is the radius of the pulley, which can be significant. The linear motion per revolution is $2 \times \pi \times$ the pulley radius, which can make for significant speeds. With the higher speed does come a higher reflected inertia, but a stiff belt can keep the resonance frequency high enough for a tight, quick closed loop motion. Note that the motor can be fixed and the belt moving, or the belt fixed and the motor

carried on the payload. A 20 mm pulley would have a radius of 10 mm; that same 1 kg load now reflects $1e-4 \text{ kg}\cdot\text{m}^2$ with a motion of 62.8 mm/revolution. Belt drives are commonly used for lighter loads needing rapid motion.

Rack and pinion

A rack and pinion acts much like a steel belt drive — the rack taking the place of the belt and the pinion gear replacing the pulley. Light rack and pinions can be directly driven by a motor, although gearing before the pinion gear is common for heavier loads. The rack typically has a much higher stiffness. As there is little give, care needs to be taken to control the load between the pinion and rack to keep backlash reasonable. The high stiffness results in the capability for very high forces and very high speed operation.

Linear Motors

There are multiple linear motors that directly generate thrust without the need to convert a rotary motion. The Sawyer motor is a linear step motor that runs on a planar platen. The platen made of a high permeability material into which slots have been cut and filled with low permeability material (like epoxy) and ground to make a flat surface. The head carries both the magnets and the coils which are used to energize the motor. The sawyer motors are also available in XY configurations, even with limited rotary capability. This gives a direct XY capability without any rotary conversion.

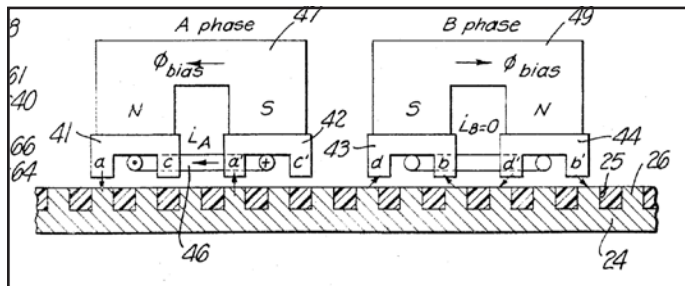


Figure 7 Sawyer Planar Motor.

There are also linear motors that directly move a pusher rod in and out. These are available in both sawyer type (magnets and coils on the driver) and conventional with stacked NSNS...NS magnets in the rod, with corresponding drive coils for higher force and velocity capability. Some of these rod type motors also include hall effect sensors to provide closed loop position capability.

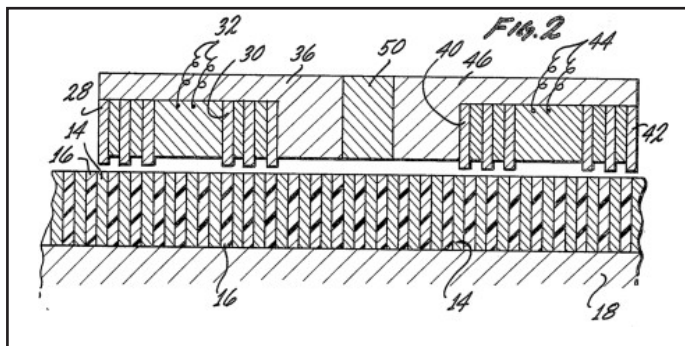


Figure 8 Linear Step Motor.

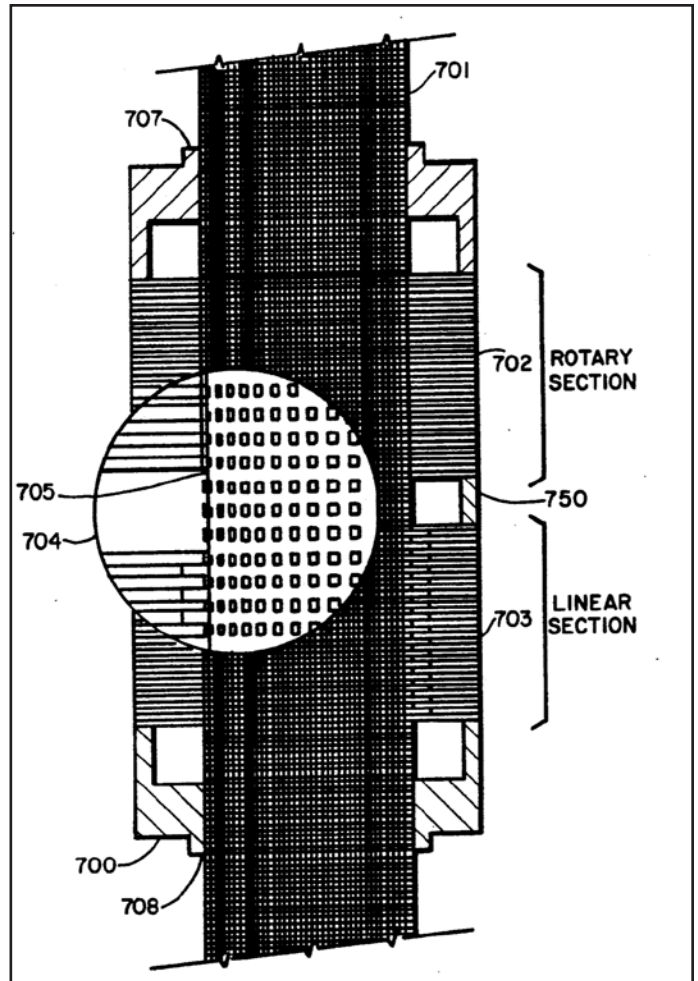


Figure 9 Linear + Rotary Step Motor.

There are even motors that combine two motor stages to provide both the rotary and linear capability for a Z-Theta capability.

Although this article touches just a small bit of the art in attaching motors to loads, focusing on small and servo motor applications, there are many ways to accomplish motion and it is often worthwhile looking at the options. **PTE**

Donald Labriola P.E. is president at QuickSilver Controls, Inc. He has been working with step motors since high school, and has had these motors operating field-oriented closed loop control since 1984.



don_labriola@quicksilvercontrols.com

In the Fast Lane with the FVA-Workbench: Formula Student Team KA-RaceIng

Benjamin Abert

The software developer FVA GmbH assists the winning KA-RaceIng team from the Karlsruhe Institute of Technology (KIT) with the *FVA-Workbench* gearbox development software. KA-RaceIng is one of the most successful teams of the Formula Student Germany international design competition, in which universities compete against each other with self-made formula racing cars. In 2020, KIT outperformed the competition in the overall category, as well as almost every sub-category of the online event. The car was made even better for the 2021 competition, with the main focus on further development of the drivetrain. To do this, the Karlsruhe team relies on the leading *FVA-Workbench* design software.

