

# PTE

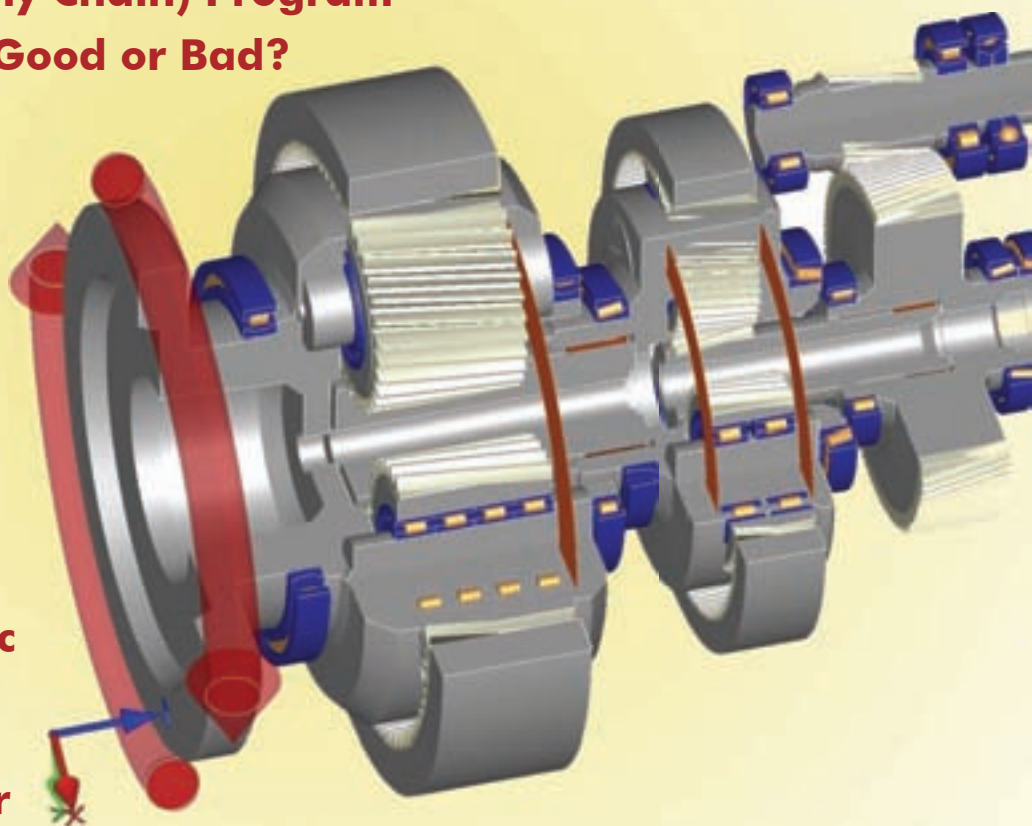
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## Supply Chain Management

- Get with the (Supply Chain) Program
- "Buy American"—Good or Bad?

### Features

- Case Study: SEW Gearmotors
- Motor Solutions for Hybrid Electric Drivetrains
- No Great Loss—Reducing Stepper Motor Drain



### Power Play

- Fundamentally Green Redevelopment

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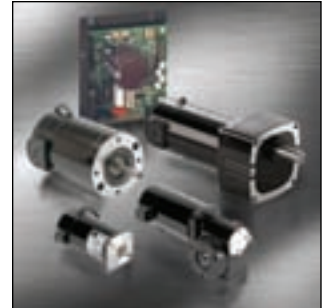
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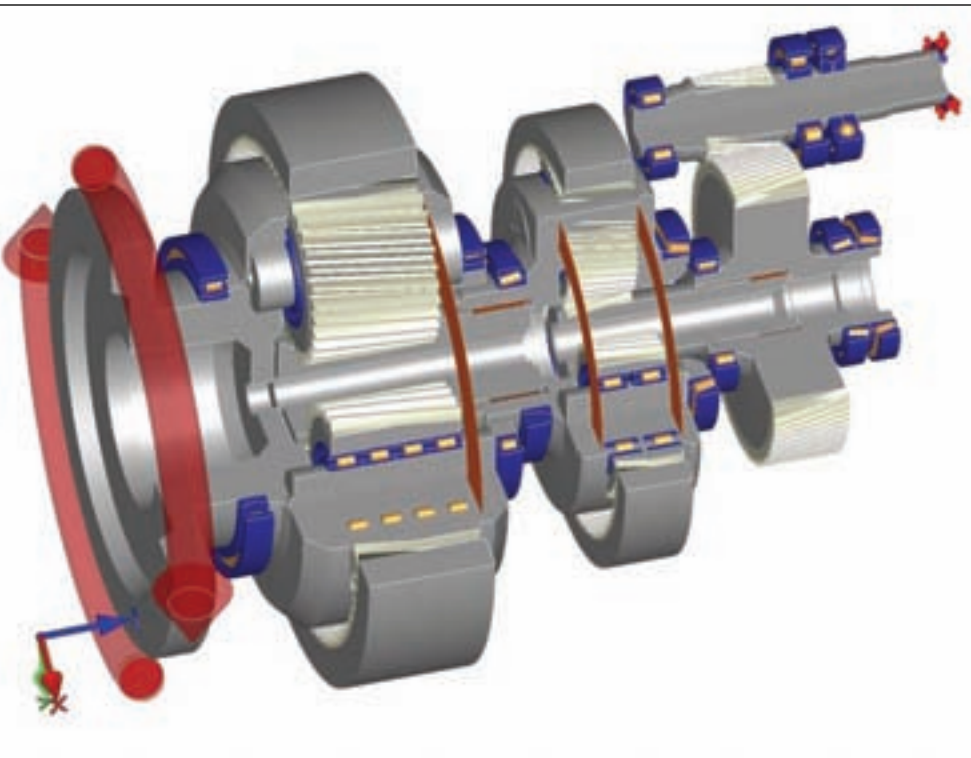
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A schematic cutaway drawing of a two-stage planetary gearbox with one spur gear stage.



Modular RN bearings from NKE are specially designed for wind turbine planetary gearbox applications.

## Wind Turbine Bearing System

### SIMPLIFIES LOGISTICS

NKE Austria developed a modular bearing system for use alongside planetary gears in wind turbine gearboxes. The bearing assemblies offer reduced diversity of parts and simpler logistics.

The modularity is based on single-row cylindrical roller bearings in the RN range, which don't have an outer ring. They are outfitted with a single-piece solid brass cage guided by the inner ring. The cage has inspection grooves for endoscopic inspection of the inner raceways. The bearings can be assembled in sets of two, three or four bearings depending on the load and design parameters of a specific gearbox.

The bearing sets are supplied ready to install. Each bearing has an overall height with tight tolerances for even distribution of radial loads. The sets include all necessary components for locking the bearings axially in the planetary gears. NKE can adapt the overall width of a bearing set to operating conditions if required.

According to NKE, some of the benefits of the modular bearing concept include simpler planetary bearing designs, reduced required number of bearing variants and simpler adaptation of bearing set characteristics to each gear stage requirement. Other advantages include the quality of rolling element guidance during rapid acceleration due to the brass cage and improved lubrication from lubrication grooves.

### For more information:

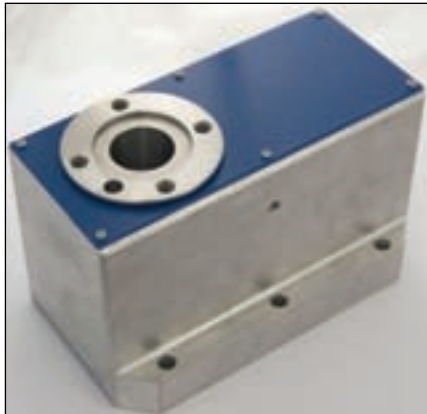
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Representative Office  
20 Barney Road  
P.O. Box 5255  
Clifton Park, NY 12065  
Phone: (518) 371-5759  
Fax: (518) 383-6487



## Rotary Table

### OPTIMIZES SMALL SPACES

Techno, Inc. Linear Motion Systems' Rotary Table ZR20 is a small



footprint stepper motor rotary table. It is powered by a two-phase stepper motor with a 20:1 ratio. The motor withstands a maximum load of 10 kg, and the resolution is 2.7 arc/minutes at 200 steps per revolution, half step.

“Our new rotary table is great for machine builders and in-house manufacturing engineers that need a powerful unit but are limited to a smaller space,” says Joe Griffin, Linear Motion Systems sales manager. “The ZR20 is ideal for countless automation applications that include pick and place, assembly, testing, inspection, dispensing and part transferring. A prime example of use would be rotating a part in and out of a UV curing station or paint booth.”

The ZR20 comes with an internal limit switch for homing functions. The stepper motor is prewired into a DB9

connector, minimizing setup time. It measures 138 mm by 86 mm wide by 88 mm high, uses a NEMA 17 frame motor and can be mounted to any assembly via six through holes on the mount flanges. The AR20 can be used by itself or in any combination of linear slides and other rotary tables.

### For more information:

Techno, Inc.  
2101 Jericho Turnpike  
P.O. Box 5416  
New Hyde Park, NY 11042-5416  
Phone: (800) 819-3366  
Fax: (516) 358-2576  
[lminfo@techno-isel.com](mailto:lminfo@techno-isel.com)  
[www.technoautomation.com](http://www.technoautomation.com)

## ThreeAxis Motion Controller, Driver

### IMPROVED WITH USB

The ESP301 from Newport Corporation is a three-axis motion controller and driver that adds a USB interface and integrated manual front panel interface to improve on its predecessor, the ESP300. It provides maximum backward compatibility to integrate into new or existing motion systems by the ESP stage auto-detection and auto-configuration combined with two-character software commands.

