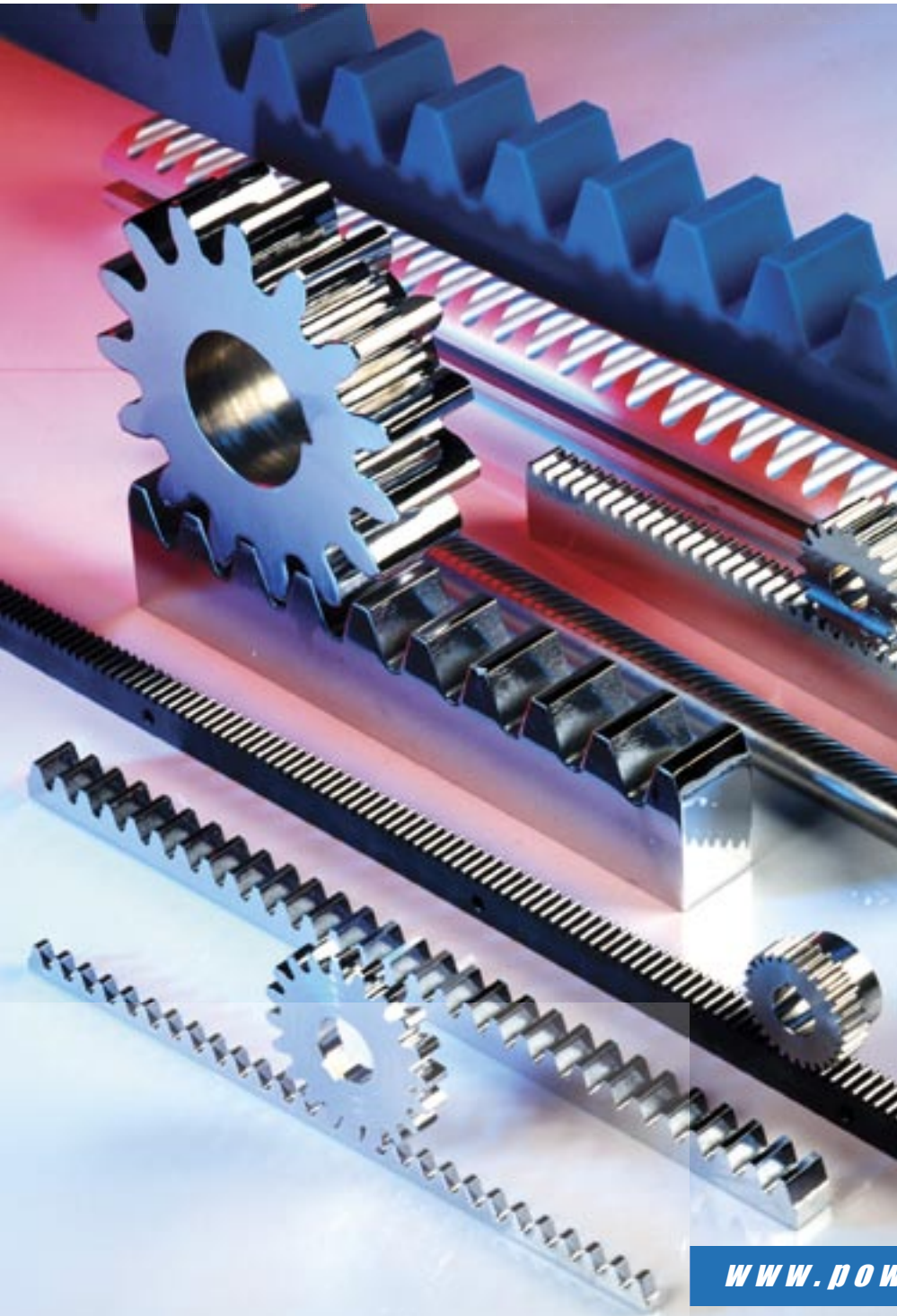


# PTE

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- Sun Bots Make Solar Happen
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## Technical Articles

- A Guide to Belt Maintenance
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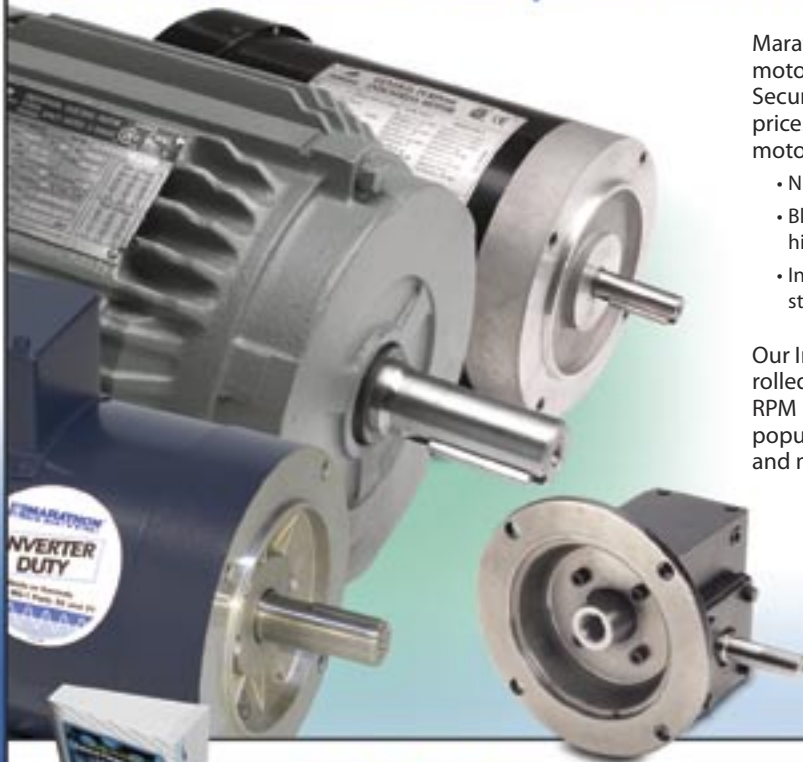
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**Photo courtesy of Halifax Rack and Screw**

## Linear Stage

### POSITIONS IN NANOMETER FIELD

The ANT130-L series stages from Aerotech are designed for high performance in speed, accuracy, resolution, repeatability, reliability and travel range. Aerotech offers the stages in two accuracy grades.

A center-driven, non-cogging, non-contact linear motor and encoder drive the stages. The direct drive linear motor performs without backlash or windup that other lead or ball screw drives exhibit. The motor also allows for higher speeds and accelerations; peak unloaded acceleration hits 1 g and maximum velocity is 350 mm/s. The product's design was specifically targeted towards high-performance nanometer applications.

"While other Aerotech linear stages employ some of the same features such as the cross-roller bearings and/or linear motor, everything about the ANT130-L was designed for ultra-high performance positioning in the nanometer realm, including the use of linear amplifiers with the product," says Robert Novotnak, group vice president at Aerotech. "The ANT130-L was designed not just as a component, but as part of a complete system using mechatronic design principles. That is, this level of nanometer performance is achieved through an optimum combination of mechanics, electronics, and software."

The ANT130-L meets the demands of step-to-step resolution necessary for alignment applications with an incremental step size of 1 nm. The stage's linear motor is responsible for making precise, small resolution steps that are critical in alignment applications that require the highest level of step accuracy.

"This level of performance was previously limited to piezo stages that had very limited travel—tens or



hundreds of microns," Novotnak says. "This often required a macro stage to perform load and/or unload operations or other movements that required long travel—tens of hundreds of millimeters—while the piezo stage was used for nanometer-level moves. The ANT130-L performs in both realms, with travels from 35 to 160 mm and fine positioning accuracy measured in nanometers. This saves time, expense and the additional complexity required for a multi-stage coordinated motion solution."

Part of the ANT130-L product design was driven by industry trends reflected by customer use of Aerotech products. "We've found that many high-accuracy alignment, inspection, positioning and measurement stations now require accuracy, repeatability, resolution and in-position stability in the nanometer realm," Novotnak says. "In particular, we've found quite a bit of interest in the ANT130-L and its sister products, ANT95-L and ATN95-XY,

in laboratory research and development products."

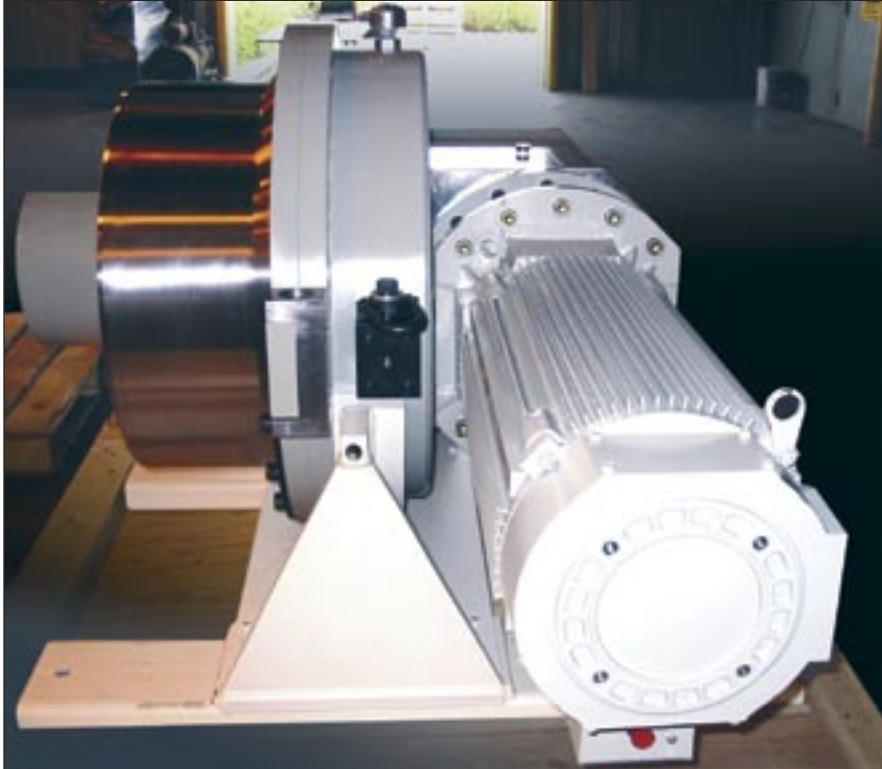
The ANT130-L series stages can be configured as XY assemblies. Optional features include orthogonality alignment to 5 arc seconds and vertical axis solutions.

#### For more information:

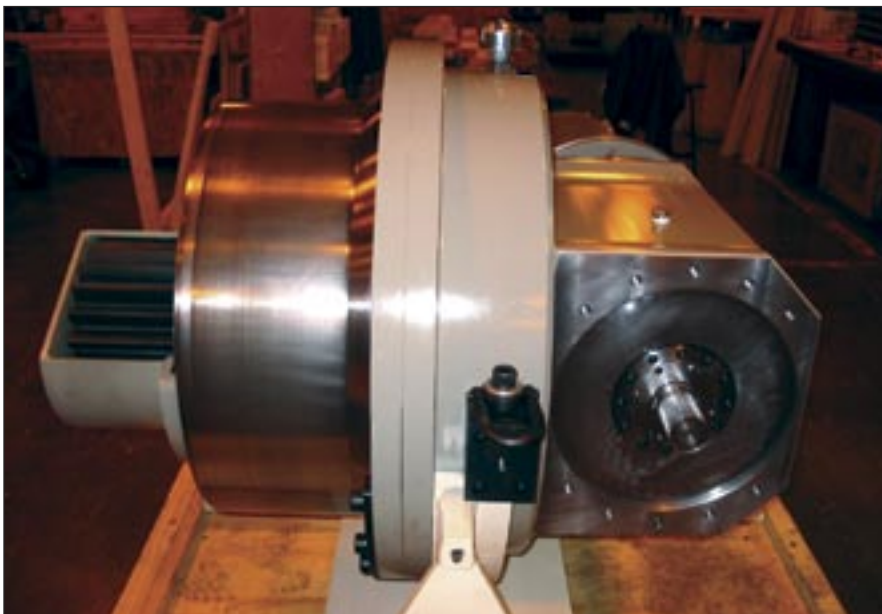
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Fax: (412) 963-7459  
sales@aerotech.com  
www.aerotech.com

## Excel Gear

DESIGNS, PROTOTYPES  
NAVY GUN SYSTEM GEARBOXES



The Excel Gear 38:1 gear ratio gearbox used on the Advanced Gun System (AGS) built by BAE Systems.



An internal view of the gearbox that helps move the 78-ton AGS gun mounts.

Excel Gear has transitioned from prototype to production of 38:1 ratio gearboxes designed for positioning the gun mount in the Advanced Gun System (AGS) used by the U.S. Navy and Marine Corps.

The AGS is used in the DDG 1000 destroyers that support Navy and Marine Corps expeditionary and joint operations in the littorals and deep inland. BAE Systems of Minneapolis develops the AGS as a complete weapons delivery system that uses rapid and virtual prototyping for the gun, magazine, ammunitions and support subsystems. The system produces gunfire for guided and unguided projectiles at targets over 70 nautical miles.

Excel Gear designed and prototyped the gearbox used in the positioning execution of movements on the gun mount. The main gear diameter in the unit measures 17", and overall the gearbox is 46" long with 36" in diameter and weighing 3,740 lbs.

A successful pair of prototypes was produced for evaluation and performance testing prior to the production order.

"This achievement marks a very important milestone in the history of our company, and we all worked very diligently as a team to attain this business and see its successful execution," says N.K. Chinnusamy, president of Excel Gear.

Excel's gearboxes help the rotary and vertical positioning of the gun mount. Testing was performed at the Excel and BAE Systems' facilities. One challenge for Excel in this project was limiting backlash, as Chinnusamy explains. "Backlash in this case is controlled by precision grinding gears to close tolerance and also grinding splines to fit master gages. The gearbox had to meet very precise backlash, lost motion and stiffness criteria. Our two prototype gearboxes met all the criteria without any exceptions."



## For more information:

Excel Gear Inc.  
11865 Main Street  
Roscoe, IL 61073  
Phone: (815) 623-3414  
Fax: (815) 623-3314  
sales@excelgear.com  
www.excelgear.com

## User-Friendly Non-Contact Torque Sensor

MOUNTS IN MOMENTS

Sensor Technology Inc.'s RWT 350/360 TorqSense is a non-contact digital torque measuring system that features an integral sprocket or pulley to eliminate the engineering required to

mount previous models, which featured an in-line shaft for connecting to equipment. The product is appropriate for any equipment driven by a belt or chain drive, including where space limits or restricted access are a factor.

"Belt and chain drives naturally have a high radial load, which has to be accounted for when mounting a standard TorqSense," says Tony Ingham of Sensor Technology. "It's not rocket science, but it can be fiddly, especially if access is physically difficult or time is limited.

"The new RWT350/360 simply replaces an existing pulley/sprocket, can be fitted in minutes and automatically compensates for the radial load. It's little more than tighten up a few Allen screws and checking alignment."

The control electronics are separate from the sensing head, so the head can be placed in a tight space while the electronics are mounted an appropriate



distance connected by a cable.

TorqSense features piezo-ceramic combs—surface acoustic wave (SAW) devices—that are fixed to a flange. The SAW devices distort proportionally to the instantaneous torque level. This distortion produces RF data signals that transmit to a non-contact radio frequency coupling instead of by clip

**continued**

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rings or high inertial rotary transformers, which tend to be clumsy. The data signal transmits to a control unit for reading on an alpha-numeric display or moving to a PC for storing and review.

The RWT350/360 is appropriate for use with a range of sensing applications "Our larger sensors are used in many applications at the heavy duty

end of industry, whereas our smaller ones are found in applications such as fine chemical dosing and lab-based research," Ingham says. "Right through this spectrum are applications where mounting is associated with a belt or chain drive. And the new RWT350/360 makes this a simple plug-and-play operation."

#### For more information:

Sensor Technology Ltd.  
P.O. Box 99605  
Raleigh, NC 27624  
Phone: (919) 954-1004  
Fax: (919) 954-1009  
[info@torqsense.com](mailto:info@torqsense.com)  
[www.torqsense.com](http://www.torqsense.com)

## Step Motor Driver

### REDUCES DESIGN TIME

The R525 microstepping step motor driver from Lin Engineering helps reduce overall design time and system cost in a range of step motor applications that require high torque, power and smooth motion. Measuring just over 3.3 inches long and 1.3 inches high, the R525 is suitable for most systems.

The R525 outputs up to 5 amps peak current and handles up to 75 volts DC. It is compatible with all NEMA 8, 11 and 17 motors, most NEMA 23 motors and some NEMA 34 motors.

The unit has built-in RS485 communication for connecting to a computer easily, and it is configured using Lin Engineering's graphical user



interface, LinDriver. Configurable settings include step resolution, run current, hold current, damping modes for smoother motion and choice of sensing step pulses on the rising or falling edge.

