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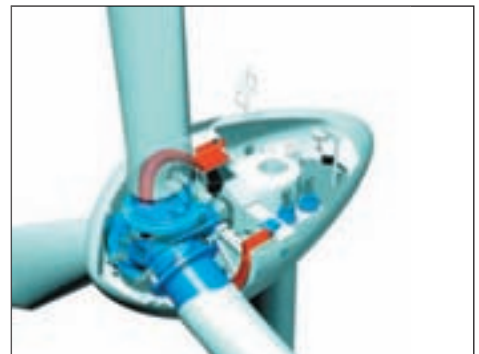
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VOL. 2, NO. 1

Randall Publishing, Inc.
 1425 Lunt Avenue
 P.O. Box 1426
 Elk Grove Village, IL 60007

Phone: 847-437-6604
 Fax: 847-437-6618

EDITORIAL

Publisher & Editor-in-Chief Michael Goldstein
publisher@powertransmission.com

Managing Editor William R. Stott
wrs@powertransmission.com

Senior Editor Jack McGuinn
jmcguinn@powertransmission.com

Associate Editor Matthew Jaster
mjaster@powertransmission.com

Assistant Editor Lindsey Snyder
lsnyder@powertransmission.com

Editorial Consultant Paul R. Goldstein

ART

Art Director Kathleen O'Hara
kathyohara@powertransmission.com

ADVERTISING

Advertising Sales Manager Ryan King, RK Media, Inc.
ryanking@powertransmission.com

CIRCULATION

Circulation Manager Carol Tratar
subscribe@powertransmission.com

RANDALL PUBLISHING STAFF

President Michael Goldstein
Vice President Richard Goldstein
Accounting Luann Harrold



Photo courtesy of NKE Austria GmbH.



Philips

DEVELOPS INNOVATIONS IN STANDARD LINEAR MOTORS

Philips Applied Technologies recently developed a technique allowing standard linear motors to simultaneously provide movement along two axes rather than a single axis. This technique, patented as NForcer Technology, will allow designers to reduce the number of motors and electronic drive modules typically required for industrial automation machines.

According to Philips, manufacturers of pick-and-place and wafer processing equipment can produce more accurate production stages using this technology. The dual-axis linear motor provides a cost-effective solution for pick-and-

place applications and comes with all the benefits of linear motors.

“The beauty of this new innovation in linear motor operation is that it requires absolutely no modification to existing motor components,” says Dr. George Angelis, senior scientist at Philips Applied Technologies. “All you need to do is reposition the components slightly, and drive them in an intelligent way.”

The technique allows horizontally mounted linear motors to generate lift as well as lateral motion, providing both axes of motion from just one motor. It also enables the production of precision, magnetically levitated platforms with six axes of controlled motion.

In a conventional linear motor, the current-carrying conductors are arranged in coils with only the vertical sides in the magnetic field, resulting in lateral

motion. To achieve two-dimensional motion from a single motor, researchers at Philips Applied Technologies have shifted the position of the coils so the lower horizontal section also sits in the magnetic field.

According to the company’s press release, NForcer Technology allows the production of fully floating bearingless platforms that can be used in a vacuum, unlike air-bearing solutions. This platform can be implemented with only four horizontal magnet tracks and six forcers.

Philips first tested NForcer Technology by electromagnetic and mechanical dynamic modeling in a simulation environment. To confirm simulations, engineers also tested a commercially available motor by measuring the forces and torques

continued

product news

generated with NForcer. The engineers began designing a few prototype systems with their results.

Philips demonstrated this technology last October at the American Society for Precision Engineering annual meeting in Dallas. Demonstrations included a single-track roller bearing pick-and-place mechanism with 20 cm horizontal and 3 cm vertical movements achieved with a single forcer and a magnetically levitated platform, movable in six degrees of freedom with nanometer accuracy. Both were constructed from standard “off-the-shelf” motor components.

“The reaction from the linear motor companies was, ‘Why didn’t we think of that?’” says Joost Maltha, communications manager at Philips Applied Technologies. “Engineers were dumbfounded and surprised by the simplicity of the invention.”

The development of NForcer stems from Philips Applied Technologies’ work in providing industry with mechatronic solutions ranging from servomechanisms to positioning platforms for silicon chip manufacturing. The company will license NForcer to linear motor manufacturers/suppliers so they can immediately utilize the technology.

For more information:

Philips Applied Technologies
High Tech Campus 5
5656 AE, Eindhoven
The Netherlands
Phone: +31 6 10558116
joost.maltha@philips.com
www.apptech.philips.com

Applied Motion

EXPANDS STEPPER DRIVE LINE

The ST10-Q stepper drive is the latest addition to the product line at Applied Motion Products. It offers eight digital inputs, four digital outputs and two analog inputs. According to the



company’s press release, it is engineered in a compact and cost-effective package and is easily programmed with Q—a comprehensive programming language used to create and edit stand-alone programs. Option boards are available to add encoder feedback and RS485 functionality.

For more information:

Applied Motion Products
404 Westridge Drive
Watsonville, CA 95076
Phone: (800) 525-1609
Fax: (831) 761-6544
sales@applied-motion.com
www.applied-motion.com

Parker

RELEASES CATALOG FOR TRILOGY BRAND

Parker’s Electromechanical Automation Division recently released its new catalog featuring its Trilogy brand of linear motors and linear motor positioners.

The 114-page guide covers ironless and ironcore linear motors as well as industrial-grade and precision-grade linear motor positioners. New products include the Ripped series ironcore linear motors and the T1S/T1D positioners.

The catalog also includes an engineering guide offering discussion of linear motor technologies, advantages

and applications. For a free copy of Parker’s new product guide, visit www.parkermotion.com or call (800) 358-9070.

For more information:

Parker Electromechanical Automation
5500 Business Park Drive
Rohnert Park, CA 94928
Phone: (707) 584-7558
thiserodt@parker.com
www.parkermotion.com

SKF

OFFERS SPECIALTY COATING FOR BEARINGS

SKF has recently announced a patented NoWear coating application for bearings to promote longer life and increased machinery uptime. According to the company’s press release, the coating can withstand severe operating conditions due to load and speed variations, poor lubrication conditions, vibration, smearing and/or solid particle contamination. Applications include compressors, pumps, fans and blowers, and gearboxes.

For insulation, INSOCOAT roller bearings by SKF are available to protect against damage caused by AC or DC



electric current. These bearings feature a thin oxide layer that integrates the electrical insulating function to protect against electric arcing and damaging bearing erosion. All coated bearing boundary dimensions conform to ISO and ABMA standards.

For more information:

SKF USA Inc.
1530 Valley Center Parkway
Bethlehem, PA 18017-2266
Phone: (800) 541-3624
Fax: (610) 861-4811
skfusainfo@skf.com
www.linearmotion.skf.com

Heidenhain

RELEASES COMPACT MAGNETIC ENCODERS



Heidenhain recently released the new ERM 2400 series of modular magnetic encoders. Featuring more compact dimensions than the 200 series, the ERM 2400 series can be used in applications such as in spindles for milling machines. According to the company's press release, the encoders consist of a scanning head and scale drum assemblies. The scanning head has been redesigned, and offers a choice between a radial or axial cable outlet. The scanning heads have a 1-VPP interface. The scale drums are available in two versions—one that features a continuous centering collar on its inner circumference and is fastened with a frictional connection, and another that has feather-key slots to prevent unintentional rotation. These features

result in a compact encoder series that offers higher accuracy than gear wheel encoders and high permissible shaft speeds.

For more information:

Heidenhain Corp.
333 E. State Parkway
Schaumburg, IL 60173

Phone: (847) 490-1191
Fax: (847) 490-3931
info@heidenhain.com
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Garlock Klozure

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product news

WEG

SUPPLIES AUTOMATION PACKAGE FOR USIMINAS



A WEG turnkey system including transformers, MV motors and MV frequency inverters is used to automate a crane that carries molten metal at a plant in Brazil. Usiminas, a producer of iron and steel, employs the crane, which is one of the very few in the world to be controlled by a PLC and digital frequency inverters connected over the Profibus-DP communication network.

According to the company's press release, WEG's motors are designed for use in difficult operating environments, notably offshore oil and gas installations where safety and reliability are necessary. The MV motors achieve high-voltage efficiency while minimizing components levels. They also employ high-voltage IBGTs to reduce harmonic currents to low levels.

For more information:

WEG Electric Motors Ltd.
1327 Northbrook Parkway
Suwawee, GA 30024
Phone: (800) 275-4934
bquattlebaum@weg.net
www.weg.net

Pepperl & Fuchs

INTRODUCES NEW DEVICENET GATEWAYS

With K20 housing styles, the new DeviceNet gateways from Pepperl & Fuchs are available in single- or dual-channel versions. They are cUL listed to simplify panel construction for North American-based machine builders and users.

According to the company's press release, these gateways provide diagnostic capabilities while supporting polled I/O and change-of-state (COS) operations. Additional features include detected slave display, visual fault diagnostics, support for analog I/O and the ability to network safety devices.

These devices handle the complete data transfer, cyclically polling all participants connected to the wiring

system. The gateway can be placed anywhere in the AS-Interface segment. Single-channel gateways can handle hundreds of inputs/outputs connected up to 62 addressable I/O modules. The dual-channel gateways can support twice as many modules.

For more information:

Pepperl+Fuchs Inc.
1600 Enterprise Parkway
Twinsburg, OH 44087
Phone: (330) 425-3555
Fax: (330) 425-4607
sales@us.pepperl-fuchs.com
www.pepperl-fuchs.com



Midwest Motion Products

UNVEILS DC GEARMOTOR

Midwest Motion Products recently released a DC motor that measures just 2.14" in diameter and has a keyed output shaft of 12mm by 25mm. Compact-sized, the motor requires 7.2 amps at 12 volts to generate full load torque. According to the company's press release, it's rated at an IP54 protection range for operation in harsh environments. This high-torque, low-speed unit provides benefits for battery-powered electric vehicles, UGVs and military robotics.

For more information:

Midwest Motion Products
10761 Ahern Avenue SE
Watertown, MN 55388
Phone: (952) 955-2626
Fax: (480) 247-4096
randy@midwestmotion.com
www.midwestmotion.com

Flomerics

OFFERS FLOXPRESS SIMULATION SOFTWARE

Flomerics Inc. recently announced that its *FloXpress* simulation software will be available free of charge to all *SolidWorks 2008* users. *FloXpress* is a cut-down version of its *COSMOSFloWorks* product that enables engineers and designers to simulate complex, 3D fluid flow and heat transfer processes via a user interface.

According to the company's press release, *FloXpress* will enable users to predict and optimize flow and heat transfer processes without leaving the *SolidWorks* environment. It utilizes a CAD-to-CFD technology to detect and

mesh fluid regions within the model.

"Now, for the first time, *FloXpress* enables all *SolidWorks* users to try their hand at fluid flow simulation free of charge and find out just how quick and easy it can be," says Mike Reynell, director of marketing at Flomerics.

For more information:

Flomerics Inc.
4 Mount Royal Ave. Suite 450
Marlborough, MA 01752
Phone: (508) 357-2012
Fax: (508) 357-2013
info@flomerics.com
www.flomerics.com

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Schurter

OFFERS METAL SWITCH WITH DOUBLE POLE CONTACTS AND SEALED MICROSWITCH

Schurter Electronic Components has expanded its vandal-proof metal switch to include double pole and sealed microswitch versions. The MSM DP momentary switch is designed with separate switching contacts for applications including industrial, commercial and public access areas where signals are used to indicate when an apparatus is in use or an emergency situation is present.

According to the company's press release, The MSM SPDT and DPDT feature seal protection that enables the units to be used in adverse conditions where increased humidity, condensation or water may get into equipment. These switches are used in outdoor installations, commercial cooking appliances and industrial laundry equipment.

The MSM switches feature stainless steel construction and are available in several mounting dimensions. Standard

or lettered versions with optional point or ring illumination are also offered. Pricing starts under \$10 for 100 pieces.

For more information:

Schurter Inc.
447 Aviation Blvd
Santa Rosa, CA 95403
Phone: (707) 636-3000
mtibbs@schurterinc.com
www.schurter.com



Hoerbiger-Origa

LAUNCHES
NEW SIZING PROGRAM



Hoerbiger-Origa Ltd. recently released a program that assists design engineers with sizing and selecting electric linear actuators. According to the company's press release, *EL-sizing* offers an intuitive, user-friendly work environment that carries out calculations of static and dynamic movement parameters.

Upon entering the values, a list of suitable linear drives is created. Complete linear drive/motor packages can also be selected. An automatically generated

parts list, complete with order numbers, searches for the right drive, motor and accessories to meet clients' needs.

For more information:

Hoerbiger-Origa Ltd.
Unit 12 Brunel Court
Waterwells Business Park
Gloucester GL2 2AL
United Kingdom
Phone: (+44) 8700-600655
Fax: (+44) 8700-600656
info-hogb-sales@hoerbiger.com
www.hoerbiger.com

Ono Sokki

LAUNCHES SLIM-BODY
GAGE SENSOR



Ono Sokki Technology, Inc. recently unveiled its GS-4630 linear gage sensor capable of measuring dimensions, thickness, displacement, height, depth and flatness.

According to the company's press release, the sensor maintains high, consistent accuracy using linear glass scale technology. It produces measurements of 0.00004" with a measuring range of 0-30 mm. Endurance testing has rated the gage sensor over 5 million cycles.

Designed to fit tight quarters, the GS-4630 boasts a waterproof seal and a dust bellows. Its slim body makes it more flexible for mounting inside machinery with limited access space.

The sensor is compatible with an array of remote displays, comparators and interfaces with various outputs. A variety of interchangeable contact points are also available.