"To continue to be successful in the competition, we have to bring the gearbox design up to the current state-of-the-art, season after season. The *FVA-Workbench* enables us to integrate the latest research findings into our gear design, which makes it possible for us to design our car at a professional level," says Daniel Hartmann, KIT KA-RaceIng Electric Drivetrain Team Leader.

FVA-Workbench: Cutting-Edge Gearbox Design Software

Automotive and drive technology product development cycles are becoming shorter and shorter. This makes fast, reliable gearbox modeling and calculations even more important. Many companies rely on the *FVA-Workbench* for efficient simulation and calculation of gearbox systems. The software's features can be highly automated and are easy to customize. Analytical approaches guarantee fast and reliable solutions to key drive technology issues. Calculations for bodies that cannot be precisely described analytically are supplemented with suitable numerical methods. The software's intuitive modeling techniques guarantee consistent, valid, and manufacturable

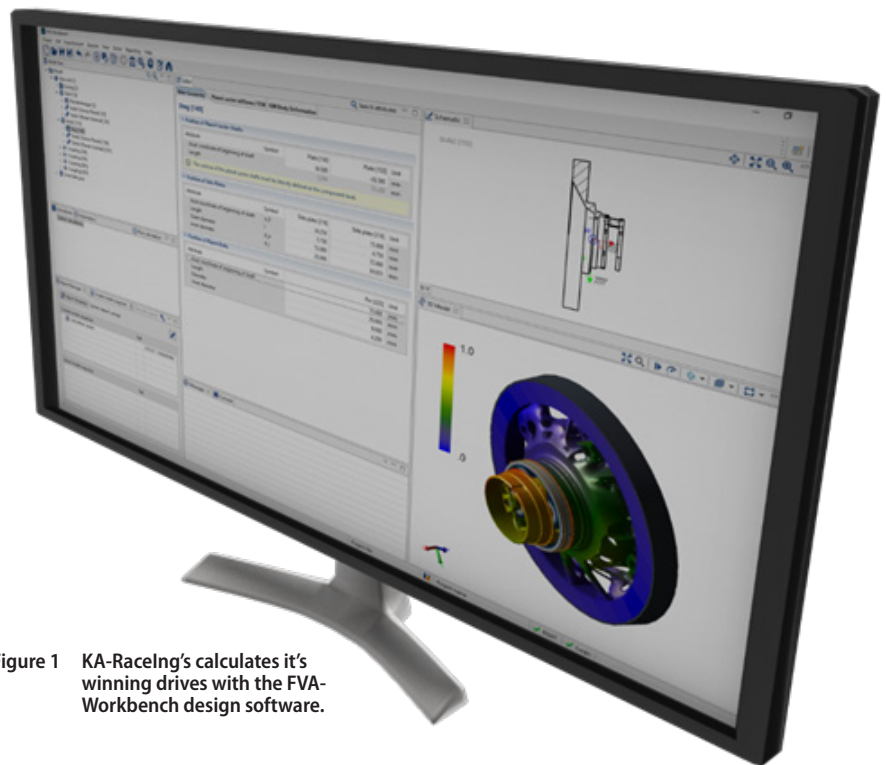


Figure 1 KA-RaceIng's calculates it's winning drives with the *FVA-Workbench* design software.

gear systems every time (learn more at: www.fva-service.de).

Formula Student 2021: a Winning Drive with the *FVA-Workbench*

KA-RaceIng's goal for this year's competition was to design the KIT21e race car to be even lighter and more aerodynamic than its predecessors. To achieve this, the team used empty space in the wheels to house the new gearbox. This makes the monocoque narrower, allowing additional aerodynamic functional surfaces to be added. The power density is also increased, as the necessary torque is converted just before the wheel makes contact with the road. Upstream of the gearbox, the load on the shafts is reduced accordingly. This allows the use of very thin shafts, which greatly reduces the overall weight of the vehicle.

KA-RaceIng's New Drive Concept

The drive concept provides for a two-stage planetary gear in the hub of each wheel. The drive is supplied by a custom-designed, flange-mounted electric motor. The two-stage planetary gear converts torque and speed from a maximum of 20,000 to around 1,500 rpm in a compact space. Integrating the wheel bearings into the planet carrier of the second stage allows the wheel loads to be dissipated using the shortest possible path.

The high cornering speeds in the competition generate high transverse forces, which lead to deformation of the wheel suspension and the planet carrier. In the worst case, these deformations can lead to uneven load distribution and ultimately to premature gearbox failure. For this type of design, it is essential to prove that the deformations do not have a negative influence on the gears.

One-click FEM Design Workflow with the FVA-Workbench

“The simple application of FE methods and excellent reporting in the FVA-Workbench have allowed us to quickly implement this new concept,” says Daniel Hartmann, KIT KA-RaceIng Electric Drivetrain Team Leader.

While developing the new KIT21e drive, the KA-RaceIng team was particularly impressed with the ability to consider the planet carriers as finite element components in the *FVA-Workbench*. All components can be directly imported from CAD, positioned, and then considered with the *FVA-Workbench's* one-click FEM design workflow. Additional calculations in external tools are no longer needed, and

FEM is the correct positioning of the FEM mesh relative to the gearbox model. An interactive dialog guides the user through the process to ensure that all bores are positioned correctly. Internally, the positioning corresponds to a transformation from the design coordinate system to the coordinate system of the FVA-Workbench. This potentially error-prone process is fully automated. Finally, the connecting nodes between the analytical components and FE structures are located and selected in the *FVA-Workbench*.

User-friendly output reports make teamwork easy. Following the calculation, the KA-RaceIng team must interpret and document the results. The reporting system in the *FVA-Workbench* greatly simplifies this process. The re-

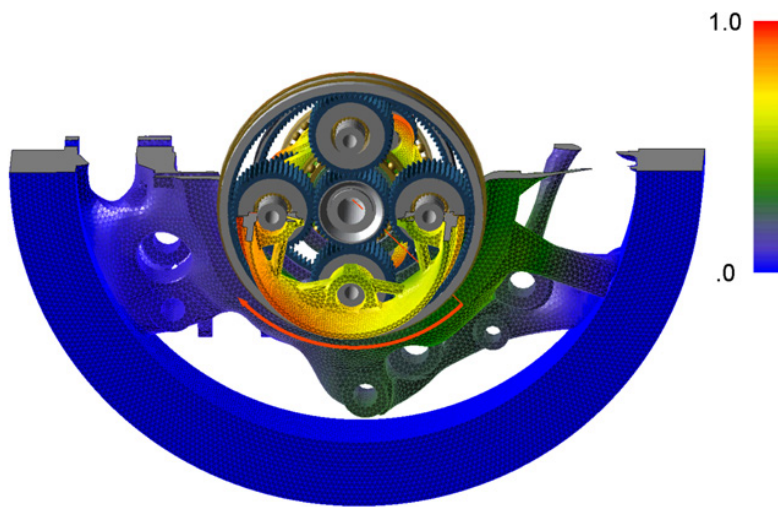


Figure 2 The planet carrier of KIT21e as a finite element component in the FVA Workbench report.

any potential errors can be avoided.