#### For more information:

Lin Engineering  
1990 Russell Avenue  
Santa Clara, CA 95054  
Phone: (408) 919-0200  
Fax: (408) 919-0201  
[sales@linengineering.com](mailto:sales@linengineering.com)  
[www.linengineering.com](http://www.linengineering.com)

## Gearless Optical Encoders

### INSENSITIVE TO MAGNETIC FIELDS

Turck USA's Kubler F36 series absolute optical encoders feature a gearless design and eliminate wear and sensitivity to magnetic fields. With a compact size of 36 mm and a hollow shaft diameter up to 10 mm, the F36 encoders are appropriate for drive and

medical applications.

There are two versions available. The F36 single-turn encoders feature resolution up to 17 bits, and the multi-turn encoders have resolution up to 41 bits with over 16 million revolutions. They handle harsh environmental conditions with an IP 67 protection rating and a temperature range of -40 to 90 degrees Celsius.

The Kubler by Ruck encoders use an OptoASIC technology with high integration density, so there are fewer components and connection points

to increase operational reliability. A patented bearing structure increases the encoders' ability to withstand vibration and does away with installation mistakes.

#### For more information:

Turck USA  
3000 Campus Drive  
Minneapolis, MN 55441  
Phone: (800) 544-7769  
Fax: (763) 553-0708  
[www.turck-usa.com](http://www.turck-usa.com)

## Machinable Nylon Grade

BROADENS SIZE RANGE



Nylatron NSM, a wear-resistant machinable nylon grade, is available in a wider range of tubular shapes for machining larger bearings, bushings and wear parts. Nylatron manufacturer Quadrant introduced the new sizes in response to engineers and designers looking to reduce material costs and fabrication time in larger bearing applications.

Tubular Nylatron shapes are normally produced with diameters up to 34 inches, but larger diameters are possible as well. Wall cross section is as thin as 1 inch, and the tubes come up 39 inches long. Nylatron NSM has a wear life five times more than other cast nylon materials, and it allows for higher loads and speeds based on an LPV of 15,000.

### For more information:

Quadrant Engineering Plastic Products  
2120 Fairmont Avenue  
P.O. Box 14235  
Reading, PA 19612  
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The issue the Self Opening Clamp feature solves involves removing a motor in which the clamping collar bonds to the steel shaft from fretting corrosion. This R+W feature temporarily increases the inside diameter of the clamp, so installation is smoother. It also helps break the bond between the hub and shaft that occurs after extended use, so removing the shaft is easier. The Self Opening Clamp is available for all R+W couplings with clamping collar, and it is standard on larger couplings.

### For more information:

R+W America  
1120 Tower Lane  
Bensenville, IL 60106  
Phone: (630) 521-9911  
Fax: (630) 521-0366  
info@rw-america.com  
www.rw-america.com

## Micromanipulator

FEATURES COMPACT DESIGN,  
TWO-AXIS STAGE POSITIONS  
PRECISELY



The MP63 three-axis micro manipulator module from Steinmeyer, Inc. is a fully enclosed, three-axis positioner with 25 mm stroke in each direction. All components of the assembly are internal, and they include DC gear motors, rotary encoders, lead screws and non-contact limit switches.

Each direction has accuracy of 5 microns with  $\pm 1$  micron repeatability. Standard straightness and flatness is  $\pm 3$  microns, with 1 micron as an available option. The assembly weighs approximately 2 kg. Cable connectors are on one end, and the assembly can be manufactured clean-room compatible as an optional feature.

Steinmeyer also released a two-axis system for laser machining and other extended travel applications that require precision positioning. The LT490-450-EDLM is a fully enclosed two-axis stage with 450 mm stroke. Each assembly includes iron-core linear motors, linear



guideways, linear measuring system and E chain cable carriers. Maximum speed capability is 500 mm/s with acceleration of 5 m/s<sup>2</sup>. Accuracy in each direction is 1 micron with  $\pm 0.5$  micron repeatability.

### For more information:

Steinmeyer, Inc.  
56 Middlesex Turnpike, Suite 200  
Burlington, MA 01803  
Phone: (781) 273-6220  
Fax: (781) 273-6602  
www.steinmeyer.com

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The Single Axis Robot RS Series Actuators join the Single Axis Actuator line from Misumi USA. They are used in a range of automated machine applications that rely on precise motion control, including part assembly, pick-and-place, stacking, inserting, inspection, alignment and testing.

The Single Axis RS Series Actuators are CE compliant and come in six small sizes and six large sizes, in addition to Clean Room Class 10 versions, which feature a sealed design and high durability stainless steel cover. The smaller RS types are driven by stepper motors while the large types, known as RSH, are driven by AC servo motors. The product line features a rated life span of 10,000 km and higher and a 50

to 1,050 mm configurable stroke with constant load capacity unaffected by speed.

#### For more information:

Misumi USA, Inc.  
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Schaumburg, IL 60173  
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## Gantry Machine

PROVIDES COMPLETE  
AUTOMATION PLATFORM



Techno, Inc. Linear Motion Systems introduces the TechnoMod gantry machine, a multi-axis motion platform complete with controls, cabling, software and enclosure, all fully assembled. The TechnoMod is available in three different sizes and can be used for pick and place, dispensing, assembly, testing, drilling, routing, welding and general automation applications.

Joe Griffin, Techno Linear Motion sales manager says, "The new TechnoMod machine is completely assembled when it arrives. All electronics are wired and software installed, allowing customers the ease of running the machine in any work cell shortly. The only setup customers may

have to perform is the mounting of drill, dispenser, laser or automation tooling required for their application, and in many cases Techno can do this for the customer prior to shipping."

Travel ranges are 650 x 300 x 275 mm for the Model 30, 650 x 450 x 275

**continued**

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mm for the Model 45 and 650 x 650 x 275 mm for the Model 65. Additionally, a fourth or fifth rotary axis can be added to the machine for more complex operations, while all drive motors are DC brushless servos providing high torque and precision. The TechnoMod can be delivered with or without electronics as well as a sliding front door with safety interlock. It has a built-in industrial computer and rugged swing arm console, which includes a monitor and keyboard.

View CAD drawings, catalog specifications and more information on the TechnoMod gantry at [www.techno-isel.com/tic/Catdas/TechnoModGantry.htm](http://www.techno-isel.com/tic/Catdas/TechnoModGantry.htm).

#### For more information:

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2101 Jericho Turnpike  
New Hyde Park, NY 11040  
Phone: (800) 819-3366  
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The FMAC and FMBC ECO are for drive systems in applications such as material handling and conveyors, medical equipment, electrical or renewable energy equipment installations, uninterruptible power systems for telecommunication and computer and data center systems.

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## T-Series Encoders

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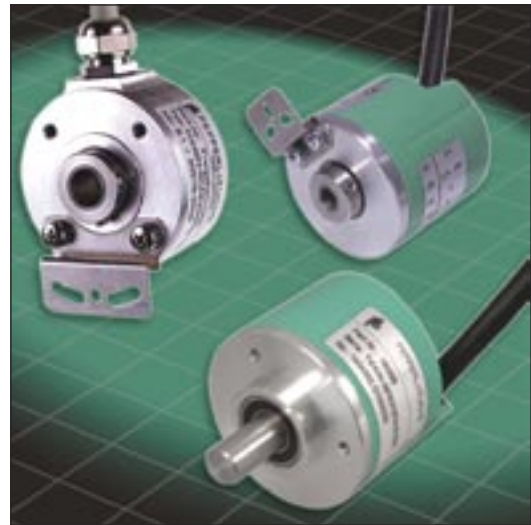
The T-Line 40 mm series incremental rotary encoders from Pepperl+Fuchs is now offered in standard inch shaft and coupling sizes. The 400 mm diameter (1.57 inch) encoders are compact and come standard with an integral 2 meter cable. They provide output resolution up to 1,024 ppr in an IP54-rated housing. They run on a 4.75-30VDC supply voltage, making them suitable as a feedback solution for most light- to medium-duty applications in material

handling, packaging and printing industries.

The TVI40 solid shaft encoders come with 1/8 inch and 1/4 inch shaft sizes. THI40 hollow shaft encoders come with 3/16 inch, 1/4 inch and 5/16 inch shaft coupling sizes. TSI40 recessed hollow shaft encoders come with shaft bore sizes of 3/16 inch, 1/4 inch, 5/16 inch and 3/8 inch shaft couplings. T-Line 400 mm series rotary encoders accommodate 4, 6 or 8 mm shaft applications.

#### For more information:

Pepperl+Fuchs  
16000 Enterprise Parkway  
Twinsburg, OH 44087  
Phone: (330) 486-0001  
Fax: (330) 405-4710  
[Fa-info@us.pepperl-fuchs.com](mailto:Fa-info@us.pepperl-fuchs.com)  
[www.pepperl-fuchs.com](http://www.pepperl-fuchs.com)



## Linear Actuator Drive Mechanism

ELIMINATES OVER-DESIGN

The SCN5 series actuators from Dyadic Systems feature a linear actuator drive mechanism that optimizes the



screw and nut for high accuracy, long life and low cost while providing high speed and peak thrust. The product concept provides engineers with a wider range of options for eliminating over-design.

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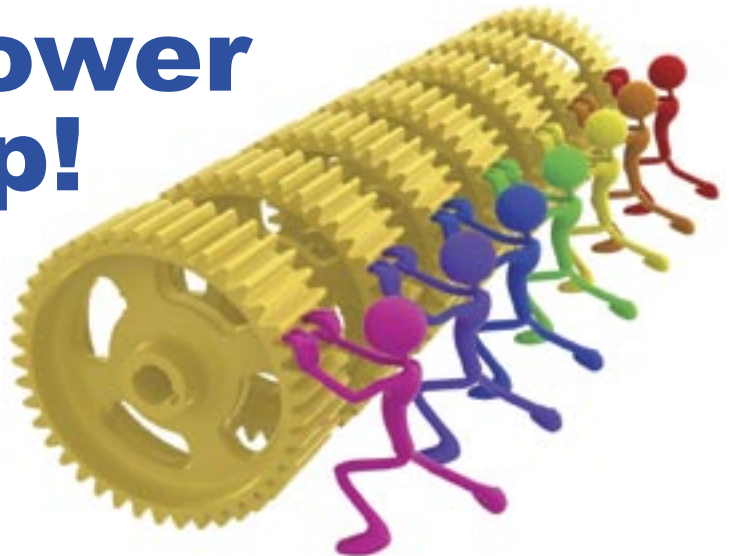


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# Power Up!



If you have a background in gears, bearings, motors, belts, couplings, sensors or actuators, we'd like to talk to you. Power Play, the back page feature in *PTE*, is all about your industry. If you've got a funny anecdote, an interesting observation or perhaps a limerick on motion control, feel free to send it our way. This column is dedicated to the stories too radical to make the cut in industry or product news. We need story ideas, and we're confident you can provide them.

The rules are quite simple: submit a story idea about the power transmission industry, make it entertaining as well as informative, and become a *PTE* magazine editor-at-large today (salary not included). Submit your award-winning material to [publisher@powertransmission.com](mailto:publisher@powertransmission.com).



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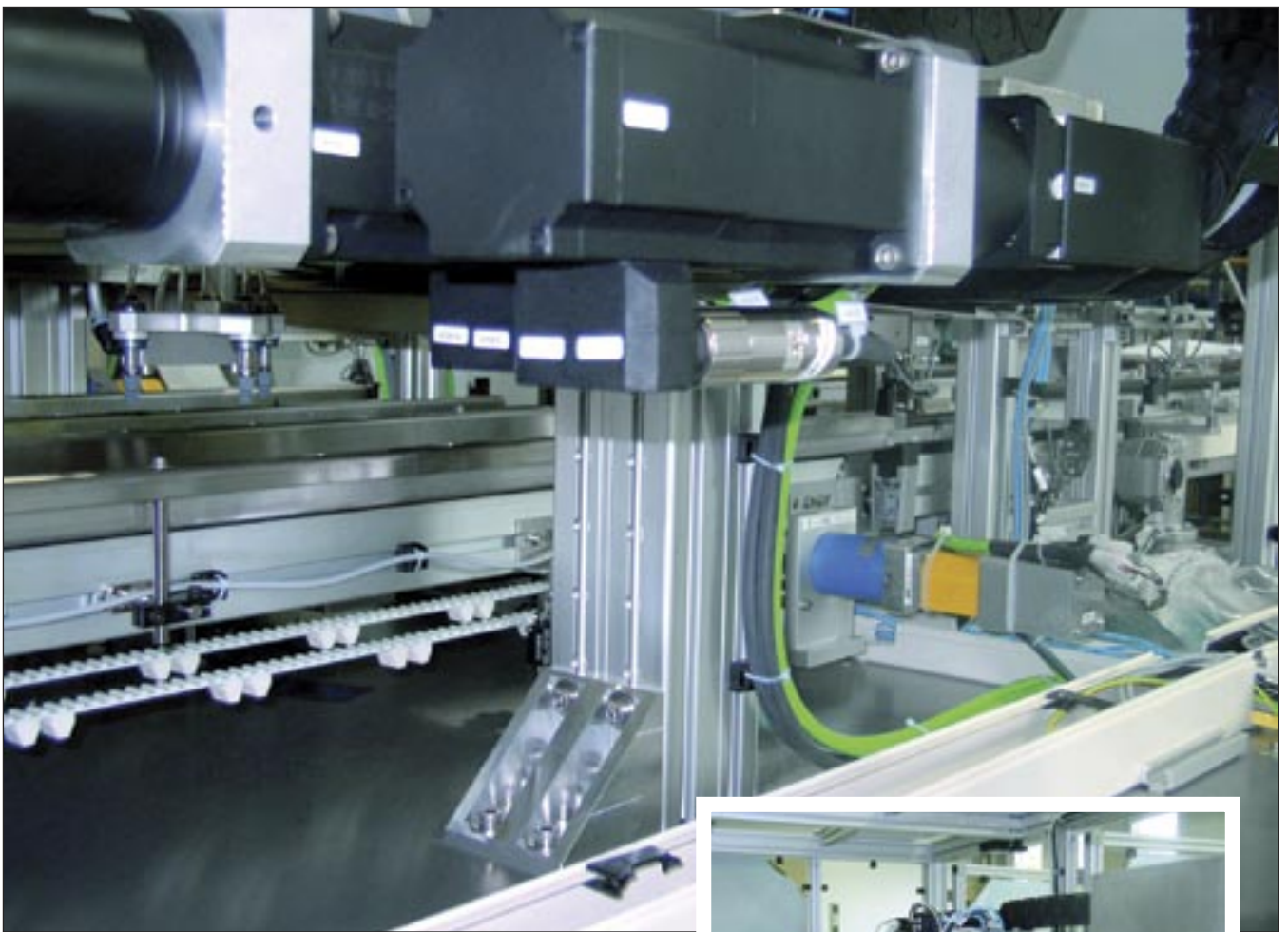
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Courtesy of Bosch Rexroth.



# Solar Energy

## THE ALTERNATIVE ALTERNATIVE

Matthew Jaster, Associate Editor

**W**hile gear and bearing manufacturers engage in a wind energy arms race, the robotic automation industry has its sights set directly on the sun. Solar power—wind energy’s somewhat neglected step brother—has been gaining ground in alternative energy since 2001.

Robotics companies can provide solar cell wafer handling, panel and module assembly, spraying, inspection and packaging processes to solar manufacturers. In a market that handles delicate materials like mirrors, panels and small components, robotic automation will see plenty of growth opportunities in

**continued**

the next five to 10 years, and the power transmission industry is starting to pay attention.

“Robotic automation is a perfect fit for solar manufacturing applications because [robots] help manufacturers improve productivity by reducing scrap and rework, improving product quality and reducing the labor required to manufacture the products,” says Keith Fox, business development-alternative energy at ABB Robotics.

“The industry and processes are evolving so rapidly that flexibility in capital investment to manufacture the product is key to the solar OEM’s ability to survive,” adds Chris Blanchette, national distribution account manager at FANUC Robotics America, Inc. “The ability to utilize the same equipment for the manufacturing process will significantly reduce the changeover time and the cost associated.”

### **Robotics and Solar: Two Peas in a Pod**

FANUC has been involved to some degree in solar power manufacturing since the early 2000s, from the production of raw silicon material to the assembly of completed solar panels.

“We increased our involvement as the industry evolved and demand for the products increased,” Blanchette says. “As the demand has grown, there has been a need to shift to more reliable, repeatable and faster mechanisms of manufacturing.”

Currently, FANUC has more than 200 robot model variants designed to suit an array of application needs as well as engineering experience to help guide the selection process. The company continues to develop products to serve growth industries like solar manufacturing, so it can respond with developments supportive of the processes required. These include unique integrated intelligent-based options that are built into many of their robotic systems.

“Some of these developments have features like vision, force control, and accuracy tools,” Blanchette says. “These built-in features allow users to process parts with much less difficulty in programming and at a lower cost. Because

FANUC has a large development team right here in North America, we are very quick to react to process needs that require product changes or new options.”

ABB Robotics first became active in solar panel manufacturing in Germany in 2005 when manufacturers were looking to increase throughput and quality as well as reduce overhead costs.

“We provide a number of products and solutions for solar panel system builders, integrators and manufacturers,” Fox says. “This includes six-axis articulated robot products with lifting capacities that range from the new IRB120 with a 3 kg lifting capacity to the IRB7600 robot that features a 500 kg lifting capacity.”