For more information:

Ono Sokki Technology, Inc.
2171 Executive Drive #400
Addison, IL 60101
Phone: (630) 627-9700
Fax: (630) 627-0004
kujjiye@onosokki.net
www.onosokki.net

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Bortech

INTRODUCES WELD
OVERLAYING
AND RESTORATIVE SYSTEM



Bortech Corp. recently introduced BoreClad, a new system for weld overlaying and restorative buildup. The system is used for applications in restoring worn construction, industrial and military equipment, pit, quarry and mining processes and other parts needing rebuilding due to abrasive wear.

BoreClad uses MIG, solid or flux core weld processes along with the company's patented step method to position weld beads inside round components. This system offers optional weld/no weld zones to accommodate keyways, and can weld mild steel and all stainless steel and nickel alloys.

The BoreClad machine has a current capacity of 200 amps at 100% duty cycle. Standard torches work

within IDs of 1.2" to 13". Custom overlay machines can be manufactured for larger workpieces.

For more information:

Bortech Corp.
66 Victoria St.
Keene, NH 03431
Phone: (603) 358-4030
Fax: (603) 358-4007
lwhite@bortech.com
www.bortech.com

Belden

OFFERS CORROSION-
RESISTANT JOINTS FOR
VACUUM APPLICATIONS

Belden Inc. recently unveiled a line of corrosion-resistant joints for ultra-high vacuum applications. The assemblies are manufactured from a variety of stainless steel grades including AISI 303, 304, and 316L. The yokes and the pins and blocks of the joints are machined from the same stainless steel material.

According to the company's press release, the joints can be custom-assembled for specific applications and operating criteria. They can also be supplied free of grease and lubricants to minimize the effort needed to clean the parts for installation.

For more information:

Belden Inc.
2500 Braga Drive
Broadview, IL 60155
Phone: (708) 344-4600
Fax: (708) 344-0245
info@beldenuniversal.com
www.beldenuniversal.com

SKF

PROMOTES HIGHER SPEEDS
AND LOW NOISE WITH
BALL SCREWS

SKF's compact, long-lead ball screws with a rotating nut design allow the drive motor to move with the nut to reduce inertia, require less power and achieve higher linear speeds. According to the company's press release, these ball screws integrate a nut rotating inside the bearings and along the screw shaft.

They're available in Series SLT and Series BLT versions, with diameters ranging from 25 mm to 50 mm and leads ranging from 20 mm to 50 mm. Custom options include double-protection wipers and brush wipers as well as custom long-lead screws. Applications include packaging and automation systems, laser cutting and production machinery.

For more information:

SKF USA Inc.
1530 Valley Center Parkway
Bethlehem, PA 18017-2266
Phone: (800) 541-3624
Fax: (610) 861-4811
skfusainfo@skf.com
www.linearmotion.skf.com



Bosch Rexroth

OFFERS LINE OF HYDRAULIC CYLINDERS

The CDT1 and CDT4 series of NFPA tie-rod hydraulic cylinders are available with fluorocarbon, NBR, PTFE and wear-resistant polyurethane seals. Rexroth uses a chrome-plated piston rod to extend life and prevent damage. The cylinders also feature a single removable bearing made of ductile iron.

Piston rod diameters range from ½ inch to 5 ½ inches on the CDT1 series and from 1 inch to 5 ½ inches on the CDT4 series. The cylinders are designed for applications such as machine tool, automotive, press, plastics, civil engineering, material handling and wood/paper equipment.

For more information:

Bosch Rexroth
5150 Prairie Stone Parkway
Hoffman Estates, IL 60192
Phone: (610) 694-8298
Fax: (610) 694-8339
aaron.weida@boschrexroth-us.com
www.boschrexroth-us.com

Sakor

ANNOUNCES NEW TEST SYSTEM FOR HYBRID DRIVETRAINS

Sakor Technologies Inc. recently unveiled the *HybriDyne* series of hybrid vehicle driveline test systems. According to the company's press release, *HybriDyne* is a comprehensive test solution for calibrating the performance, efficiency and durability of all aspects of hybrid drivetrain systems including electrical assist, diesel electric and fully-electric vehicle systems.

The system is capable of simultaneously determining the performance and efficiency of each component and sub-system being tested, as well as the entire system as a whole, in real time. The mechanical control and data acquisition components manage and monitor all engine and mechanical system functions, while the subsystem monitors and controls all electrical values. The *DynoLAB* system provides steady-state testing, as well as complete road load and in-use simulation as customer requirements dictate.



For more information:

Sakor Technologies, Inc.
2855 W. Jolly Rd.
Okemos, MI 48864
Phone: (517) 332-7256
Fax: (517) 332-7250
info@sakor.com
www.sakor.com

Danfoss Drives

INTRODUCES FCD QDRIVE FOR WALL OR RAIL MOUNTING

Danfoss Drives recently introduced the FCD QDrive, an enclosed drive solution engineered for wall or rail mounting in any position or atop a motor without a circuit breaker or output contactor. According to the company's press release, the FCD

QDrives deliver 0.5 to 4 horsepower and provide automatic motor tuning, dynamic braking and AC braking and mechanical brake control.

Features include a closed-loop controller, precise stop, speed-compensated stop, counter stop and flying start. They can be utilized for bus communication across a number of industry standard configurations in material handling, packaging and food and beverage applications.

The QDrives eliminate the need for fuses and are equipped with a built-in RFI filter and harmonic filter. They provide complete drive and motor protection, with options including a local control pad, circuit breaker and output contactor.

"FCD QDrives minimize wiring to eliminate the need for expensive shielded cables and hours of costly installation work," says Darren Lecke, product manager at Danfoss. "Additionally, all drive functions can be grouped in one module of a plant to reduce installation time as well as planning and commissioning, which is particularly significant for OEMs striving for modularization."

For more information:

Danfoss Drives
4401 N. Bell School Rd.
Loves Park, IL 61111
Phone: (800) 432-6367
Fax: (815) 639-8000
salesinformation@danfoss.com
www.danfossdrives.com



product news

PI

EXTENDS LINE OF STEERING MIRROR PLATFORMS

PI (Physik Instrumente) recently extended its line of S-330 steering mirror platforms. According to the company's press release, these new additions will provide larger angles, higher bandwidth and more stability. Six closed- and open-loop models are available for mirrors up to 50 mm. These flexure-guided, piezoelectrically driven systems can provide higher accelerations than other actuators, enabling step response times in the sub-millisecond range.

Applications include beam correction, laser surgery, image stabilization, interlacing, dithering, laser scanning/beam steering, optical communications and high resolution microscopy/spectroscopy.

PI steering mirrors are based on a parallel-kinematics design with coplanar rotational axes and a single moving platform driven by two pairs of differential actuators. They provide symmetrical dynamic performance in both axes with faster responses and better linearity in a smaller package.



For more information:

PI
16 Albert St.
Auburn, MA 01501

Phone: (508) 832-3456
Fax: (508) 832-0506
info@pi-usa.us
www.pi-usa.us

Stafford

RELEASES ROTARY ENCODER COLLARS

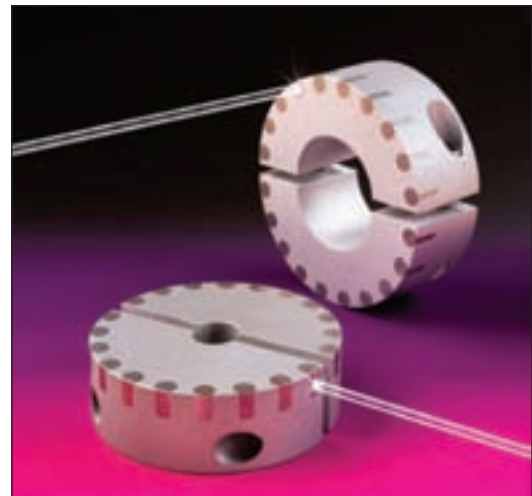
A standard line of rotary encoder collars providing sensing capability from their OD or face is now available from Stafford Manufacturing. According to the company's press release, the collars mount directly onto any shaft and feature corner-mounted steel targets. Made of anodized aluminum, these two-split designs come in 11 standard sizes and are unaffected by oils and coolants.

Applications for the rotary encoder collars include electromagnetic sensor mounting assemblies that are compatible with all popular sensors. Special bore

configurations, target locations and custom sizes for shafts up to 10" OD are also offered. Collars are priced to size and quantity; literature is available upon request.

For more information:

Stafford Manufacturing
P.O. Box 277
North Reading, MA 01864-0277
Phone: (800) 695-5551
Fax: (978) 657-4731
jswiezynski@staffordmfg.com
www.staffordmfg.com



Renold Gears

ASSISTS TIRE MANUFACTURER
WITH GEARBOX



Mitas, one of the largest tire manufacturers in the Czech Republic, recently commented on the use of Renold gearboxes for their calendar machines. According to the company's press release, the Renold PM series geared motors and smaller jPM wormgear units have been delivering faultless reliability 24 hours a day.

"Renold's products have proven over the last 10 years that they perform consistently under extremely arduous conditions," says Ivan Komanec, maintenance manager for Mitas in Prague. "We appreciate the local support we get from the Czech Renold sales operation. They provide the service we need to keep our production running without suffering costly breakdowns."

The Renold Gears PM series is a gearbox design featuring a single-piece case which allows worm gears, helical-worm gear combinations and complete helical-bevel gears to be assembled into the same case, thus giving the customer the advantage of flexibility of ratios and mounting variations.

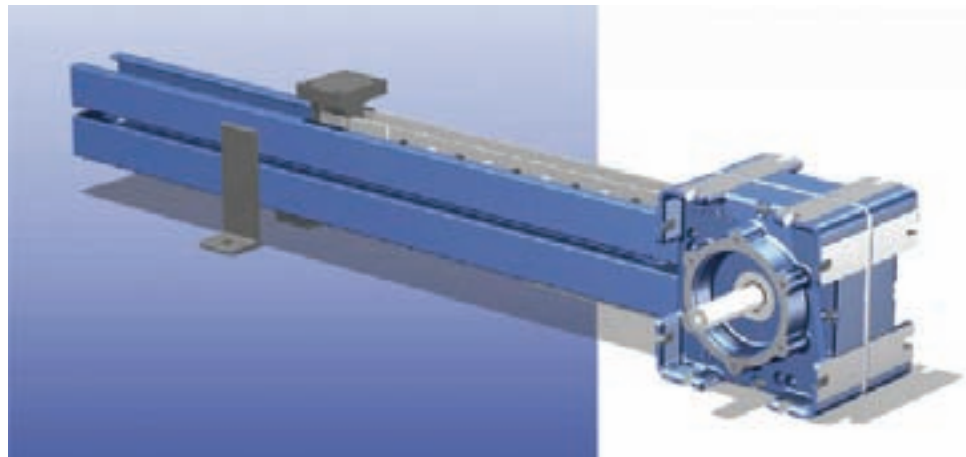
For more information:

Renold
Renold House
Styal Rd.
Wythenshawe, Manchester M22 5WL
United Kingdom
Phone: +(44) 161 498 4500
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For more information:

Serapid
5400 18 Mile Rd.
Sterling Heights, MI 48314
Phone: (586) 274-0774
Fax: (586) 274-0775
info-us@serapid.com
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Troubleshooting with Torque Transmission

Matthew Jaster, Associate Editor



The issue might be a faulty treadmill at a local gym, the need to update orthopedic surgery equipment or simply a train stuck in neutral at the toy store. Whatever the case may be, viewing e-mails in the marketing department at Torque Transmission is like opening Christmas presents every morning.

It gives the Ohio-based designer and manufacturer of power transmission components the opportunity to expand business relationships by offering simple mechanical solutions to their clients.

Torque Transmission has provided power transmission components to several different industries including medical, food processing, point of purchase (P.O.P.), automotive, printing, semi-conductor manufacturing and sports equipment.

“We send potential clients our catalogs, offer technical assistance, highlight products that may be useful down the road,” says Gary Rusnak of the marketing department at Torque Transmission. “Mostly, we just offer our products and get out of the way.”

Whether via e-mail, a follow-up call or simply dropping by for a visit, communication is a vital part of Torque Transmission’s business strategy.



This was certainly the case with a recent business venture with Darko Inc., a company specializing in the development and production of point-of-purchase displays. Darko needed a mechanical device to demonstrate how the Geotrax train from Fisher-Price moved back and forth along the tracks in its holiday display.

Due to the logistics of the display, the standard controller could not be used to operate the toy train cars. After several tests, engineers at Darko came up with a solution using roller chain sprockets provided by Torque Transmission.

According to the company’s press release, Darko ran the train through more than 35,000 cycles, measuring each time it moved forward, then backward. With the sprockets, engineers were pleased the display functioned exactly how it was originally designed to operate.

“With the train securely fitted on the track, it was able to
continued

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move easily using the roller chain sprockets," says Dave Ireland, Darko's engineering manager. "The Torque Transmission sprockets provided Darko with the perfect solution for what it needed."

This business relationship started back in February of 2005 when Rusnak sent a products catalogue to Darko. When the mechanical issue occurred with the Geotrax train, Darko began placing multiple orders for roller chain sprockets from Torque Transmission.


Other clients have called on Torque Transmission to provide assistance with items like thrust bearings, right-angle gear drives and shaft-locking mechanisms.

"Each situation is different," says Rusnak, "this is what makes what we do so interesting. Once the mechanisms are used to solve these problems, they're put on file for future reference."

Torque Transmission publishes a quarterly newsletter highlighting case studies where their products have been used to solve these mechanical issues. It also provides information on why the product is of value to potential customers.

Rusnak is quick to point out that the work they do in the marketing department is not rocket science. "We have a variety of products like pulleys, gearboxes, ball thrust bearings and roller sprockets that provide simple solutions, but it's the engineers that make it happen. They do their nutty professor thing and we simply provide the necessary material."

The point of purchase industry is particularly useful for Torque Transmission. All the gadgets that turn magazine racks, sunglass racks and register displays typically feature tiny mechanical components. While they're currently not working with any new clients in this industry, Rusnak says it won't be long before someone calls with a technical problem.