Up to three axes of motion are controlled by the ESP301 using DC or two-phase stepper motors up to 3A per axis. Control is synchronized by a 64-bit, floating point, DSP processor. Velocity profile tracking is ensured by a digital PID-feed forward servo loop. Smooth, low-speed stepper-positioning capability is provided by a 1,000x programmable micro-step resolution. An 18-bit DC motor command output allows for

stability in applications requiring precision.

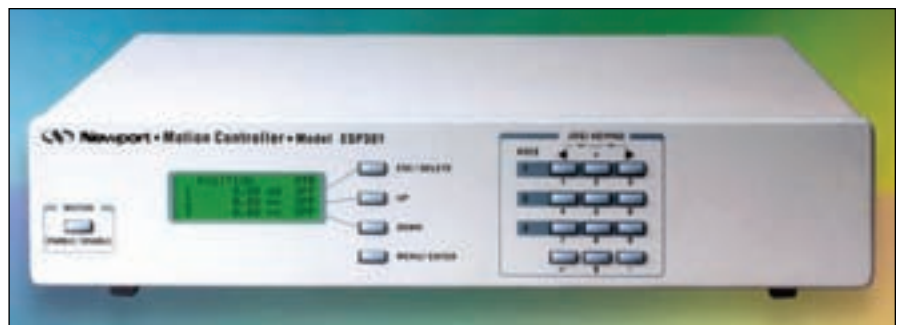
Several positioning modes are provided by the ESP301, including synchronized and non-synchronized point-to-point, jogging, linear or circular interpolation and continuous path contouring. Other features include on-the-fly position, velocity, or trajectory changes in complex motion and alignment routines; advanced origin search routine, which includes encoder index pulse consideration for precision homing; and backlash and linear error compensation eliminate repeatable system errors.

“We are very pleased to announce the ESP301 because we believe it provides significant benefits to our cus-

tomers,” says Beda Espinoza, product line manager for Newport’s motion products. “Affordable and easy to operate, it offers faster USB communication and a new, intuitive front panel menu. The ESP301 features the same industry-leading reliability as the ESP300 with excellent functionality and robust construction.”

### For more information:

Newport Corporation  
1791 Deere Avenue  
Irvine, CA 92606  
Phone: (949) 863-3144  
Fax: (949) 253-1800  
[www.newport.com](http://www.newport.com)



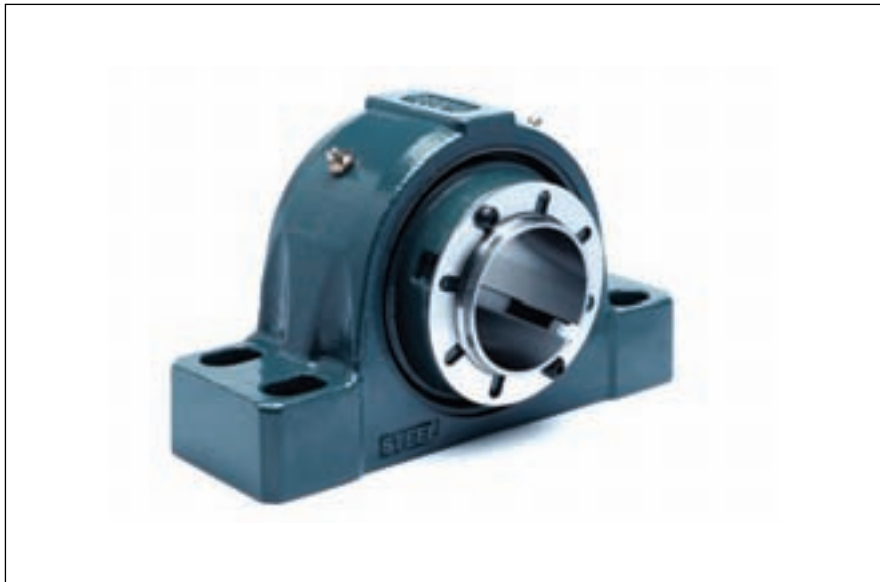
## Dodge Bearing

INSTALLS, REMOVES QUICKLY

The Dodge Imperial HD mounted roller bearing from Baldor Electric Company features a cast-steel housing and is designed for heavy-duty applications. The steel housings are available in pillow block, flange, edger flange and piloted flange configurations.

The bearing is easy to mount and dismount because of an adapter mount system. The adapter nut is turned clockwise to tighten the adapter on the shaft using the Imperial insert. The adapter nut is held in place by a lock plate, and feeler gauges are unnecessary in setting the bearing's clearance. While operating, the adapter sleeve aids concentricity and minimizes vibration.

The Imperial's insert has a built-in bearing puller, so the shaft is easy to remove by taking out the lock plate and turning the nut counter-clockwise, so the bearing slides off the shaft.



The bearing elements are shielded by a nitrile, multiple-lip seal that resists heat and chemical breakdown. High-temperature and high-speed capabilities are achieved when an optional metallic labyrinth seal is paired with the standard steel cage. End caps are also an option for added protection.

### For more information:

Baldor Electric Company  
5711 R.S. Boreham, Jr. Street  
P.O. Box 2400  
Fort Smith, AR 72901  
Phone: (479) 646-4711  
Fax: (479) 648-5792  
[www.baldor.com](http://www.baldor.com)

## Stepper Drive

TAKES LOW-FRILLS APPROACH  
TO MOTION CONTROL



The Compumotor Open Frame Stepper (OFS) microstepping drives stand as an affordable alternative for less demanding, point-to-point applications—low-frill and high-value, according to Parker's Electromechanical Automation Division in a press release.

"Many high-end, multi-axis automated machines require only two or three highly coordinated, high-precision axes out of the group. There may be another six, eight or dozen axes that rarely move, except for setup and periodic alignment of various elements of the machine," says Marc Feyh, stepper drive product manager. "For these setup and alignment axes, a simple, easy-to-use and inexpensive stepper drive can hold position just as well as an expensive one that requires a commissioning process with installed software

and programming just to get started. OEMs can save both time and money by applying the right level of step drive complexity to their machines, focusing valuable resources where they're really required—on the core high-precision axes."

The OFS step drives have three-state, PWM, MOSFET H-Bridge technology. They are capable of providing 3.5 amps peak current per phase and can drive from size 11 through size 34 step motors.

### For more information:

Parker Electromechanical Automation  
5500 Business Park Dr.  
Rohnert Park, CA 94928  
Phone: (707) 584-7558  
[www.parkermotion.com](http://www.parkermotion.com)

## High Performance Linear Drive

OVERCOMES HIGH INERTIA MISMATCHED STAGES

The TA333 high power linear drive from Trust Automation includes a Class-AB linear amplifier with pure analog throughput at currents up to 25 A. The drive can be used with a brushless motor with external sinusoidal commutation, an internally commutated brushless motor with Hall Effect sensor feedback for smooth trapezoidal operation, a two-phase stepper motor or



up to two voice coil motors. The TA333 can be used in applications that include extremely high-resolution inspection systems, metrology instruments and medical applications.

The drive overcomes issues like high inertia mismatched stages and low inductance motors. The configuration flexibility allows designers to integrate developments in sinusoidal motor control and its benefits, which include zero cogging, no torque ripple and smooth motion.

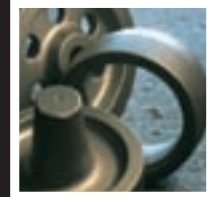
An external 24 VDC for the internal logic is used in applications that depend on very low electrical noise, and for applications not as sensitive, the TA333 can use an internal 24 VDC source.

The TA333 can interface with any

**continued**

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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).



# product news

motion controller with a  $\pm 10$  VDC command output. It features dynamic transconductance selection (DTS) control. This permits torque control to be altered at any time for high-resolution control without losing power.

Measuring 14.9 inches by 7.7 inches by 4.7 inches, the TA333 features integral thermally controlled, variable speed, forced air cooling; ribbon connectors; SMB coaxial connectors; and plug-gable-terminal connectors.

## For more information:

Trust Automation, Inc.  
143 Suburban Road Bldg. 100  
San Luis Obispo, CA 93401  
Phone: (805) 544-0761  
sales@trustautomation.com  
www.trustautomation.com

## Low-Voltage Gearmotors, Controls

### APPLY TO SOLAR APPLICATIONS

Bodine Electric Company released a line of 12 volt permanent magnet DC gearmotors, motors and DC motor

speed controls for continuous duty OEM applications. They are compact and perform for low-voltage, battery powered, remote location or solar applications. Together, the products are a complete, single-source motion control system.