All common CAD formats, as well as native Abaqus and Ansys FE meshes, are available for the import. CAD geometries are directly meshed and qualified with the *FVA-Workbench's* internal mesher. The qualification examines the mesh for critical or unsuitable elements that can negatively influence the solution. This provides users with real-time information about the quality of the mesh.

The most important step in one-click

results of the design are presented in interactive, easy-to-understand HTML reports, which can be customized and adapted to the current task. New graphics can be added or tables can be adapted to include additional information quickly and easily. Interactive HTML reports make it simple to share data with colleagues, supervisors, or customers. Recipients can open and edit the reports without any additional programs. **PTE**

M. Sc. Benjamin Abert is
Head of Consulting & Service,
FVA GmbH.



Linear Motion Components Take Flight in Aerospace and Defense Industry

Chris Nook, CEO, Helix Linear Technologies

The aerospace and defense industry are positioned as one of the largest and most powerful industries in the United States. In fact, for over 100 years, this industry has moved, connected, and secured the modern world we live in today. It spans five markets: military aircraft, missiles, space, commercial airlines, and general aviation. Moreover, the United States aerospace sector is considered the most significant globally and serves as the primary military and civil aerospace hardware supplier.

Key Advantages Linear Motion Components in Aerospace Applications

The use of linear motion systems in aerospace and defense applications continues to drive technological advances, resulting in minimized weight, improved fuel efficiency, and precise movement. Miniature, lightweight lead screws, and actuator assemblies translate to less mass to move and exceptionally smaller design footprints. In addition, advanced manufacturing options make these parts fully customizable in size, material, coatings, machined ends, and motor mounting choices. Several additional advantages include:

- High accuracy and repeatability
- Addition of encoders for enhanced positioning, accelerometers for velocity, and load cells for applied force control
- Lower costs compared to ball screw assemblies and pneumatic or hydraulic actuators
- Easy interface into existing electrical systems
- Addition of intelligent motors to generate infinite motion profiles
- Corrosion protection through specific material selection
- Lubrication-free options via the use of internally lubricated plastic nuts that operate without additional lubrication, reducing maintenance and environmental contamination
- Clean, quiet operation

The reliability and accuracy of these systems are crucial. Helix Linear Technologies engineer Alex Gates agrees that the use of lead screws and electrical linear actuators offers significant advantages in multiple aerospace and defense applications.

“Compared to pneumatic or hydraulic cylinders, the advantage of linear motion products and linear actuators used in aerospace applications has greatly increased accuracy and repeatable operation. The inherent advantage of the electrical motors is the mechanical connection between a nut and screw versus a pump compressing a fluid and then pressing against a plunger. There is always more variability in fluids and flows than in electricity and mechanical connections. If you are trying to precisely move the flaps on an airplane wing

or the fins on a missile, this level of mechanical accuracy is critical for flight surface control.”

Along with added accuracy and control, enhanced field performance is propelling linear motion into the forefront of aerospace applications. Lead screws feature a unique thread that maintains a tighter, more rigid contact angle, resulting in lower contact stresses, higher load carrying capacity, reduced wear, optimum thrust control, and maximum predictable life. In addition, material selection specifically made for strength and durability — like high-strength steel, bronze or engineered high-PV plastics — offer proven dependability in rigorous and demanding environmental conditions and speeds. Lead screws also offer the opportunity to apply dry lubricants to reduce the maintenance frequency and increase the life of the overall assembly.

Select lead screw manufacturers also produce their own thread rolling dies and design custom thread forms when specific linear motion rates, speeds and forces are required. This in-house capability can offer shorter lead-times for prototype parts as well as reducing the risk of down time when rolling dies need to be replaced due to wear.

Lead screws perform optimally in a wide range of temperatures, from -50° to 140°F, when the design incorporates thermal expansion. High forces are also well-managed by selecting appropriately high tensile lead screw nut materials like bronze and high-PV polymers. Nuts manufactured from bronze or polymers combined with glass or Kevlar can be utilized with a PTFE coating on the screw as a dry lubricant. PTFE coatings can increase the life of lead screw nuts by up to ten times.

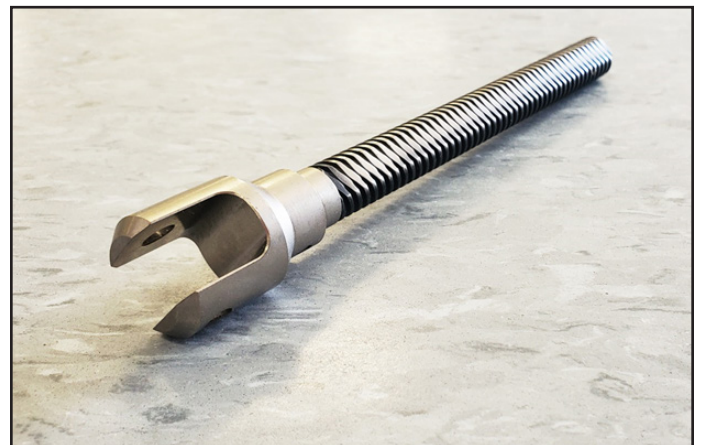


Figure 1 Lead screw with clevis; flat along the length of the screw provides anti-rotation.

Design Flexibility

The versatility and design flexibility afforded by using linear motion components like lead screws, liner guide rails, and electric linear actuators provide flight engineers with design freedom that was not previously possible. Lead screw nut design can be maximized to efficiently incorporate other components, reducing part counts and simplifying designs. Threaded inserts can be added to the nut design using ultrasonic welding or using inserts welding processes. Lead screws can also be manufactured from a wide array of materials to meet the specific aerospace requirements, including:

- Titanium
- Stainless Steel
- Aluminum
- Engineered plastics
- High strength Alloys
- Bronze



Figure 2 Hollow lead screws help to reduce overall weight of the actuation system; gear nuts also increase system rigidity.

These materials can also be utilized to manufacture hollow screws for weight reduction purposes and have custom-machined ends to accommodate bearings, pulleys, couplings, motors, and other assembly components.