"Every contract with P.O.P. displays is unique. We'll eventually come back full circle with the same sort of assistance we provided Darko." 

For more information:

Torque Transmission
 1246 High Street
 Fairport Harbor, OH 44077
 Phone: (440) 352-8995
 Fax: (440) 352-7682
 sales@torquetrans.com
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Grip Tight Done Right

BALDOR'S BEARINGS MAKE THE GRADE WITH SAPPHIRE AND TWIN CITY

Matthew Jaster, Associate Editor

Since its inception in 2001, Sapphire Energy Recovery has provided solutions for end-of-life car and van tires using high-throughput shredding machines. These machines process tires into chips that can be used as an alternative to coal in the cement manufacturing industry. The system provides an effective means to fully consume the tires.

Sapphire Energy Recovery was originally formed as a joint venture between the LaFarge Group and Michelin Tire. LaFarge was looking for a way to secure its tire supply while Michelin needed to meet its obligations as a tire producer.

Now the company collects end-of-life tires from sources such as wholesalers, vehicle dismantlers and local authority schemes. These tires are brought to a Sapphire processing center via a collector network and then used to produce a specific grade of chipped tire for the cement industry.

Problems occurred, however, when the chips were graded for size by a classifier with 36 bearings. Whether it was the water used for cooling or the fine metal wires in the tires, the bearings were being damaged at an excessive rate.

"The aggressive nature of tire shredding meant that repairing these machines was taking up far too much of our time, and reducing our productivity," says Andy Booth, reliability manager at Sapphire.

Replacing the bearings could take up to two hours per piece. In some cases, corrosion meant the bearings needed to be loosened by heat. In other circumstances, the entire shaft had to be replaced. The end result was an expensive repair problem. Booth called Bearing Transmission & Pneumatics for help.

Bearing Transmission & Pneumatics suggested a specific type of ball bearing from Baldor called the Dodge Grip Tight. "Our work means that we tend to see a lot of bearing failures, and we've come to regard the Dodge Grip Tight as a genuine problem solver," says Edward Fielding of Bearing Transmis-

sion & Pneumatics. "Although the major requirement was to simplify changeover, this bearing also manages to survive much longer in hostile operating conditions."

The Dodge Grip Tight is an adapter-style bearing with a mechanical feature that loosens it by simply turning a nut. This automatically pulls the bearing off, avoiding forcible removal or expansion heating. The Grip Tight includes a built-in flinger seal for protection in hostile environments.

According to the company's press release, the Grip Tight bearings were more expensive than the sets-crew type Sapphire had been using. Demonstrations and testing convinced Booth and his team that the easy-off mechanism would make changeovers a predictable operation.

Booth purchased the Grip Tight bearings and began installing them at Sapphire. Following a 24-month period, operators can now replace the bearings start to finish in 15 minutes. Booth reports no shaft damage to date, and the bearings have lasted twice as long as previous models.

"Grip Tight bearings have given us back predictability of maintenance, with the welcome bonus of much longer life, protecting some of our company's most crucial assets," says Booth. "Our operational team now has the time to be more proactive, focusing its major efforts on preventive maintenance rather than breakdown maintenance."

Twin City Challenge

When Twin City Fan & Blower needed to compete for the business of three automotive plants, they had to face the challenges of improving fan designs, tightening up shafting tolerances and lowering vibration to get the contracts. The fans would have to meet an automotive specification in which the allowed maximum vibration amplitudes were far below industry standards.

"We could either sit on the sidelines, or we could be ag-

continued

gressive and say ‘Yes we can meet these specs,’” says Dick Williamson, engineering vice president for Twin City Fan. “We made the commitment to make it happen, and we got to work.”

Vibration analysis began at the company’s South Dakota facility, testing a variety of bearings from manufacturers. The Grip Tight and Imperial bearings from Baldor came out on top.

“We save a lot of time in our manufacturing process; plus, because of the quality of the product and the tighter toler-

ances that have been engineered into the bearings, we also save time in our acceptance testing,” says Matt Benson, plant manager at Twin City Fan.


The effort of Twin City Fan paid off when they received their largest automotive order for fans to date. Williamson believes the company will continue to work with Dodge bearings in the future. “The engineers who design Dodge bearings have already helped us meet the expanding needs of our customers, and we’ll continue to ask for their advice.”

The Anatomy of a Bearing

So what exactly appeals to manufacturers using the Dodge Grip Tight line? For Darin Davenport, product manager at Dodge Roller Bearings, it begins and ends with accessibility.

“The installation and removal saves time, minimizes wear and tear, and can accommodate commercial and undersized shafts.”

Davenport also points out the patented “push/pull” thin-wall adapter system that allows damage-free shafting and reduced vibration. According to the company’s press release, the bearings can operate at higher speeds and run cooler than competitive products, allowing for increased bearing life.

Grip Tight bearings are off-the-shelf and shaft-ready and are available in a variety of styles including pillow block, tapped base, two-, three-, four-bolt flange, piloted flange, take-up and E-Z Kleen design. 



For more information:


Baldor Dodge/Reliance
6040 Ponders Court
Greenville, SC 29615
Phone: (864) 297-4800
Fax: (864) 281-2433
www.baldor.com

Sapphire Energy Recovery
Yelsway Lane, Waterhouses
Staffordshire Moorlands
ST10 3AZ, UK
Phone: +44 8452 602040
info@saphirerecovery.co.uk
www.saphirerecovery.co.uk

Twin City Fan & Blower
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Capacity— and the Lack of It—Rules

U.S. WIND TURBINE GROWTH PUTS A



Outsized wind turbines such as these are now populating the prairies where long-abandoned grain elevators and silos once stood. The U.S. market for wind energy is huge, far outstripping industry projections and suppliers' ability to meet the demand. (Courtesy Kaydon Bearing)

NEW SPIN ON BEARING MANUFACTURE



It's a fact that bearings help make our world go 'round. It is also a fact that now is a very profitable, yet daunting, time for bearing manufacturers as they attempt to ramp up production to meet the runaway growth of wind turbines here and abroad. Bearing makers are also enjoying an international construction and mining boom, given the bearings needed for cranes, earthmovers and other heavy equipment in those industries. However, somewhat along the lines of be careful what you wish for, that upward spike has taken a heavy toll on bearing manufacturers' capacity worldwide, given that the extremely high-grade steel needed for bearings in those applications is also required for turbines.

All of which explains—at least in part—why there is ongoing angst among the OEMs and suppliers of perhaps the fastest-growing, domestic manufacturing segment in the United States—wind turbines. Crimps in the wind turbine supply stream—primarily gears, gearboxes and bearings—are the root cause of the anxiety, with no long-term corrective action on the near horizon. In fact, most players in the industry believe it will take up to two years for suppliers of those components—especially bearings—to catch up with the demand.

“There has been a general supply bottleneck for bearings, especially for

larger sizes, as the demand for energy and the surge in wind turbine production has by far outstripped the production capacities,” says Daniel Thalmann, an application engineer with NKE Austria. “Like NKE Austria, most of the leading suppliers are expanding their production capacities, which should be in full operation in one year's time.”

It's all about the steel. Thalmann's outlook is rosier for Europe than that of industry watchers here in the states for one reason—Europe is where the steel is; especially the pristine, highly engineered steel needed for mega-sized wind turbine bearings. Without that, bearing makers here are left doing the best they can to fill orders while also searching—hoping would be a better word—for additional premium steel sourcing. And, unfortunately, domestic sources are virtually non-existent.

“The steel qualities used for the manufacturing of bearings are regulated by international standards, which are further refined in company standards to ensure that the steel has the quality required to produce premium-class bearings and to ensure a maximum of reliability,” says Thalmann. “The cleanliness is important mainly to achieve high-quality surfaces, to prevent stress peaks underneath the surface occurring due to inclusions, and to get superior heat treatment characteristics and results.”

continued



A look at Rotek's Ohio facility. Its parent company is building a new plant that will better serve turbine bearing production's space needs.



Only the highest-grade steel—typically sourced in Western Europe—is specified for wind turbine bearings. Here we see workers at NKE's Austrian plant doing final assembly.

Back stateside, Bob Hersko, vice president of sales and marketing for Aurora, OH-based Rotek, Inc. (a ThyssenKrupp Industries company), provides other insights into why such high-grade steel is needed for turbines, especially the 1.5MWs and 2.5MWs sprouting around the country.

“The (turbine) bearings are heavily loaded; the raceways—especially on the pitch bearings—have to carry a significant preload in the system,” he says. “That’s only because if there was any evidence of clearance in there because of the vibration, or what is referred to as flutter, those raceways would spall. Any evidence of dirt—dirty steel—is just going to lead to those raceways failing prematurely.

“But in fact the bearings really don’t get rotated; they are pitched through 15° or so, but they really don’t go through 360° revolutions. So you have to be careful with lubrication, and if they do have any kind of surface impurities after the hardening process and so on, there’s going to be problems.”

Those “problems,” says Hersko, include an unwanted increase in torque, which in turn leads to an asymmetrical speed distribution among the three huge turbine blades, thus impairing proper rotation. And then, of course, there are standards to contend with, which pose challenges for bearing makers in design considerations beyond acquiring the steel.

“The steel quality requirements for wind turbine builders are very strict,” says Brian Lage, business manager at Muskegon, MI-based Kaydon Corp. “The steel has very precise chemical properties and hardness requirements and that also limits your supply base.”

With turbines, it’s demand first, supply second. Supply base—two little words that bring into sharp relief the problems facing OEMs and suppliers to the U.S. wind turbine industry. The demand for components is skyrocketing while suppliers are left scrambling to meet it. It is the central challenge facing the bearings industry, says Lage.

“The biggest issue today is that demand is far outstripping capacity. We

have demand from multiple sources that far exceeds our ability to manufacture,” he says. And this is despite Kaydon’s recent \$76 million investment in equipment and facilities (plus the recent purchase of Avon Bearings). “Other issues are delivery lead time on machine tools and availability of good, quality forgings in the size required for utility-class wind turbines.”

To underscore the viability—and sometimes volatility—of the domestic wind energy market, consider this comment by Ajay Das, general manager/wind energy for The Timken Company.

“Bearings for wind turbines are likely to become one of the highest growth segments for Timken into the foreseeable future,” says Das. “The U.S. has huge wind potential.”

“I’ve been with Rotek some 30 years and I have never, ever, ever seen anything even remotely close to what this market is right now, here and offshore.” *Bob Hersko, Rotek.*

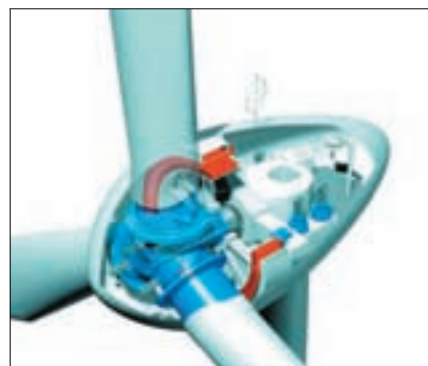
And Rotek’s Hersko says that currently bearings for wind turbines constitute “around 40 percent or less” of its business. “It’s huge, and it could be five times that, but we tell manufacturers that we don’t want to promise something that we can’t deliver on.” He adds that ThyssenKrupp is in the midst of investing—after some necessary, farsighted concessions by the state—“hundreds of millions of dollars” in a new Aurora, Ohio-based facility “wholly dedicated to wind energy,” set to open by 2010 or sooner. The net result—over 300 new, good-paying manufacturing jobs for that community. He adds that ThyssenKrupp is building a \$3.7 billion steel plant in Alabama. All of this on top of the land office business the company is currently doing in the aforementioned heavy equipment segment, here and abroad.

“I’ve been with Rotek some 30 years and I have never, ever, ever seen anything even remotely close to what this market is right now, here and offshore,”

he says.

Size and R&D matter. So where does Rotek purchase the precious steel needed for production? “We have agreements with two offshore suppliers and three domestic suppliers,” he says. “Not all of them can supply the necessary sizes or material grades we want. But having said that, what we do is lock in blocks of time for six months (with steel suppliers). But if you’re starting from scratch—good luck. If you’re established (in the industry), it’s about a six- to eight-week wait for steel.”

At Kaydon, the picture is about the same. “We have multiple vendors domestically and overseas to support our demand because we’re dealing primar-



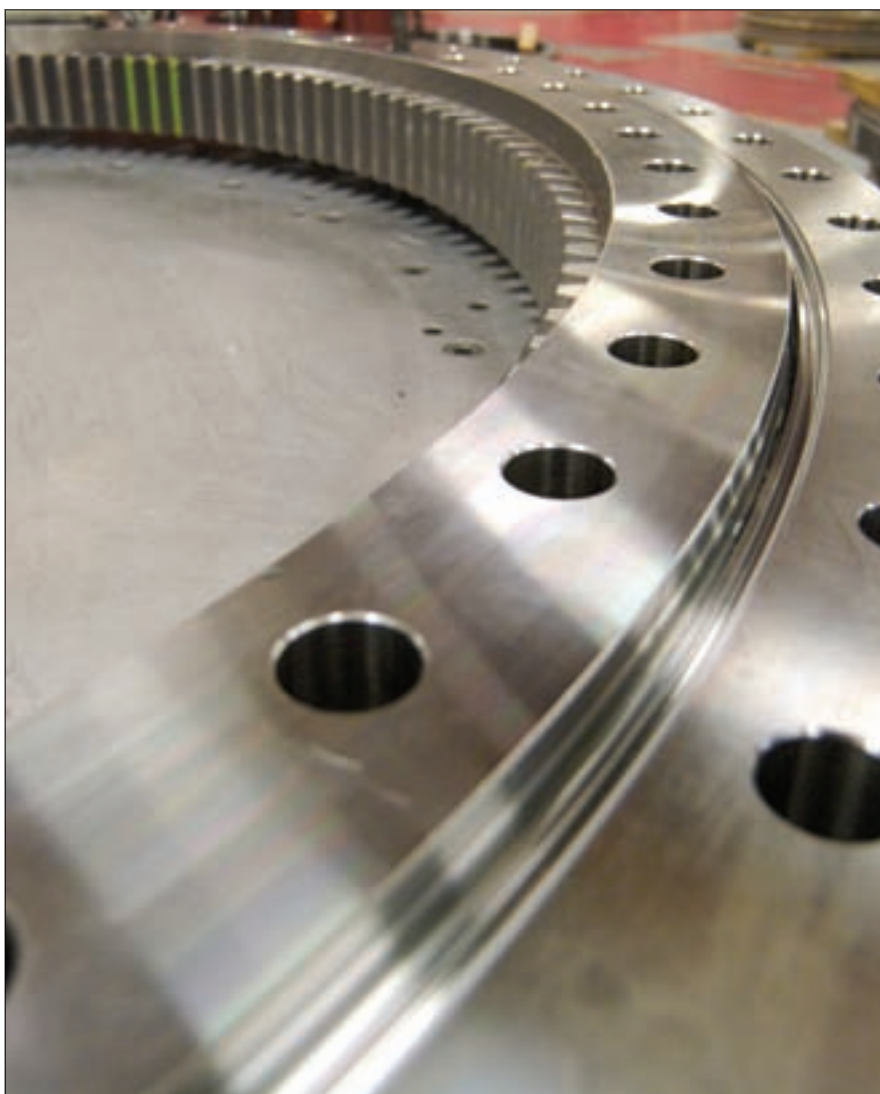
A look at a cutaway illustration of an intricate, Timken-designed bearing set for one of the larger wind turbines.