The PMDC gearmotors and motors come in 24A and 33A frame motor sizes and can be combined with most of Bodine's parallel shaft, hollow shaft or right-angle gearheads. They generate

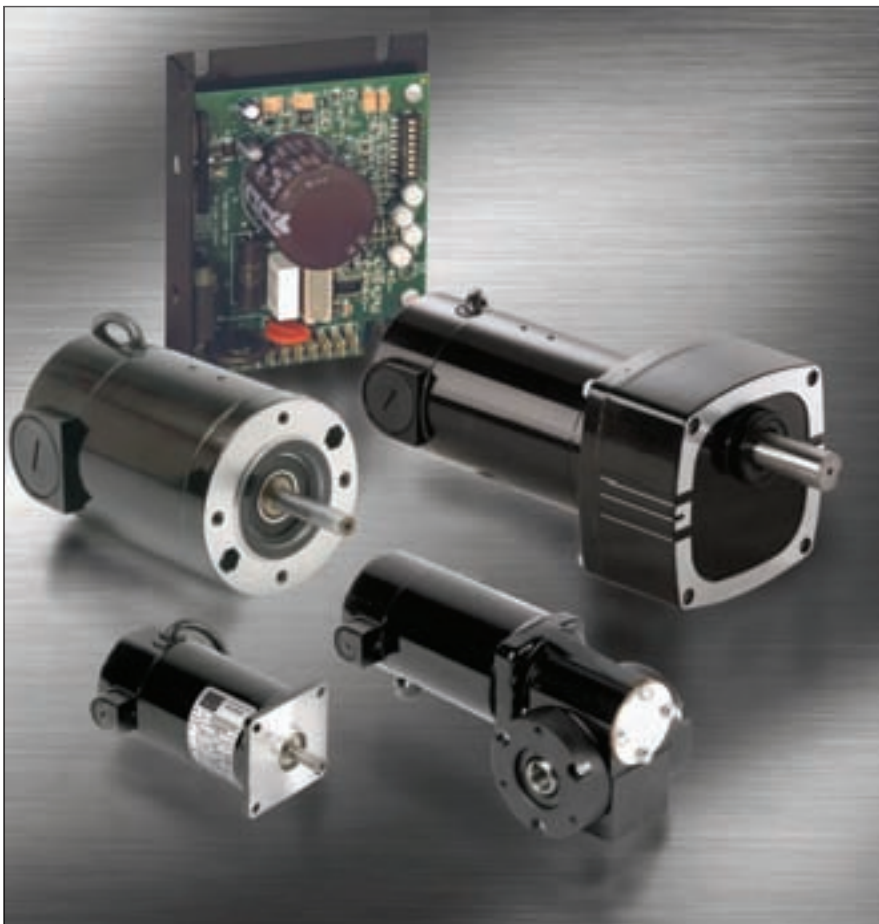
up to 310 lb-in torque and have horsepower from 1/50 to 1/8 hp. Custom models are available with encoders, special output shafts, cords and mounting configurations.

The Type WPM 12 VDC speed control features a pulse-width-modulation speed control for cool motor operation, long brush life, lower noise and a wide speed range. The control is easily calibrated for different motor sizes by DIP switches. The control is intended for battery powered, solar powered and other low-voltage applications that call for basic, single-direction speed control.

"A customer recently selected our low-voltage 12 VDC product to drive solar powered pumps on pipelines," says Terry Auchstetter, manager for custom product development. "Because these pumps are used in some of the world's most remote locations, it was critical that the motors did not drain the back-up battery when solar power was not available. By choosing the most efficient winding, gear ratio and control combination, we were able to create a dependable system that is already being used in over 500 systems worldwide."

## For more information:

Bodine Electric Company  
2500 West Bradley Place  
Chicago, IL 60618-4798  
Phone: (773) 478-3515  
Fax: (773) 478-3232  
info@bodine-electric.com  
www.bodine-electric.com



## Linear Drive

### RUNS WITHOUT CONTROL SYSTEM

The Uhing RG linear drives, supplied by Amacoil, Inc., use mechanical control over travel direction and linear speed to eliminate the need for an electronic control system. The RG linear drive is a motion system that can be used in packaging, converting, textile, wire/cable and automotive applications.

Regardless of the speed or rotational direction of the shaft, travel direction reversal is automatic. End stops set manually are used to change travel length. A manual control on the drive unit can regulate travel speed without necessitating changes to the motor speed or gearing. The RG drive requires minimal lubrication once every month, according to Amacoil.

The RG drive comes in 17 sizes meeting thrust requirements from 7



to 800 pounds. Rolling ring bearings maintain constant point-contact with the shaft to eliminate backlash. Rotary motion is converted to linear motion output as soon as the shaft rotates, and there is no play or free movement between shaft and bearings.

Built-in overload protection is provided by the smooth shaft, so if the system becomes overloaded, the nut will slip instead of churning or grinding over threads, where debris could be trapped and clogs or jams could occur. Amacoil provides the RG linear drives

separately or as part of custom fabricated assemblies with shaft and end supports.

### For more information:

Amacoil, Inc.  
2100 Bridgewater Road  
Aston, PA 19014  
Phone: (610) 485-8300 or  
(800) 252-2645  
Fax: (610) 485-2357  
[amacoil@amacoil.com](mailto:amacoil@amacoil.com)  
[www.amacoil.com](http://www.amacoil.com)

## Linear Actuator Upgrade

### PROVIDES EXTRA MUSCLE

Macron Dynamics Inc. is offering an optional heavy beam extrusion upgrade to the Macron 14 series linear actuators, providing strength and rigidity in heavy-duty linear motion applications. The extrusion adds a thicker internal structure and extra weight to the Macron 14's beam.

"The upgrade allows our already heavy-duty Macron 14 actuators to be used in applications with higher moment loads and in support of heavy loads over greater distances," says Craig Marshall, executive vice president at Macron Dynamics, on the company's website. "The Macron 14 actuator has become the workhorse of our belt drives and linear actuator product line. It provides the greatest versatility in horizontal,

vertical or any mounting plane for professional grade, robust industrial linear motion applications."

Macron Dynamics recently enhanced the actuators' design with a die-cast housing for both idler and drive and pulley assemblies. The die-casting allows two radial bearings to be added on the idler assembly and an extra bearing on the drive end. Thermal conductivity and pulley assembly damping characteristics are improved with the new design. The actuators operate cooler and quieter.

The Macron 14 actuators can be coupled with other Macron 14, Macron 135 and Macron 6 linear actuators or "Z" variants—vertical actuators—to create custom gantry or Cartesian robotic systems.

Available in three models, the Macron 14 linear actuator is customizable for user specifications. The standard model is capable of motion up to 400 inches per second. The Macron 14

H model is designed more rugged and for heavier duty applications featuring wide belt and pulley assemblies with a larger, more rigid cart design. The Macron Z model is designed for vertical motion applications. The Macron 14 actuators travel up to 250 feet or 20 feet vertically.

"Whether moving heavy loads, performing high-speed motion, integration into clean, dirty or corrosive environments or multi-axis applications, the Macron 14 provides the versatility to meet many different specifications," says Joe Baird, national sales manager.

### For more information:

Macron Dynamics, Inc.  
100 Phyllis Drive  
Croydon, PA 19021  
Phone: (215) 443-8888  
Fax: (215) 443-0981  
[info@macrondynamics.com](mailto:info@macrondynamics.com)  
[www.macrondynamics.com](http://www.macrondynamics.com)

# Packaging Stimulus

## SEW-EURODRIVE PROVIDES ECONOMIC SOLUTIONS FOR HARTNESS INTERNATIONAL

Few industries are experiencing change quite as fast as the packaging arena. Lighter-weight containers are being introduced to reduce costs and energy use, packaging is being redesigned to attract consumer attention and manufacturers are using fewer materials in an effort to address environmental concerns.

Hartness International, a manufacturer of packaging equipment for bottling and material handling, makes it a point to stay close to the customer in such a fluid environment, where new demands are being made every day. The company has equipment in more than 160 countries and all 50

states. Three generations of the Hartness family are active in the business, and more than 450 employees are located around the world, including a network of service professionals whose primary job is to keep customers up and running at all times.

Innovative product developments have led Hartness to form new divisions within the organization that focus on integration, robotics, automation, conveyors and production performance.

“Our customers want to go to one-source for an integrated packaging line solution, and that means we have to continually evolve to stay competitive,” says Robert Beesley, engineering manager at Hartness. “Since packaging is always changing, the systems we build are highly customized.”

The company’s latest shrink wrapping system reflects the continuing evolution of the packaging industry. “Our GlobalShrink film-only multi-packers and tray former shrink wrappers are especially useful for manufacturers selling to club stores such as Wal-Mart, Sam’s Club and Costco,” Beesley says.

Hartness eliminates complex control schemes in favor of systems that are easy to operate and maintain. Lean engineering principles and cellular manufacturing techniques enable the company to build a new machine in as little as 12 weeks from purchase order to shipment. The company even makes many of its own parts, with steel that is laser cut at its Greenville, SC plant.

“This gives us a lot of flexibility,” Beesley says. “If we can draw it, we can cut it.”

Responding quickly to the latest customer requests is the foundation of the company’s success, according to Beesley. Hartness is constantly testing and



**Hartness International manufactures equipment for bottling and material handling applications (courtesy of SEW).**



re-engineering equipment to handle new container designs, materials and packaging approaches. With every machine built to order and speed a critical factor, Hartness expects the same kind of responsive service from its suppliers.


“SEW has become the standard for gearmotors in the packaging industry,” Beesley says. “Not only is the quality and reliability of their products very high, but they also offer a wide range of sizes and torques and they build the order very fast.”

Since all SEW products are modular, Hartness is able to use different components to engineer solutions for several applications. Examples include connecting SEW gear reducers to servo drives when more precise positioning or higher acceleration is needed, or using an SEW gearmotor with encoder feedback as an economical alternative to servos in applications that don't require high acceleration, such as filler machines.

Hartness is the first OEM in the United States to use energy-efficient motors from SEW on equipment being sold to Australia, where strict energy efficiency standards are enforced. SEW has developed an encapsulated motor where the stator is completely filled with epoxy resin. This non-porous material replaces the air that normally surrounds the stator windings. By keeping moisture and cleaning agents from reaching the windings, the resin prevents motor failure. It's an innovation that's been especially important for keeping machines running reliably in breweries, dairies and other washdown environments where the liquids are corrosive.

“Before we started using SEW gearmotors we had to buy the motor and reducer and integrate it ourselves. This took more design and assembly time, and occupied more space,” Beesley says. “SEW provides us a more convenient, economical solution that has helped us make machines smaller and more reliable.”