Linear motion applications in this industry are widespread. Several common examples include:

Missile fin actuation. Precision-engineered miniature lead screw assemblies replace hydraulic and pneumatic actuators formerly used in these instances. Each lead screw and nut combination converts torque to thrust as the screw or nut turns, moving the mated piece in a linear direction. In addition, the lead screw mechanism eliminates sliding friction and stick-slip, therefore requiring little or no maintenance

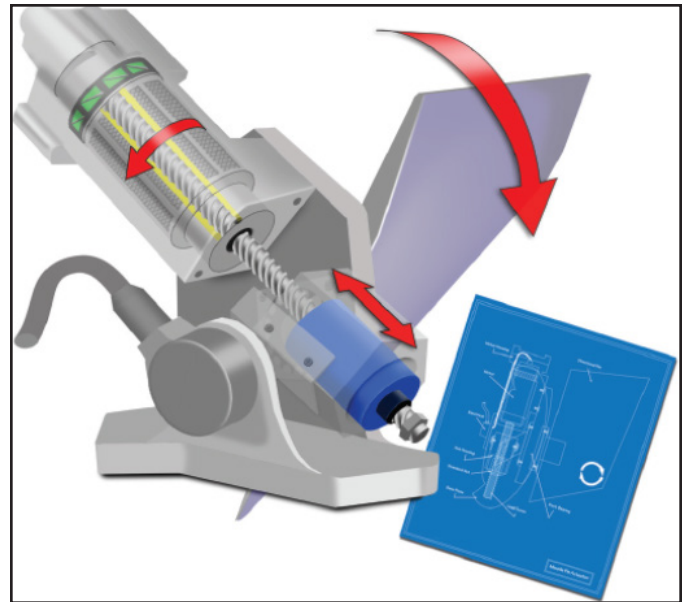


Figure 3 The lead screw mechanism eliminates sliding friction and stick-slip, requiring little or no maintenance after initial lubrication.

after initial lubrication. Lead screws automatically minimize the power required to drive missile-fin actuation due to their high efficiency. The size and weight of the fin drive transmission are also reduced, making lead screws a better option for small missiles and targeted munitions.

Unmanned aerial vehicles. The global UAV drone market is poised for rapid growth fueled by increased use of UAVs/drones in the military and defense industry. Fixed-wing sub-segments and military and defense sub-segments are estimated to lead the market. Lead screws and lead screw-driven actuators are quickly becoming a solution of choice as a product of their performance options and the speed to market for custom solutions.

Ranging in cost from several hundred dollars to hundreds of millions of dollars, the aircraft used in these systems vary widely — from a miniature scale weighing less than a pound to large aircraft weighing over 50,000 pounds. Unmanned aerial vehicles (UAVs) are designed to perform under high force, with high linear precision and in wide temperature ranges. Combining these design specifications with highly customizable manufacturing options (including non-standard materials like titanium or aluminum and specialty hollow lead screws for weight reduction) makes lead screws perfect for aerospace and unmanned vehicle applications.

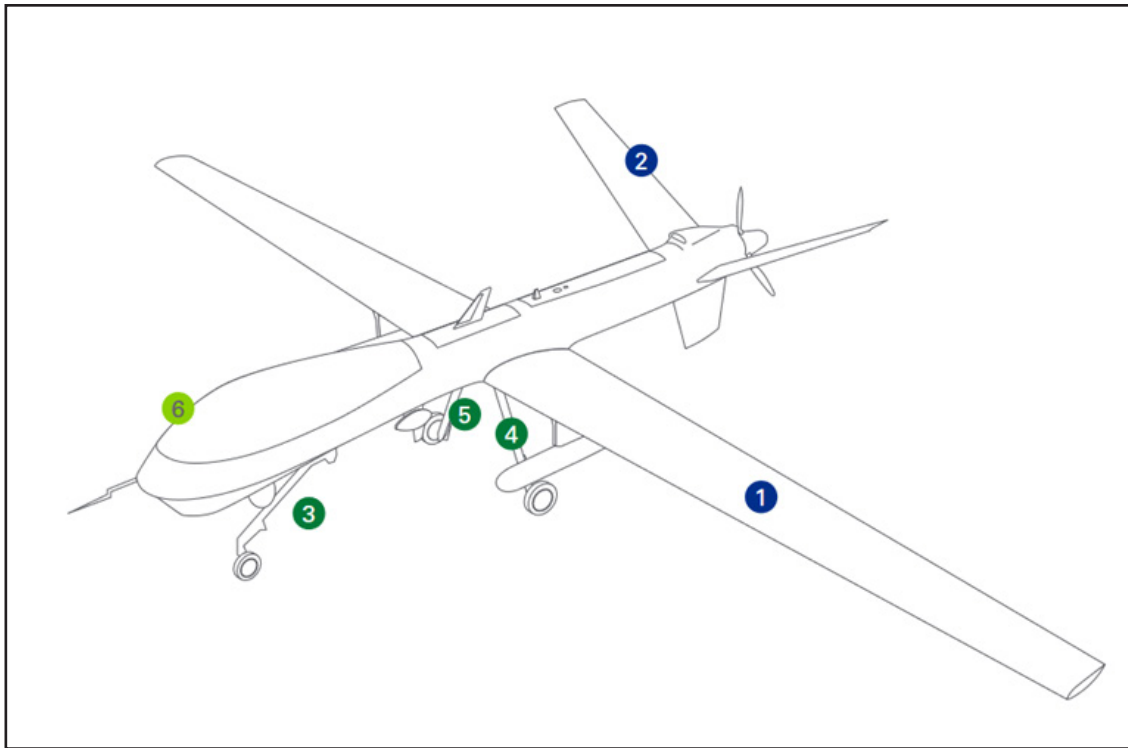


Figure 4 Common areas of linear motion product incorporation in UAVs.

1. Wing flap actuation – titanium screws with bronze or polymer nuts
2. Tail fin actuation – titanium screws with bronze or polymer nuts
3. Landing gear actuation – lead screw linear actuators are used to extend and retract landing gear and landing gear door hatches
4. Payload door actuation
5. Parking brake actuation
6. Pan/tilt actuation of cameras and vision systems

Seat actuation. Acme thread forms are ideally suited for seat actuation due to their highly dependable and repeatable performance over the lifespan of an aircraft. Additionally, when coupled with proven aerospace-grade motors, seat actuators designed with lead screws from Helix Linear technologies can be packaged and weight-optimized to comply with the multitude of safe air travel regulations.

Electronic sight systems. Most electronic sight systems involve a combination of integrated cameras, sensors, and positioning mechanisms that require high degrees of accuracy for data acquisition and pan/tilt actuation. Precision lead screws not only offer the same high degree of linear actuation precision afforded by ball screws, but they also provide a highly customizable solution at a fraction of the cost.

Thrust reverser screws. Thrust reverser screws allow the adjustment of the thrust reverser for deceleration aircraft, reducing brake wear and enabling shorter landing distances.

These examples are a small sampling of the technological advances made possible by linear motion systems. Other common uses for lead screws and linear motion

guidance systems in the aerospace industry include gun-sight actuation systems, tank sighting systems, antenna elevation, and azimuth actuation systems.