In addition, ABB has a unique second-generation, four-axis robot, the IRB360, which is typically utilized for wafer and cell handling. ABB has developed three standard manufacturing cells for the solar manufacturing industry including an automated robotic bussing station, an automated robotic panel trimming and taping cell and an automated robotic framing station.

According to both companies, the growth in the solar industry in the last three years has been relatively significant in Europe and Asia. In 2009, the market has begun to pick up in North America.

“With help from the economic stimulus fund and government direction for green energy, the solar market in North America is ramping up rapidly,” Blanchette says. “Solar power manufacturing has been one of the top three growth areas this year at FANUC.”

Fox has noticed the solar market expanding outside of Europe today more than ever with growth areas in North America, South America, China and India.

“To date, ABB has seen a lot of activity that revolves around the American Recovery and Reinvestment Act as well as our government’s incentives,” Fox says. “However, it has taken a while for the activity to turn directly into ‘real’ opportunities. With that being said, it looks like we are in for a busy 4th quarter and are looking forward to the opportunities in 2010.”

And the optimism couldn’t come at a better time. Many robotics companies are still trying to bounce back from the shaky collapse of the automotive industry.

“The North American automotive sector has declined dramatically over the past year with the bankruptcy announcements by Chrysler Corp and General Motors,” Fox says. “But we’ve seen dramatic cutbacks by all automotive manufacturers including Toyota, Honda and other transplants that are manufacturing vehicles here.”

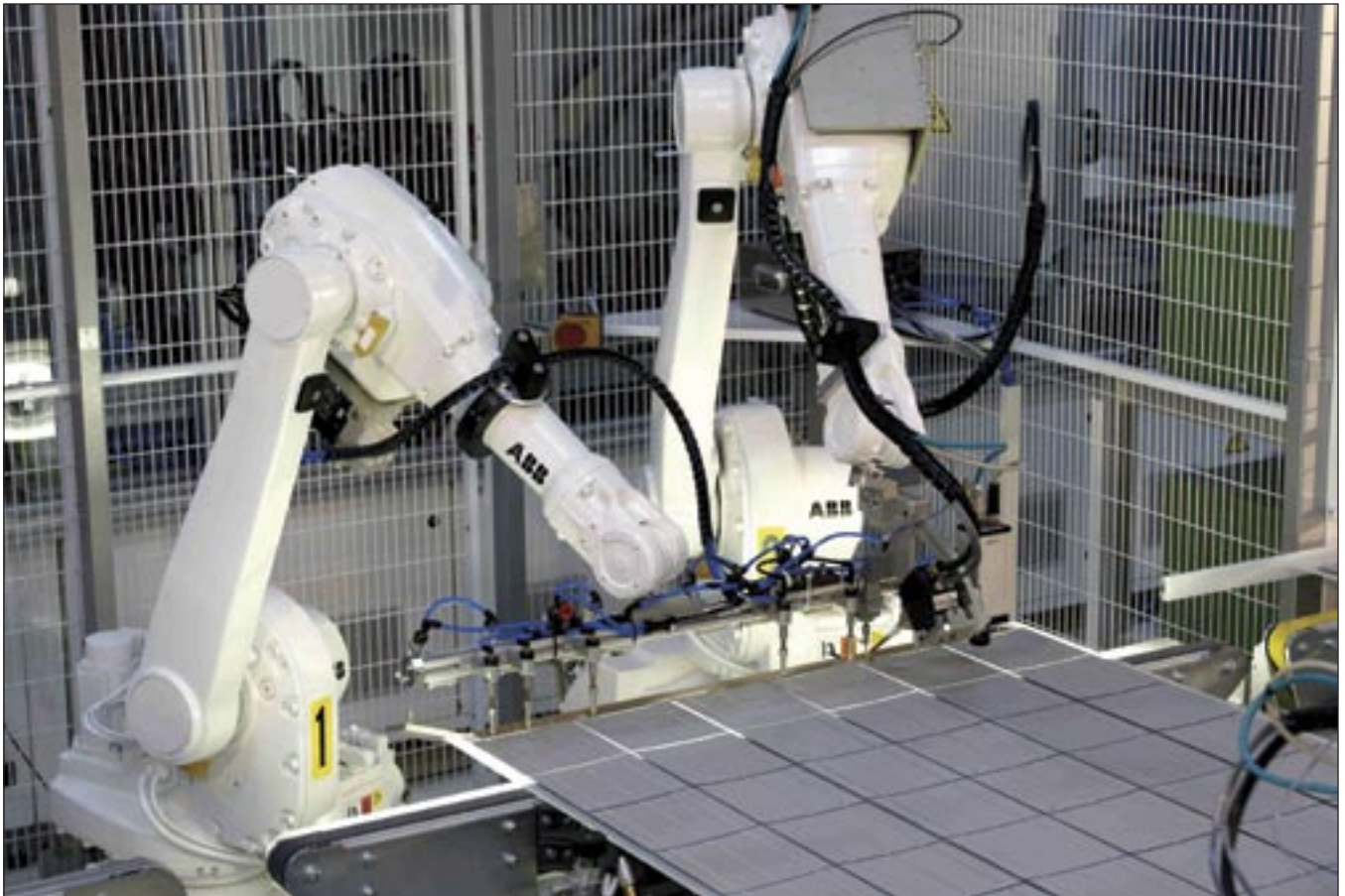
Blanchette notes that solar power gives robotics companies an additional opportunity outside their automotive comfort zone, though many aren’t ready to pull the plug on the Detroit Three quite yet.

“We’ve seen some decline in the automotive and related industries, but we fully expect that these sectors will recover over the next few years. We see solar market opportunities as an expansion of our current business and not a replacement for traditional business.”

The topsy-turvy marketplace won’t keep companies from searching for growth potential in areas like alternative energy.



**FANUC has incorporated vision, force control and accuracy tools into robotics used in solar manufacturing (courtesy of FANUC).**



**ABB Robotics provides diverse robotic solutions for solar PV lines (courtesy of ABB).**

“Solar manufacturers can see positive results by incorporating robots into their manufacturing processes as early on as the development stage of the product. Having robotics perform many of these processes generates consistency in the final product,” Blanchette says. “We’ve had many startup companies purchase robots specifically for this purpose. Adding robotics to the mass manufacturing process also helps to reduce the time it takes to get into production because the processes can be predicted and optimized more quickly.”

Typically, the capital payback for solar manufacturers that incorporate robotics is between 12–18 months.

“This does not include the immediate impact on scrap savings and a reduction in warranty costs once the products have been sold,” Fox says. “This market is another avenue for ABB to sell its products and services. Additionally, it provides us a new customer base that can provide feedback for robot products that are needed in the marketplace, but not yet engineered.”

### **Industry Specific Applications**

One doesn’t need to be a robotics company to find opportunities in solar energy. Companies like Bosch Rexroth and SKF have been keeping a close market watch on solar manufacturing as well, offering a variety of tools to complement the industry’s various needs.

For Bosch Rexroth, the plan is to offer custom automation support to clients involved in solar manufacturing since standard solutions are rarely enough to get the required results. This is especially the case in filigree handling systems where more often than not special machine construction

and standardization are considered incompatible. Handling system operations that include gripping, lifting, rotating, positioning and placing are usually never undertaken by a complete system.

Bosch Rexroth has recently changed this trend with a partnership between Schiller GmbH & Co. KG of Sonnenbühl, Germany. Schiller develops automation solutions in the production of solar cells. In order to achieve accuracy requirements for individual handling systems, the company incorporated Bosch Rexroth’s Cartesian Motion building system, called the camoLINE, a modular system that covers common handling tasks with linear motion, assembly, pneumatics and drive and control technology.

In a case study by Rexroth, Karl Letzgas, chief designer at Schiller explained the benefits of the handling system.

“With this system we can guarantee repetitive accuracies of 0.02 mm and in particular stress-free handling of sensitive cells.”

This was accomplished by interlinking 18 process modules, including de-stacking and transport of the blanks, loading and unloading of the process stations, precisely aligning the cells, inline quality checks and sorting into power ratings, through to magazinging of the finished solar cells.

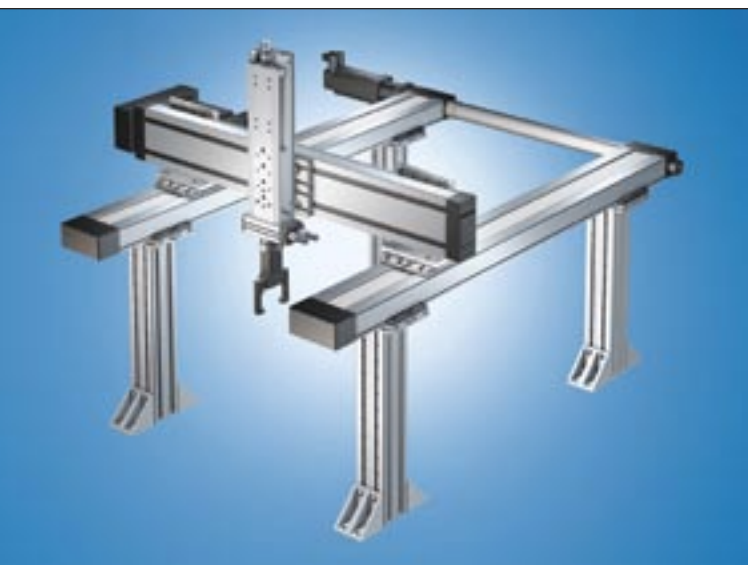
“We can now achieve a level of accuracy in the basic structure that we could previously only obtain with specially milled parts,” Letzgas adds.

Stress-free handling is the key to the process, as the slightest stress could shatter the solar cells. Splinters can also contaminate and damage the system; therefore, special

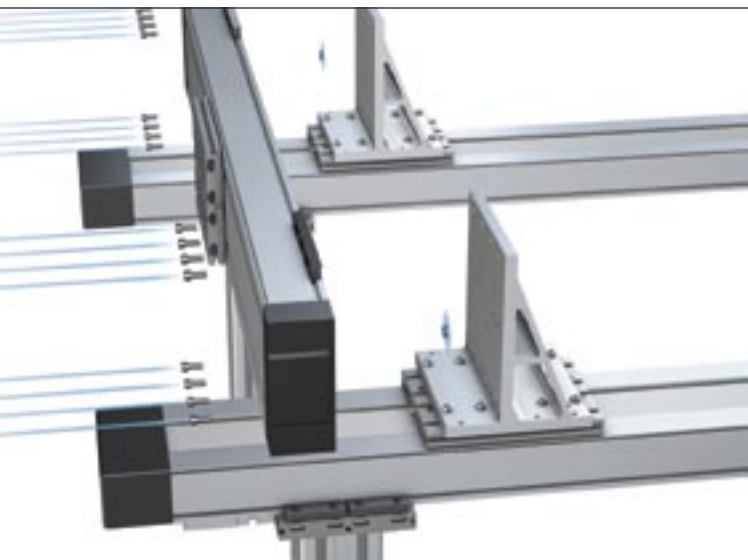
**continued**



**ABB sees the solar market as a growth opportunity to expand its customer base (courtesy of ABB).**



**Bosch Rexroth worked with Schiller GmbH on the automation of solar cells using its camoLINE modular system (courtesy of Bosch Rexroth).**



**Bosch Rexroth's camoLINE offers multiple modular systems to fit Schiller's solar manufacturing needs (courtesy of Bosch Rexroth).**

motion profiles have been implemented for safe cleaning.

Since the manufacturing of solar cells needs more than individual modules to fulfill the requirements, Rexroth's camoLINE has been a great fit for solar applications.

"On completion of the concept phase we are up to 30 percent faster with such components in the subsequent project design phase by using this modular building system," Letzgus says.

The camoLINE product offers electrical and pneumatic axes, connecting elements and profile struts, ball screw assemblies for high positioning accuracy and toothed belt drives. Depending on customer requirements either servo or stepping motors can be used with integrated belt drive or planetary gear.

"Even once we have developed a modular system with which the customer can realize complex tasks completely independently, we would never leave him in the lurch," says Ralf Schirmer, sales representative at Rexroth.

Schiller was able to combine aluminum profiles, linear motion systems and electric and pneumatic drives thanks to this collaboration.

"We have achieved a high-precision and stable supporting system for the first time by using intelligent connection technology," Letzgus says.

Also, the shorter response time to changes made in the outline conditions makes it considerably easier when it comes to meeting the deadline for commissioning the solar cells.

"In a simultaneous engineering process we have actually realized the various handling modules being carried out by the customer," Letzgus adds.

Companies like SKF see solar energy as a business venture that will allow them to offer complete system solutions across the board.

"SKF has been monitoring growth opportunities in solar power with significant annual growth rates across the various solar technologies" says Mahdi Sebti, global business development-renewable energy at SKF. "With SKF's multi platform strategy, SKF can offer a complete array of tracking solutions to the market including bearings, lubrication and lubrication systems, sealing solutions, mechatronics, which include actuation systems, and service."

The company is focusing on solar tracking components and systems, developing the controller and modifying the satellite actuator product for solar energy collectors, a technology that will maximize energy from solar cells by enabling them to accurately track the sun. They've even dedicated team members to seek out specific solar energy applications where SKF can provide optimal results.

"SKF is supporting this growing industry through development activities with some key market players, which consists of design development, design optimization, design validation, problem solving, as well as engineering consultancy services" Sebti says. "SKF is looking at providing reliable solar tracking solutions through the integration [of] its 100 years of engineering knowledge, multi platform capabilities, and its more recent renewable energy experience. SKF's value offerings consist of bearings, sealing solutions, lubrication solutions, and actuation systems (mechatronics)."

Much like the robotics organizations, SKF is prepping

for a surge in solar energy on a global basis, which could be supported by their global developments centers and global manufacturing footprint.

### The Sun Will Come Out

Though the economic downturn took some of the buzz away from growth opportunities in alternative energy, the general consensus is that wind, hydroelectric, geothermal and solar will be just fine in the long run. The largest solar trade show in North America, the Solar Power International 2009 takes place from October 27–29 in Anaheim, California, covering the entire supply chain including photovoltaic, solar thermal and concentrating solar. As the general economy picks up, so will new energy business.

“925 companies from the solar value chain sold out the exhibit floor at the Anaheim Convention Center, reserving a record 203,900 net square feet of floor space. In 2008, Solar Power International had 422 companies occupying 88,000 net square feet of floor space,” says Monique Hanis, spokesperson for the Solar Energy Industries Association. “Solar can be deployed in a variety of ways from distributed generation to utility-scale with a variety of technologies that accommodate different climates and locations. It works in all 50 states and the public is unanimously supportive of expanding our nation’s use of solar, more than any other energy source, traditional or renewable.”

Neal Lurie, director of marketing and communications for the American Solar Energy Society, says solar energy is a multi-billion dollar industry that has been growing steadily since 2001.

“Currently, manufacturing production capacity and supply exceed demand due to the recent economic downturn,” Lurie says. “This has put downward pressure on solar prices and decreased profit margins. But lower prices will boost demand in the months ahead.”

Both Lurie and Hanis see a manufacturing renaissance in fields dedicated to solar energy applications.

“Manufacturing automation will be a core part of solar production and solar installation will continue to be a more labor-intensive process,” Lurie says. “The industry offers tremendous long-term opportunities for robotics companies.”

“Many photovoltaic manufacturers are implementing similar manufacturing processes and techniques used in the semiconductor industry,” adds Hanis. “Equipment manufacturers from semi have moved into PV, like Applied Materials and Oerlikon, bringing their expertise to the emerging U.S. solar market.


“Several new plants will be built in the United States over the next one to five years. There will also still be the need for labor in construction of manufacturing plants, construction of utility-scale solar plants and installation of rooftop and ground-mounted solar energy systems,” Hanis says.

Lurie notes that many experts fully expect that the U.S. will be the world’s largest solar market by 2013, if not sooner. “By then, prices will be on par with (or lower than) fossil fuel prices, without government incentives in the next four to eight years. Once that happens, growth will only accelerate.”

And when the big players get involved, that’s when the industry really begins to gain some momentum. General Electric recently announced plans to produce a thin-film solar

cell material made from cadmium telluride at the EmTech conference at MIT.

In a luncheon presentation at the conference, Michael Idelchik, vice president of advanced technologies at GE Global Research, explained that solar would be the next wind at GE. “It’s not there yet, but it’s moving very rapidly.”

By 2030, these opportunities in solar energy are expected to double. Seems like the perfect time to pay a little more attention to the sun. 

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[www.seia.org](http://www.seia.org)

# case study



Omaha's Henry Doorly Zoo opened its Skyfari ride this Spring. The Skyfari transports guests over various animal exhibits (courtesy of Omaha's Henry Doorly Zoo).

# Power Transmission Vs. Wild

GEAR REDUCER PROVIDES COMPACT SIZE & MOUNTING  
OPTIONS FOR UNIQUE ZOO APPLICATION

Matthew Jaster, Associate Editor

**T**ypically, zoo safari rides consist of cramped trams that take guests five miles-per-hour past various exhibits. You might catch a bear sleeping, hear scripted, narrated fun facts or be somewhat entertained by eccentric tour guides, but there's never much to look at except concession stands or souvenir shops.