When new gearmotor sizes were required for machines scheduled to ship from the Hartness facility in Anzio, Italy, SEW had the gearmotors quickly assembled in Germany and flown to Rome. When a truck could not be secured, SEW hired several taxis to deliver them to Anzio in time to meet the customer's delivery date.

“Like Hartness, SEW is a family-owned company that has built its reputation on delivering exceptional quality and service,” Beesley says. “We both do whatever it takes to satisfy the customer.” 

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**SEW motors keep moisture and cleaning agents from reaching the windings (courtesy of SEW).**



**Hartness International was the first OEM in the United States to use SEW's energy efficient motors (courtesy of SEW).**





DualTherm  
LPC System

ModulTherm  
LPC System



## Yes. ModulTherm is a powerful gear design tool from ALD-Holcroft

ModulTherm® is a low pressure carburizing (LPC) system that allows engineers to design out problems like intergranular oxidation (IGO), post heat treat machining, and poor surface finish. It gives gear designers unparalleled control over alloy selection, heat treatment, quenching, and end product performance.

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ModulTherm gear design benefits include alloy flexibility, no IGO, no decarburization, little or no part distortion, and excellent root and deep blind hole penetration.

ModulTherm gear manufacturing benefits include quench flexibility, the industry's largest vacuum chambers, 15 to 25% shorter cycle times than atmosphere furnaces, part-to-part consistency, less machining, less destructive testing, lower product costs, and a low Green House Gas emission profile.

ModulTherm installations are fully integrated, fully automated systems with up to 20 vacuum chambers. Lower volumes are handled by DualTherm®, a dedicated LPC/HPGQ system.

ALD-Holcroft Vacuum Technologies Co., Inc. has 80 years of vacuum-based gear processing experience. Our e-mail address is [sales@ald-holcroft.com](mailto:sales@ald-holcroft.com). Our phone number is 248.668.4130. If you design, manufacture, or heat treat gears, call. With an

ALD-Holcroft ModulTherm or DualTherm LPC system, everyone wins.

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more about ModulTherm and DualTherm

# Beyond the Quick Fix

## SUPPLY CHAIN SOFTWARE AIMS TO REDEFINE BUSINESS MANAGEMENT TECHNIQUES

Matthew Jaster, Associate Editor

In order for a company to be as efficient as possible, production, inventory and distribution components must be a top priority. A focused supply chain that gets the right materials to the right places in the allotted time frame encourages repeat business. These are concepts somewhat overlooked by many business executives in today's economy.

In 2009, the focus of supply chain management is on technology convergence—how production, inventory and distribution can be monitored using a variety of innovative software tools. There is no right or wrong answer when it comes to choosing supply chain management software. The question is determining what system best fits the needs of each organization.

Companies like Infor, Epicor, i2 Technologies and Siemens offer a variety of software solutions. Some present individual management practices that focus on specific areas of the supply chain such as warehouse or transportation management while others have a more unified approach encompassing the entire organization. The one constant throughout the supply chain software industry is that customers have plenty of options.

### Infor: Industrial Strength ERP

Enterprise resource planning (ERP) is just a fancy term for smorgasbord. ERP

**continued**



**Manufacturing execution is an aspect of enterprise resource planning (courtesy of Infor).**





**Infor specializes in manufacturing planning, demand planning and warehouse management for industrial manufacturers (courtesy of Infor).**

brings all the functions of a company together into a single computerized software system. From customer and supplier relationships to advanced planning and manufacturing execution, its true ambition is to integrate all aspects of a company under one universal management structure.

Infor, one of the largest supply chain software providers in the world, offers these ERP systems with several software functions and a lower total cost of ownership.

"Infor delivers a complete concept-to-customer vision that allows manufacturers complete visibility and control of the product life cycle," says Andrew Kinder, director of supply chain product marketing at Infor.

These supply chain concepts include network design, demand planning, manufacturing planning, scheduling, transportation management, warehouse management and event management. The company also has several management solutions built specifically for industrial manufacturers.

"Our solutions for industrial equipment and machinery manufacturers help meet the business and industry-specific requirements needed for each company," says Kevin Piotrowski, director of discrete industry and product marketing. "Infor has more customers in industrial equipment and machinery than

any other industry solution vendor."

Infor takes a holistic view of its supply chain network rather than seeking local optimums at an individual level.

"We know each customer has a different starting point in improving the efficiency of its supply chain. They may have to solve a forecasting problem, a planning problem, a warehouse issue or transportation problem. Next year, it will be a different challenge," Kinder says. "We aim to improve specific areas of the supply chain to achieve a strong and quick return of investment in the process."

At the core of its supply chain principles, Infor assists companies by improving productivity and reducing costs.

"During times of slower growth, we find manufacturers use the opportunity to reexamine some of their business processes, streamline them and focus on supply chain initiatives that can bring them relief now and better prepare the business when the economy improves," Kinder says.

Many organizations have shed labor and closed production lines or even entire factories. This has led manufacturers to look at alternative ways to meet customer demands with fewer resources.

"They look at how IT solutions can help them gain more from less, keeping output high with less capacity," Kinder

says. "Companies are increasingly turning to analytics to understand where costs and opportunities can be found."

A renewed interest in lean manufacturing principles has also offered various ways for companies to examine supply chain management.

"Business and manufacturing is more complex than ever, and companies must become more agile and flexible. They have to prioritize what will drive profitability. Many progressive companies are applying lean philosophies to supplier replenishment in an effort to improve customer satisfaction," Piotrowski says.

Additionally, the company has incorporated many elements of sustainability and energy efficiency into its supply chain software. Both the *EAM Asset Sustainability Edition* and the *SCM Network Design* platforms incorporate management solutions to monitor energy usage and carbon emissions.

"*SCM Network Design*, for example, enables companies to factor carbon emissions related to nodes, such as plants, warehouses and stores, and transport modes including rail, air, trucking and ocean freight," Kinder says. "Organizations can take the first steps in greening their supply chain, by first calculating the carbon emissions generated and then fine-tuning it to lower those emissions, achieving cost and service objectives along the way."

In the near future, Kinder believes many supply chain software providers will begin to extend their ERP systems with specialist applications.

"Software configuration management (SCM), project management (PM), enterprise asset management (EAM) and customer relationship management (CRM) systems will replace ERP systems, which can be expensive, disruptive and require a lot of resources to manage," Kinder says. "These smaller investments are easier to manage and deliver substantial results quickly. This could be a time for innovators to take the lead again."

#### **Epicor: Cornering the Mid-Market**

Knowing your client's market is the first step in establishing the right software system. Epicor, a provider of supply chain software solutions for mid-market organizations, was founded in 1984 and serves more than 20,000 customers in 140 countries.

"We're a mid-market player in supply

chain solutions,” says Rodney Winger, senior director of product marketing. “We understand exactly what this market requires and we offer software solutions on par with some of the larger providers like SAP and Oracle.”

*Epicor 9*, the company’s latest software system, is an ERP system that introduces a new approach to the way supply chain systems are designed, built and used. The architecture of the software can be used for any type of enterprise. This is part of the reason the company is referring to its product line as “business without barriers.”

The software allows companies to select the fundamental options that fit their particular strategies. Customers have the option of choosing the application suites that work best with their individual needs.

“This is a continuation of what we started five years ago with the Vantage product line. It’s a rebranding of sorts, the next generation of Vantage with our latest toolset,” Winger says. “*Epicor 9* brings together manufacturing, distribution and financial capabilities into one system.”

Winger says *Epicor 9* can be utilized effectively in the aerospace, automotive, defense and medical device industries because of its groundwork in the manufacturing sector.

“The industrial machinery market is one we examine very closely. It’s a target market where our software service has always been strong in the past.”

Companies like Triumph Group, Symetrics Industries, Specialty Screw Corp. and Independent Component Parts have all used many of Epicor’s software solutions.

TEAM Industries, a designer and manufacturer of powertrain and chassis components, was one of the first companies to run Vantage software, and Epicor remains the foundation of its manufacturing processes and lean initiatives.

In a case study for Epicor, TEAM Industries system analyst Mark Olson discussed the company’s history with the Epicor brand. “Our fingerprints are all over Vantage,” Olson says. “Over the years, through focus group and other feedback we’ve worked cooperatively with Epicor to develop a product that meets our business needs.”

Epicor has been able to bring the best of its product lines on a single code set to assist companies with the end-to-end

solutions.

“Whether you’re using a high-end product configurator, a sales order system or a mobile system, it is all under one engine,” Winger says.

The benefit of this integration is that many of Epicor’s customers are using many of these supply chain functions and can quickly adapt to a general purpose software solution. With the Epicor *Everywhere Framework*, customers can run the software anywhere they want.

“Mac, Safari, Firefox—it’s an everywhere capability. It doesn’t matter to us what you run it on,” Winger says. “The application even works on a Blackberry or iPhone.”

Expectations for many customers shopping for software solutions are that one vendor should be able to provide everything they might need. For this reason, Winger states that all the software

support and implementation services are delivered by Epicor and Epicor only.

“We have 300 partners worldwide that handle our products and help with distribution, but no matter what the application is, it all goes through Epicor’s support system.”

This mixed-mode manufacturing capability gives companies options in quality management, product lifecycle management, master data management and many other areas.

Sustainability is also a growing interest at Epicor. Under its enterprise performance management (EPM) system, more than 500 key performance indicators track a variety of environmental solutions involving energy use and transportation costs, a growing need in supply chain management.

The strongest selling point for Epicor

**continued**



**Infor believes ERP solutions will be replaced with smaller system management solutions (courtesy of Infor).**





**Sustainability features allow companies to monitor energy usage on the manufacturing floor (courtesy of Infor).**

might be the company's ability to address real-time business strategies under a variety of different circumstances.