As linear motion technologies continue to develop, so do the manufacturers that produce these innovative solutions. They have evolved to offer specialized services and end-to-end capabilities while supporting aerospace client partnerships through world-class engineering, BOM reduction, and testing assistance. These relationships are also being forged much earlier in the project lifecycle. A manufacturer's agility in the prototype arena, combined with the flexibility to run small batch components and aid in part validation, allows aerospace engineers to get from prototype to production in drastically shortened timeframes. As industry pressure demands increasingly intelligent, lighter, and more accurate aerospace and defense solutions, linear motion components will continue to support these initiatives. **PTE**

Christopher Nook is the Founder and Chief Executive Officer of Helix Linear Technologies. With thirty years of linear motion expertise, Nook oversees product innovation, strategic planning, and development of linear motion markets. Helix Linear Technologies is a leading manufacturer of linear motion products. With decades of innovation, the company has partnered with clients to engineer success in a wide range of aerospace, defense, medical device and diversified industrial aerospace markets.



Schaeffler

LAUNCHES SHARE PROGRAM IN NORTH AMERICA

In collaboration with The Ohio State University (OSU), Schaeffler recently launched its first Schaeffler Hub for Advanced Research (SHARE) Program in North America. Located on the Ohio State campus in Columbus, Ohio, the collaborative program begins in August and will focus on all solid-state electrolyte (ASSE) battery development with future plans for fuel cell research and development.

Schaeffler's e-mobility team — Patrick Lindemann, president of BD transmission systems and e-mobility; Jeff Hemphill, chief technical officer; Philip George, director, region innovation; and Rashid Farahati, director of wet friction material and surface technologies — recently joined Ohio State's Center for Automotive Research (CAR) team to celebrate the kickoff of the program.

"This program is an ideal way for Schaeffler to inspire and foster the next generation of automotive and mobility engineers," said Jeff Hemphill, CTO, Schaeffler Americas. "Building on the success of our established international programs, we hope our work with OSU will expand the current state of ASSE and fuel cell technology, which we believe are key components for the future of mobility."

The SHARE program uses the "company on campus" concept that includes dedicated offices for full-time Schaeffler employees at the university to foster a close collaboration between Schaeffler employees, university researchers, Ph.D. candidates and students.

As part of the initial program, Schaeffler is sponsoring a Ph.D. student who will also be an integral part of Schaeffler's on-site team. Supporting a Ph.D. candidate who will concurrently focus on ASSE battery manufacturing development is yet another example of how the SHARE program advances e-mobility innovation while also giving back to higher education.

The SHARE program at Ohio State builds on Schaeffler's long-term commitment to supporting academic and economic growth in the state of Ohio. Schaeffler and Ohio State have previously collaborated on several research initiatives — including the GearLab and as a member of the CAR Consortium — to drive technology advancements and promote the automotive field with a particular focus on e-mobility. These collaborations are a key component of Schaeffler's commitment to fostering the next generation of mobility engineers while helping stimulate the innovations needed to support the evolving auto industry.

"This SHARE program is an excellent initiative and an ideal model for academia — industry collaboration. I believe that the impact of this initiative on research and education will be invaluable in preparing Ohio State students to be the next-generation leaders in energy storage and vehicle electrification," said Giorgio Rizzoni, professor of mechanical and aerospace engineering (MAE) and director of CAR.

"All solid-state electrolyte (ASSE) battery will be a breakthrough for the next-gen electric vehicles technology. Through the SHARE program, Schaeffler and Ohio State will be able to innovate and develop jointly the manufacturing processes of ASSE battery that can be upscaled and implemented to electric vehicles," said Jung-Hyun Kim, assistant professor of MAE and associate fellow at CAR.

The Ohio State University is Schaeffler's fifth SHARE program presence globally and the first in the Americas. The



other SHARE programs include partnerships with:

- The Karlsruhe Institute of Technology (KIT) in Germany focusing on electric and automated mobility;
- Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) in Germany focusing on digitalization and data science;
- Nanyang Technological University (NTU) in Singapore focusing on robotics and Industry 4.0; and
- Southwest Jiaotong University (SWJTU) focusing on interurban mobility, especially railway technology.

www.schaeffler.com/content.schaeffler.com/en/innovation/open_innovation/share_network/share_network.jsp

Formic Technologies

OFFERS ROBOTICS-AS-A-SERVICE

Robotics-as-a-service company Formic Technologies recently launched a simple value proposition: hire fully customized robots from top vendors at a low hourly rate and no upfront cost. To help small and medium-size manufacturers benefit from automation, Formic handles every aspect of a financing and deployment—from scoping, engineering, purchasing, implementation, and maintenance. The company also guarantees uptime, with customers paying nothing for system downtime.

Traditionally, manufacturers buy robots, which is a lengthy, complex, inflexible, and expensive process. These barriers to entry are so high for smaller manufacturers that they often refrain from deploying automation altogether.



“We started Formic because we saw all that automation can do, and we wanted to provide a way for any manufacturer to easily adopt automation in a simple, risk-free, and on-demand way,” said Saman Farid, CEO and co-founder. “With Formic’s fundamentally different approach to financing and deployment, manufacturers can do more with automation without high costs or a lengthy and complicated purchasing and deployment process.”

Formic’s model was designed to systematically remove every barrier to entry, allowing manufacturers to deploy automation efficiently and cost effectively. Testing shows that Formic’s deployments are 50% faster than traditional approaches and save customers 42% on their operating expenses from the first day.

According to Farid, an engineer and robotics start-up investor who founded Formic with former Universal Robots salesperson Misa Ikhechi, a unique combination of products and services make Formic’s model possible:

- Systematized deployment processes
- In-house equipment financing
- Formic-designed solutions featuring products from leading robotic vendors such as Universal Robots, Fanuc and ABB

“We came to the conclusion that what manufacturers needed was not any specific new technology, but a better way to access the technology that would best meet their needs,” Farid said. “Formic offers that access at a fraction of the cost or energy, as Formic takes on the heavy lifting.”

www.formic.co/

Bonfiglioli

CELEBRATES 40 YEARS IN THE UK

This year marks the 40th anniversary of the establishment of the first subsidiary of Italian drive specialist Bonfiglioli Riduttori in the UK. A good reason to celebrate, as Bonfiglioli’s development in the UK over the 40 years has been a true success story.

Today, Bonfiglioli UK’s 2,400 m² facility is located in Warrington, near Manchester, and is one of 21 commercial branches worldwide. As a wholly owned subsidiary of Bonfiglioli S.P.A., Bonfiglioli UK Limited is responsible for all sales activities of the Mobility & Wind (M&W) and Discrete Manufacturing & Process Industries (D&P) as well as Motion & Robotics (M&R) business units in the UK. Today Bonfiglioli UK is 23 employees strong and generated sales of £34m in the last financial year.