A birds-eye view of the machine room—including Timken-supplied bearings—of a wind turbine, which dwarfs the landscape. The sheer size of the components needed is a major reason for the ongoing supply chain bottlenecks frustrating industry OEMs and suppliers.



Like most wind turbine bearing manufacturers, Rotek is a one-stop shop. That includes gear hardening, as seen here.



An up-close-and-personal view of a nearly completed wind turbine bearing at Rotek. (Photos courtesy of Rotek.)

ily with rings from 80 to 125 inches in outer diameter,” says Lage, “and many forging suppliers cannot handle the upper-size range.” Nevertheless, Lage pegs his company’s turbine bearings sales at about 25–30 percent, “And we expect that to continue to grow,” he adds.

And this in an industry that Lage and industry reports see growing as much as 40 percent annually for the foreseeable future. Care to do the math?

Beyond all of these supply-and-demand issues is the actual turbine bearings manufacture; bearings reliant on top-tier engineering and technology in order to ensure their performance, reliability and durability. To meet these challenges, what was done at Timken some years ago is a useful case in point.

“Back in 2000,” says Timken’s Das, “as part of getting into the wind energy business, the first thing Timken did was to create a team of engineers to look at the application—the kind of loads, duty cycles, etc.—and that team of 10 or 12 engineers worked on that for about five years.” One direct result of that R&D was what Timken calls its integrated flex spin bearing. “Those bearings were installed in 2004,” says Das, “and the gearboxes are still running without any trouble.”

At NKE, says Thalmann, there is a clear appreciation of the many complex factors involved in making bearings for such a demanding application.

“Bearings for large turbine gearboxes and mainshafts must fulfill the most stringent quality criteria, as—especially concerning the required lifespan and operational reliability—these bearings are used in one of the most demanding applications. Exquisite care has to be taken during the specification, design and manufacturing of the bearings and the calculation of the gearbox in order to fulfill the requirements set forth in the applicable standards, and by the customers and the official bodies governing the wind industry.”

Speaking of standards, Lage points out that “Wind turbine builders (here

and abroad) follow standards established by Germanischer Lloyd (GL) and certify the entire turbine, so these requirements flow down to the component suppliers such as bearing manufacturers. Our design engineers take into account the GL requirements along with other design standards.”

Standards notwithstanding, what, exactly, is the turbine bearing of choice among designers? It depends, says Thalmann.

“We see different design philosophies in wind turbine gearboxes, without a clear preference for a single bearing type. Several companies (OEMs) prefer tapered roller bearings wherever possible, while others tend to use mainly cylindrical roller bearings. For mainshaft bearings, typically a combination of tapered or spherical roller bearings and a cylindrical roller bearing is used.”

Space does not permit an in-depth look at some of the other exigencies involved in turbine bearing production, such as lubrication and heat treating, for instance, the “black magic” component of any acceptable turbine bearing. Software and other technology advances also play a big part. Look to further issues of *PTE* and our sister publication, *Gear Technology*, for more on those issues.

Late to the dance. OK; having cited the numerous supply chain bottlenecks retarding the continued growth of the U.S. wind turbine market—especially bearings—begs the question: Why is this happening? The reasons are many; some understandable, others perhaps having more to do with the current state of manufacturing in the United States.

Lage alludes to the projected 25 to 40 percent annual growth in explaining in part why most U.S. manufacturers capable of entering the turbine market were caught with their collective pants down.


“The growth was unexpected and actually appears constrained by component suppliers,” Lage says. “Ramping up operations for bearings, gears and forgings takes a lot of time versus an

assembly operation.”

Says Hersko, “It came so fast. It was so subject to the whim and fancy of Congress with these PTCs (federal incentivizing production tax credits). And the best thing that ever happened to this industry in my mind is that (GE Energy) got into it and they are forcing issues now. I mean, the (U.S.) growth rate that GE is projecting is unbelievable.”

With that said, how long can U.S. wind turbine players expect the shortfall in bearings and other components to last?

“That’s the \$25,000 question,” says Lage. “I think maybe a lot of bearing manufacturers are going to remain a little cautious (of ramping up production), because if this wind market repeats previous market declines, there isn’t enough non-wind business to soak up this new capacity.

“The forecasts from industry analysts and our customers are extremely positive, but Congress needs to pass long-term legislation so manufacturers have more stability and can continue their investments in wind.” 

For more information:

Brian Lage, business manager
Kaydon Bearings Division
Phone: (231) 755-7038
Fax: (231) 759-4102
blage@kaydon.com
www.kaydon.com

NKE Austria GmbH
Ennser Strasse 41a
A4407 Steyr-Gleink, Austria
Phone: + 43 7252 866670-0
Fax: + 43 7252 86667-59
office@nke.at
www.nke.at

Rotek, Inc.
1400 Chillicothe Rd.
P.O. Box 312
Aurora, OH 44202
Phone:
(330) 562-4000; (800) 221-8043
Fax (Engineering): (330) 562-2709
Fax (Sales): (330) 562-4620
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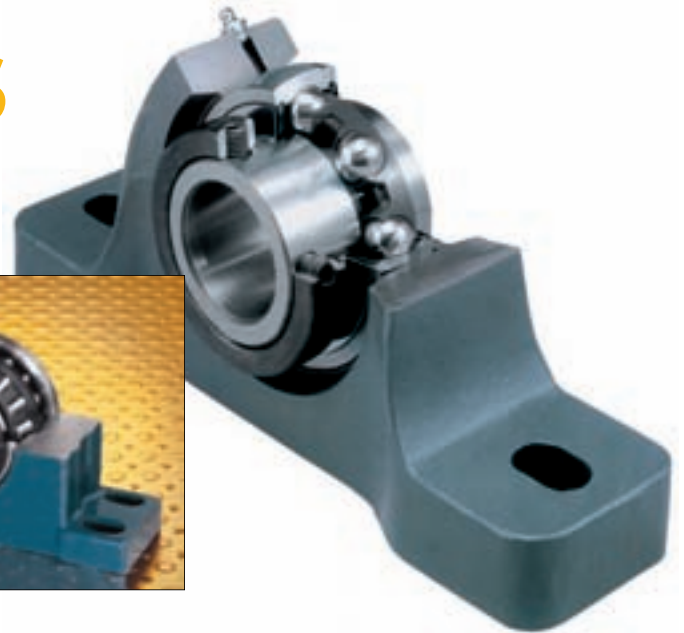
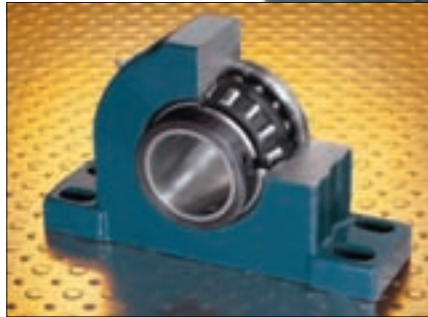
The Timken Company
1835 Dueber Ave. SW
Canton, OH 44706
Phone: (330) 438-3000
www.timken.com



The design and manufacture of the gears, gearboxes and bearings for wind turbines are some of the most intricate and challenging in the industry. These turbines are fitted with Kaydon bearings.

Bearing Lubrication Under Extreme Conditions

Dale E. Stallard, Rexnord Bearing Products



This article is Part II in a series on bearing lubrication for extreme applications. Part I of the series, Bearings for High Temperatures, appeared in the Fall 2007 issue of Power Transmission Engineering. Part I can be found online at www.powertransmission.com/issues/1007/bearings.htm.

Rolling element or sleeve bearings often are required to operate under extreme conditions. In these instances, it is more important than ever to follow proper lubrication selection and maintenance procedures to maximize effective life and efficient performance. In this article, we explore examples of bearings that are exposed to moisture, severe "dirt" contamination and high vibration. In these applications, bearings can only achieve the design life expectancy when the correct lubricant is selected and properly applied. Long-term analysis of field data shows that the lack of proper lubrication is the most commonly cited cause of bearing failure and accounts for more than 40% of breakdowns (Fig. 1).

Moisture

In many bearing applications, the

bearing unit comes in contact with moisture on a regular basis. This includes diverse types of farm machinery, equipment that might sit idle in open storage prior to use, steel mill quench rolls, and food machinery that must be washed down for maintenance and cleaning. For industrial and agricultural equipment not involved in the direct handling or processing of foods, greases having a lithium base and/or corrosion inhibitors offer excellent moisture-resistant properties. FDA regulations restrict the application of certain types of lubricants on equipment used for handling or processing food products. To conform to these restrictions, the oil or grease must not contain any soaps or additives that may be hazardous to human health. Special lubricants have been developed by the petroleum industry for this type of equipment.

When bearings are exposed to moisture, corrosion damage can occur in two basic forms. The first is the ingress of water or liquid chemicals from direct impingement. The second is moisture condensation or chemical vapors. Condensation can occur on the bearing sur-

faces from moisture in the air, which is chilled to the dew point. Damaging effects of corrosion can be reduced to some degree by using high-quality greases with corrosion inhibitors and good moisture control characteristics.

Where bearing speed is relatively low, bearing protection can be increased by keeping the bearing and housing cavities completely full of lubricant. This evacuates most air and lessens the level of condensation. Bearings on equipment that operates at higher speeds can be protected in the same manner during extended periods of storage under moist conditions; however, some of the housing grease must be displaced or removed prior to full-speed operation to avoid overheating.

Severe Contamination

Another type of extreme bearing application is exposure to severe contamination. Dirt and abrasive contamination are especially severe on applications such as foundry and steel mill equipment, aggregate or cement processing machinery, and taconite-handling conveyors. Much of the equipment used in the agricultural, wood products, construction and

utility industries is also subject to this type of contamination.

In severely contaminated environments, the lubricant alone cannot provide adequate protection to the bearing and is only part of the solution to proper bearing performance. Additional protection for bearing components requires proper seal selection. First, use the typical criteria of load, speed, operating temperatures and environmental factors to select a premium-quality ball or roller bearing lubricant. Then, turn the attention to sealing and re-lubrication frequency.

In the presence of contamination, sealing is often the key to prolonged bearing service life. The sealing system must resist contaminant ingress and still retain the lubricant in the bearing cavity. In many of these applications, a bearing with a grease-flushable seal can provide added protection and dramatically longer bearing life.

To maximize the seal effectiveness, a proper re-lubrication schedule is required. Often, more frequent re-lubrication can enhance the effectiveness of a sealing system by expelling contaminants that advance past the seals. A fresh purge of grease will also clean the seal contact area, prolonging seal life. The frequency of re-lubrication is application-specific. Severe environments may require virtually continuous lubricant replenishment, while heavy-to-moderate levels may require purging every 8 to 10 hours of service. Re-lubrication intervals for specific applications can be determined by inspecting the condition of the used lubricant purged from the bearing after the initial interval. The re-lubrication cycle can then be shortened or lengthened based on initial and subsequent inspections.

Severe Vibration

A third type of extreme bearing application is severe vibration. A certain amount of vibration is inherent in all equipment but more prominent in vibrating screens/feeders, fans or gyratory crushers, to name a few. Operating such equipment beyond recommended balance limits exposes bearings, housings and lubricants to extreme vibration.



Figure 1—Degraded lubrication is the No. 1 cause of bearing failures.

These conditions tend to work-shear some greases. Eventually, this will damage the chemical chains formed by additives and cause work-softening and liquefaction of the grease thickener structure. The liquefied grease will either leak out of the seals or produce an added churning-friction effect in the bearing. The churning effect can increase operating temperatures significantly, especially where high speeds prevail. This may lead to an accelerated breakdown of the grease and premature bearing failure. Greases with minimal work-shear tendencies generally should be specified for bearing lubrication on vibrating-type equipment.

Only greases with excellent mechanical properties should be used for high-vibration applications. Applications such as vibratory shaker screens, tampers, shaker tables, or vibratory rollers require grease with the proper consistency and sufficient mechanical stability to prevent it from collapsing back into the path of the bearing rolling elements. A proper grease will channel away from the rolling element path, thus preventing churning of the excess grease.

Laboratory and field experience has led to a preference for NLGI No. 2 or 3 lubricants, with a lithium or lithium-complex soap base for vibratory type applications. The mechanical stability of these grease products minimizes churning and lubricant deterioration.