Omaha's Henry Doorly Zoo recently took the safari ride in a slightly different direction by putting patrons 40 feet above the various animal exhibits. The Skyfari, an open air chairlift, provides unique perspectives of the cheetahs, elephants, rhinos, monkeys and giraffes on-hand at the zoo.

While not the first of its kind, the Skyfari is an amusement park/zoo attraction that carries up to 800 riders an hour in each direction, moving at 200 feet per minute. Guests are treated to spectacular views of gardens, lagoons and animal exhibits from a point of view they won't get from a safari tram ride.

The Skyfari is the brainchild of SkyTrans Manufacturing LLC, located in Contoocook, NH. For years, SkyTrans has taken new and refurbished aerial tramways and converted them into rides at amusement parks, zoos and other attractions nationwide.

In order to make the safest and most cost effective system for the Skyfari, SkyTrans enlisted the help of Lane Conveyors and Drives, in Brewer, ME, to help choose the planetary gear reducer used for turning the large cable and sheave that move the chairs on the ride.

Lane, a material handling and power transmission supplier, had worked with SkyTrans on previous projects and had

a pretty good idea what the company was looking for.

"The customer came to us looking for a right angle reducer, and we originally offered a couple of different options," says Ray Vigue, sales representative at Lane. "The Bonfiglioli reducer was chosen due to its compact size, high torque rating and competitive cost."

Bonfiglioli's 50-plus years of experience with gearboxes and electronic drives in industries from renewable energy and industrial automation to construction and heavy equipment projects helped in the initial decision-making process. Here was a company with a diverse portfolio of power and control solutions that could quickly meet the requirements SkyTrans was looking for.

Vigue says the fact that Bonfiglioli was able to provide a reducer with higher horsepower and torque rating in the same package size helped the cause.

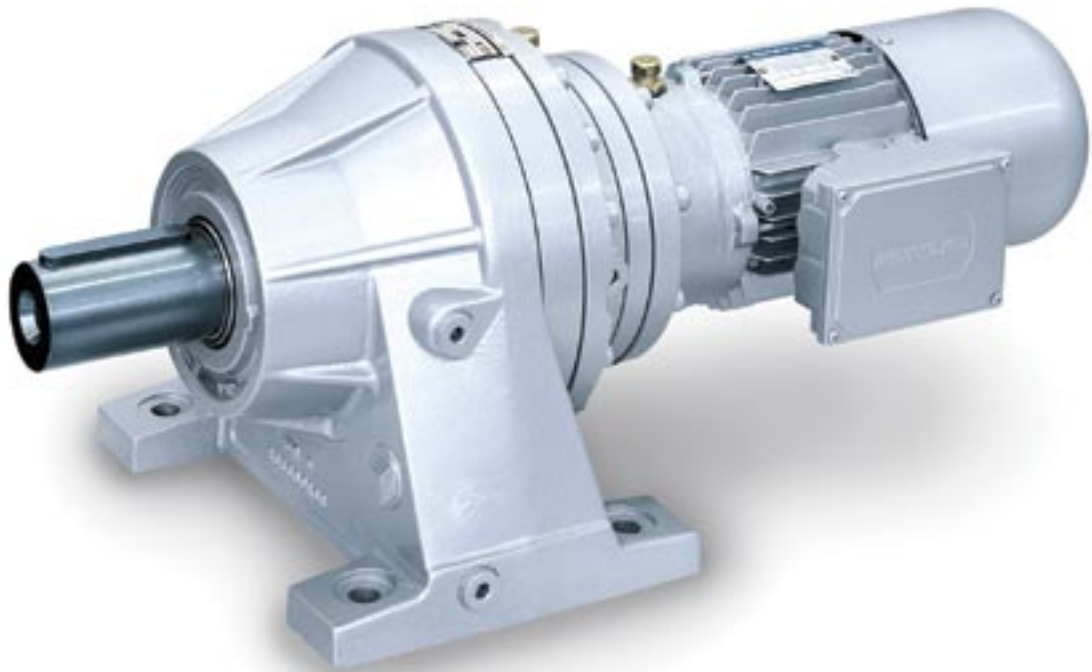
"For this installation, mounting flexibility and torque density were the most important considerations. The compact size and the availability of a right angle input stage gave the customer more mounting options."

The key to the project revolved around reliability. What components would best fit an application where safety, service and flexibility were considered pivotal to the final product? It's not every day engineers have to sort out how guests are going to safely move 40 feet over animal exhibits.

"We needed to put a few things together for the client to ensure that the machine wouldn't die in the middle of

continued

# case study



**Lane Conveyors and Drives suggested Bonfiglioli's gear reducer for the Skyfari project due to its compact size and competitive cost (courtesy of Bonfiglioli).**

a Sunday afternoon during open hours," says Jeff Bower, regional sales manager at Bonfiglioli. "All the drive components were sized with a generous service factor. How much horsepower and torque would it take to move the gondolas across the park? What do I need the gearbox to do? What had to be done in general so that the equipment did not fail?"

Answering these questions helped Bonfiglioli provide a gear reducer that could attain green and energy efficient elements simply by sizing the unit properly and measuring the service factor.

The company also took some direction from a retrofit project for a paper milling application where they installed a similar 300 Series planetary reducer.

"The benefits of that application were enormous since we were working with very clear cut space restrictions," Bower says. "Historically, that unit would only last about a year before it needed to be replaced. When we decided to come in with a smaller reducer, it gave us more flexibility and longer life."


On the Skyfari project, safely transporting guests across the zoo became the top priority. Along with the service factor, SkyTrans installed a hydraulic braking system that holds the wheel in place. This failsafe device will immediately stop the attraction if something happens to the drive system.

Once these challenges were met and the reducer was installed, Skyfari was up and running. In April 2009, Omaha's Henry Doorly Zoo opened the Skyfari to the general public, giving guests an entirely new experience of viewing the animals.

This 20-minute air ride across the zoo grounds covers more than 130 acres, much to the delight of the smallest

guests. From this view, there are plenty of different things to look at thanks to the custom solutions provided by SkyTrans, Bonfiglioli and Lane Conveyors and Drives.

Vigue has no trouble recommending Bonfiglioli products for similar applications.

"The project went well and SkyTrans will continue to use Bonfiglioli reducers on future projects." 

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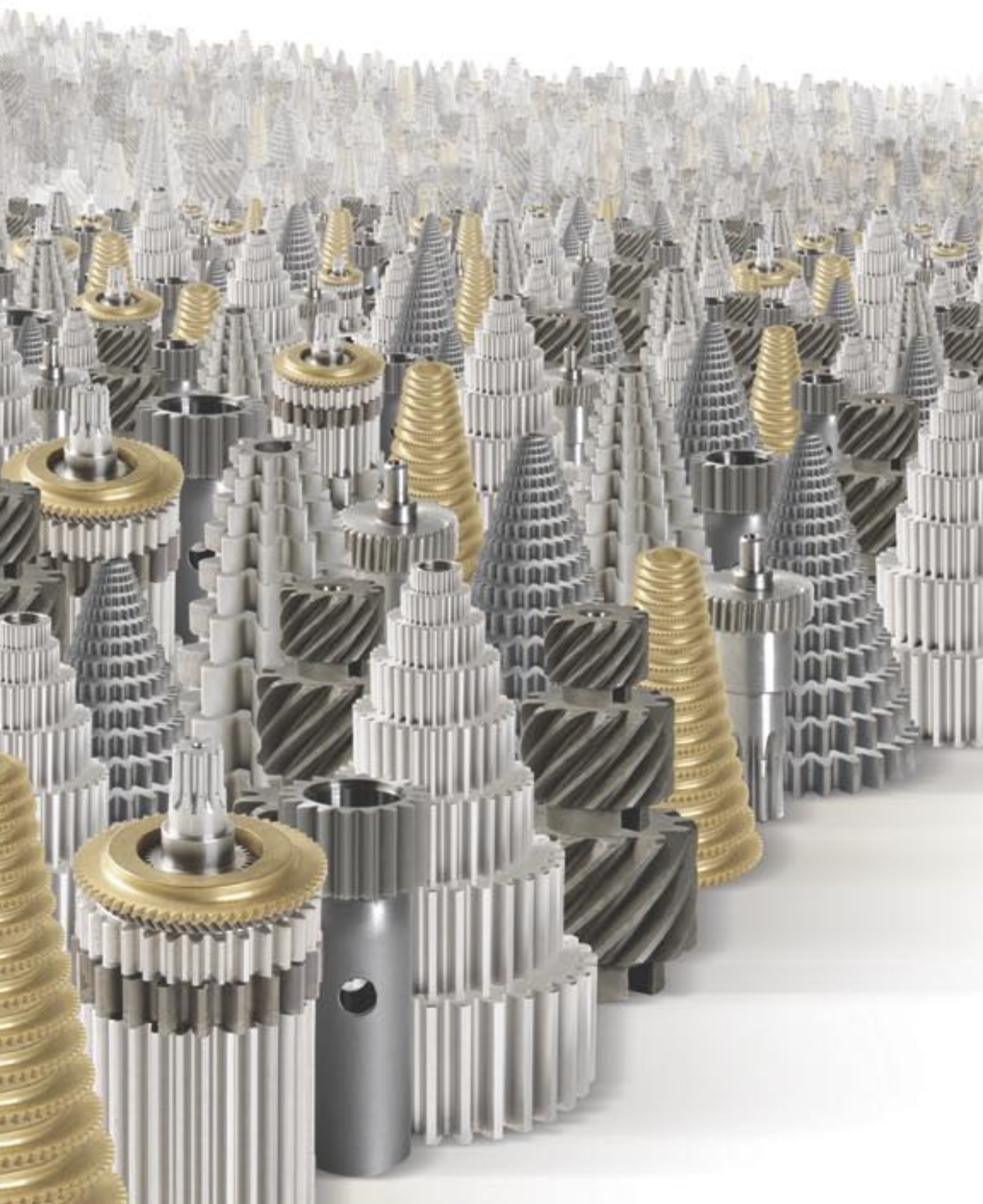
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# Hardware-Software Synergy

## AUTOMATES POWER PLANT DATA COLLECTION

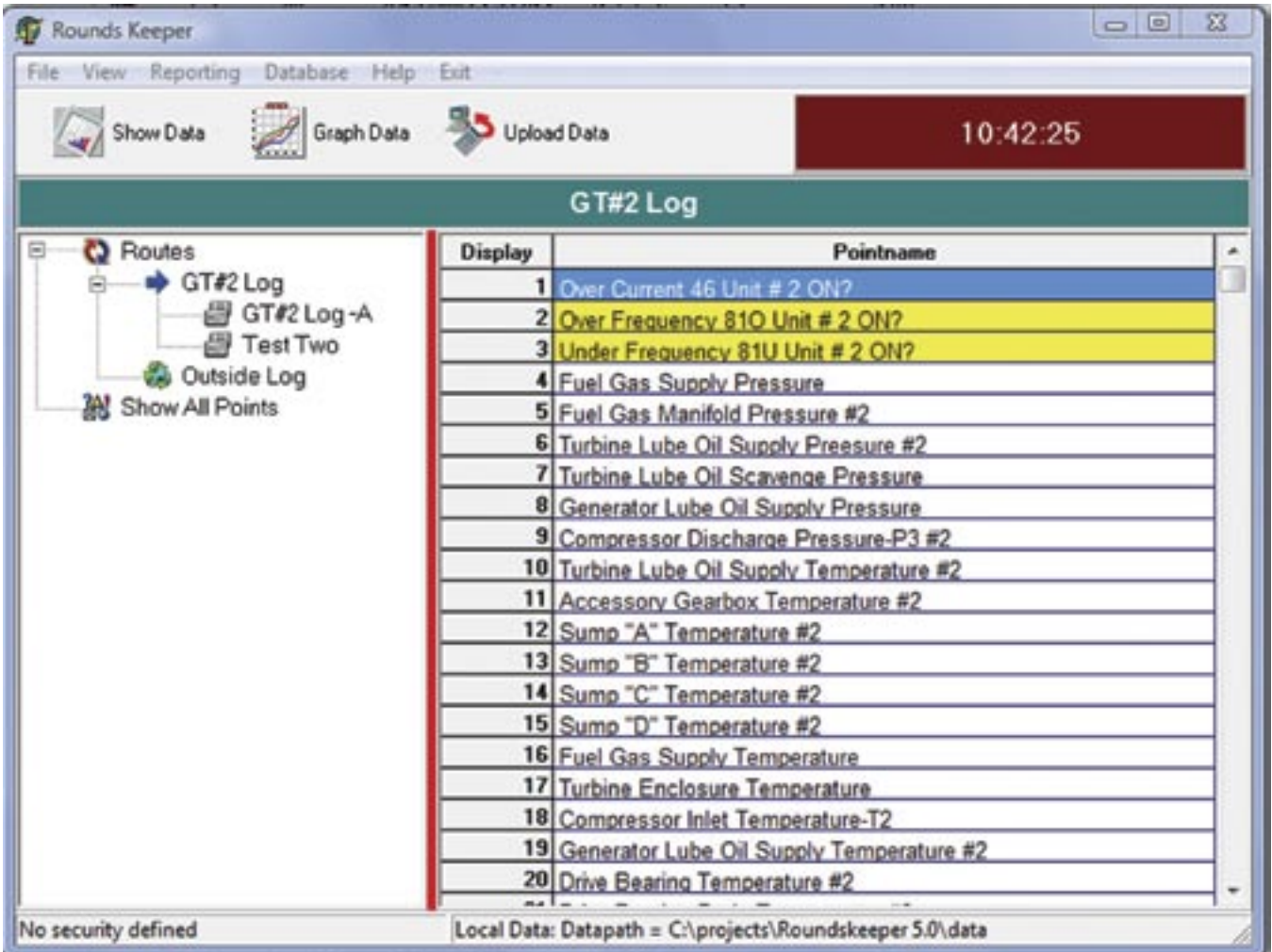
Lindsey Snyder, Assistant Editor

**R**obotics and other advanced automation technology systems are viewed as a looming threat to some in the plant maintenance field. Although there is a constant battle for some workers to remain useful while machines are continuously fulfilling more roles on the

plant floor, there are those who in turn have found a better use of their newly freed time.

One such scenario is exemplified by the service technicians at the Agua Mansa Power Plant in Colton, CA, where a recent software-computer hardware partnership has eliminated

the manual recording of equipment performance. The new technology, consisting of the CipherLab 9400 handheld computer bundled with Instamation Systems' *Roundskeeper* software and provided by global distributor BlueStar, has not served to make any traditional jobs obsolete, though. The automated



The screenshot displays the 'Rounds Keeper' software interface. The window title is 'Rounds Keeper' and the menu bar includes 'File', 'View', 'Reporting', 'Database', 'Help', and 'Exit'. Below the menu bar are three buttons: 'Show Data', 'Graph Data', and 'Upload Data'. A digital clock in the top right corner shows '10:42:25'. The main content area is titled 'GT#2 Log' and features a tree view on the left with 'Routes' containing 'GT#2 Log', 'GT#2 Log-A', and 'Test Two', and 'Outside Log'. A 'Show All Points' button is also visible. The main table has two columns: 'Display' and 'Pointname'. The table lists 20 data points, with the first three highlighted in yellow. The status bar at the bottom indicates 'No security defined' and 'Local Data: Datapath = C:\projects\Roundskeeper 5.0\data'.

Display	Pointname
1	Over Current 46 Unit # 2 ON?
2	Over Frequency 810 Unit # 2 ON?
3	Under Frequency 81U Unit # 2 ON?
4	Fuel Gas Supply Pressure
5	Fuel Gas Manifold Pressure #2
6	Turbine Lube Oil Supply Pressure #2
7	Turbine Lube Oil Scavenge Pressure
8	Generator Lube Oil Supply Pressure
9	Compressor Discharge Pressure-P3 #2
10	Turbine Lube Oil Supply Temperature #2
11	Accessory Gearbox Temperature #2
12	Sump "A" Temperature #2
13	Sump "B" Temperature #2
14	Sump "C" Temperature #2
15	Sump "D" Temperature #2
16	Fuel Gas Supply Temperature
17	Turbine Enclosure Temperature
18	Compressor Inlet Temperature-T2
19	Generator Lube Oil Supply Temperature #2
20	Drive Bearing Temperature #2

**Roundskeeper** software automatically processes data collection, which effectively renders manual data collection obsolete. Information is incorporated straight into a database for trending, archiving and other reporting.

data collection of the power plant's equipment has enabled the plant to save much sought after downtime and money, which allows workers to concentrate their energy predicting maintenance rather than solving problems as they occur.

"Because we are required to regularly record many visual readings and observations of power plant equipment, finding a mobile solution to automate this process and communicate it back to our database was essential," says Mike Kokebeck, lead service technician at Agua Mansa. "By automating data capture with BlueStar's bundled Instamation-CipherLab solution, we are able to gain enhanced insight into the performance of the power plant equipment. This saves us time and money because we are able to use all of the collected data to quickly and efficiently predict maintenance needs. Before we adopted this data collection system, we attempted to do this manually, which proved to be extremely inefficient and sometimes inaccurate."