In the UK, all the business areas of the Bonfiglioli Group are represented. The D&P business area is active in many mechanical engineering sectors, among others, and also offers the right solutions for almost all industrial applications. A very extensive product portfolio ranging from precision gearboxes to extremely powerful large planetary gearboxes is the basis for further growth. The M&W business unit supplies many well-known manufacturers of mobile construction machinery, cranes, and agricultural applications. In addition to hydraulic applications, Bonfiglioli accompanies the market in the electrification of these machines, doing pioneering work that demonstrates the company’s innovative strength. In azimuth and pitch drives for wind turbines, Bonfiglioli has a global market share of around 35% and therefore rightly considers itself the market leader. The M&R business unit rounds off the drive portfolio with its

high-performance frequency inverters and servo controllers. In the market, Bonfiglioli has built up a reputation as a reliable partner for complete drive systems with its broad product range.

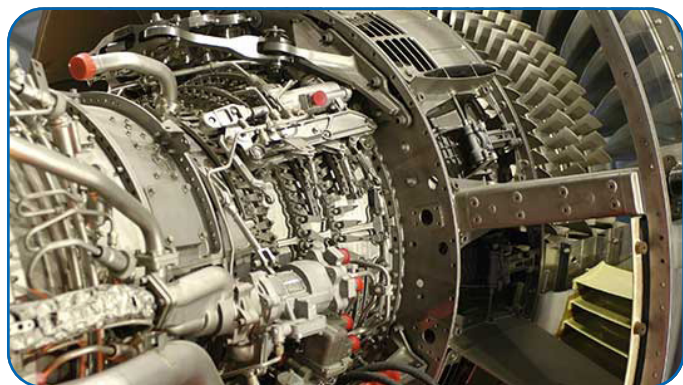
The UK is an economically important market for Bonfiglioli. This is another reason why the 40th anniversary is a very special date for the company

www.bonfiglioli.com

Epicor

RECOGNIZED FOR MANUFACTURING VISION AND EXECUTION

Epicor Software Corporation, a global provider of industry-specific enterprise software to promote business growth, has been named a Visionary in the 2021 Gartner Magic Quadrant for Cloud ERP for Product-Centric Enterprises for the third consecutive year.



“We believe that placement in the Visionary quadrant reinforces our focus on building Kinetic with our customers, for our customers,” said Epicor President Himanshu Palsule. “Kinetic has the functionality necessary to run a modern, future-ready, manufacturing business looking to capitalize on data, transform digitally in the Cloud, and innovate without limits. The partnership with our customers is critical. And that’s why we prioritize customer touch-points and feedback that influence our product innovation.”

Epicor operates in 150 countries around the world with 20,000 customers utilizing its expertise and solutions to improve performance and profitability for manufacturing, distribution, and retail.

www.epicor.com

Velo3D

EXPANDS TEAM IN EUROPE

As global demand for top-quality 3D-printed industrial parts continues to grow, California-based Velo3D, Inc., a leader in advanced additive manufacturing (AM) for high-value metal parts, has announced the appointment of two new Europe-based senior executives.

Managing Director, **Dr. Jose Greses**, will be based between Germany and Spain while Sales Director, Xavier Fruh, will be located in France. They join Jon Porter, who was appointed earlier this year as European Business Development Director based in the U.K.



Dr. Greses holds a Ph.D. in laser welding from the University of Cambridge (U.K.) and a M.Sc. in Marine Technology from Cranfield University (U.K.). He has worked for a number of leading European manufacturing companies in laser welding and 3D-printing—most recently with GF Machining Solutions and, prior to that, for 14 years with German AM company EOS.

“Our goal is to help industries solve their engineering challenges by delivering unprecedented design freedom, part repeatability and quality in metal 3D printing,” says Dr. Greses.

Quicksilver Controls silverMax™ Integrated Hybrid Servos

Motor + Encoder + Controller + Driver

High Efficiency Over Wide Speed Range
Highly Programmable
Handles Large Inertia Mismatch
NEMA 23 and 34

Bringing Our 23 years of
Hybrid Servo Expertise
to Your Project!



+1 909 599 6291

www.QuicksilverControls.com



“We’re here to provide the European markets with a seamless transition to Velo3D’s end-to-end manufacturing solution including its advanced support-free technology.”

Xavier Fruh has a Master’s degree in electrical engineering from ESIGELEC Rouen and an M.B.A. from the Strasbourg School of Management, both in France. He has years of experience in the welding industry and most recently did business development around Europe for four years with AddUp, a French group specializing in AM technology.



“I am passionate about innovation and technology,” Fruh says. “I’m keen to support our customers in overcoming the limits of traditional manufacturing and to help them take advantage of everything that AM, the next generation of manufacturing engineering, has to offer.”

Benny Buller, founder and CEO of Velo3D, views his company’s European growth as a sign of greater awareness of the production metrics delivered by advanced 3D-printing systems. “Expanding our footprint in Europe comes in response to new demand for the very highest-achievable levels of metal AM quality that only Velo3D provides--as well as design freedom that can unleash innovation and improve competitiveness for industries such as aerospace, oil and gas, and alternative energy,” he says.

In March, Velo3D announced plans to merge with JAWS Spitfire Acquisition Corporation and become a public company.

Velo3d.com

Mujin

BRINGS ROBOTICS SOLUTIONS TO U.S. LOGISTICS COMPANIES

Mujin, a Japanese industrial robotics company bringing machine intelligence to robots throughout Asia since 2011, has established US-based Mujin Corp. and recently opened its first office in North America. Located in Sandy Springs, north of Atlanta, the office will house the company’s expanding engineering, sales and support staff, including Mujin co-founder and Mujin Corp. CEO Ross Diankov. The office will serve as a hub for expanding the company’s multi-award-



winning solutions into the U.S.’s burgeoning logistics automation market.

Mujin’s flagship product, the Mujin Controller, offers the first all-purpose intelligent robot control system. It uses real-time perception, motion planning and universal control to create robots that can handle complex logistics tasks that were previously not possible by making the system deployment faster, reliable and more affordable, and without the need for coding or “teaching.” The Mujin Controller can manage any robotic application by guiding the movement of any robot arm via machine intelligence, a new and advanced category of artificial intelligence that automatically manages potential downtime scenarios through autonomous motion planning and perception without the need for human intervention.

“Companies that want to automate mundane and repetitive material-handling tasks face a myriad challenges, from the high costs of developing solutions for their difficult applications to unscheduled downtime and reprogramming costs when things don’t go as planned or when robots must be reprogrammed due to a change in product or workflow,” Diankov said. “As some of the largest companies in Asia have experienced, Mujin will bring a new wave of robotics technology to the U.S. market, with robots no longer needing to be taught how to move explicitly. Instead, the robots will already ‘know’ what they need through what we call ‘machine intelligence,’ which enables more capability and efficiency for robot picking applications that were previously impractical or difficult to deploy.”