Re-lubrication frequency in vibratory applications depends on rotational

speed, frequency and magnitude of vibratory action, operating temperature, and environmental factors such as moisture, dirt, abrasives and service cycle. In addition, the proper re-lubrication interval can be determined by examining the condition of the purged lubricant from the seal area and making adjustments based on these observations.

Bearings are often required to operate in adverse environmental conditions as those discussed above. By following these recommended guidelines, successful bearing operation can be achieved even in the most severe operating conditions.

Dale E. Stallard is a senior application engineer with Rexnord Bearing Products in Indianapolis.



Motorsports in Motion

KD-RIG PUTS ACCELERATING DEVELOPMENTS INTERNATIONAL IN LIMELIGHT

Matthew Jaster, Associate Editor

Before last December, few companies outside the NASCAR community had heard of Accelerating Developments International (ADI). The North Carolina-based provider of technology, engineering and product innovations for the automotive and motorsports industries quietly went about its business until a gala dinner in Cologne, Germany put its engineering team in the proverbial driver's seat.

According to Jay Drake, general manager and head of research and development at ADI, race teams like IRL, F1, Champ Car and Daytona Prototype wanted to work with the company after they were honored with the 2007 "Best Testing Technology of the Year" award at the Professional Motorsports World Expo in Germany.

"The award brought ADI a great deal of recognition from teams that weren't aware of us before," says Drake. "It was an honor for ADI to be recognized by a panel of its peers."

The award in question came from the creation of the KD-Rig, an advanced diagnostic testing system that provides motorsports teams with detailed simulation data about the chassis and suspension of a race car.

"The KD-Rig is very different in function and testing approach," says Drake. "The wheels are mechanically coupled to the road actuators, and these road actuator towers float in the x and y directions. This allows us to track the suspension movements in x, y and z."

The four KD-Rig towers are powered by a Rexroth EchoDrive MKD synchronous servomotor. In addition, Bosch Rexroth supplied sub-components such as servo amplifiers and linear bearing products.

"As a drive and control technology supplier, we've had a long-standing relationship with them," says Dave Giffels, business planning manager at Bosch Rexroth Corporation. "Originally, we provided the hydraulics equipment and then the servo technology and linear motion components used to simulate the movement of the suspension system."

"The test rig turned out to be an exceptional device. Not only are we proud that Rexroth technology helped ADI win an award for their rig, but it's also neat knowing that our components play such a big role in helping those race teams make their cars go faster."

The simulator provides precise sus-

pension motion while measuring bump steer, camber change and wheel loads. The KD-Rig also allows interference checking throughout the travel range. The system offers up to eight times faster motion, coupled with high-speed control and data acquisition.

Teams have also been using the rig for coil bind setups in the suspension. "Coil bind" occurs when the spring coil is fully tightened and becomes rigid. The KD-Rig identifies how loose the coils should be at the start of a race and the necessary adjustments needed throughout it.

"Considering the new direction set-up is taking and limited track time, there's no question that ADI with its KD-Rig can sort through the set-up and even eliminate many of the variables encountered during track testing. ADI and their KD-Rig can definitely speed the learning curve with its car well before you leave the shop and head for the track," says Larry McReynolds, Fox Sports analyst and former NASCAR crew chief, in a press release.

ADI overcame many challenges during the execution of the KD-Rig project. The team had to rethink how to best implement force control when

they decided to switch from hydraulic to electro-mechanical actuation. Drake says the engineers had to design the complete rig in 3D and run virtual simulations to debug any issues in advance. They assembled all the components of the rig in their final prototype. Luckily, everything worked according to plan.

“We’ve made some improvements since then,” says Drake, “but it was a successful startup right from the original design.”


And who can argue with the results? Several industry insiders were delighted by the innovations of the KD-Rig at the Expo.

“The best race car technologies are innovative and provide measurable benefits to on-track performance,” says Graham Heeps, editor of *Professional Motorsport World* in a press release. “I for one felt the KD-Rig ticked those boxes, and when the other judges’ scores came in, KD-Rig emerged as a clear winner in the Testing Technology of the Year category.”

The panel of judges for the event included Michael Andretti, CEO of Andretti Green Racing, Ulrich Baretzky, head of engine technology at Audi Sport and Jost Capito, director of Ford TeamRS. Sam Tong, development engineering manager at ADI, accepted the award on behalf of the ADI team.

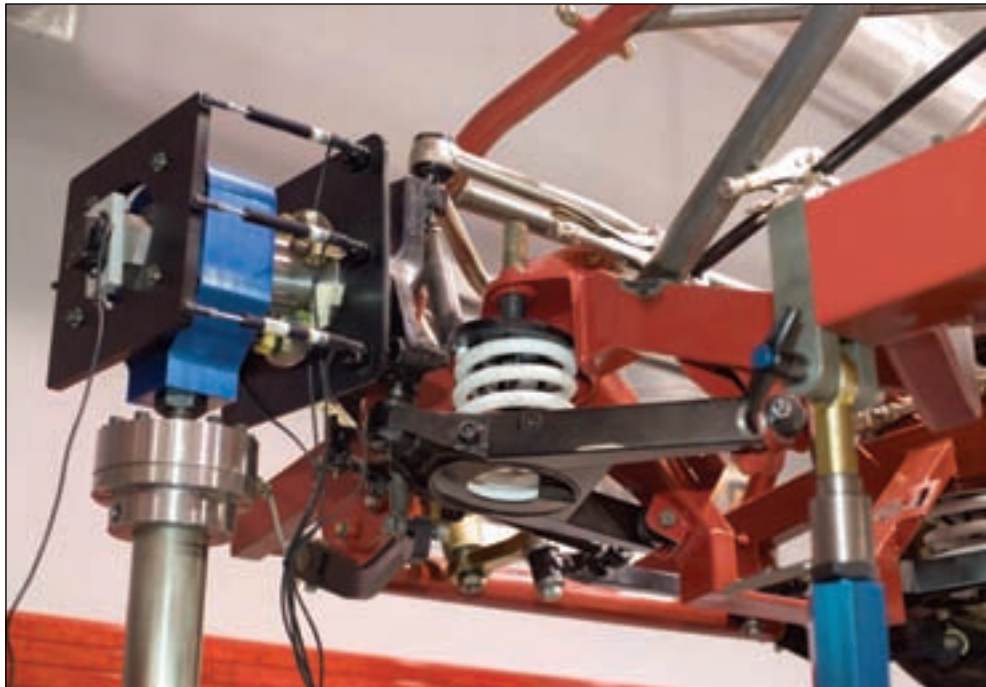
Drake says the KD-Rig signifies a whole new method of testing that applies dynamic vehicle conditions while extracting all of the vehicle’s kinematics/geometrical changes. The entire process required endless hours in programming for preprocessing, motion control and post processing.

ADI is developing additions that will allow all the car details and physics to become plug-in data that will generate a theoretical track map.

“Currently, we do the reverse, where we’re using measured track data from a vehicle and processing it into a generic track map,” says Drake. “In the near future, we will no longer be dependent on any measured track vehicle data.” 



The rig raises the car off the ground to identify and resolve any issues.



A critical component called "coil bind" is being tested by engineers.

For more information:

ADI
4512 Raceway Drive
Concord, NC 28027
Phone: (704) 721-0385
Fax: (704) 721-0386
swigger@acceleratingdevelopments.com
www.acceleratingdevelopments.com

Improved Fuel and Energy Efficiency

Through Optimized Bearing Design and Selection

Mark Joki, The Timken Company

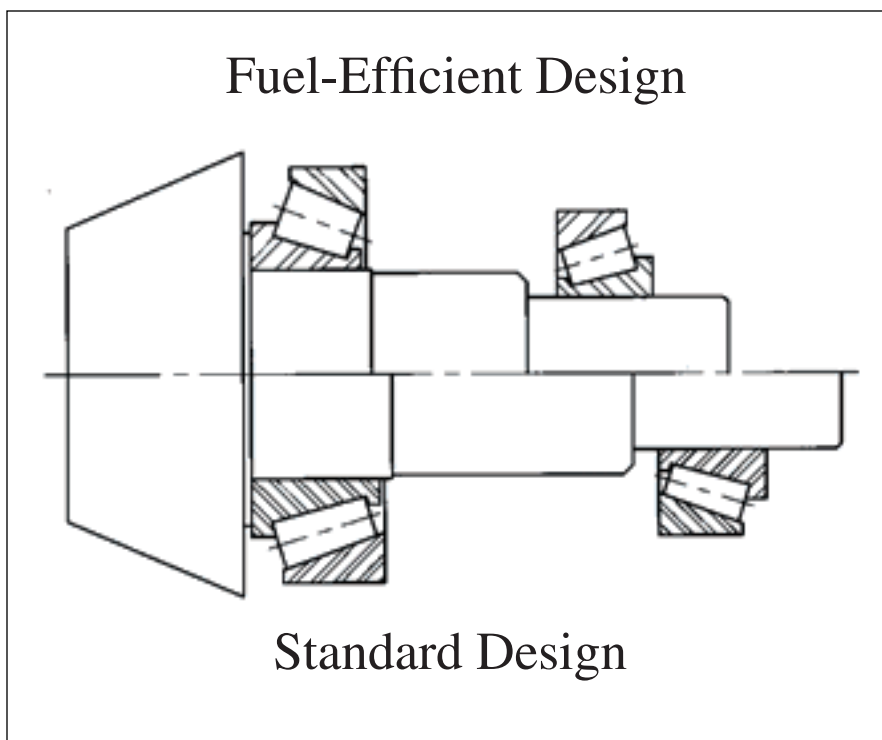


Figure 1—The Fuel-Efficient Bearing Design Reduces the Axle Size and Weight.

Introduction

Today, better fuel economy is a main objective in the automotive development process. It remains top-of-mind with the auto industry and consumers because of costs and environmental impacts. Because the industry's average fuel-economy standard is required to increase by 40 percent by 2020, manufacturers and engineers are working to develop fuel-efficient, environmentally friendly and reliable designs for vehicles.

The benefits referenced in this article focus on the automotive industry, but obviously provide energy efficiency savings for industrial power transmission designs and applications, as well.

For driveline and transmission component suppliers, this translates into more challenging requirements for power capacity, weight, volume and power-loss characteristics of their

products. More specifically, bearings on high-speed shafts in transmissions and on the pinions of differentials are a major contributor in the overall fuel-efficiency picture of the vehicle. An optimized design of the tapered roller bearings employed in these applications could significantly contribute to increased power availability—as well as mass and dimensions—translating into better fuel economy.

Driven to find a more efficient bearing solution, recent fuel-efficient tapered roller bearing (TRB) designs were compared to angular ball bearings solutions and standard TRB designs. The results proved that the fuel-efficient design reduced running torque, simultaneously meeting other technical requirements such as system life, stiffness, weight and package size.

More specifically, research and system analysis for alternative bearing arrangements was done on the pinion bearing arrangement in the rear axle (Fig. 1) and the transfer shaft bearings of a commercially available CVT (Fig. 2) because these two applications can have a high impact on fuel efficiency of the overall axle system.

Proven Results

Fuel Efficient Design for the Pinion Bearing Arrangement. To better understand the benefits of fuel-efficient TRB designs, The Timken Company defined a coherent bearing design strategy that significantly reduces the power loss and simultaneously maintains or improves some of the other system performance characteristics such as stiffness, operating temperature and debris resistance.

The basic concept was to convert the excessive bearing life margins into advanced design features, resulting in better efficiency. The other main principles promoted a reduction of the unnecessary bearing spread and the optimization of the raceway contact through adequate profiling.

An important aspect for accurate results is correctly defining the operating conditions used for the design optimization exercise. This was done under the consideration of typical driving behaviors and of a fuel economy cycle (FEC) (Fig. 3).

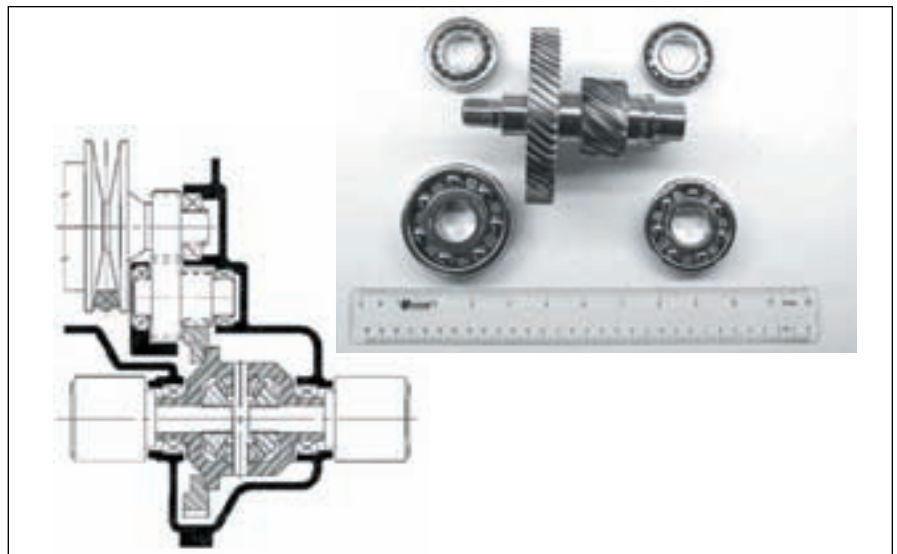


Figure 2—CVT Transfer Shaft Bearing Positions.