The CipherLab 9400 is a handheld mobile computer that integrates barcode scanning and data capture features that include high-resolution touch-screen VGA display, a two-megapixels camera and a full or shared alphanumeric keypad for data input. Users can scan, RFID tag, batch upload and print wirelessly from any field location. It supports *Microsoft Windows CE 5.0* and is compliant with other popular wireless communications platforms.

Instamation Systems *Roundskeeper* is a software system to automatically process data collection. It was designed to do away with manually collecting data, so the information is directly incorporated into a database for trending, archiving and other reporting on. "*Roundskeeper* requires a portable data collection unit to provide it with the data that it saves," explains Steve Wagner, president, Automation Systems. "The device should be well made, resilient to the environment, easy to use and cutting edge technology. The CipherLab 9400 met these requirements."

The product collaboration was put together by BlueStar, a distributor of RFID, Auto ID, POS and other mobility products. "BlueStar introduced me to the product after I solicited their




**The CipherLab 9400 handheld mobile computer was an attractive product to Instamation Systems for pairing with the *Roundskeeper* software due to its ease of use, compactness, embedded *Microsoft Windows CE 5.0* operating system, large bright screen, good construction and low cost of ownership.**

help in finding a suitable data collection device," Wagner says. "I then talked to CipherLab and visited them at their facility in Texas where I was convinced to try the 9400. Pairing of the *Roundskeeper* was easily accomplished in a short period of time."

The Agua Mansa Power Plant powers the Southern Californian city of Colton and also contributes to the California Independent System Operator Corporation (ISO) grid. The California ISO is a nonprofit corporation that operates most of the state's high-voltage wholesale power grid, linking power plants and utilities. Through this grid, Agua Mansa provides power to other cities in emergencies.

Energy is a precious commodity, especially in California, where the state grid has to juggle energy for millions of people," says Al Crawford, CipherLab's vice president of technology. "By streamlining the daily maintenance of the Agua Mansa equipment, we're able

to minimize the plant's downtime, thus reducing the stress on the California power grid." 

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# Analyzing Synchronous Belt Failure

The Gates Corporation



Figure 1—Normal fatigue failure.

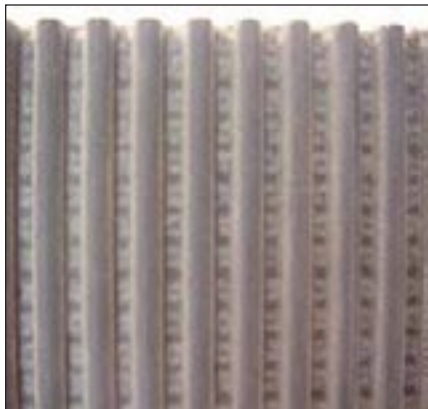


Figure 2—Fuzzy belt tooth appearance from wear.

## Introduction

If you're replacing your belts more than once per year, it's time to analyze your drive. From belt crimping damage to high belt installation tension to sprocket misalignment and adverse environmental conditions, this guide walks you through how to identify the reasons behind premature failure and makes recommendations on corrective and preventive measures.

Synchronous belt failure results in ever-decreasing performance and often-costly belt replacement. A careful diagnosis of your drive's underlying issues, however, will ultimately save you money and maintenance time.

## Part 1: Common Causes of Belt Failure

Identifying the cause of belt failure can be challenging. In this section, we'll define, illustrate and diagnose some of the most common culprits, so you'll be prepared to correct the problem and take preventive measures in the future.

*Normal belt wear and failure.* A failure that occurs when a belt reaches its ultimate tensile cord fatigue life, after running for a period of two to three years, may be considered to be normal. Belt tensile failure due to cord fatigue after a long running period is considered to be ideal. Figure 1 illustrates a jagged 45-degree belt fracture that is typical of tensile cord at the end of its fatigue life.

Synchronous belt teeth can also fail, but that is considered to be a non-ideal type of belt failure. After a long period of service, belt teeth may appear to be worn, although they should retain their original size and form. Protruding fibers from the jacket may give belt teeth a fuzzy appearance, as illustrated in Figure 2.

No corrective action is needed for belts performing for a long time period. Belt life can vary significantly from application to application due to numerous factors, including the transmitted power level, the environment, belt in-

stallation tension, shaft/sprocket alignment, sprocket condition and even how the belt was handled prior to and during installation.

**Belt crimp failures.** A “crimp” type belt failure often resembles a straight tensile failure as illustrated in Figure 3. A straight type of break like this may occur when belt tensile cords are bent around an excessively small diameter. A sharp bend may result in large compressive forces within the tensile members, causing individual fibers to buckle or crimp and reducing the overall ultimate tensile strength of the belt. Belt crimping damage is most commonly associated with belt mishandling, inadequate belt installation tension, sub-minimal sprocket diameters, and/or entry of foreign objects within the belt drive.

Belt crimping due to mishandling can result from improper storage practices, improper packaging and belt handling prior to and during installation.

Belts operating in an under tensioned condition may allow belt teeth to ride out of the sprockets until an acceptable belt tension level is achieved. This phenomenon is called “self-tensioning.” Self-tensioning can be most clearly observed at the point of lowest dynamic belt span tension, or where the belt teeth are entering the driven sprocket grooves. When a belt is self-tensioning, the belt teeth ride up out of the sprocket grooves until increased span tension from the approaching tight side tension forces the belt teeth back down into the sprocket grooves. The point at which the belt teeth are forced back down into the sprocket grooves often results in a sharp, momentary point of bending that can result in belt tensile cord damage. This point of tensile cord damage is referred to as a crimp. If the tight side tension does not force the belt teeth back down into the sprocket grooves, the belt will ratchet. Belt ratcheting can also result in tensile cord crimp and belt tooth damage.

Subjecting belts to sub-minimal

bend diameters can also result in belt tensile cord damage, or crimping. This can be caused by sprockets or flat back-side idlers in sub-minimal sizes, or even hand bending a belt too sharply.

Foreign objects located between the belt and sprocket can also result in belt crimping. They can lift the belt away from the sprocket at a sharp angle, creating a point of tensile cord crimp. Tools used to force belts onto sprockets, such as screwdrivers or bars, can also cause belt cord crimp damage. Belts subjected to foreign objects or improper use of tools during installation may not fail immediately after being damaged; however, the overall belt life will be reduced.

**Shock load.** Shock loading in belt drives occurs when higher-than-normal intermittent or cyclic torque loads are generated by the driven equipment. These shock loads result in higher-than-normal belt stresses and can act as a catalyst for belt failure. While conventional V-belt drives may exhibit intermittent slip under peak torque load conditions, synchronous belt drives must transmit the entire magnitude of the peak loads.

Severe shock loads can result in belt tensile breaks with a ragged and uneven appearance, as illustrated in Figure 4. The particular belt teeth engaged in the sprocket at the instant of the shock load may also develop root cracks and/or exhibit tooth shear. If the shock load occurred only once, or was cyclical and repetitious at one specific location around the belt, the remaining belt teeth may appear normal. Figure 5 illustrates how root cracks caused by shock loading can propagate through the teeth. Cracks forming at the tooth roots sometimes move towards the tooth tips. Teeth containing multiple cracks may then shear, leaving only a portion of the tooth behind.

The shock loads generated by the driven equipment may be an inherent part of system operation or may result



Figure 3—Crimp failure.



Figure 4—Typical shock load failure.



Figure 5—Tooth root crack propagation.

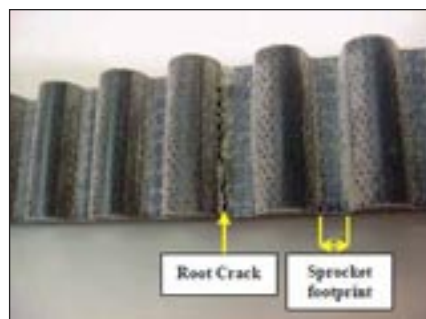


Figure 6—Crushed land areas.

continued



Figure 7—Excessive land area wear.



Figure 8—Tooth separation failure.



Figure 9—Excessive tooth wear.



Figure 10—Extreme belt edge wear.



Figure 11—Uneven belt wear.

from an occasional harsh condition such as jamming. If the drive shock loads cannot be eliminated, the belt tensile strength may need to be increased or the synchronous belt drive replaced with a more forgiving V-belt drive system capable of intermittent slip.

### Part 2: Improper Belt Installation Tension

In this section, we'll focus on the effects of improper belt tensioning—from applying excessive installation tension to insufficient tension—to help prevent premature belt failure.

**High belt installation tension.** Applying excessive installation tension to a synchronous belt may result in belt tooth shear or even a tensile break. Many belts that have been excessively tensioned show visible signs that sprockets have worn the belt land areas. Figure 6 illustrates a belt with crushed land areas and a crack that formed at the root of the belt tooth. A root crack will often propagate down to the tensile member and travel to the next root crack. Individual belt teeth will then separate from the body of the belt and often fall off. Figure 7 illustrates a belt that had been over tensioned on large sprockets. High belt land pressures caused excessive belt land area wear, ultimately revealing individual tensile cords. In order to prevent belt wear problems like these, proper belt installation tension levels must be determined and set accurately.

**Low belt installation tension.** Applying insufficient installation tension to belts operating on moderately to heavily loaded drive systems may also result in premature failures. A common belt failure mode resulting from insufficient belt installation tension is referred to as tooth rotation. Belt tooth rotation can occur as belt teeth climb out of their respective sprocket grooves (self tensioning) and drive loads are no longer applied at their roots. Drive loads applied further down the belt tooth flanks cause the belt teeth to bend (like a diving board) and “rotate.” Belt tooth rotation can result in rubber tearing at the base of the belt teeth along the tensile member. As rubber tearing propagates, belt teeth often begin to separate from the belt body in strips, as illustrated in Figure 8. Failures due to excessive tooth rotation may resemble failures caused by insufficient rubber adhesion to the ten-

sile cords. Unlike tooth rotation failures, failures from insufficient rubber adhesion leave the exposed tensile members clean where the belt teeth were once located.

As belt teeth climb out of their respective sprocket grooves to self tension, belt ratcheting or tooth jumping may occur before rubber tearing and belt tooth separation occurs. Belt tensile cord damage resulting from ratcheting can cause premature belt tensile failures. These tensile failures may resemble crimp-type breaks (straight and clean) as well as shock load-type breaks (jagged and angled). If belt ratcheting does not occur and belts continue to operate while self tensioning, excessive belt tooth wear often occurs. This tooth wear is referred to as “hook wear” and results from improper belt tooth meshing with the sprockets, as shown in Figure 9. Hook wear-type belt failures result from insufficient belt installation tension and from weak drive structures that allow center distance flexing while the drive system is under load.

Increasing belt installation tension levels generally prevents premature belt failures due to tooth rotation and hook wear. If increasing the belt installation tension level does not prevent this type of failure, the drive structure may not be rigid enough to prevent deflection. Added structural support may be necessary to improve belt performance. If it is not practical to increase belt installation tension levels, increasing the sprocket diameters will allow higher drive loads to be transmitted with less belt tension.

### Part 3: Belt Drive Hardware Problems

In this section, we'll examine the negative effects that problems with belt drive hardware have on the operation and life of your belts.

**Sprocket misalignment.** Belts operating on drives with angular shaft misalignment or tapered sprockets often exhibit an uneven wear pattern across the belt tooth flanks and uneven compaction in the land areas (in between belt teeth) due to the uneven application of load to the belt. Belt failures often occur from tooth root cracks or tears initiating on the side of the belt that is carrying the highest tension and propagating across the belt width, ultimately resulting in tooth shear. One edge of the belt may



also show significant wear due to high tracking force and may even roll up or attempt to climb the sprocket flange(s). Figure 10 shows extreme belt edge wear from a high tracking force.

Belts operating on flanged sprockets with parallel misalignment (offset sprockets) may exhibit excessive belt edge wear on both edges if the belt is pinched between opposite flanges. Belt failures may then occur by tooth root cracks or tears initiating from both edges of the belt. These tears may eventually extend across the entire width of the belt, resulting in tooth shear.

Belts operating on a combination of both flanged and non-flanged sprockets with parallel misalignment may walk or track partially off of the non-flanged sprocket(s). The portion of the belt remaining engaged with the non-flanged sprocket(s) will carry the full operating load and may develop a concentrated area of wear after running this way for a period of time. Figure 11 shows concentrated wear across the majority of the belt tooth face with a portion relatively unworn. A root crack has also developed below the worn area. This may ultimately result in premature belt failure due to either tensile or tooth fatigue.

**Sprocket(s) out of specification.** Premature belt failures resulting from sprockets either manufactured or worn outside of design specifications are difficult to recognize. This is partly due to the fact that sprockets are rarely inspected closely when a belt fails. Premature belt failures are often assumed to be the fault of the belt alone.

Belts operating on sprockets that are out of dimensional specification often show a high degree of tooth flank wear with the jacket flank exhibiting a fuzzy or flaking appearance, as shown in Figure 12.

Curvilinear (HTD and GT) belts operating on subminimal sprocket diameters usually fail by land disintegration, illustrated in Figure 13, and tensile breaks. Trapezoidal (XL, L, H) belts will usually fail by tooth root cracks and tooth shear; however, tensile breaks are not uncommon.

A higher rate of sprocket wear may occur from belts that have been installed with excessive installation tension. Belts that have been in operation for a long time have sometimes had the

tooth facing or jacket completely worn away. Belts in this condition indicate that significant sprocket wear may have also occurred. Belts worn to this point also sometimes allow belt tensile members to contact the sprockets resulting in a grooved wear pattern around the outside circumference.

A good indication of sprocket wear is when a ridge along the tip of sprocket teeth becomes visible, as illustrated in Figure 14. Use caution: severely worn surfaces on sprocket faces may become very sharp. It is best to use a screwdriver or other tool to feel for the ridge in order to prevent finger cuts. When a ridge on the sprocket face is detected, the sprockets should be replaced.

The most rapidly and severely worn sprockets are most commonly found in abrasive atmospheres. Severely worn sprockets often exhibit groove wear as well as a reduction in the outside finish diameter. A typical belt failure on worn sprockets exhibits polished land wear and may have teeth worn to the point of serious dimensional distortion (hook wear). Sprockets plated with a hard chrome finish can be used to extend the sprocket life in abrasive atmospheres.

Another indication of severe sprocket wear is when replacement belt life is noticeably reduced from previous belts. When this occurs, sprockets should be examined closely for excessive wear.

**Excessive sprocket run-out.** Belts operating on sprockets with radial run-out are subjected to a cyclic rise and fall in belt tension as the sprockets rotate. The greater the run-out, the higher the peak belt tension grows. Belts subjected to significant cyclic peak tensions exhibit land areas with a crushed appearance. Crushed land areas and tooth shear are both visible in Figure 15. A crushed land area condition may appear similar to belts operating on moderate size sprockets under excessively high tensions. Belts subjected to extreme cyclic belt tension variations often fail from either tooth shear or tensile break.

Excessive sprocket run-out is most often observed when sprockets are mounted improperly on bushings, or when minimum plain bore sprockets are improperly re-bored and mounted.

**Part 4: Negative Effects of Environmental Conditions**

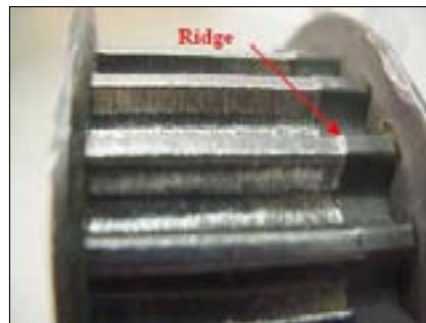
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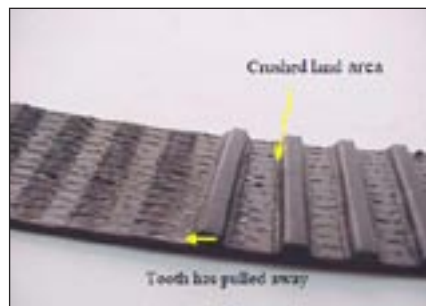
**Figure 12—Extreme tooth wear from worn sprockets.**



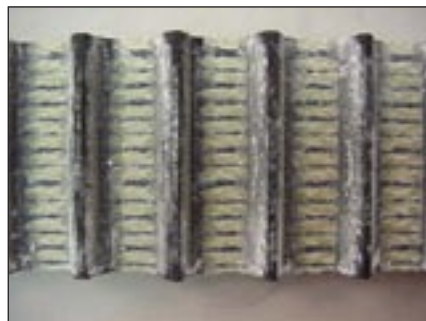
**Figure 13—Land disintegration.**



**Figure 14—Excessive sprocket wear.**



**Figure 15—Extreme land crushing and wear from excessive sprocket runout.**



**Figure 16—Extreme wear from abrasion.**



**Figure 17—Cracking from high-temperature operation, rubber.**



**Figure 18—Melting from high-temperature operation, polyurethane.**



**Figure 19—Tensile cord failure from debris.**



**Figure 20—Crimp failure due to debris.**

In this section, we'll zero in on the environmental conditions—abrasive atmosphere, heat degradation, chemical degradation and foreign objects—that can negatively impact your belts.