Machine Intelligence vs. Machine Learning & Human Control

Engineered by Mujin, “machine intelligence” is the fusion of real-time motion planning, perception, simulation, and control technologies. Unlike traditional ‘teach-based’ systems that require experts to program each movement or machine learning systems that ‘learn’ how to pick items over time, machine intelligence, enables the Mujin Controller to give a robotic system real-time decision-making capability that allows truly autonomous, reliable and production-capable robot applications.

With Mujin Controller, users begin by modeling the environment and setting relationships between the robots and target objects in a high level. The system then allows the robot to safely perform tasks by offering high-level goals without explicitly telling the robot where to go or how to move.

“With the robot motion now computed in real time without human intervention, the system must understand the intuitions behind completing tasks and then positions them in a way that enables the robot to dynamically adapt to changing circumstances,” Diankov added. “With the mindset of machine intelligence, Mujin makes every robot more capable, efficient and reliable, and allows robots to perform practically any application with optimum efficiency.”

www.mujin-corp.com

DMSC

ANNOUNCES UPDATE WITH MTCONNECT INSTITUTE

The Digital Metrology Standards Consortium (DMSC, Inc.) is pleased to announce an update to the Memorandum of Understanding (MoU) with the MTConnect Institute. The original MoU was signed in 2011.

As technology has evolved, both organizations recognize an even greater need to optimize the way industrial software and machines work together, to encourage manufacturing standards development, and to use data modeling to enable information interoperability by specifying the content of specific information and where it is stored — all with the goal of improving manufacturing efficiency.



DMSC and MTConnect are leading modern industrial standards development by crafting a common, standardized, machine-readable information schema. This makes it easier for software developers, quality managers, engineering, and manufacturing to use quality and manufacturing data together. By promoting the Quality Information Framework (QIF) and MTConnect integration, manufacturers will have access to a wider variety of world class manufacturing machine and software solutions. The two organizations plan to support and promote joint projects that will encourage integration and use of standardized information frameworks for parts and processes.

Curtis Brown, president of DMSC, commented “We’re enthused about collaborating with MTConnect in an effort to support and expand the use of QIF for manufacturing applications. A key benefit of collaboration between our two organizations will be expanded industry availability and enhanced implementation of QIF where an information schema for Quality data is needed. We look forward to integrating our data models with the promise of better connectivity between quality-related information and manufacturing process information in a more reliable and secure manner.”

Doug Woods, president of the MTConnect Institute, said “Manufacturers looking to rapidly digitize their operations want integration across all departments. MTConnect breaks down silos, but harmonization with other standards is absolutely necessary to stay relevant. Working with DMSC on functional, technical interoperability is a big milestone for MTConnect and for smarter manufacturing.”

qifstandards.org

STLE

ANNOUNCES FREE PODCAST SERIES

The Society of Tribologists and Lubrication Engineers (STLE)—the technical society for individuals in the field of tribology and lubrication engineering—is pleased to announce a new, free podcast series titled “Perfecting Motion: Tribology and the Quest for Sustainability.”



The series is hosted by Neil Canter, Ph.D., STLE advisor, technical programs and services and Tribology and Lubrication Technology (TLT) writer. Content will feature insights from leading industry professionals about some of today’s most important issues and trends impacting the global tribology and lubricants community.

In the introductory podcast, Canter discusses a series of technological developments that illustrate how tribology and lubrication can help address the threat of global warming and promote the movement toward sustainability.

“Tribologists are working on new approaches for further reducing friction and wear that will hopefully improve the efficiency of internal combustion engines, leading to a reduction in carbon dioxide emissions and an improvement in sustainability,” says Canter. “Current research seeking to achieve this objective will be covered in future podcasts.”

The second podcast will focus on tribochemistry and will include interviews with STLE board members, Kuldeep Mistry, Ph.D. (The Timken Company) and Nic Argibay, Ph.D. (Sandia National Laboratories). Canter says, “Tribochemistry explores the reactions that can occur between lubricants and surfaces under boundary lubrication conditions where there is little room between the two. Research is ongoing to determine how specific lubricants can react with surfaces under these severe conditions to produce materials, such as diamond-like carbon (DLC), that have the potential to achieve superlubricity where coefficient of friction values are below 0.005.”

Future STLE podcast topics include:

- Additive Manufacturing
- Lubricant Additives
- Nanolubricants/Nanoadditives
- Lubricant Testing
- Graphene

www.stle.org/podcast

CALL FOR PAPERS!

Are you sitting on an idea for a technical paper but wondering where to present it? Do you have one already written, sitting on your desk, gathering machine dust?

How about *Power Transmission Engineering*? We are always looking for gearing- and power transmission component-relevant technical papers for publication in the magazine and in its digital version. Having your work appear in *Power Transmission Engineering* guarantees you an audience of the most experienced and discriminating industry players. You say your work has not been peer-reviewed? Not a problem, as we are lucky—and thankful—to have on-hand some of the most experienced and brilliant minds in the industry—our technical editors. So if your work “passes muster” and is published, you’ll know you were reviewed by the best—and most demanding.

Chances are you’ll be creating the paper under the auspices of the company for whom you work or own, or for one of the various industry-relevant associations. That means they as well will bask in the reflected glory that accrues with publication in *Power Transmission Engineering*.

For publication guidelines and more information, please contact Jack McGuinn at jmccguinn@powertransmission.com.

ABB

Page 3
abb.com/us

Andantex

Page 14
andantex.com

B&R Machine and Gear

Page 38
www.brgear.com

Beyta Gear Service

Page 2
www.beytagear.com

Bonfiglioli USA

Page 13
shop.bonfiglioli.com

Brother Gearmotors

Inside Front Cover
BrotherGearmotors.com

Continental

Page 5
www.continental-industry.com

CTI Symposium

Page 25
www.drivetrain-symposium.world/de

Designatronics

Pages 9, 32
www.sdp-si.com

Diequa Corp.

Pages 12, 39
www.diequa.com

JIE USA

Page 37
www.jie-drives.com

Lubriplate

Page 11
www.lubriplate.com

McInnes Rolled Rings

Page 18
www.mcinnesorledrings.com

NES Bearing Co. Inc.

Pages 19, 30
www.nesbearings.com

Neugart USA

Page 2
www.neugart.com/en-us

Nordex Inc.