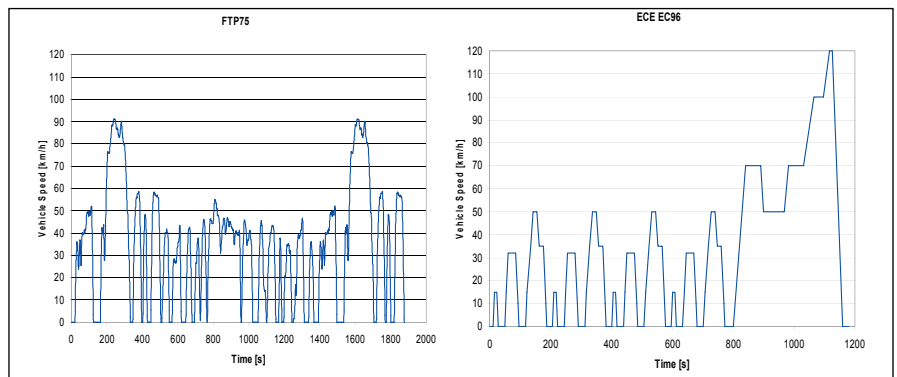


Figure 3—FTP75 and ECE EC96 Fuel Economy Cycles.

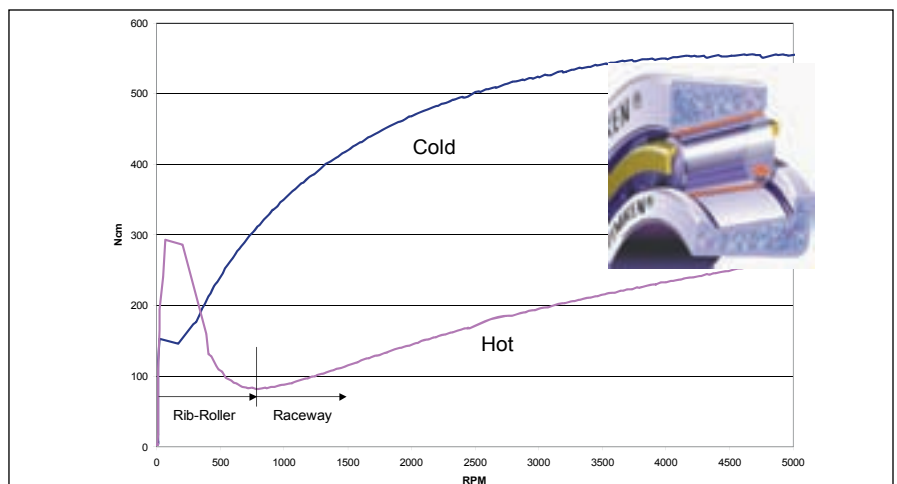


Figure 4—Typical Tapered Roller Bearing Torque Behavior.

For an axle application, the vehicle speed/time chart describing the FEC was converted into a diagram specifying the cycle percentage driven at a certain pinion gear speed range, and into a diagram depicting the relative energy lost by a unit of torque. The analysis showed that higher speeds bring the most significant contribution to the energy loss over the FEC. Accordingly, the design

optimization will target the parameters directly involved with the high-speed torque reduction.

The typical torque behavior of a tapered roller bearing is shown in Fig. 4. At relatively low speeds, the rib-roller torque dominates, while at higher speeds, the roller raceway contact generates a higher torque contribution.

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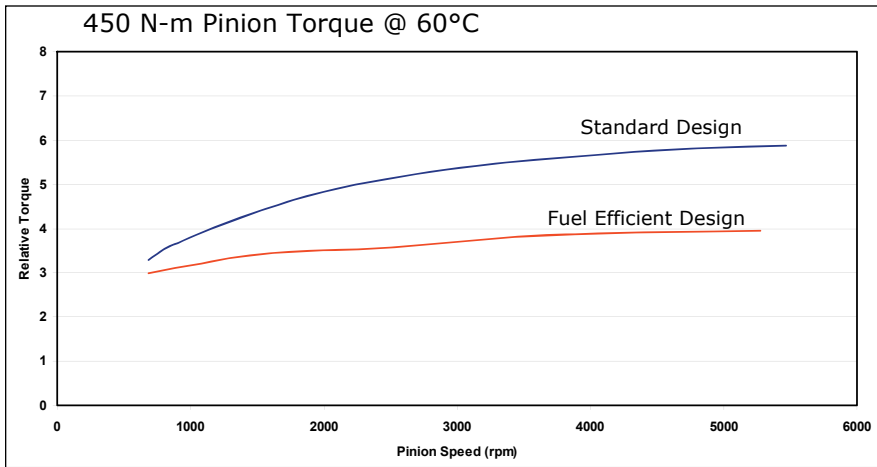


Figure 5—Pinion Bearing Torque Test Standard Design vs. Fuel Efficient Design.

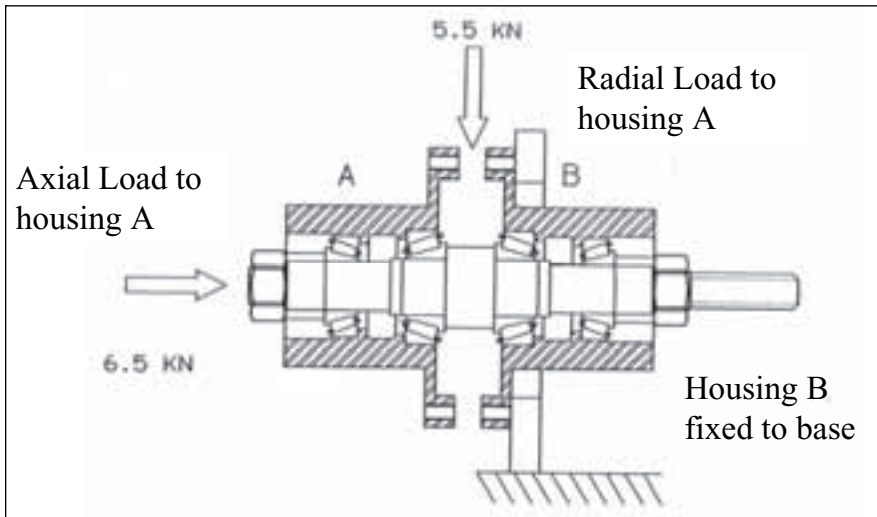


Figure 6—Pinion Simulation Test Arrangement.



Figure 7—Bearing-in-a-Bearing Concept.

In addition to torque behavior—based on the specific durability, stiffness and efficiency targets—the fuel-efficient bearing arrangement also offers the opportunity for axle housing weight and size reduction (Fig.1). This design was tested under various speeds, pinion torque and temperature conditions while compared to the standard design (Fig. 5). The test fixture is presented in Fig. 6.

In general, the fuel-efficient bearings yielded 30 percent lower torque values over the entire speed range in a clean oil environment. At 2,500 rpm and 60 degrees Celsius, this represents a 0.33 kW power loss reduction.

Similar tests were conducted in a debris-laden environment, demonstrating additional benefits related to the wear characteristics and operating temperature of the fuel-efficient bearings. The amount of worn material and the temperature levels were significantly lower compared to the standard product.

The conclusive 36 percent parasitic torque reduction obtained with a fuel-efficient TRB represents the highest achievable efficiency level in the industry, even when compared with the tandem angular ball bearing solution, at a significantly lower cost.

Power Density—

Prerequisite for Fuel Efficiency

During decades of continuous innovation and improvements in bearing design, increased power density has continued to be a main design and development goal of The Timken Company. Power density can be defined as the ratio between the power transferred by a machine component and its size or weight, and the following features beneficially influence it:

- High load capacity per unit of radial section
- Clean material
- Optimized stress distribution over the bearing race profile
- Low roughness finishing

Applied consistently, these design principles lead to significant reduction in bearing envelope dimensions and to the concept of “bearing in a bearing”

(Fig. 7). The small bearing can carry the same amount of load as the large one, but can fit into its bore. Such design modifications allow smaller bearings to deliver an equal amount of power but with more efficiency.

In order to deliver superior results, it is critical that bearings are made from the highest grade materials to meet the increased demand for power density. To help explain this importance, the evolution of the Timken steel cleanliness compared to relative life estimates is shown in Fig. 8. By utilizing advanced manufacturing processes, the summed total length of inclusion stringers was reduced by several orders of magnitude.

Progress continues to be made in profiling the bearing races in order to improve the stress distribution (Fig. 9)—another important piece of the power density pie.

Case Study of Possibilities

TRB Selection and Design Optimization for a CVT Transfer Shaft Application. The commercially available CVT utilizes a fixed and a floating ball bearing to support the transfer shaft. Using fatigue life and rolling torque criteria as a guide, a TRB design was refined to result in an optimum TRB design for maximum efficiency. A comparison between the dimensional characteristics and the weight of the ball bearings and of the proposed tapered roller bearings is shown in Figure 10.

The most objective validation of the TRB selection can be obtained only through the comparison with the ball bearings' performance over a vehicle or transmission duty cycle. Using sophisticated simulation techniques, the influence of the environment and design characteristics on the bearing performance was accurately quantified.

An important aspect of this study is the reduction of the radial deflections at the gear mesh points, achieved by both TRB designs, with a beneficial impact on the noise and durability parameters of the gear train.

The *Syber* software package developed by The Timken Company allows the analysis of a complete system consisting of shafts, gears and bearings

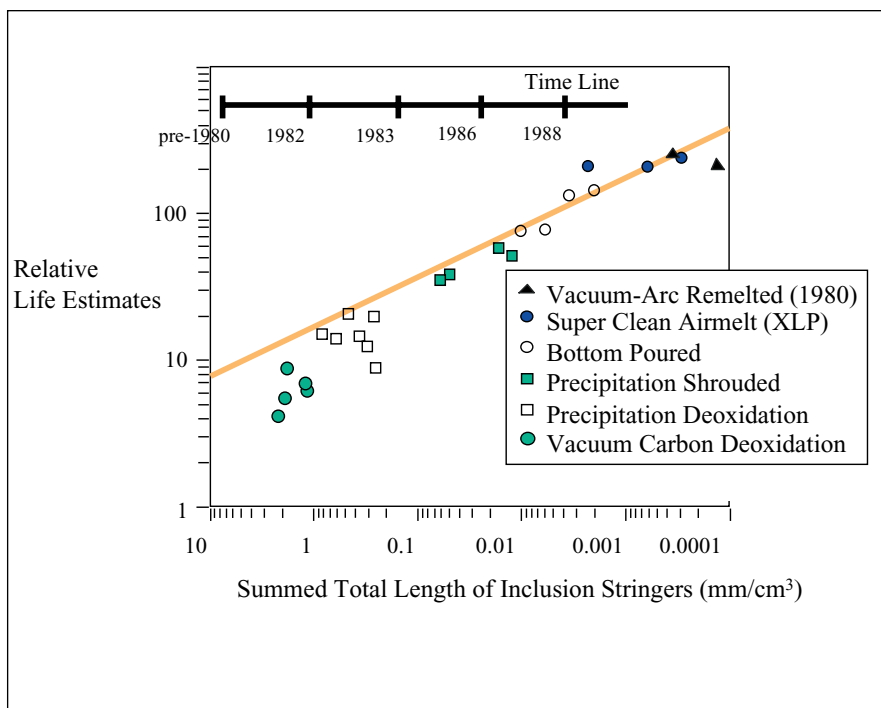


Figure 8—Timken Steel Cleanliness Constant Improvement.

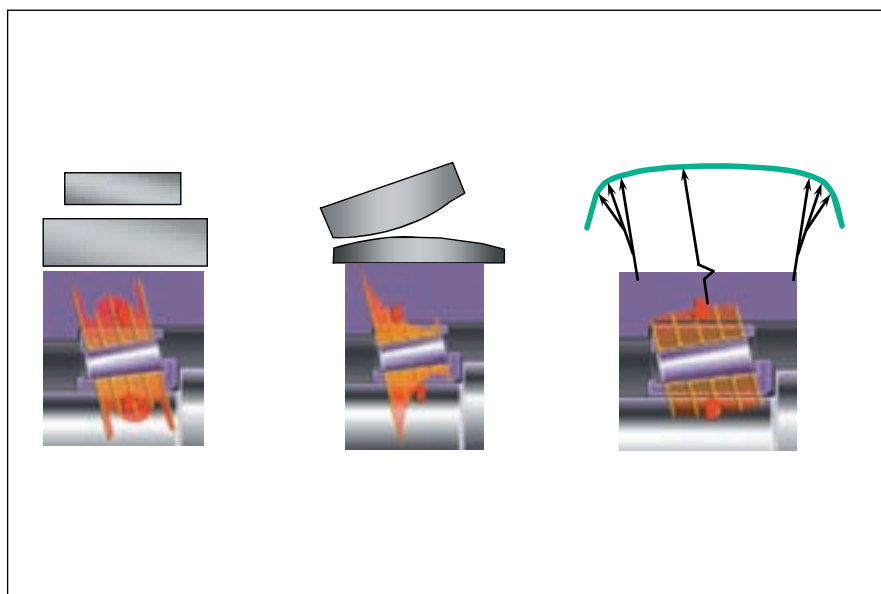


Figure 9—Bearing Race Profile for Improved Stress Distribution.

under a wide range of load, speed and temperature operating conditions. The output of the program contains fatigue life, contact stresses and running torque results for the bearings as well as deflection results for the shafts and gears, representing valuable information for the transmission designer.