"Quite honestly, our software systems are developed with synchronous integration in mind," Winger says. "Whether a customer is assembling products itself or assembling-to-order where the material is completely outsourced, we've leveraged the framework and knowhow of *Epicor 9*, and it has truly become a global offering."

#### Siemens: An SRM Solution

A Supplier relationship management (SRM) system developed in a joint venture between Siemens and Capgemini helps customers negotiate agreements, exchange data, monitor supplier performance and identify and optimize supply sources.

Based on Siemens *Teamcenter* software, this SRM alliance is a set of processes that empower purchasing to work with suppliers to minimize costs while maintaining and improving quality, service and innovation. The software brings together product life-cycle management (PLM) and direct material sourcing with services that include solution configuration and installation, content creation and ongoing application support.

The SRM alliance is focused on delivering value to the automotive, aerospace, consumer goods, machinery and high-tech industries. It supports the

levels of supplier collaboration that are required to deliver sustainable savings and create value.

According to Siemens representatives, *Teamcenter* bridges the traditional wall that exists between development and purchasing by allowing the customer to improve financial performance. By combining this knowledge with Capgemini's ability to bring specific and focused experience in the practice of sourcing and procurement, a global alliance agreement was reached.

Siemens representatives believe none of the traditional ERP suppliers provides the sourcing functionality embedded in the *Teamcenter* backbone. Organizations are seeking suppliers to help them innovate, change and improve specifications to become part of the cost management solution. Companies want to be in a position to drive down costs.

"In terms of supplier relationship management, the perfect storm is upon us—collapsing commodity markets, increased supplier risk and tighter budgets. Now is the time for companies to consider sourcing practices that can be sustained over time. There is no substitute for strategic sourcing. Procurement has a tremendous opportunity that has not been seen in more than 50 years," says a Siemens representative.

#### i2 Technologies: A Global Impact

i2 Technologies assists global industrial clients with supply chain processes. Visibility, planning,

collaboration and execution solutions by i2 are used by seven of the top 11 industrial OEMs in the world. i2 believes a systemized approach is necessary to manage various cultural differences in the global market.

"We are no longer dealing with local supply chains or plants," says Aamer Rehman, vice president of manufacturing solutions. "Activities are now distributed across various trading partners around the world so our software solutions need to provide a scalable foundation for planning, collaboration visibility and exception monitoring."

i2 is well aware how the global market has impacted the supply chain software industry in the last five years.

"Different suppliers are in different stages of sophistication, so the technology platform and applications need to cater to a wide range of requirements," Rehman says. "We need to enable an evolution rather than a restricted process common with the traditional ERP approach."

i2 provides a complete footprint for order-to-delivery workflows. The software solutions can broadly fall into categories such as factory management solutions, supply and demand, transportation and custom order creation.

"The level of complexity has increased in terms of demand variation and mix variation, which supply chain planning and scheduling tools need to handle," Rehman says. "The factories of today are hybrid environments that need to address make-to-order and make-to-stock modes of production using the same set of software tools."

Tracking sustainability and environmental concerns allows i2 to keep its customer base up-to-date on green manufacturing processes, an essential service in the new energy economy.

"Our tools have the ability to consider transportation, procurement, production and other costs as planning parameters from an environmental standpoint," Rehman says. "Also, we can track actuals for effective Plan-Do-Check-Act (PDCA) procedures."

The traditional model of sales and operation planning is not feasible in today's manufacturing sector, according to Rehman. Therefore, supply chain software needs to provide a synchronized and repeatable management process.

"The existing credit crunch, a focus on improving working capital and a lower threshold in software investment



has driven software providers to offer various options to reduce the total cost of ownership. This includes managed services, software as a service (SaaS) offerings and subscription-based licensing.”

**The Future of the Industry**

AMR Research, Inc., a group that studies supply chain and enterprise technologies, estimates that the supply chain software industry is a \$6.5 billion industry today and will grow to \$9.2 billion by 2012. The research firm predicts that recent global economic challenges will offer greater opportunities for this industry in the months and years ahead as companies continue to look for shortcuts to increase efficiency and cut down costs.

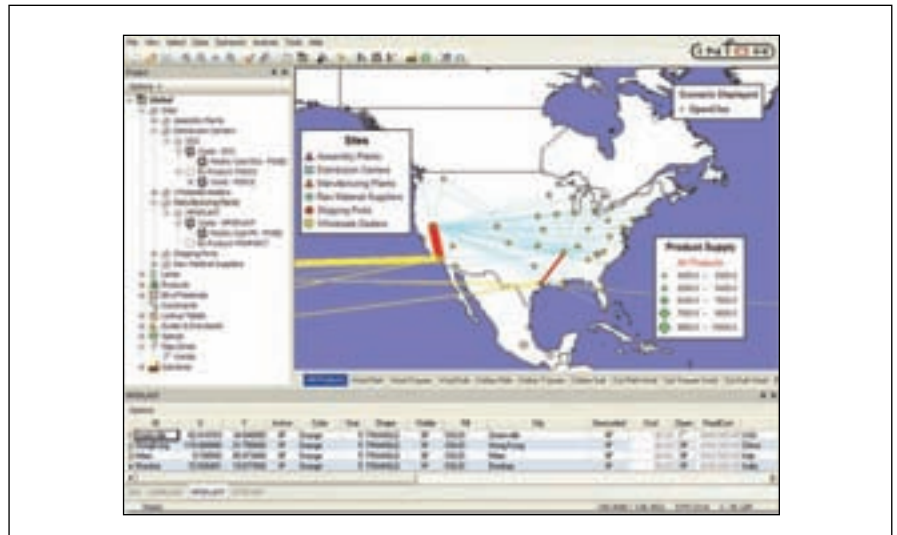
This growth will be fueled by several factors, according to AMR, including regulatory requirements to drive efficiency; growing technology markets in Europe and Asia; the need for greater supply chain flexibility; mid-market companies that want to build network capabilities; wholesale distribution and logistics industries that need a technology overhaul; and the pressure to conserve cash. Many of these factors will intrigue companies looking for long-term solutions for supply chain management.

Whether you’re searching for individual business applications or an overall management solution, supply chain software is available in various levels with plenty of customizable options. Many of these programs work hand-in-hand with lean initiatives, green manufacturing techniques and time management principles. The key when seeking out this type of software service is to do some homework.

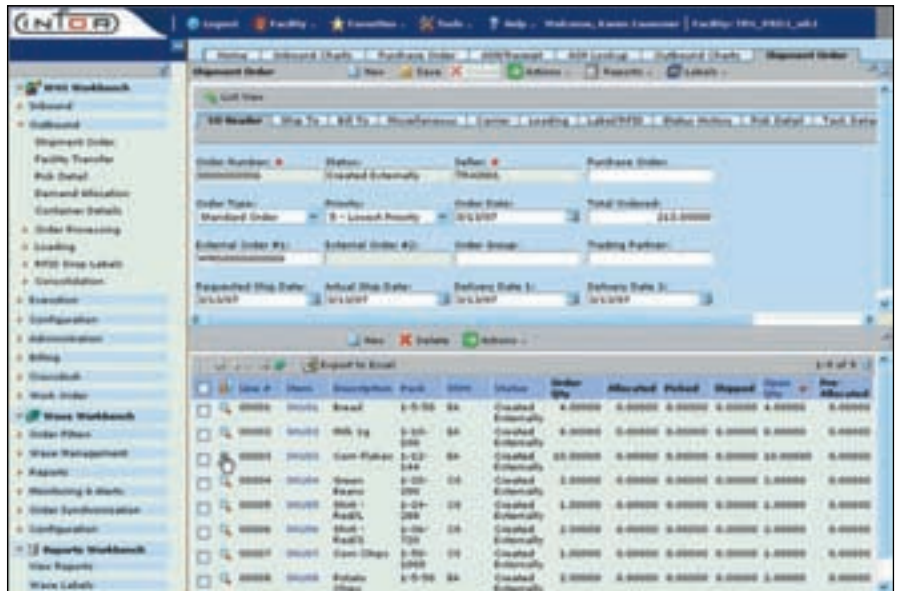
“There are no silver bullets in supply chain management. Ultimately, you have to excel in all areas if you want to achieve lower inventories, faster service, cash-to-cash cycle times and greater profitability,” Infor’s Kinder says. “In today’s economy, these are not just ‘nice to have’ measures—they are survival practices.”

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**Infor SCM Network Design helps plan the entire supply chain from materials sourcing to manufacturing and distribution sites to method of transport between locations (courtesy of Infor).**



**Infor SCM Warehouse Management enables companies to see what inventory is or will be available, organize work and align resources and labor to satisfy customer requirements (courtesy of Infor).**

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# To Buy American or Not

## —THAT IS THE QUESTION

Lindsey Snyder, Assistant Editor

Much has been argued about the “buy American” clause included in the American Recovery and Reinvestment Act of 2009. At face value, there are certainly good intentions embodied in such a provision. After all, what more is threatening the U.S. economy than a deterioration of the manufacturing sector and the job losses that go along with it? (Well, besides the massive banking and housing sector failures.) Mandating infrastructure projects funded with government stimulus dollars to embrace American suppliers will undoubtedly promote a much needed burst of activity manufacturers have been grasping in thin air for. Not to mention the immediate, well-paying jobs created as a result.

“‘Buy American’ ensures that American taxpayer dollars are used to strengthen jobs in the United States. The stimulus package should help to get steel mills running again—utilization rates have been hovering around 50 percent,” says Adam Parr, of the Steel Manufacturers Association. “This will put Americans back to work. Steel industry jobs also have a tremendous trickle-down employment effect, with each steel industry job supporting four to five jobs in related industries. There are also provisions in ‘buy American’ to protect American taxpayers through waivers for expense and material availability.”