**Abrasive atmosphere.** Belts operating in abrasive atmospheres on applications like foundry shakers, taconite processing equipment and phosphate mining conveyors often exhibit a high degree of belt land and tooth flank wear. Worn areas frequently have a polished appearance. Figure 16 illustrates a severely worn Gates Poly Chain GT2 belt that ran in a highly abrasive environment. Sprocket wear is generally rapid in abrasive environments; therefore, sprockets should be replaced along with belts. To extend the life of belts and sprockets, a sealed guard that is pressurized with clean air can be installed to help keep out abrasive dust and contaminants.

**Heat degradation.** When rubber belts operate at elevated temperatures (greater than 185°F) for prolonged periods of time, the rubber compound gradually hardens resulting in back cracking due to bending. These cracks typically remain parallel to the belt teeth and usually occur over land areas (in between belt teeth), as illustrated in Figure 17. Belts generally fail due to tooth shear, which often leads to tensile cord fracture. High-temperature rubber belt constructions are available for belt drives that must operate in high-temperature environments. These special belt constructions help to improve belt service.

The body material used in urethane belts such as Poly Chain GT Carbon belts is thermoplastic, meaning it has a melting point. When subjected to environmental temperatures in excess of 185°F, the teeth may begin to soften and deform. In addition, the tensile cord to urethane adhesion loses its integrity. Figure 18 illustrates a Poly Chain GT2 belt that was exposed to a high environmental temperature.

**Chemical degradation.** Rubber belts subjected to either organic solvent vapors or ozone will resemble belts that have been subjected to high environmental temperatures. The rubber compound will harden and belts will exhibit back cracking. The cracking pattern will differ, though, in that the compound hardening occurs mostly at a surface

level allowing cracks to form in both lateral and longitudinal directions. A “checkered” appearance may result.

**Foreign objects.** The introduction of foreign objects between a belt and sprocket often damages both belt teeth and tensile cords. Tensile cords often fracture internally (see Figure 19) or fail later due to crimping, as shown in Figure 20. Once a portion of the tensile cords has fractured, the remaining tensile strength of the belt has been reduced considerably. This often results in a dramatic reduction in belt life. If belt damage from debris is noticeable, the belt should be replaced and the sprockets checked for damage. Damaged sprockets should also be replaced. 

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# Improving Equipment Uptime

## COMPOSITE SEALS MEET THE CHALLENGE

Chris Tones and David C. Roberts

### Management Summary

In an industrial application, equipment uptime is vital for on-time performance and profitability. The rotating members of industrial machines are subject to the highest degree of wear and are more susceptible to failure than non-moving parts. Bearing surfaces are the most critical and often the most expensive portion of the rotary assembly; it is imperative to protect these components. The primary protector of these components is the industrial seal. Composite seals are a significant means to protect bearings. This paper examines three methods in which composite seals meet this challenge: 1) by providing key advantages over traditional sealing devices, 2) by improving overall sealing life, and 3), by providing a quick repair option when seals have reached the end of their service life.

### Advantages of Composite Seals

The concept of utilizing a bearing surface for rotating machine members dates back over 5,000 years. Evidence suggests that lubrication was used on bearings as early as 1400 B.C. (Ref. 1). By the 1800s, the Industrial Revolution created demands for more sophisticated lubrication systems (Ref. 2). In order to retain lubrication, a sealing system was needed. Originally, seals consisted of either leather straps or braided rope. By the 1920s, lip seals made of leather were being produced. The 1930s and 1940s saw development of the synthetic rubber oil seal, which is still in use today. The most common radial lip seal (or oil seal) design is the metal-cased seal. A molded rubber-sealing element is captured inside of a carbon steel case. The rubber may be chemically bonded to the metal or mechanically pressed into place (Fig. 1). A spring—either garter- or finger-type—provides an energized lip to accommodate misalignments in the application.

A common drawback to the metal-cased seal design is that the carbon steel case is exposed to the environment and therefore susceptible to corrosion. This can be resolved by using stainless steel case material; however, this significantly impacts the cost of the seal due to material expense and processing constraints. Another concern is that the metal case is press-fit into the application housing. This metal-to-metal press fit can create a challenging installation, usually requiring an arbor press or other equipment. The metal case may also present problems with galling when installed in a housing made from softer materials, such as aluminum or bronze.

An all-rubber seal is a simple way to address these issues; however, an all-rubber seal lacks the rigidity of a metal-cased

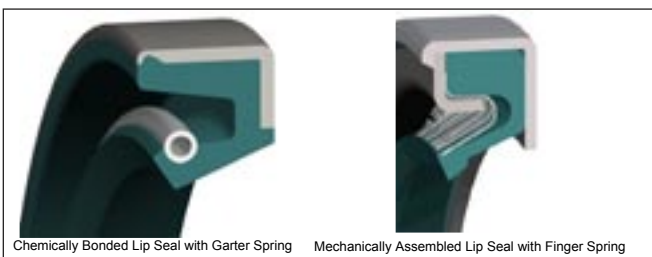
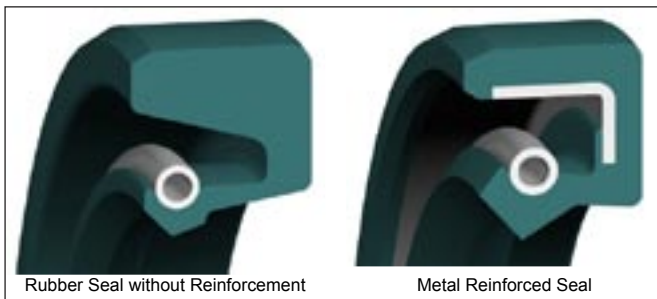


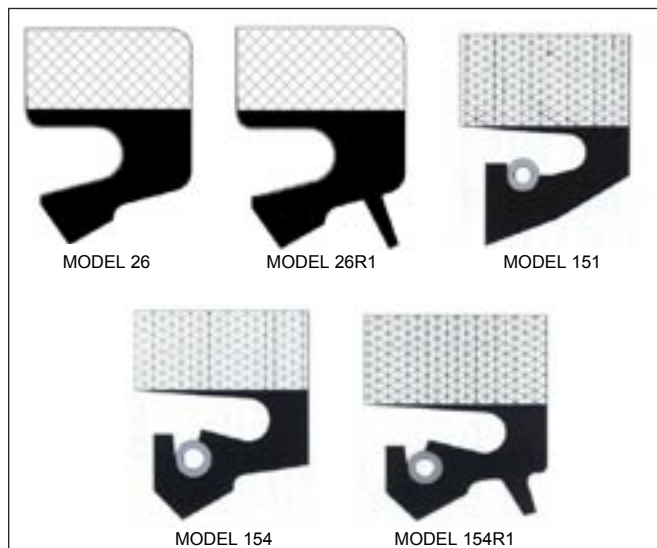
Figure 1—Bonded and assembled radial lip seals.

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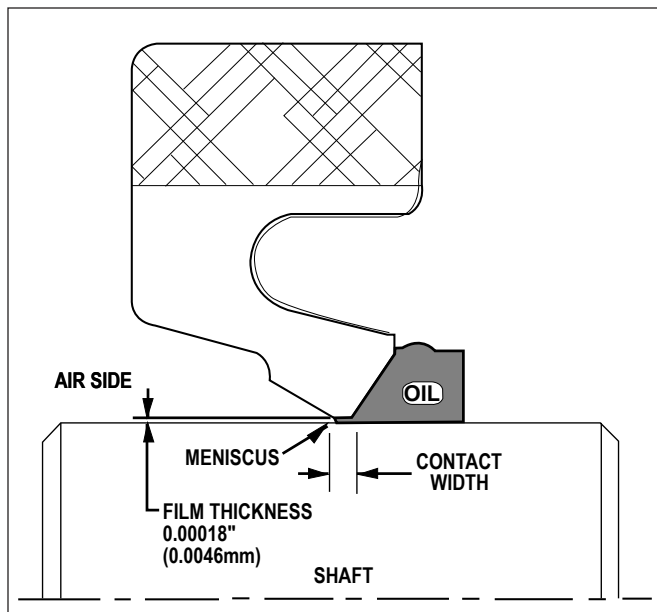
seal. An effective compromise between these two options is the composite seal, which has an all-rubber exterior molded over a reinforcing media such as fabric or rubber-compressed fiber compound. While some designs reinforce seals with metal, a composite seal offers superior strength over all-rubber options while eliminating costly metal components. Furthermore, unlike metal-reinforced seals, composite seals may be split, facilitating simpler installation practices.



**Figure 2—Various rubber OD seals.**



**Figure 3—Garlock Klozure composite seals.**



**Figure 4—Hydrodynamic sealing.**

### High-Performance Elastomers Increase Service Life

All radial lip seals are contact seals—the sealing lip is in contact with a rotating surface, usually a shaft. The hydrodynamic sealing concept shows that when operating under normal conditions, a radial lip seal will draw lubricant under the sealing lip and re-circulate it back into the system. Thus a thin layer of fluid—or meniscus—is formed between the sealing lip and the sealing surface (Fig. 4). Under optimum conditions, the meniscus actually creates the interface between the shaft and the sealing lip (Fig. 5; Ref. 3).

However, most applications do not run under optimum conditions at all times. Functional testing experiments demonstrate that at start-up, a radial lip seal consumes considerably more power than it does at normal operating speeds (Ref. 4). This is due to the fact that the hydrodynamic meniscus cannot form at lower speeds. The three key variables that contribute to this phenomenon are fluid viscosity, rotational speed and applied pressure (Ref. 5). Seal geometry also plays an important role in developing the hydrodynamic meniscus.

Thus, while hydrodynamic sealing is the goal, there will be times when the seal is in direct contact (dry running) against the shaft. The durability of the material plays a key role in protecting the seal geometries during these periods. Lower-grade sealing materials may wear excessively during dry running periods and lose their critical geometries. The lack of these geometries will prevent the formation of a hydrodynamic meniscus—leading to further seal degradation.

The most common sealing materials include acrylonitrile butadiene (nitrile, NBR), hydrogenated nitrile (HNBR) and fluoroelastomer (fluorocarbon, FKM, FPM). Fluoroelastomer is often referred to by the DuPont trade name Viton. The general service grades of these elastomers provide acceptable performance in many applications. However, in heavy industrial applications where uptime is critical, high-performance elastomer grades can offer a significant increase in uptime.

Key properties in determining elastomer performance include tensile strength, elongation, tear resistance, coefficient of friction, hardness, abrasion resistance and compression set (Ref. 6). When initially manufactured, the above properties of a radial lip seal are known for a given material. However, when subjected to a variety of operating environments, these seal properties may undergo significant changes.

Newly developed elastomer materials allow for marked improvements in properties—such as abrasion and chemical resistance—even after extended service. Garlock’s Mill Right family of elastomers is an example.

These new high-performance elastomer grades offer superior performance over general service materials. A key area to consider is abrasion resistance. A material’s abrasion resistance is measured by the Taber wear test (ASTM D4060). The Taber wear test starts with precisely weighed sample specimens of a particular elastomer.

The specimens are “mounted to a rotating turntable and subjected to the wearing action of two abrasive wheels, which are applied at a specific pressure (Ref. 7).” When the test is completed, the specimens are re-weighed to determine how much material was abraded away. Results are reported in mg loss/1,000 cycles. Therefore, the lower the reported value, the better the abrasion resistance of the material.

Table 1 relates the improvements in abrasion resistance that the Mill-Right elastomers offer. Mill-Right N reports a Taber Wear Factor of 145.5 mg loss/1,000, compared to 548 mg loss/1,000 for general-service grade nitrile rubber—a 73% improvement in wear resistance. Similarly, the resistance of Mill-Right ES was increased 65% over general-service grade HNBR, and that of Mill-Right V 90% over general-service grade FKM. (For charted improvements in abrasion resistance, see Appendix A.)

In addition to improving the physical properties themselves, the Mill-Right elastomers offer improvements in the retention of these properties in service. The radar chart in Fig. 6 demonstrates Mill-Right V's improved physical property retention over general-service grade FKM. The dotted black line represents perfection—i.e., no change in physical properties at all—while the red and green lines represent general-service grade FKM and Mill-Right V, respectively. While perfection is the obvious goal, it is understood by elastomer engineers that it is quite unlikely that it will be achieved. But notice how much closer Mill-Right V gets to this goal than its general-service counterpart. (For radar charts on all three Mill-Right grades, see Appendix B.)

### Split Oil Seals Improve Mean Time To Repair

Inevitably, no matter how well-engineered the material is, all contact seals will have a finite service life. Service life is affected by a variety of factors, including equipment condition, environmental condition, thermal factors and surface velocity. When a seal has reached the end of its service life it must be replaced. The ease in which this can be done will significantly impact uptime. A measurable indicator of this is the Mean Time To Repair (MTTR), which is simply a ratio of the total repair time to the number of repairs completed.

Replacing solid oil seals in the field can have a significant negative impact on MTTR. This is because the entire system must be taken off-line, disassembled and then reassembled in order to introduce a solid seal into the housing. This may involve the removal and re-installation of pillow blocks, motor housings, pump housings, etc. This is because solid seals must be installed over the free end of a shaft with all attached components removed from the assembly. The innovation of a split oil seal allows the user to install the sealing device without having to completely disassemble the equipment, drastically reducing maintenance time.

A split oil seal is a relatively simple concept. It involves removing a section of a solid composite seal to create a seal with a single split point. The seal can be opened along the axis of rotation to allow easy assembly over the diameter of the shaft. Some split oil seals include a garter spring, which needs to be assembled around the shaft onto the seal during installation. Care should be exercised when selecting a split oil seal with a garter spring, as the spring may become dislodged during installation of the seal into the housing bore. Some composite split oil seals include a molded-in finger spring, which eliminates the need for a garter spring and contributes to even load distribution at the contact point on the shaft (Fig. 7).

Most split oil seals require a cover plate in order to be fully retained within the housing bore (some solid models also have this requirement). Otherwise, the seal may become dis-

continued

	General Service Grade NBR	Garlock Klozure Mill-Right N	General Service Grade HNBR	Garlock Klozure Mill-Right ES	General Service Grade FKM	Garlock Klozure Mill-Right V
Taber Wear Factor (mg loss/1,000)	548.0	145.5	113.2	39.2	481.4	49.2

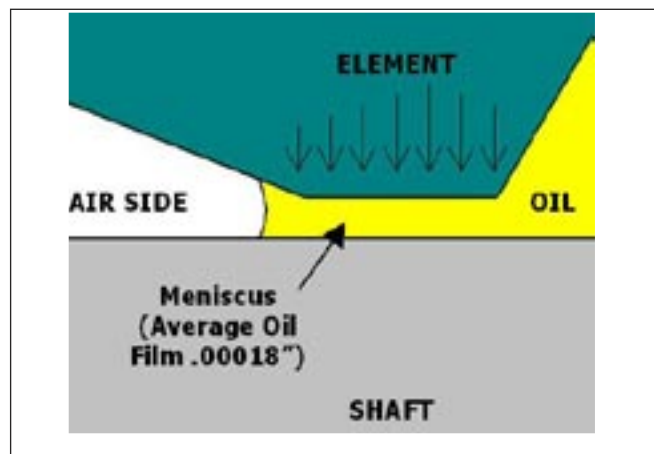


Figure 5—The sealing meniscus.

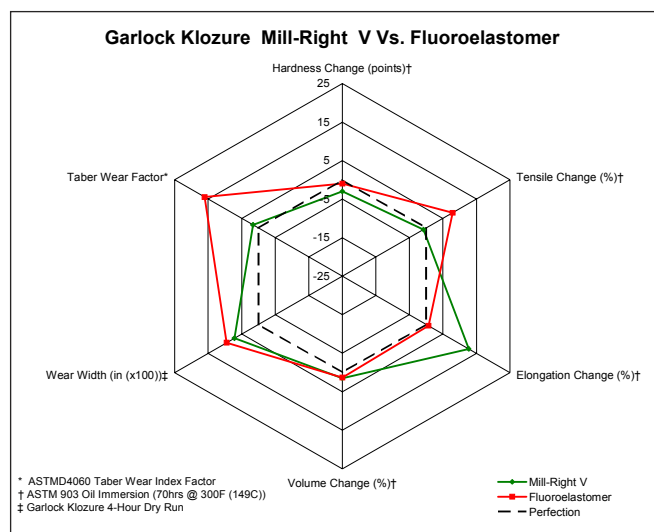


Figure 6—Mill-Right V radar chart.

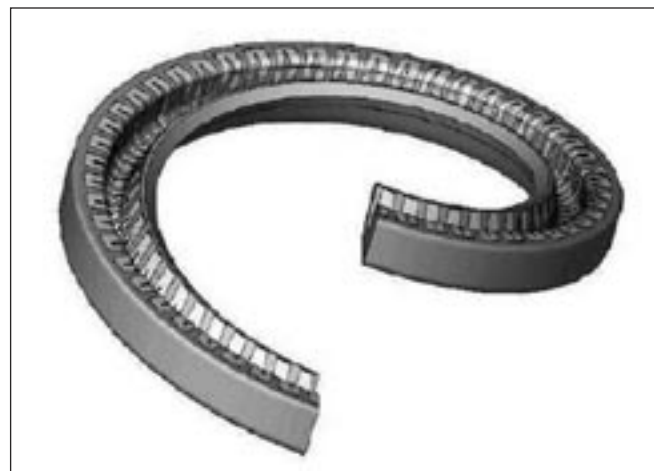



Figure 7—Garlock Klozure composite split oil seal with finger spring.

engaged from the application during operation. A cover plate is simply a flat metal plate—either whole or split—that can be bolted against the housing to provide proper compression of the seal (Fig. 8).