Page 38
www.nordex.com

PBC Linear

Outside Back Cover
pbclinear.com

Philadelphia Gear

Page 7
PhilaGear.com/MyMission

Quality Bearings & Components

Page 9
www.qbcbearings.com

Quicksilver Controls

Page 51
www.QuickSilverControls.com

Regal Beloit

Front Cover, Pages 28-29, 31
Regalbeloit.com/powertrain

SDP/SI

Page 9, 32
www.sdp-si.com

SEW-Eurodrive

Inside Back Cover
www.seweurodrive.com

U.S. Tsubaki

Page 35
ustsubaki.com

Worldwide Electric

Page 15
worldwideelectric.net

Zero-Max

Page 17
www.zero-max.com

Power Transmission Engineering®

FREE SUBSCRIPTION

20PTEALL

Please Respond

Your response ensures that we deliver the magazine only to those who want it. It also gives us the vital information we need to serve you best.

- YES** I want to receive/continue to receive **Power Transmission Engineering**
- NO** Thanks anyway, but I don't need the world's best publication on mechanical components.

Name _____ (please print) Job Title _____

Signature _____ (required) Date _____

How would you like to receive Power Transmission Engineering?

- PRINT Version (Verify mailing info below)
- DIGITAL Version (E-mail required)
- BOTH Print AND Digital (E-mail required)

E-mail _____ *

***You can OPT OUT of your e-mail subscription at any time.**

How is THIS LOCATION involved with power transmission products? (Check all that apply)

- WE MAKE power transmission products
- WE BUY power transmission products
- WE SELL power transmission products (Distributors, sales reps, etc.)
- WE DESIGN products with power transmission components in them
- Other (please describe) _____

What is your company's principal product or service? _____

MAILING INFORMATION

NAME:

JOB TITLE:

COMPANY:

ADDRESS:

- Check if this is a home address

CITY:

STATE/Province:

ZIP/Postal Code:

PHONE:

FAX:

If your label is incorrect or incomplete, please update it above!

FAX to 1-847-437-6618

SCAN to: subscribe@powertransmission.com

Adapting Aerodynamics

Northwestern University Introduces Smallest Human-Made Flying Structure

Matthew Jaster, Senior Editor

The new flying microchip (or “microflier”) does not have a motor or engine. Instead, it catches flight on the wind — much like a maple tree’s propeller seed — and spins like a helicopter through the air toward the ground.

By studying maple trees and other types of wind-dispersed seeds, engineers at Northwestern University have optimized the microflier’s aerodynamics to ensure that it—when dropped at a high elevation—falls at a slow velocity in a controlled manner. This behavior stabilizes its flight, ensures dispersal over a broad area and increases the amount of time it interacts with the air, making it ideal for monitoring air pollution and airborne disease.

As the smallest-ever human-made flying structures, these microfliers also can be packed with ultra-miniaturized technology, including sensors, power sources, antennas for wireless communication and embedded memory to store data.

“Our goal was to add winged flight to small-scale electronic systems, with the idea that these capabilities would allow us to distribute highly functional, miniaturized electronic devices to sense the environment for contamination monitoring, population surveillance or disease tracking,” said Northwestern’s John Rogers, a professor of materials science and engineering. “We were able to do that using ideas inspired by the biological world. Over the course of billions of years, nature has designed seeds with very sophisticated aerodynamics. We borrowed those design concepts, adapted them and applied them to electronic circuit platforms.”

According to the Northwestern University website, Rogers’ engineering team drew inspiration from a child’s pop-up book.

His team first fabricated precursors to flying structures in flat, planar geometries. Then, they bonded these precursors onto a slightly stretched rubber substrate. When the stretched substrate is relaxed, a controlled buckling process occurs that causes the wings to “pop up” into precisely defined three-dimensional forms.

“This strategy of building 3D structures from 2D precursors is powerful because all existing semiconductor devices are built in planar layouts,” Rogers said. “We can thus exploit



the most advanced materials and manufacturing methods used by the consumer electronics industry to make completely standard, flat, chip-like designs. Then, we just transform them into 3D flying shapes by principles that are similar to those of a pop-up book.”

The microfliers comprise two parts: millimeter-sized electronic functional components and their wings. As the microflier falls through the air, its wings interact with the air to create a slow, stable rotational motion. The weight of the electronics is distributed low in the center of the microflier to prevent it from losing control and chaotically tumbling to the ground.

In demonstrated examples, Rogers’ team included sensors, a power source that can harvest ambient energy, memory storage and an antenna that can wirelessly transfer data to a smart phone, tablet or computer.

In the lab, Rogers’ group outfitted one device with all of these elements to detect particulates in the air. In another example, they incorporated pH sensors that could be used to monitor water quality and photodetectors to measure sun exposure at different wavelengths.

Rogers imagines that large numbers of devices could be dropped from a plane or building and broadly dispersed to monitor environmental remediation efforts after a chemical spill or to track levels of air pollution at various altitudes.

“Most monitoring technologies involve bulk instrumentation designed to collect data locally at a small number of locations across a spatial area of interest,” Rogers said. “We envision a large multiplicity of miniaturized sensors that can be distributed at a high spatial density over large areas, to form a wireless network.” **PTE**

www.youtube.com/watch?v=x6gB1hKjDys&t=48s



- ✓ Called SEW
- ✓ Got expert solution
- ✓ Ordered complete package
- ✓ Dinner with family M-F
- ✓ Home on Sat/Sun!



Honey, I'm home!

Tired of working nights and weekends on motion control projects? It's time to contact an automation specialist at SEW-EURODRIVE for help.

We provide a **complete package** from start to finish, including project planning, software, components, commissioning, troubleshooting, and worldwide support.

Get your free time back!

SEW
EURODRIVE

Robust Precision You Can Rely On

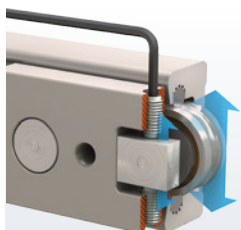
Now with 5 Wheel, 4 Wheel, and 3 Wheel Carriages

Increased Moment Load Capacity
Increased Radial and Axial Load Capacity
Increased Design Flexibility

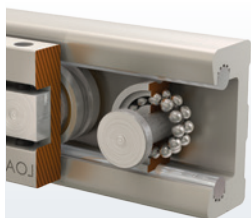
Where two carriages might have been needed, now one can carry the load, saving space and cost.

Redi-Rail Advantages

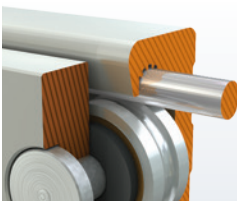
Precision straight rails and hardened gothic arch rollers are ideal for high speed and moderate load linear motion.



Patented side adjusted preload simplifies assembly and installation.



Double row bearings sealed against contamination and maintenance free.



Rails are integrated with hardened steel races to ensure strength within a lightweight design.

Request Your
FREE Sample



bit.ly/Sample-RediRail