“Buy American” would seem to

be a surefire quick-fix to the growing unemployment situation; however, there are many strong and focused opponents. On the flip side of the argument sit broader implications for international trade and the United States’ reputation in other countries’ eyes. The evil “p-word” is flung around the buy American debate like a pingpong ball. Protectionism certainly has its downside; this is well-documented historically. While exclusively buying American products is, in practice, a good example of protectionist ideology, it will not alone create an isolated, self-sustaining economy. Other characteristics of protectionism include predatory pricing, trade distorting subsidies and government ownership.

“‘Buy American’ is not protectionist,” Parr says. “We have the most open markets in the world—as evidenced by the largest deficits in trade and current [economic] account in world history. The U.S. has every right to use its taxpayer dollars on domestically produced goods.”

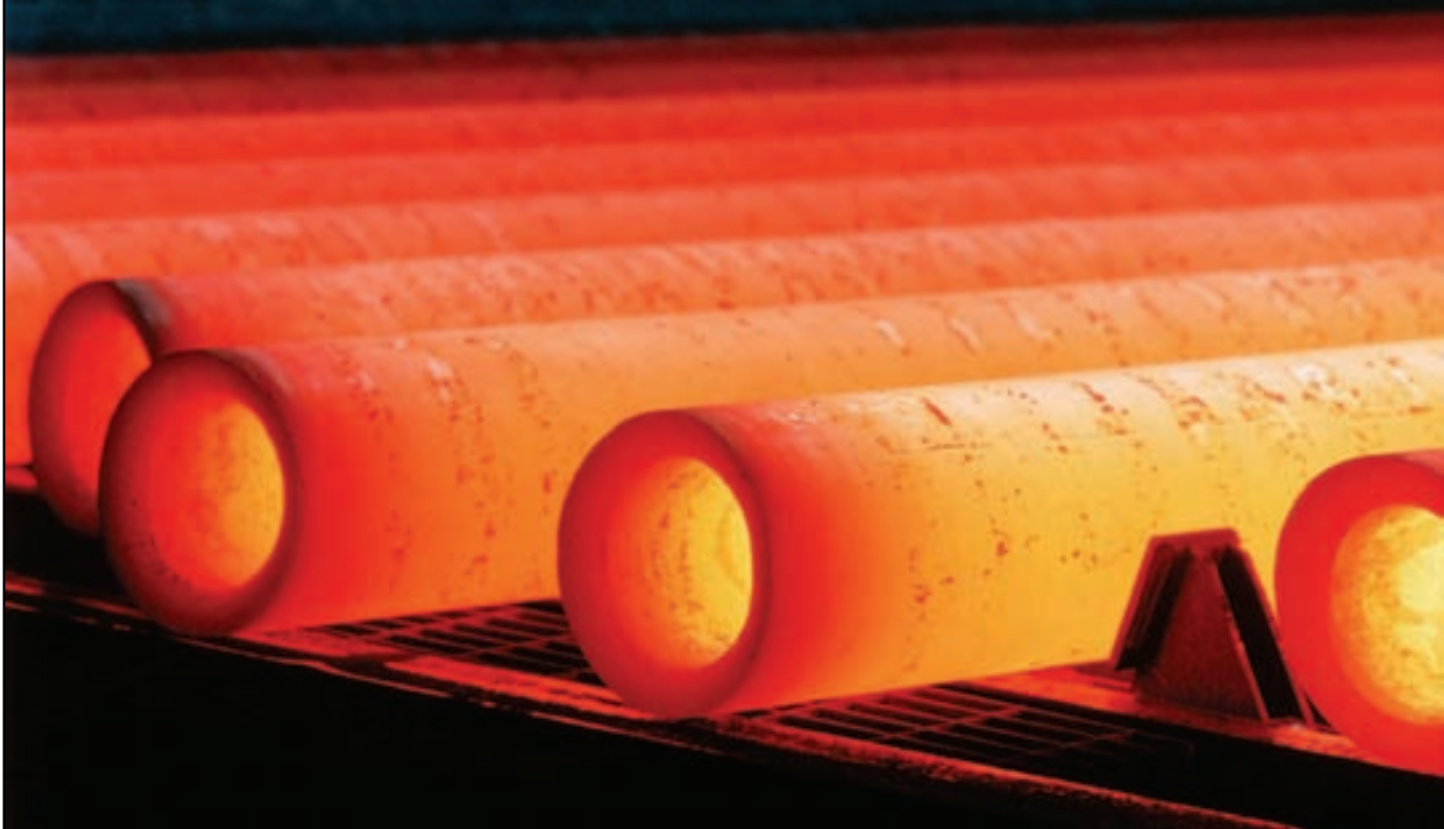
One of the biggest concerns in the debate is that other countries, like those in Latin America and Asia, will counter with similar provisions in their own stimulus plans as retribution.

The Alliance for American Manufacturing (AAM)—a non-partisan, non-profit partnership made to strengthen U.S. manufacturing—released an FYI factsheet designed to debunk common myths about the “buy American” debate. In response to the threat of trade retaliation, the AAM asserts that “The U.S. is, by far, the world’s largest importer, soaking up a net \$819 billion in goods in 2007 [U.S. Census Bureau



Steel industry jobs tend to demonstrate a trickle-down employment effect as an integral component of the industrial supply chain, and the steel industry stands to benefit from the “buy American” clause contained in the U.S. stimulus package (courtesy of U.S. Steel).





**Industries that depend on alloy mechanical seamless tubing include automotive, aircraft, railroad, textile, mining, anti-friction bearing, oil and gas drilling, machine tool, construction equipment and farm machinery (courtesy of Timken).**

Data]. The U.S. imports far more than it exports, (which is) a balance of sales that our trading partners are anxious to preserve. This is not about restricting imports. It is about using taxpayer dollars, when allowed by our international obligations, to purchase U.S.-produced goods. As the global downturn has progressed, many industrialized countries such as France and China have already taken similar action to support their domestic manufacturing base.”

China has been a particularly vocal opponent. The country’s official news agency published an editorial referring to the “buy American” clause as a form of trade protectionism, which is a “poison to the solution,” but Chinese economic policies are far from innocent in the scope of world trade.

“The U.S. has been a leading advocate for global procurement agreements,” Parr notes. “Some nations—notably China—have resisted the reform movement and have instead opted to promote their own manufacturing base through self-procurement programs. China continues to subsidize its own steel production and illegally undervalue its currency. Conditions in the U.S. would further deteriorate if we were to continue to make unilat-

eral concessions, while some of our major trading partners play by their own rules.”

The United States currently has six active WTO disputes against China, listed in the 2008 United States Trade Representative Report to Congress on China’s WTO Compliance—a 115-page document.

What many people don’t seem to realize is that the “buy American” concept is not new. According to the AAM, “The U.S. has had such laws in place for 70 years, starting with the Buy American Act of 1933. The Department of Defense has had its own ‘buy America’ provision (The Berry Amendment) since 1941. In addition, the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA) and Federal Railroad Administration (FRA) all have long-standing ‘buy America’ provisions.”

Several steel industry trade organizations—the American Iron and Steel Institute, Committee on Pipe and Tube Imports, Steel Manufacturers Association and the Specialty Steel Industry of North America—submitted a joint letter to congressional leaders pointing out the historical precedence of “buy American” requirements in

legislation, and the letter also states that the legislation at hand only requires federally-funded transportation projects use American iron and steel, made by American workers if it is readily available, and the provision has yet to bring about any trade wars.

“Procurement of competitively priced steel products and specialty metals from competitive domestic sources will not cost the U.S. taxpayer more,” the letter states. “It will in fact generate payroll and income tax returns to the U.S. government as a result of stimulating American jobs. To allow the materials to be sourced from outside the U.S. will defeat the economic multiplier effect that is the basis of any form of monetary stimulus.”

Domestic steel suppliers stand to benefit the most from “buy American” while manufacturers with high export rates seem the most at risk of international backlash.

Dan DiMicco, CEO of American steel producer Nucor Corporation, is one individual who pushed strongly for the “buy American” clause. In an interview for *60 Minutes*, he said, “What we’re saying is, ‘Listen, yes “buy American” benefits the steel industry in the United

**continued**



States. Absolutely.’ But what we’re saying also is ‘might that concept not also benefit the U.S. economic engine, get it started again.’”

In response to the trade retaliation argument, DiMicco said, “It’s all garbage.”

He also denied being a protectionist and said he believes the concept of free trade “is an academic luxury the real world doesn’t enjoy.”

Caterpillar is one company that stands to be hurt by the “buy American” clause, with around 75 percent of sales made outside the country, according to CEO Jim Owens. Although he expressed considerable concern over the “buy American” clause in the same *60 Minutes* episode DiMicco appeared on, Caterpillar later released a statement attributed to him in support of the stimulus package; no mention was made of the “buy American” issue.

“The President and I fundamentally agree that the U.S. stimulus package will be beneficial to the U.S. economy and should spur demand for the types of products made by Caterpillar,” Owens said in the statement.

“As a bellwether company for the global economy, we are experiencing the unprecedented depth of this still unfolding global recession, and we believe strongly a fiscal infrastructure investment will create construction jobs in the near term and enhance the competitive position of the U.S. in the global economy.”