It is vital that the seal width and bore depth be properly fitted so that there is appropriate axial retention of the split seal. Some high-performance split seals include significant OD interference, to the extent that a cover plate is not necessary within a particular size range.

For example, the Garlock Klozure Model 26 split seal does not require a cover plate for housing bores under 10.000 inches (254mm) in diameter (Fig. 9).

### Conclusion

Improving uptime is not a simple task. Equipment needs to be broken down into systems, systems into sub-systems and sub-systems into components. Identifying critical components that will significantly impact uptime is vital. Since rotating components are so critical to function, protecting these systems will positively impact uptime. Composite seals are a primary method for protecting these systems. These seals offer significant advantages over standard designs. The options of both general-service and high-performance grade elastomers provide the end user with the ability to select the grade to meet specific needs. Utilizing timesaving designs such as split seals serves to dramatically reduce downtime. Good use of all these innovations will positively impact uptime and ultimately improve profitability. 

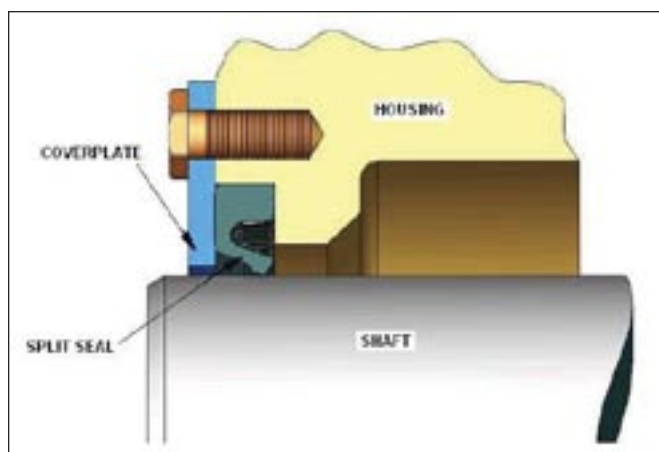


Figure 8—Split oil seal with cover plate.

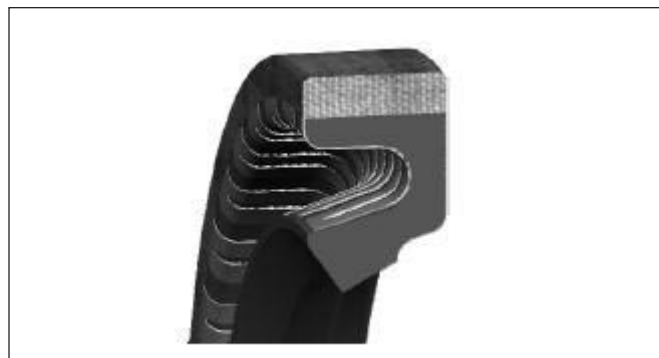


Figure 9—Garlock Klozure Model 26 composite split oil seal.

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### For more information:

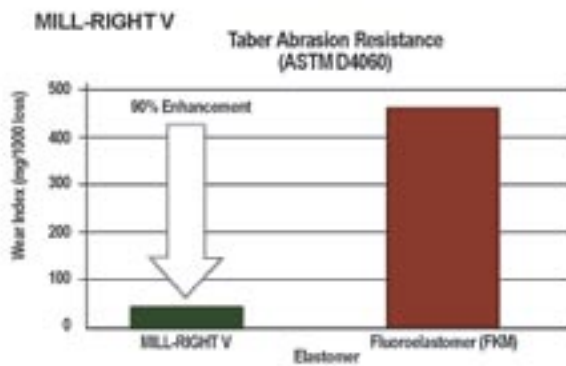
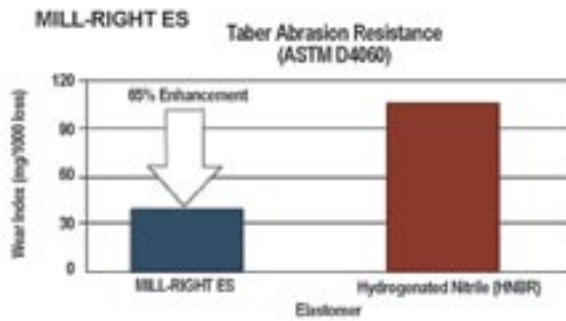
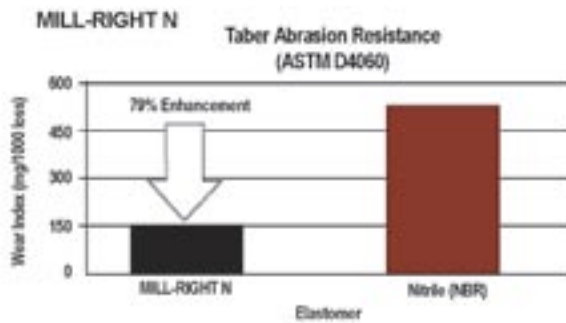
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Phone: (315) 597-4811  
Fax: (866) 645-7325  
[www.garlock.com](http://www.garlock.com)

David C. Roberts currently holds the position of product engineer at Garlock Sealing Products, an EnPro Industries company. In this position, Roberts is responsible for the design, development and testing of sealing devices for dynamic applications. Principal product lines supported include radial lip seals, bearing isolators and mechanical seals. Prior to his role as a product engineer, Roberts held the position of applications engineer for radial lip seal and bearing isolator products. Roberts' published works include "Extending Equipment Life through Improved Sealing Technology," published at the Power-Gen Conference, 2007, and "Improving Equipment Uptime: Composite Seals Meet the Challenge," published at the AIST Conference, 2009. Roberts holds a bachelor's degree in mechanical engineering technology from the College of Applied Science and Technology at Rochester Institute of Technology and is licensed as a professional engineer in New York state.

Chris Tones currently holds the position of product engineer at Garlock Sealing Products, an EnPro Industries company. In this position, he is responsible for the design, development and testing of sealing devices for dynamic applications. Principal product lines supported include radial lip seals, bearing isolators, and mechanical seals. Prior to his role as a product engineer, Tones has held positions including process engineer, materials engineer and test lab technician. He holds a bachelor's degree in organizational management, associate's degree in mechanical engineering and four U.S. patents on bearing isolator and radial lip seal technologies.

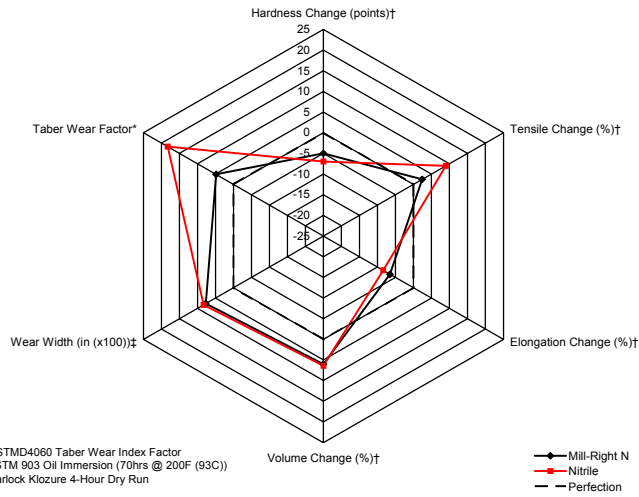
## Appendix A

### Abrasion Resistance Improvements

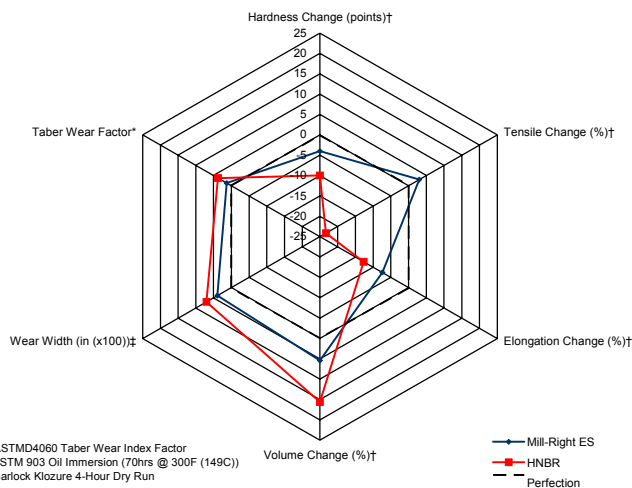


# Appendix B – Radar Charts

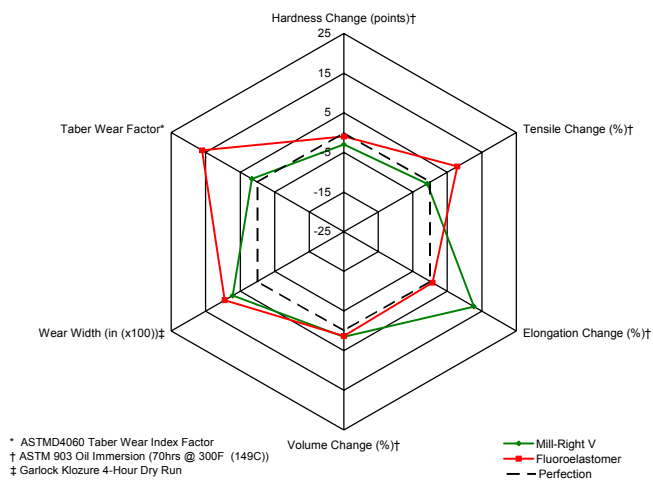
**Mill-Right N Radar Chart**  
**Mill-Right N Vs. Nitrile**



**Mill-Right ES Radar Chart**  
**Mill-Right ES Vs. HNBR**



**Mill-Right V Radar Chart**  
**Mill-Right V Vs. Fluoroelastomer**





## **October 25–29—Materials Science and Technology Conference and Exhibition.**

David L. Lawrence Convention Center, Pittsburgh, PA. MS&T '09 is a professional forum addressing structure, properties, processing and performance throughout the materials science community. The technical program focuses on ceramic and glass materials, electronic and magnetic substances, environmental and energy issues, fundamentals and characterization of the materials industry, iron and steel, nanotechnology as well as processing and product manufacturing. The trade show is the result of a four-way partnership between the American Ceramic Society (ACerS), Association for Iron and Steel Technologies (AIST), ASM International and the Minerals, Metals and Materials Society (TMS). For more information, visit [www.matscitech.org](http://www.matscitech.org).

## **October 27–29—Solar Power International.**

Anaheim Convention Center, Anaheim, CA. As North America's largest business-to-business solar industry event, Solar Power International 2009 is already much larger in floor space reserved than the previous show in 2008. The expo hall features over 900 exhibitors covering all solar technologies: PV, CSP, solar hot water, solar heating and cooling and solar pool heating. Over 25,000 attendees are expected that include sellers, buyers and stakeholders, manufacturers, integrators, installers, utilities, investors, builders, architects, large energy users and policymakers. There are over 65 educational sessions, 200 speakers, two CEO panels and two keynotes. Educational tracks include finance, policy, markets, technology, crosscutting and implementation/execution. For more information, visit [www.solarpowerinternational.com](http://www.solarpowerinternational.com).

## **November 2–4—Machine Maintenance: Hydraulics Training Course.**

North American Die Casting Association (NADCA) Headquarters, Wheeling, IL. Part of NADCA's education and training course program, this three-day course is designed to improve the performance of the hydraulic-drive systems in die casting equipment by understanding and applying the principles of effective maintenance programs. With increased technology and automation, hydraulic circuits are much more complex in the way they interact with electro-mechanical PLC processes. Troubleshooting and maintaining hydraulic components has become an important part of daily operation of die casting equipment. Cost is \$700 for corporate NADCA members, \$805 for individual members and \$945 for nonmembers. For more information, visit [www.diecasting.org/education](http://www.diecasting.org/education).

## **November 3–5—SMMA Fall Technical Conference.**

Sheraton Chicago Northwest Hotel, Arlington Heights, IL. Motor technology leadership is the theme of SMMA's 2009 Fall Technical Meeting. Energy efficiency requirements, environmental initiatives and anticipated inflation are topics that are or will be impacting the motors and drives industry in the near future, according to co-chairs Dave Beth, vice president engineering for Emerson Tool Co., and John Calico,

senior research engineer, Moog Components Group. The conference kicks off Tuesday evening with a plant tour of Essex Active in Willowbrook, IL. Essex is a converter/fabricator of electronic parts and electrical insulating materials. There are several other pre-conference options to take advantage of. Registration is open to members and prospective members. Prices vary depending on the various options to choose from. To register online, visit [www.smma.org/ConfReg\\_Fall09\\_rev3.pdf](http://www.smma.org/ConfReg_Fall09_rev3.pdf), or for more information, visit [www.smma.org](http://www.smma.org).

## **November 5–6—Machine Maintenance: Mechanics Course.**

North American Die Casting Association (NADCA) Headquarters, Wheeling, IL. This two-day program addresses the mechanics of die casting machinery, from the foundation to its maze of linkages and to the die itself. The course focus is on the practical requirements of machine repair and preventive maintenance with emphasis on the mechanics and assembly of the die casting machine. Cost is \$500 for corporate members, \$575 for individual members and \$675 for nonmembers. For more information, visit [www.diecasting.org/education](http://www.diecasting.org/education).

## **November 15–18—Fabtech International and AWS Welding Show.**

McCormick Place, Chicago, IL. Billed as North America's largest metal forming, fabricating and welding exposition and conference, Fabtech International and AWS Welding Show including Metalform brings buyers and sellers of metal forming and fabricating technologies together. The concurrent conference sessions feature over 100 programs on a variety of metal forming, fabricating, welding technologies and processes and other related business topics. Two keynote panel discussions will address "Best Practices for Thriving in Tough Times," and "Energy—The Outlook is Bright, But Where Will it Lead Us." On the show floor is a Solutions Showcase, which presents free presentations on a range of topics. For more information, visit [www.fmafabtech.com](http://www.fmafabtech.com).

## **April 9–11, 2010—Techno 4.**

CODISSIA Trade Fair Complex, Coimbatore, India. Techno 4 is a new trade exhibition focusing on four different sectors of the engineering industry: pumps and ancillary equipment, foundry, motors and rotating machines and light engineering. The exhibition takes its cue from the rapid expansion of these four engineering sectors in the Indian economy, which stand as the largest contributor to Indian exports. Coimbatore is a hub for engineering businesses in India. It is the second largest city of Tamil Nadu and one of the fastest growing cities in the country. The business infrastructure is in place to hold successful trade events, including an international airport, telecommunication links and multi-lingual opportunities. For more information, visit [www.techno4india.com](http://www.techno4india.com).

## IPSO Alliance

ANNOUNCES COMPLIANCE AND CERTIFICATION PROGRAM



This map shows the location of sensors, each indicated by a dot, that were part of the second IPSO interoperability test taken in June.

The IP for Smart Objects (IPSO) Alliance has a new compliance and certification program aimed at speeding up use of IP in embedded smart objects like sensors and actuators in a range of emerging applications that include smart grid and energy management, building automation, urban infrastructure, industrial and process automation, healthcare and home automation.

The IPSO Alliance was formed in 2008 and serves technology providers and end-users looking to establish Internet Protocol as the standard of choice for interconnection of physical objects. The alliance held the world's first global interoperability event in March, when the foundation was placed for this compliance and certification program. IPSO has successfully demonstrated IP-based global interoperability with IP-based sensors, networking infrastructure, servers and applications.

The IPSO Alliance intends to lead the effort to transition into IP-enabled devices of existing or emerging application layer frameworks and plans to coordinate with other groups and standard-setting bodies to help this transition.

"We have already shown that by using open IP standards (IPv6 and 6lowpan) we can connect small embedded devices—smart objects—from different vendors around the world," says Geoff Mulligan, chairman of IPSO. "With our new program, we are raising the bar of testing and certification to bring assured interoperability to the entire industry. The IPSO Alliance program covers all types of physical communications links, wired or wireless, including 802.15.4, 802.11, PLC (such as HomePlug). We are not limited to any single technology."

The IPSO compliance and certification program is a comprehensive, industry-wide effort that includes collaborating with the Internet Engineering Task Force to develop basic standards; delivering testing and compliance programs, so vendors can validate product compliance to IP standards; developing programs to encourage development of adaptation layers for IP over new communication links; facilitating the movement of existing or emerging systems

onto IP-enabled devices and working with other industry alliances and associations.