The target fatigue life (L10) on the duty cycle was 250 hours. Although several TRB design variations were considered in this study, only the comparison

between the fixed and floating ball bearings used in the original transmission layout and two TRB designs are included here. The TRB designs included a commercially available standard design and a new design that featured a special race profile. The results of the simulation over the duty cycle demonstrated that both TRB designs meet the application requirements, validating their selection. Combined with the dimensional and

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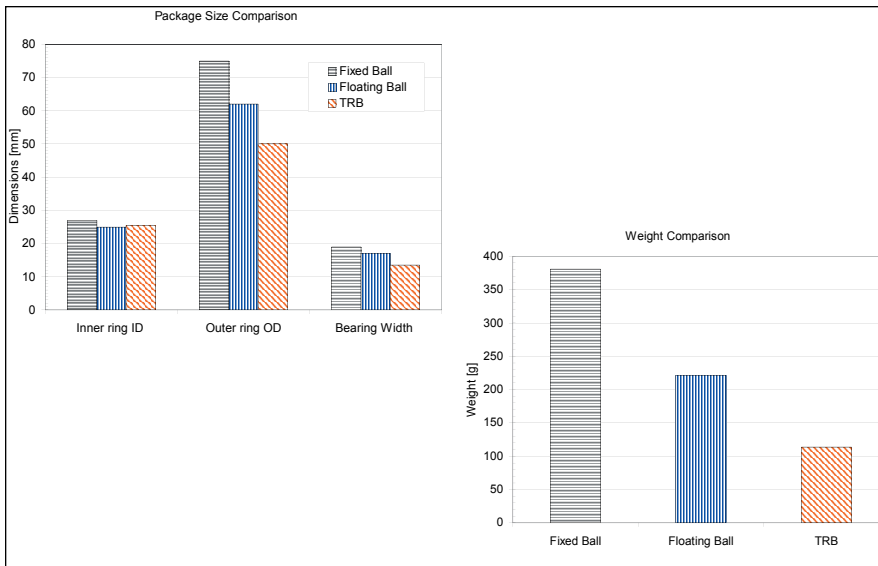


Figure 10—Package Size and Weight Comparison between the Fixed and Floating Ball Bearings and the TRBs.

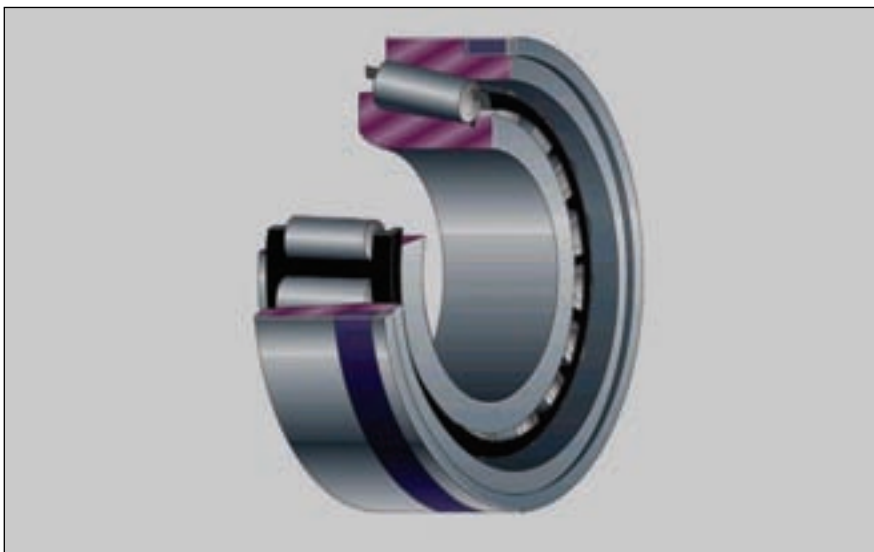


Figure 11—Thermal Compensating Tapered Roller Bearings.

weight advantages shown in Figure 10, this translates into remarkably high power density for the TRB.

The special profile TRB design, optimized for the present application, reduced the stress level along the cone race, especially the edge stress at the roller-cone contact (Fig. 9), significantly increasing the fatigue life compared to the standard design.

The differential thermal expansion between the transmission housing (aluminum) and the transfer shaft (steel) is minor in this case, due to the compactness of the design. It also did not affect the bearing setting and, implicitly, the life performance. Over the assumed operating temperature range

of -40 degrees to 120 degrees Celsius, the differential thermal expansion resulted in a maximum setting variation of 0.18 mm.

The preload force corresponding to the extremes of the dimensional setting did not exceed 800 N per bearing. At nominal dimensional settings, the preload force per bearing reached 300 N, relatively small compared to the gear loads. For the duty cycle, the resultant gear axial load varied from $12,500$ N to $2,500$ N (helix angle 33 degrees and 38 degrees for the large and small gear, respectively). However, for compensating the thermal effects in aluminum or magnesium transmissions with larger bearing spacing, adequate tapered roller bearing design solutions were commercially available (Fig. 11).

Important to note, the reduction of the radial deflections at the gear mesh points, achieved by both TRB designs, offered a beneficial impact on the noise and durability parameters of the gear train.

Evaluating Efficiency for the CVT. The emphasis of the CVT case study is not only on the superiority of the tapered roller bearings in regard to power density, but also their better efficiency characteristics. The overall vehicle efficiency is reflected in the test results over a fuel-economy cycle.

The currently used fuel economy cycles are FTP75 in the United States and ECE EC96 in the European Community (Fig. 3). A detailed analysis of these cycles shows the percentage of total cycle time for each transfer shaft speed operating condition. Taking into account the dependency of the bearing running torque on the operating speed, this analysis is essential for the bearing efficiency evaluation.

In order to isolate the bearing power loss from other transfer shaft system losses caused by the gears, drag, etc., the bearing running torque measurements were conducted on a test rig configuration similar to the one represented in Figure 6. The external loads applied on the rig were intended to simulate the loading conditions to which the bearings are subjected on a transfer shaft

transmitting two reference torque values of 100 Nm and 200 Nm, respectively. The test bearings were located in the central positions, theoretically carrying the entire applied load. Two ball bearings similar to the floating position on the transfer shaft were used as slave bearings.

When using TRBs under nominal setting (300 N per bearing), the 100 Nm and 200 Nm applied torque on the transfer shaft translates to four loading conditions. These conditions, plus the non-radially loaded pure spin condition, were used for a “one-to-one” comparison between the tapered roller bearings and the ball bearings, as well as the basis for the summation of the total measured torque of the bearing sets supporting the transfer shaft.

The measurements were conducted at three temperature levels: 30, 50 and 80 degrees Celsius, representing the different phases of the fuel economy cycles. The torque increase for the highest preload of the TRB was within 5 percent of the total running torque due to external loads. The measurement results proved the superior efficiency of the standard TRB design compared to the floating ball bearing, which, in turn, is more efficient than the fixed ball bearing. The TRB efficiency can be enhanced further through the special new design, which contains some elements derived from the fuel-efficient design strategy. The measurement results also showed a very good overlap with the torque values calculated using the *Syber* package.

The impact of these torque characteristics on the total power loss over the two representative fuel economy cycles is shown in Figure 12.

Additionally, the TRB resists debris by its continuous, self-cleaning, lubricant-pumping action. A ball bearing, with its deep groove race, traps and retains debris. Clean-sealed ball bearings are better protected from contaminants, but the running torque increases significantly due to the seals.

The running torque of the TRB, under the same operating conditions, is considerably lower than the torque of

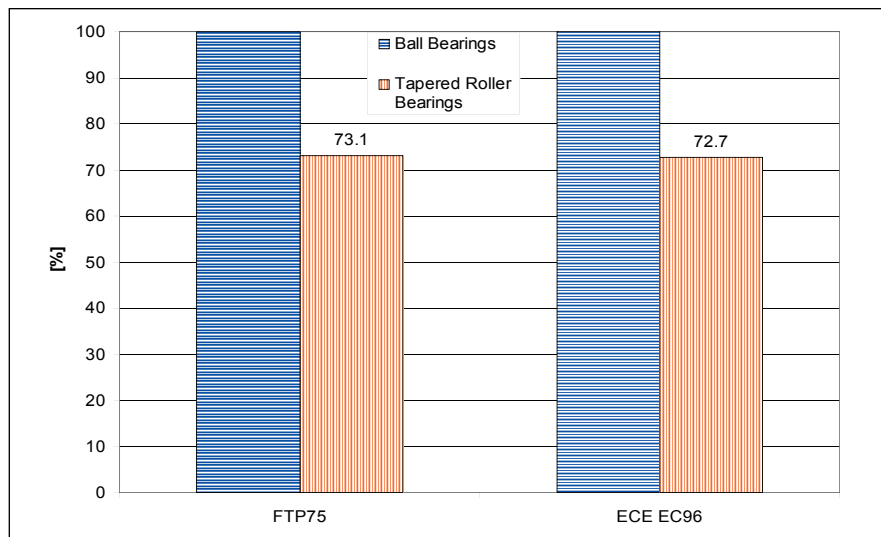


Figure 12—Relative Power Loss Performance over a FE Cycle (approx. 27% power-loss reduction by using the Efficient New Design TRBs).

the equivalent ball bearings supporting the CVT transfer shaft. Furthermore, in compact-designed automotive transmissions and axles, minimal variations due to thermal effects maintain the system life and the efficiency performance of the TRB at a superior level compared to the equivalent ball bearings.

The debris resistance of the TRBs contributes to a better running torque performance by eliminating the need for the clean-sealed technology, which involves the additional seal torque. Under the typical operating conditions of the most popular fuel economy cycles (FTP75 and ECE EC96), the TRBs provide major improvements—approximately 25 percent power loss reduction on the CVT transfer shaft analyzed in this study.

Conclusion

With the challenges that lie ahead for more fuel and energy-efficient designs, continued efforts to develop, test and implement better designs and alternatives will continue.

Fuel-efficient bearing design solutions that meet the needs for power capacity, weight, volume and power-loss characteristics will stay top of mind for component suppliers.

For more information on fuel-efficient designs, electronic analysis tools and engineering solutions, visit www.timken.com.

Mark Joki is a senior product development specialist at The Timken Company.

Our Focus

The Global Gear Industry



Trends, Challenges and Needed Solutions
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Countdown Continues for IFPE 2008



Boasting one of the largest international gatherings for power transmission professionals, the International Power Transmission Exposition (IFPE) will once again be held simultaneously with CONEXPO-CON/AGG 2008 at the Las Vegas Convention Center in Las Vegas, Nevada, March 11–15. The shows are expected to attract more than 125,000 visitors from around the world.

IFPE 2008 offers education programs, exhibit pavilions and networking opportunities for those involved in hydraulic, pneumatic, electrical and mechanical power transmission components, systems and controls. The show is run by and for industry professionals, a management philosophy that puts manufacturer and customer needs first and allows revenues to advance industry causes.

The original IFPE seminar took place in Chicago in 1984 with an early focus on hydraulic and pneumatic components, systems and controls. At the time it was known as the International Fluid Power Exposition. While the show's IFPE name stayed the same, the new buzzword became the International Exposition for Power Transmission.

According to IFPE show manager Sara Truesdale-Mooney, the IFPE 2008 Technical Conference will feature a record 107 presentations on the latest research and developments in power transmission and motion control technologies.

“Presentations will be published and made available on CD-ROM at the conference,” says Mooney. “We’ll also be offering Continuing Education Units (CEUs) for each session. This is the first time we’ve provided this to our attendees.”

The technical conference will feature topics including asset management, computational fluid dynamics, hybrid systems and suspensions and vehicle systems.

The Innovation and Solutions Center, a new program for 2008, will offer 19 free education sessions on the show floor. The sessions will focus on current and future design applications in four major areas: “green” solutions, innovative entertainment applications, fluid power solutions and motion control solutions.

For the entertainment session, Cirque du Soleil’s KÁ show head of automation, James Tomlinson, will share a behind-

continued



the-scenes look at the production's hydraulics, pneumatics and electronic setup. Other technology sessions will cover theme parks and motion pictures.

The "green" solutions segment will give attendees insight into renewable energy, hydraulic hybrid vehicles and system technologies, environmentally friendly fuels and the latest issues related to U.S. Tier 4 engine emissions.

Presentations for fluid power and motion control solutions will cover hydraulics, hose routing, seal designs, contamination control and the future of fluid power.

IFPE plans to offer the largest array of motion control products and technologies in the history of the exposition on the showfloor. The American Gear Manufacturers Association (AGMA) as well as the Power Transmission Distributors Association (PTDA) will sponsor exhibit pavilions. A sensors pavilion will feature monitoring, measurement and control equipment. International pavilions will be sponsored by China, Italy, Spain and Taiwan as well, offering international business solutions and contacts.

The conference is sponsored by more than 15 industry organizations from around the world. The broad range of programs is what has attracted attendees over the years.

"We have found the IFPE show to be a cost-effective way to meet with many of our suppliers," says Tim Wolles, project engineer at Gehl Company. "We get a chance to see their latest products and also meet new suppliers."

John Engelstad, strategic supply manager at John Deere, attends to address specific problems such as lowering costs or finding innovative drive system solutions. "IFPE allows me to see what the industry is doing and how new products are being utilized."

For the Link-Belt Construction Equipment Co., IFPE offers its engineers a chance to see the numerous companies that offer solutions that will benefit their own construction equipment. "Link-Belt works with a number of component suppliers that are integral to our product's success," says Chuck Martz, president and CEO of Link Belt. "Exploring the new technologies keeps us a major player in the crane market."

Although registration for the 2008 program is sold out, Mooney says there is a waiting list for interested parties on a first come/first serve basis.

For more information:

International Power Transmission Exposition (IFPE)

Phone: (414) 298-4141

Toll Free: (800) 867-6060

www.ifpe.com

calendar

March 26–27—Advanced Manufacturing Expo.

International Centre, Toronto, Ontario. Two events form the basis for the Advanced Manufacturing Expo—the Canadian High-Technology Show (CHTS) and Assembly Canada. Both programs feature education sessions as well as innovations on the showroom floor. Attendees will learn, compare and implement operation solutions. Assembly Canada concentrates on the assembling of discrete parts into finished products, while the CHTS focuses on products and services for electronics manufacturing. The Society of Manufacturing Engineers sponsors the event.

March 31–April 3—WESTEC 2008 Exposition and Conference.

Los Angeles Convention Center, Los Angeles, CA. With a focus on technology and professional advancement, WESTEC offers free educational programs including sessions on comparative technologies, lean principles and business management strategies in manufacturing. This year's conference features a back-to-basics program offering manufacturing career opportunities. The Society of Manufacturing Engineers sponsors the event.

April 14–16—SAE 2008 World Congress Cobo Center.