A similar cautionary tone was issued by John Engler, president of the

National Association of Manufacturers (NAM). In a letter to Senate leaders he warned such a measure could backfire, but he also later issued a statement supporting the conference version of the stimulus package. “Our member companies from around the country are telling us they agree with Congress and the Administration that decisive and immediate action is critically necessary to spur economic revitalization,” he said. “They understand that the conference version of the American Recovery and Reinvestment Act is not perfect, but they believe the overall plan is an acceptable balance of tax cuts and investment designed to help job providers and the people who depend on them.”

The package that eventually passed contained a diluted version of the initial “buy American” clause, so it does not violate international trade agreements and appeases critics and trade partners. The original bill put forth by the House asserted infrastructure projects use American steel and iron, but the initial Senate bill sought to restrict all manufactured goods to those produced domestically. The Senate eventually agreed to word the provisions so they are “applied in a manner consistent with United States obligations under international agreements.”

“Since it was changed, and the current wording and the current language means that we’re WTO-compliant and that we aren’t in violation of any of our bilateral trade agreements with that clause, that enabled us to support the overall legislation,” said Maureen Davenport, SVP of communications for the NAM. “That wasn’t why we supported it, but that change made a big difference. We opposed the original language in some of the early drafts.”

Others continue to express divergent viewpoints. Christopher Sabatini, editor-in-chief of *Americas Quarterly*, a journal devoted to furthering policy analysis and debate on economics, finance and politics in the hemisphere, wrote in his blog entry February 6, “But while the ‘buy American’ provision—even in its vague, watered-down provision—may not be protectionism in the strict sense, it will have the same effect: increasing costs of projects, wasting taxpayer dollars, sparking retaliation


from our trading partners in the hemisphere and undermining U.S. jobs.”

The issue of inflated project costs is addressed in the AAM factsheet. “Additional cost—if any—is more than justified. Purchasing high-quality, American-made materials yields an enormous productivity dividend, both in terms of jobs created and the overall reward to the economy. Infrastructure investment would undoubtedly create millions of new U.S. jobs, but there is also the importance of revitalizing the American manufacturing base, which is uniquely capable of generating 4–5 new jobs for each employed manufacturing worker.”

In a random survey of 1,001 Americans conducted by Harris Interactive between January 29 and February 1, 84 percent support federal requirements for American-made materials in all federally funded infrastructure investment in the recovery bill. Only four percent strongly oppose the “buy American” requirements with seven percent somewhat opposing; 66 percent strongly favor and 18 percent somewhat favor it. The support was consistent despite gender, age, income level, education or geographic regions included in the data.

Is what’s good for America good for the rest of the world? The international community has been looking to the United States to lead the world out of this great recession.

“The global economy is inextricably linked to the health of the U.S. economy,” Parr says. “The U.S. has taken steps, consistent with its trade obligations to improve the health of its economy and domestic manufacturing base. Exporting nations are dependent upon access to healthy U.S. markets.”

As the debate carries on, stimulus bill funds are beginning to reach the eager, flailing hands of construction project managers and all the way down the supply chain. The true effects of buying American steel and iron in the recovery plan remain to be seen. One thing is for sure: The results, whatever they may be, will be evident from the steel mills in Pittsburgh to auto suppliers in the Midwest to assembly plants in California and everywhere in between. 



**The bottom-pour operation processes steel at Timken’s Faircrest Steel Plant (courtesy of Timken).**



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**John Glavin**

Supervisor, Hobbing Department



# Facing the Challenges

## OF THE CURRENT HYBRID ELECTRIC DRIVETRAIN

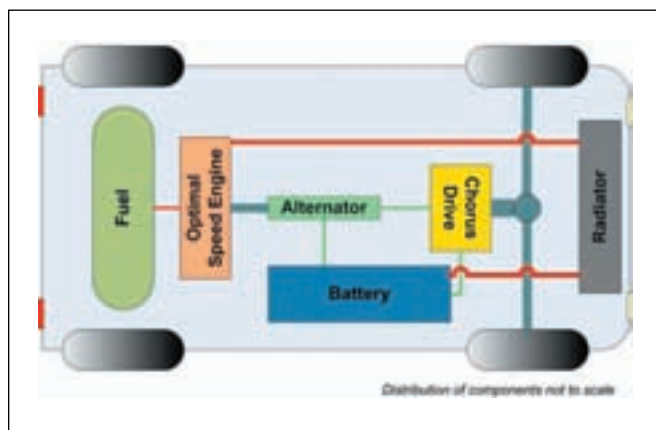
Jonathan Edelson, Paul Siebert, Aaron Sichel and Yadin Klein

(SMMA Fall 2008 Technical Conference. Reprinted with the permission of the Small Motor & Motion Association)

### Introduction

Presented is a high-phase, order-induction motor drive for use in a series hybrid architecture. This solution overcomes numerous compromises in current hybrid powertrain designs. Notably, it allows for a vehicle that is competitive in terms of performance and cost. (Editor's Note: More information is available at [www.ChorusCars.com](http://www.ChorusCars.com) and [www.ChorusMotors.com](http://www.ChorusMotors.com).)

To arrive at a motor and drive solution for a cost-competitive hybrid drivetrain, we started by selecting the preferred hybrid architecture and used United States DOT road data to define real-world requirements for drivetrain capabilities. With these two pieces, we have designed a drive that should provide excellent performance without the cost premium that hinders market acceptance of hybrid vehicles today.



**Figure 1—The series hybrid permits the internal combustion engine to operate at optimal speed for any given power requirement.**

### Selecting the Ideal Powertrain Architecture

The hybrid-electric drivetrain uses an electric motor to enhance the efficiency and performance of an internal combustion engine-powered vehicle. The size of an unassisted combustion engine is typically set by short duration performance requirements; thus the “base load” efficiency of the engine suffers because it is oversized for its average operating power requirements, which are quite low. However, using a smaller engine improves efficiency at the cost of performance. The hybrid approach restores performance while using a small, efficient engine operated at near-full power.

The simplest hybrid electric approach is the series hybrid—essentially a fully electric car combined with a fuel-powered generator. This is the same approach currently used in diesel electric trains and modern ships. The series hybrid approach requires the electric motor/inverter to meet both the continuous and peak operating requirements. All power from the engine is converted into electricity and then back into mechanical power.

Slightly more complex is the parallel hybrid, in which both the internal combustion engine and the electric motor supply mechanical power directly to the wheels. A single electrical machine may serve as both motor and generator, and, for continuous loading, the mechanical power may be supplied directly to the wheels without conversion losses. A significant downside of the parallel hybrid is that the internal combustion engine speed must match (via gear ratios) the wheel speed.

Current production hybrids take the complexity level and “kick it up a notch,” using complex gearing and clutch arrangements to create a “series/parallel” hybrid. This offers the benefit of direct, mechanical drive—from engine to the wheels—and the ability to decouple the engine from the

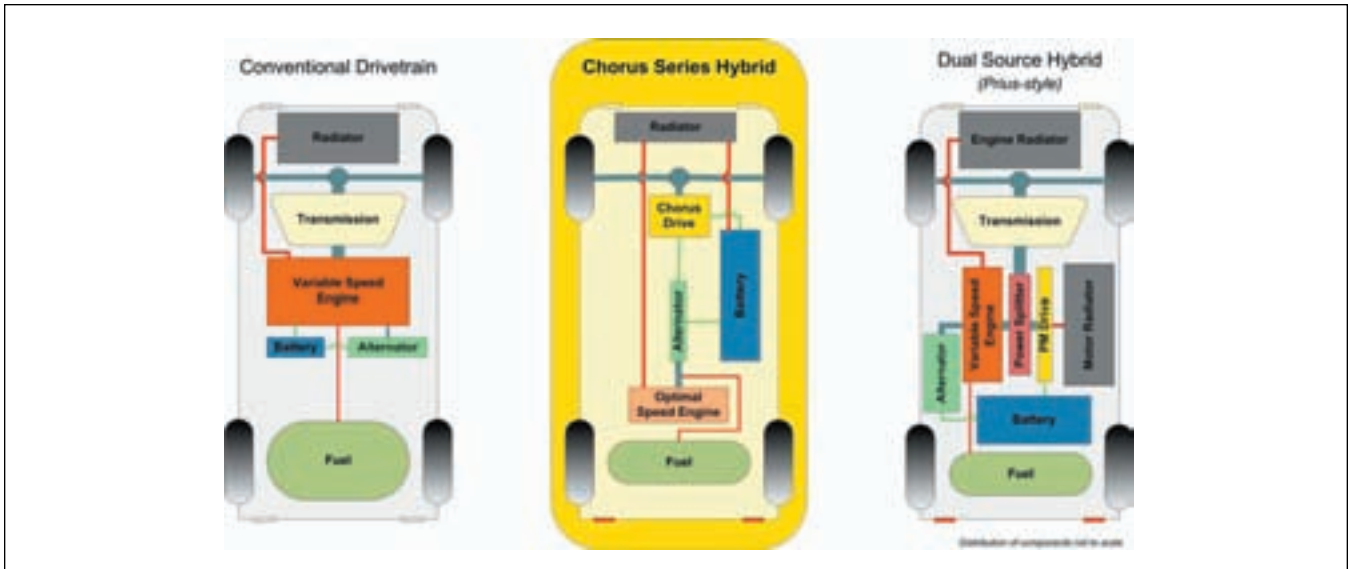


Figure 2—A comparison of a conventional drivetrain with series and parallel hybrids.