"I'm delighted to see IPSO taking the lead in the certification of IP smart objects, enabling vendor interoperability and sector-wide compliance to standards," says Alain Fiocco, senior director of IOS marketing and architecture for Cisco Systems. "Stable and open standards are critical in making smart objects communicate and deliver the network value. It is vital that this industry can rely on these standards to blossom, but it is equally important for customers and vendors alike that these standards are in place to deliver end-to-end solutions and shorten the adoption cycle"

## Renold Americas

NAMES PRESIDENT



Rick Hamilton

Rick Hamilton was named president of Renold Americas, effective immediately. In this position, Hamilton is responsible for all sales operations in the United States, Canada and Latin America. He reports to George Graham, managing director of global chain sales of Renold plc.

"We are pleased Rick accepted this position with the Renold organization," Graham says. "He has the vision and

ability to lead the Renold Americas group to greater success."

Hamilton has previous experience in management, sales and manufacturing. He most recently served as president of Renold Canada. He has held positions at Martin Sprocket and Gear Inc. and Emerson Power Transmission Corp. He received a bachelor's degree in industrial distribution from Texas A&M University, College of Engineering.

## Iwis

RELOCATES HEADQUARTERS TO INDIANAPOLIS

Chain manufacturer Iwis Drive Systems, LLC moved into new headquarters in Indianapolis. The 5,000 square meter building consists of offices, dedicated assembly hall,



chain testing laboratory, fabrication shop and inventory warehouse. Due to significant business expansion, especially in the agricultural chain division, the move was necessary to accommodate these changes.

## Pacamor

### EXPANDING CLEANROOM FACILITY

In response to growing demand from aerospace OEM and MRO customers, Pacamor Kubar Bearings (PKB) is expanding its current ISO 9001:2000 and AS9100:2004 certified cleanroom environment facility in Troy, NY to double its current size.

The expansion is scheduled for completion in the fourth quarter of 2009, and it will be equipped to provide complete bearing assembly processes including component inspection, bearing assembly, lubrication, specialty inspection processes, secondary operations, test and packaging capabilities.

New equipment for the expanded facility will include a Running Torque Tester equipped with tooling for every bearing size manufactured by PKB; a heated vacuum impregnation chamber and a high speed centrifuge for lubrication processes; a nitrogen gas backfill system for specialized packaging processes; and many other specialty instruments and production tools. The new cleanroom will also have an automated bearing wash system, various Class 100 laminar flow benches for ultra clean processing, various gages and precision inspection instruments.

The expanded facility is being designed to provide tight temperature, humidity and particulate control. The cleanroom regularly is measured using particle counters to read the return air stream particulate level. PKB's current cleanroom

continued

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---

## Germanischer Lloyd

### AUTHORIZES CENTA TO TEST OWN COUPLINGS

Centa is the first company worldwide to receive the Germanischer Lloyd (GL) authorization for alternative product certification of type-approved couplings. This means that in future operations, Centa has the authority to carry out acceptance testing and final stamping of those couplings that have been classified as approved types. These tests are required to be performed in accordance with the “Alternative Product Certification,” a modular certification system developed by GL.

Several other international classification societies have provided Centa the authority to use their approval stamp on its couplings, including the Det Norske Veritas (DNV), Nippon Kaiji Kyokai (NKK) and the maritime Register of Shipping (MRS).

GT is one of 10 internationally recognized classification societies. It has developed technology and quality standards for over 140 years. “We have maintained close cooperation with several classification societies for more than 20 years,” says Gerhard Kirschey, founder of Centa Antriebe Kirschey GmbH. “We continually strive to improve the quality of our products and processes. Approval by Germanischer Lloyd for carrying out acceptance testing of our couplings on our own, in-house, indicates that our quality management system is on the right track. We are very proud of this sign of confidence and confirmation of our efforts, which are supported by our employees’ high commitment level.”

## TSD Integrated Controls

### TRANSITIONS FROM JOINT VENTURE TO STRATEGIC PARTNERSHIP

TSD Integrated Controls has been a joint venture of Sauer-Danfoss Inc. and Topcon Positioning Systems, Inc., operating successfully in the road building and agricultural markets since 2001. As market dynamics in road building and agriculture evolve, the two parent companies decided jointly to turn the relationship from a joint venture operation to one of strategic partnering. Both companies believe this is the best way to serve the future interests of the TSD customer base.

“We have had a very successful joint venture partnership, developing industry-leading solutions like 3DmmGPS-based controls for the asphalt and concrete paving markets, and the TruPath automated guidance system for the ag market,” says Bill Welscher, TSD general manager. “This updated arrangement will continue the positive cooperation, but will also allow the parent companies to more fully focus on their individual strengths within their respective technologies.”

As of September 1, 2009, all TSD OEM customers in the road building market are represented by Sauer-Danfoss for commercial relationship and sales support. Topcon continues to exclusively supply Sauer-Danfoss with products for this market segment. Topcon will be supplying directly to customers in the agricultural market, including the TruPath autosteer product and other agricultural products.

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## Tesla Engineering Chief

Mike Donoughe resigned as executive vice president of vehicle engineering and manufacturing for Tesla Motors, effective October 1. He joins Detroit-based St. Clair Consortium, a consulting group, and he intends to contribute more time to the non-profit organization he founded with his daughter, Cornerstone Youth Development.

Tesla has not publicly named a replacement, but Peter Rawlinson, chief engineer and head of engineering on the all-electric Model S sedan will take on Donoughe’s responsibilities in that area.

“Tesla is a company populated throughout with excellent and enthusiastic people,” Donoughe says. “It has been a wonderful experience for me to have been a part of this talented team. At the same time, having the opportunity to join the St.

Clair Consortium will, along with my Cornerstone activities, enable me to continue to pursue my personal and professional objectives going forward.”

Donoughe joined Tesla in 2008, right after the all-electric Roadster sports car began production, Tesla’s first product. Donoughe contributed to fully ramping up production of the model. He focused on improving Roadster quality and executing a cost-down program that helped Tesla reach profitability in July.

“Mike joined the company shortly after we had begun manufacturing the Roadster, and his enthusiasm and expertise helped Tesla achieve fully ramped up production,” says Elon Musk, Tesla CEO. “He’s leaving the company on very solid footing and at a logical time in Tesla’s phenomenal growth curve.”

## Ruland and Belden

FORM GERMAN JOINT VENTURE



Ruland Manufacturing Co. Inc. and Belden Inc. have formed PTMotion GmbH, a joint European venture headquartered in Berlin. It began operation September 1.

The two companies joined forces in Europe due to a growing OEM customer base in Germany and other countries. The intention is to generate new business and manage distributor relationships. PTMotion is under management of Ralf Gabriel, managing director, who has been a sales engineer for Belden in Germany for several years. He is aided by Sebastian Recke as sales engineer.

Belden, headquartered near Chicago, manufactures universal joints and power transmission assemblies. Ruland, headquartered in Marlborough, MA, manufactures couplings and shaft collars. Both companies have been active in Europe for many years.

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## German Solar Company

### ESTABLISHES NORTH AMERICAN OFFICE

EEPro, daughter company of EEPro GmbH in Germany, opened its first office in North America, located in Charlotte, N.C. EEPro designs and builds turnkey photovoltaic parks and farms throughout the United States. It will be a contact point for solar power information, including the possibilities and benefits of wide-scale implementation of solar power.

“Within the United States, you rarely see mass use of solar power, as opposed to countries like Germany, where approximately one in 10 buildings has a solar power system,” says Martin Koebler, CEO of EEPro. “In America, the programs and financial incentives, which are necessary to create the cultural shift that enables the success of sun-driven power, simply haven’t existed. That’s expected to change with

the new energy bill and growing demand from conscientious corporations, communities and governments. EEPro has set up its office to address the projected need and provide the most trusted solutions in the solar market.”

EEPro is planning to install a 500 kw free-standing photovoltaic system in the Charlotte area. Such a system is capable of powering 250 homes, producing 750-800 kwh per year.

“The entire world has a growing respect for solar power, and in Europe, it’s proven method of energy harvesting and delivery,” Koebler says. “EEPro projects provide a low-risk investment opportunity.”



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## Eaton

### ENTERS JOINT AGREEMENT IN MIDDLE EAST

Eaton Corporation announced a joint venture in the United Arab Emirates operating through SEG Middle East Power Solutions and Switchboard Manufacture LLC. The Abu Dhabi-based company sells low-voltage switchboards and control panel assemblies to the Middle East power generation and industrial markets. SEG grossed sales of \$10 million in the fiscal year ending December 31, 2008.

“This joint venture provides Eaton with an established

operation that has built a successful business supplying switchboard and control solutions in the Middle East,” says Frank Campbell, president of Eaton’s electrical sector in Europe, the Middle East and Africa. “This provides Eaton with a local manufacturing presence and positions us for continued success in this high growth region.”

## Thompson

### OPENS NORTHEAST MACHINING CENTER

The 10,000 square foot Northeast Machining Center for Thomson Industries opened in Long Island, NY with the purpose of quickly delivering Thomson 60 Case Shafting, with next day shipping in quantities up to 25 pieces. Larger quantities are available for same and next day shipping depending on availability.

The machining center stocks full random lengths up to 202 inches in diameters and up to 2 inches (50 mm). Shafting can be cut to customer specifications. The center is in addition to preexisting facilities on the West Coast and in the Midwest.

“Customers increasing need high quality motion control products faster than ever before, and this program delivers on both counts,” says Dennis Howe, general manager, linear bearings and guides. “Not only will most products ship the same or next day, but Thomson toolmakers and machinists average 22 years experience, and it shows in what we believe to be the highest quality shafting available in the industry today.”



## Hydraulic Institute

### PUBLISHES ROTODYNAMIC PUMP STANDARD

A new American National Standard for Rotodynamic Pumps for Vibration Measurements and Allowable Values (ANSI/HI 9.6.4-2009) is the latest standard from the Hydraulic Institute (HI).

The standard applies to evaluating vibration on roto dynamic pump applications, specifically pertains to evaluating vibration when vibration measurements are made on non-rotating parts (bearing housing vibration). General evaluation criteria are included for acceptance tests in field environments or at manufacturing test facilities, as is appropriate and defined in the standard.

“This new normative vibration standard builds upon the trends begun in the previously published standard, with significant improvements that should facilitate the use of the document, allow it to find broad acceptance and benefit the pump industry,” says Jack Claxton, vice president of engineering for Patterson Pump Company and chairman of the Hydraulic Institute Vibration Committee.

HI intends to supplement the standard in the future by a

guideline document, *Dynamics of Pumping Machinery*, which is currently being drafted by the committee. This standard is based on experiences from pump users, manufacturers and vibration measurement data. Vibration data from factory test and field test environments have been incorporated into the maximum allowable vibration values. The values are applied when a pump is installed per Hydraulic Institute or manufacturer’s specifications.

“The newly restated HI Vibration Standard comes as a result of substantial research and brings together collective experiences of pump users and manufacturers from a variety of industry segments,” says Mick Cropper, global product development manager for Sulzer Pumps US, Inc. and vice-chairman of HI’s Vibration Committee.

## Carraro Group

### BUILDING NORTH AMERICAN HEADQUARTERS

Virginia Beach is the new home for Carraro Group's North American headquarters. The Italian company is investing \$8 million in new machinery and tools in addition to creating 35 jobs.

The company is located in the former MG Minigears facility in the Oceana West Corporate Park, and there are plans to build another facility in the future. Carraro also plans to expand manufacturing operations to include components for wind energy, solar power and hybrid technology industries.

"Green technology is an essential part of the future," says Tiziana Votta, Carraro's senior vice president of worldwide marketing and sales. "And since Virginia Beach is one of the best places on the East Coast to manufacture wind energy, it made perfect sense to expand our operations to include manufacturing components for wind turbines here."

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## Metaldyne

### AUCTIONS ASSETS

MD Investors Corporation was named the successful bidder for Metaldyne Corporations assets, which were auctioned August 6. Metaldyne also had a hearing seeking approval of the sale from U.S. Bankruptcy Court for the Southern District of New York. The sale involves Metaldyne's powertrain, balance shaft module, tubular products and chassis assets to MD Investors.

MD Investors is a new company formed by Metaldyne's existing term lenders, which is led by the Carlyle Group, a private equity firm, and Solus Alternative Asset Management LP, an SEC-registered investment advisor. MD Investors agreed to buy most of the company's assets under a 363 sale. The bankruptcy filing in May was necessitated by liquidity, excess leverage and pension and lease costs aggravated by low production volumes in the North American automotive industry.

"We are very pleased Carlyle, Solus and a group of our term lenders have agreed to purchase substantially all of Metaldyne's businesses," says Thomas A. Amato, chairman, president and CEO of Metaldyne. "It has always been our plan to divest our better performing operations in connection with our overall Chapter 11 restructuring. We believe the sale of these businesses as a going concern represents the best way to continue to serve our customers and preserve as many jobs as possible."

"We are pleased Metaldyne is moving through the bankruptcy process swiftly and on plan. The highly competitive sale process in this challenging market is a testament to the strength of our businesses, technology and the commitment of our employees."

---

## Power Generation Startup

### ESTABLISHES FACILITIES

Energy Parametrics and Communications Inc. (EP&C), a provider of environmentally-friendly power generation solutions featuring smart grid and power management technologies, announced formal plans to lease and develop its new world headquarters and southern United States power data center in Dallas, TX, and a west coast power management data center in Sacramento, CA.

"Energy Parametrics and Communications is definitely on its way to taking its position as the true power industry and energy management leader. From micro-turbine demonstrations, true smart grid system monitoring to our power management informatics patent solutions, our new corporate headquarters and data analysis centers will operate under strict environmental-friendly guidelines," says Luke Stewart, president and CEO. "Our power data management centers will serve essentially as 'smart energy command centers.' We have future plans for other data management centers throughout North America."

The world headquarters and southern U.S. power management data center covers over 20,000 square feet. EP&C is keeping its current office in Richardson, TX for operations and administrative support. The west coast power data management center is in the North Sacramento/Del Paso Heights area and covers 51,400 square feet.

"As we begin the development of our new facilities...each location will serve a variety of important energy industry functions," says Gary Rayward, COO. "Most importantly, it will showcase our company's proven products and services to create safe and reliable green energy generation and power systems management. The sites will also serve to train industry professionals and host future green energy conferences as well."



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## Meet the DustBot— A New Spin on Waste Management

In the Disney/Pixar film *Wall-E*, audiences spent time with an endearing robot that collected trash and various knickknacks as it attempted to clean up Earth. Since 2006, the Sixth Framework Programme for Research, Technological Development and Demonstration (FP6), a segment of the European Commission's community research program, has been hard at work creating a robotic system with the capabilities to sweep and collect garbage in urban environments. This real-world *Wall-E* is known as the DustBot, aimed at designing, developing, testing and demonstrating a system for improving the management of urban hygiene.

"The DustBot project was conceived to address a real need for improving curbside collection of separated urban waste and cleaning and sweeping of streets in pedestrian areas," says Pericle Salvini, a project team member from Italy's Scuola Superiore Sant'Anna. "Since the writing of the project proposal, it has been characterized by a strict collaboration with end users, namely urban hygiene companies and citizens."

Two kinds of robots have been developed under the project: the DustClean, a robot equipped with cleaning materials to remove dirt and dust from city streets and the DustCart, a waste-collecting robotic device that interacts

with its user. Both systems include ozone and carbon monoxide sensors to monitor atmospheric pollutants—think R2D2 with an environmental agenda.

The first public demonstration of the DustBot system took place in Osaka, Japan at the Universal City Walk in January 2009; it was a collaboration between Scuola Superiore Sant'Anna and the Advanced Telecommunications Research Institute International of Kyoto. Since then, the robots have appeared in Italy, Sweden and Spain for further demonstrations.

From a technological standpoint, the DustBot system is almost complete. Armed with wireless systems for navigation, the robots have been successfully tested in real scenarios in Italy and other countries. Improvements need to be made on the robot localization system, including its GPS capabilities, but overall, the researchers are pleased with the results.

"Next, we will carry out further demonstrations and evaluate the numerous proposals concerning the project's future exploitation," Salvini adds.

Once the research and prototype phase ends, the next step will be taking measures to get the robots out into the streets. With the amount of navigation and communication features, it's not far-fetched to believe these robotic

systems could be applied to industries outside of waste management, including transportation, tourism and retail.

From a sociological standpoint, most people have accepted the robots and welcome the capabilities they can provide. "This is most likely due to the robot aesthetic design and to the useful functions they carry out," Salvini says.

Currently, the project team is working with law professionals to investigate the legal requirements that will allow the DustBots to work in urban environments.

"There is a legal gap concerning autonomous robots," Salvini says. "Issues such as safety, insurance, accountability and privacy need to be solved before these kinds of robots can freely move among people."

The researchers, however, see a real opportunity to provide these robots to communities in the future once the legislation is examined.

"While the DustBot is still a prototype developed in the framework of a research project, the safety and performance results have been very promising," Salvini says.

Demonstrations for the DustBot project will occur in South Korea in October, Japan in November and Germany in December. For more information, visit [www.dustbot.org](http://www.dustbot.org).



The DustBot project contains two robotic units, the DustClean and the DustCart, for street cleaning and waste removal projects (courtesy of Evelina Dario).



Robots might eventually replace humans in industries like waste management, tourism, retail and transportation (courtesy of Evelina Dario).

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