Detroit, MI. Geared toward sharpening the skills of budding automotive engineers and training managers, the SAE 2008 World Congress includes 1,500 technical papers on topics such as propulsion and powertrain, electronics, materials, emissions and environment, management and marketplace and safety and testing. The Congress offers 40 SAE seminars, a global exhibition show floor, a technology pavilion and an international booth. Attendees represent fields in engineering, management, purchasing, manufacturing, military, academia and research in automobile technology. Sessions new to the 2008 program include, "Designing On-Board Diagnostics for Light- and Medium-Duty Emissions Control Systems," "High-Performance Engine Design and Development," "Automotive Product Lifecycle Management" and many others. For registration and contact information, call (877) 606-7323 or visit www.sae.org/seminarinfo.

April 21–25—Hannover Messe 2008.

Hannover Fairgrounds, Hanover, Germany. More than 200,000 industry professionals converge on this global trade fair highlighting industrial technology. With 10 flagship international trade shows, participants can catch up on the latest market trends, innovations and business developments from all aspects of the industry. Exhibitors have the opportunity to launch new products, meet face-to-face with customers, establish distribution channels and generate brand awareness. For registration and contact information, call (609) 987-1202 or visit www.hf-usa.com.

May 13–15—10th Annual European Supply Chain & Logistics Summit.

Düsseldorf, Germany. SCL Europe 2008 brings together practitioners and providers of supply chain management and logistics from all over Europe. The event includes keynote conference sessions, streamed focus groups, interactive event workshops and private one-on-one meetings with peers and partners. Find out how to execute effective measures to optimize your supply chain within a global and on-demand environment. For more information visit, www.supplychain.eu.com.

May 20–22—"Successful Measurement of Dynamic Force, Pressure and Acceleration".

PCB Corporate Headquarters, Buffalo, NY. PCB Piezotronics' annual three-day seminar will include in-house demonstrations for senior technicians, test engineers, engineering analysts and test facility managers. Participants will learn dynamic force principles, noise correction and sensor and system calibration as well as other data analysis. The cost for the seminar is \$595. This includes seminar materials, meals and entertainment. For more information visit www.pcb.com/events.

May 27–30—Technology Exhibitions Week.

Milan, Italy. This 4-in-1 exhibition format highlights a range of technology exhibits in automation, microelectronics, motion control systems and industrial design. A showcase on manufacturing solutions allows attendees the opportunity to optimize the whole chain of production with project-design, simulation tools and software for life-cycle management. For more information, visit www.fieremostre.it.

June 10–13—Automatica 2008.

New Munich Trade Fair Centre, Munich, Germany. Featuring pioneering developments in robotics, control systems, software, safety, supply and sensors technology, Automatica has more than 440 registered participants for the 2008 event. Automatica is logically structured into themes dealing with innovations and solutions and will be held simultaneously with the 'Robotik' congress adjacent to the exhibition center. For more information contact Carolin Schuetze at (212) 974-1880 or cschuetze@munich-tradefairs.com.

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RMB

WINS TECO WESTINGHOUSE DISTRIBUTION DEAL

RMB Engineering recently acquired exclusive distribution rights for TECO Westinghouse's supply of LV motors in the United Kingdom. The line includes high-efficiency IEC frame motors, lightweight aluminum frame motors, integrated brake motors, smoke extraction motors and heavy-duty, cast iron motors.

"We've been selling the brand for many years now and know the product range very well," says Mark Brady, operations director at RMB Engineering. "We will be stocking popular items in branches across the U.K. as well as calling on new U.K. stock from TECO."

According to the company's press release, RMB Engineering, allied with the motor experience offered by their parent company Deritend, provides a solid specification and supply route for engineers facing extended lead times from other areas of the industry.



Bosch Rexroth

OFFERS WIDE RANGE OF HYDRAULICS COURSES



Bosch Rexroth is offering customized training courses for new and existing mobile and industrial hydraulics installations. According to the company's press release, the on-site training program gives employees an opportunity to expand their knowledge on their schedule within a specified budget. The program offers training in proper start-up and preventive maintenance procedures from associates at Bosch Rexroth.

In addition, Bosch Rexroth offers a series of regularly scheduled courses throughout the year to meet the demands of hydraulic systems maintenance personnel. Training is available at U.S. locations in Bethlehem, PA, and Spokane, WA. Canada locations include Burlington, ON, Burnaby, BC, and Edmonton, AB. For a complete listing of all course titles, dates and locations, download the Bosch Rexroth 2008 Hydraulic Training Schedule at http://boschrexrothproducts.com/hydraulics_training or call (610) 694-8407.

Fenner

ACQUIRES B-LOC CORP.

Fenner Drives has acquired B-LOC Corp., a North American supplier of keyless shaft/hub locking devices for mechanical power transmission and material handling applications.

"Combining the well-established B-LOC brand with our existing Trantorque product line positions us as the market leader in the U.S. and Canada and provides a strong platform for sales growth in the Americas," said Ian Smith, executive director of global sales and marketing at Fenner Drives.

B-LOC Corp., founded in 1982, has been dedicated to developing new markets for keyless bushing technology, while Fenner Drives is a designer and manufacturer of power transmission components with plants in England, Pennsylvania and North Carolina.

Igus

SUPPLIES ROBOTICS TEAMS WITH NECESSARY COMPONENTS FOR COMPETITION

Igus Inc., a developer and manufacturer of motion control and machinery components, donated a wide range of products for the 17th Annual FIRST Robotics Competition in Manchester, NH. Held in January 2008, the FIRST (For the Inspiration and Recognition of Science and Technology) competition gives robotics students the opportunity to build a robot capable of carrying 40" inflated track balls around

a circular, indoor field. The 1,500 participating teams came from all over the world, including Israel, Brazil, Canada and the United States. Teams received a kit of common parts and had six weeks to construct their robots for the competition.

Igus has been a platinum-level supplier for the event for three years. For the 2008 competition, the company donated cable carriers, bearings, linear guide systems and aluminum shafting. In 2005, Igus launched the YES (Young Engineers Support) Program to foster mechanical design ideas for students with a passion for engineering.



“Igus has been extremely proactive about supporting organizations that promote both interest and the pursuit of degrees and careers in engineering-based fields,” says Carsten Blasé, vice president at Igus. “Through our YES program,

Igus strives to accomplish goals similar to those of FIRST Robotics, making Igus’ support of the competition a win-win situation.” For more information, visit www.usfirst.org or www.igus.com.

Tsubakimoto

OPENS NEW HEADQUARTERS IN DORDRECHT



With an ongoing commitment to the European market, Tsubakimoto announced the official opening of a new headquarters in Dordrecht, the Netherlands. The company has maintained a headquarters in the Netherlands for 35 years. The new facilities will serve customers in Western Europe, Eastern Europe, Russia, the Middle East and Africa. Additional land has been purchased at the site to house a state-of-the-art warehousing and logistics center. Tsubakimoto senior personnel joined local dignitaries at the opening ceremony in the Netherlands to commemorate the event.

The company currently supplies roller-chain, conveyor belts and power transmission products to over 70 countries worldwide, with an emphasis on efficiency and environmentally conscious manufacturing.

Tonka Bay Equity

ACQUIRES AST BEARINGS

Tonka Bay Equity Partners announced the acquisition of the AST Bearings division of Axsys Technologies, Inc. last December. According to the company’s press release, AST Bearings LLC is Tonka Bay’s seventh platform acquisition in their current investment fund and their fourth acquisition since September 30, 2007. Based in Montville, New Jersey, AST is a supplier of high precision bearings and related products.

“We are excited to partner with the strong and experienced management team at AST. As an independent company, AST will be able to invest in organic growth and pursue strategic acquisitions to achieve product line and geographic expansion,” says Cary Musech, managing principal of Tonka Bay.

“Tonka Bay’s resources and industrial marketplace experience will be very useful as we pursue our strategic initiatives, including expanding our product line offering and making add-on acquisitions to complement our core business” says Dale Kaminski, CEO of AST.

Sercos

OPENS OFFICE IN CHINA

Due to increased interest in motion control technology in Asia, Sercos International recently opened a branch office in China. The office is located in Beijing and is operated by CAMETA (China Association for Mechatronics Technology & Application), a non-profit organization involved in the development of mechatronic technologies and products.

According to the company’s press release, Sercos has been working with companies and engineers for several years in China. In 2002, a Sercos interface was added to the China National Standard allowing local companies to use certain technologies. A Chinese website has been set up for the new branch office at www.sercos.org.cn.

Bosch Rexroth

ANNOUNCES MANAGEMENT CHANGES

Bosch Rexroth recently appointed Erwin Wieckowski as vice president and general manager of its linear motion and assembly technologies group. Wieckowski most recently served as the general manager of the automation business unit as well as the national sales and marketing director at Bosch Rexroth. The new position is based in North Carolina, where Wieckowski will be



Erwin Wieckowski

responsible for aluminum structural framing, ball screws, conveyors and other key product lines. He began his career as a plant engineer, later becoming an application engineer and quality coordinator before turning his attention toward product and sales management roles. Wieckowski has degrees in applied science and management science from the University of Waterloo, in Waterloo, Canada.



Dr. Albert Hieronimus

Dr. Albert Hieronimus has recently been appointed to chairman of the board of management at Bosch Rexroth. In addition, Dr. Karl Tragl has been appointed to the board of management in a sales role. Hieronimus was previously the managing director of Motor Industries Company Limited, a Bosch subsidiary in Bangalore, India. Hieronimus held various positions at the University of Cologne before joining Mannesmann Rexroth AG in 1993. In 2001, he served on the executive management team of Bosch Rexroth, where he was responsible for human resources, IT, and coordinating post-merger integration. Tragl joined Mannesmann Rexroth in 2000, following jobs at Siemens and the German Aerospace Research Center. He was previously the president of the electric drives and control division of Bosch Rexroth.



Dr. Karl Tragl

FAG Industrial

OFFERS TORQUE MEASUREMENT SERVICE

FAG Industrial Services is offering customers torque measurement capability that monitors complete drive components. Measurements can be performed in rough ambient conditions and integrated into existing drive trains without affecting the drive elements. The measurements can be performed either sporadically or constantly, depending on the customer's needs.

According to the company's press release, the combination of torque and vibration measurement provides maintenance personnel with detailed information on the plant's condition. This helps to optimize drive components and estimate reliability.

"Torque monitoring always makes sense in applications where drive elements must be protected from overstressing or where the right torque is important for the production process," says Dr. Christian Schaaf, head of torque and design improvement department at FAG Industrial Services. "Almost all industries can benefit from this service."

All Metric Small Parts

GAINS EXCLUSIVE DISTRIBUTION RIGHTS FOR TOCHIGIYA

All Metric Small Parts (aMsp) recently announced it has become the exclusive distributor for Tochigiya, a leading manufacturer of metric standard industrial machine components based in Tokyo. Tochigiya supplies parts including handles, handwheels, cranks, grips, levers, knobs, latches, locks, catches, hinges, hardware, plungers, pins, leveling mounts and support feet. Applications for these products include machine tool boxes, electronic systems enclosures, medical equipment devices and power distribution systems enclosures. The aMsp catalog is available upon request at www.allmetricsmallparts.com.

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Eat Your Heart Out, Spielberg



“Restless Planet” transports guests to a Jurassic landscape with more than 100 animatronic dinosaurs.

A new dinosaur-based theme park that blends science and entertainment will be the closest thing to exploring the prehistoric past for visitors to the City of Arabia in Dubai, United Arab Emirates. Operating under the working title, “Restless Planet,” the 500,000-square-foot attraction will put guests face to face with giant dinosaurs in the world’s first true fusion of thrilling and educational entertainment.

The “real-life Jurassic Park” will feature more than 100 dinosaurs created by Kokoro Company Ltd., a leading Japanese manufacturer of robotically controlled animatronics. The Natural History Museum in London will provide interpretive content for the project while also serving as a scientific consultant to Kokoro.

“The Kokoro Company has vastly improved the speed and smoothness of the dinosaur movements, making them more realistic than ever before,” says Claudine Fontana, media-relations manager at the museum. “The new design incorporates servo-feedback technology with a combined analog/digital system of pneumatic controllers and electronic circuitry. The system allows us to witness large and impressively scary movements, as well as subtle movements such as breathing and lip curling.”

Kokoro Company has over 500 dinosaur creations around the world, including 250 animatronic designs at the Dinosaur Adventure Park in Saitama Prefecture, in Japan. Upon completion, the Restless Planet theme park will boast one of the largest collections of animatronic dinosaurs in the world.

Fontana says the Ilyas & Mustafa Galadai Group invited the museum into the project to help represent the Mesozoic era. “We were brought in to ensure that the theme park was not only entertaining and fun, but scientifically accurate.”

According to the company’s press release, tourists will be transported to a place where earthquakes, eruptions and meteor showers come alive before their eyes. They’ll also experience the dinosaurs first-hand as they travel across a Jurassic landscape.

The promotional video at the website boasts a terrifying monorail ride into the past, featuring music reminiscent of certain blockbuster dinosaur movies. Still, they’ve come a long way since the crude animatronics of *Jaws*.

“From dramatic rides that plunge visitors into the world of giant sauropods and terrifying raptors, to special zones exploring the prehistoric past and links to the latest discoveries, the theme park will meld science and entertainment like never before,” says Fontana. “It will combine breathtaking theme park experiences with educational content, dramatic lighting and audio/visual effects.”

The museum will continue to support the attraction beyond completion of the project by offering educational programs and relevant updates on new scientific discoveries.

Restless Planet is just a small slice of the 20-million-square-foot residential/commercial development in Dubai known as the City of Arabia, a monumental architectural endeavor that includes the Mall of Arabia, and the Wadi Walk, a collection of Mediterranean retail shops, apartments and restaurants lining a waterway. The City of Arabia is set to be completed June of 2009.

Restless Planet is being designed by international theme park specialists Jack Rouse & Associates and enclosed under a 75-meter dome designed by RH Architects. It’s scheduled to open in Dubai in 2010. For more information visit, www.cityofarabiame.com.

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