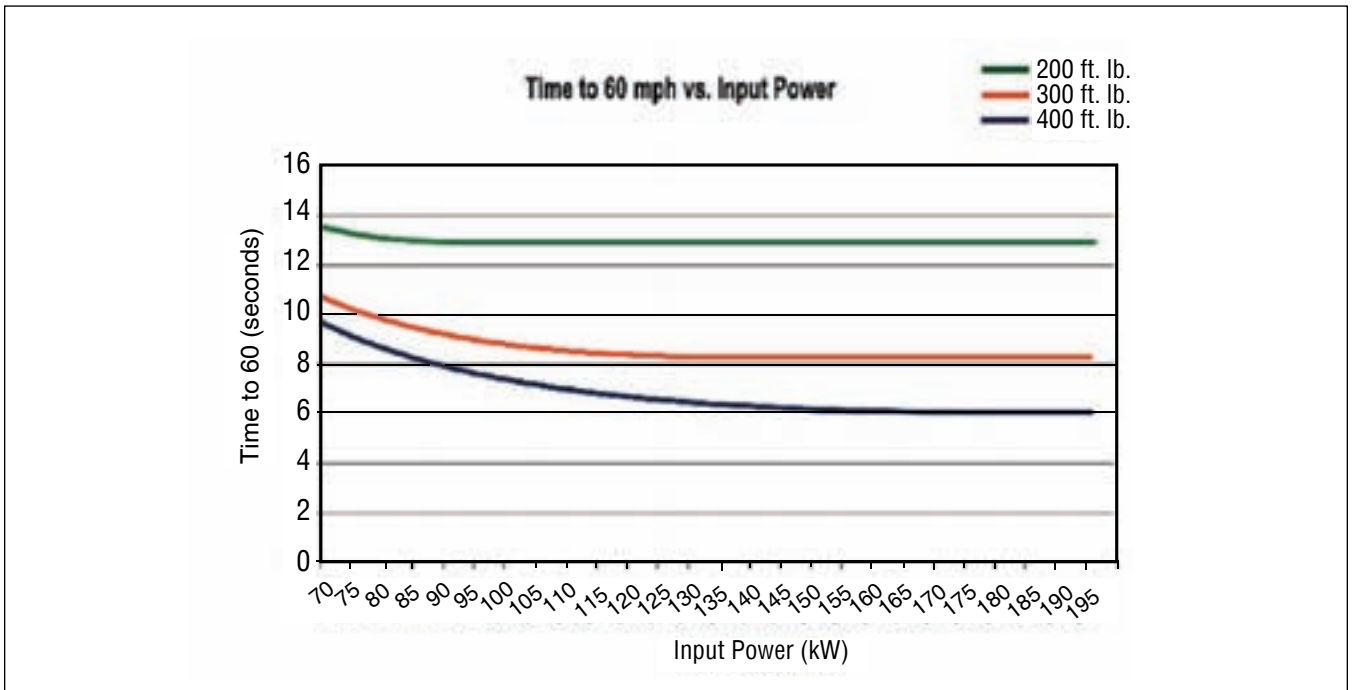


Figure 3—Peak acceleration of the vehicle as a function of the available input power; it illustrates the importance of the motor peak torque for 0–60 mph performance.

wheel. Performance is improved, compared to a parallel hybrid, but at the price of more complexity and cost.

Chorus has been exploring simple-series and parallel-hybrid approaches in an attempt to simplify the entire system. We believe that the series hybrid approach offers the opportunity to significantly improve efficiency while keeping the system simple. This will reduce costs and still provide the required performance. Figure 2 shows a comparison of a conventional drivetrain with series and parallel hybrids.

**Performance Challenges**

The first challenge faced in a pure-series hybrid is that the electric motor must be able to supply the full mechanical power requirements of the vehicle at all times. Customer performance expectations dominate this requirement. In particular, customers expect healthy acceleration, and even

a sluggish 0–60 mph time requires roughly twice the tractive effort delivered to the wheels of a steady climb up the steepest slope on American roads. A “peppy” vehicle requires even more tractive effort delivered to the wheels. These high overload requirements last for seconds at a time—long enough to control power electronics sizing and short enough that motor heating is not an issue.

Peak acceleration of the vehicle as a function of the available input power is shown in Figure 3; it illustrates the importance of the motor peak torque for 0–60 mph performance. Higher peak torques yield significantly better performance, even with limited power. Depending on available power and customer requirements, Chorus would aim to maximize the peak torque of the motor drive to achieve optimal perfor-

**continued**



mance. The graph assumes the torque is capped at 200, 300 and 400 ft.-lb., respectively.

**Stamina.** A review of roads within the United States shows real-world requirements for a drive system. Specifically, the requirements are shown in Table 1.

In order to go from these requirements to a system design, the gearing must be determined.

Gearing tradeoffs are complex: a gear is desirable to maximize the value of the motor, but a variable speed gear adds complexity, weight and cost. For this design, we settled on a gear ratio of 4:1 as a suitable compromise. This is a fixed gear to reduce complexity and cost. There is no need for the traditional mechanical transmission or clutch.

With this gear—and conservative assumptions (Mass = 1,500 kg [3,307 lb];  $C_{rr} = 0.015$ ;  $C_d = 0.28$ ; Cross-Sectional Area = 2.16 m<sup>2</sup> [23.3 ft<sup>2</sup>]; Wheel [with tire] diameter = 0.635 m [25"])—the power and torque requirements for maintaining constant speed (without accelerating) are shown in Table 2.

**Cooling.** A motor’s losses will increase as power output increases, very roughly proportional to the square of output torque. Better cooling can allow for a smaller motor or better performance from a given motor. Cooling is effected using either air or liquid.

Air cooling is generally less effective, which is why it cannot be used in this environment for thermally sensitive motors such as DC brushless machines. But it is considerably simpler than liquid cooling, which requires more hardware, complexity and moving parts.

Component temperature compatibility is the other side of the cooling equation. The hotter the motor, the more heat will dissipate to the same amount of coolant. Motor temperature is limited by winding insulation system limits, bearing lubricant limits and coolant limits, and critically limited by magnet temperature limits. On the other side of the coin, motors become less efficient as temperature increases. As the motor

temperature increases, the conductivity of copper goes down and permanent magnets get weaker.

For a given mass of iron and copper, permanent-magnet machines of this scale tend to be more efficient than electromagnetic (induction) machines; however, induction machines tend to have a wider range of temperature compatibility. These machines may reasonably be ‘pushed’ to peak winding temperatures of 200°C, with higher rotor temperatures permitted. Brushless DC machines are restricted to lower temperatures because of weakening in the magnets as temperatures rise.

For this design, we have selected a motor with passive air cooling. This is in line with the desire to have a simple and inexpensive system without the extra complexities of fans, radiators, pumps and fluid lines.

**Materials availability.** Electric motors require electrical conductors, soft magnetic materials, insulating materials and magnetic field sources. At the present time, all but one of these items have many sources of supply. High-energy product permanent magnets depend upon the availability of rare earth metals, in particular neodymium. Not all customers are comfortable with the risks associated with relying on neodymium, the supply of which is controlled by China (Refs. 1–2).

For temperature sensitivity, ruggedness and cost reasons, our design is an AC induction solution.

**Sensors and control.** Virtually all motors being considered for hybrid applications are electronically commutated, and switching events must be timed appropriately. In the case of brushless DC and switched reluctance motors, this means accurate rotor position sensing—either directly or inferred. In the case of induction motors, rotor speed sensing is desirable, but again this can be inferred from drive current measurements. Induction motors offer the benefit of operating asynchronously from the drive, which relaxes sensor requirements.

Power electronic switching elements must be sized to carry peak overload current to meet acceleration requirements. Semiconductor thermal mass is low, limiting overload capability, but heat sink mass is often significant. It is generally possible to design a 30-second overload, suitable to meet automotive acceleration requirements.

**Proposed Design Solution**

Chorus has approached these challenges with the following design:

- We have selected an induction motor using standard copper windings, standard silicon steel laminations, standard insulation materials and

**Table 1—Real-world requirements for a drive system.**

Requirement	Duration
Steepest Interstate: 7% grade at 60 mph	19 minutes
Steepest Highway: 10% grade at 40 mph	2.3 minutes
Steepest Local Road: 12% grade at 25 mph	20 minutes
98 mph (kW-limited)	19 minutes
Level 85 mph cruise	Continuous

**Table 2—Power and torque requirements for maintaining constant speed (without accelerating).**

Requirement	Duration	Torque	Power
Steepest Interstate: 7% grade at 60 mph	19 minutes	88.3 ft.-lb.	40.5 kW
Steepest Highway: 10% grade at 40 mph	2.3 minutes	105 ft.-lb.	32.2 kW
Steepest Local Road: 12% grade at 25 mph	20 minutes	118 ft.-lb.	22.6 kW
98 mph (kW-limited)	19 minutes	53.7 ft.-lb.	40.2 kW
Level 85 mph cruise	Continuous	43.6 ft.-lb.	28.3 kW

standard bearings.

- Current densities have been selected to permit a totally enclosed machine, and overload capability was selected to provide a “peppy” car with plenty of acceleration.
- We depart from the conventional induction solution by using Chorus’ high-phase-order approach coupled with a “toroidal” winding geometry.

The selection of toroidal winding permits better slot fill and larger pole area without excessive losses to end turns. Additionally, toroidal windings are most suited to large-diameter “pancake” machines, and are better matches for automotive torque/speed requirements. The toroidal winding also provides better access to core copper for cooling. Large pole areas are an optimization pushed by the use of an electromagnet machine. Finally, the selection of a toroidal winding relaxes winding symmetry restrictions and permits the use of the “harmonic mesh effect,” while operating as a variable pole machine.

The selected design is intended to power a 3,300-pound sedan, as a “pure”-series hybrid. For this paper, we have not considered battery pack mass or other balance-of-system issues. The mass of the active materials is about 135 pounds; we have estimated the total motor mass at about 310 pounds. This includes considerable material used to handle mechanical forces and potential shocks in operation. While our design may be overly conservative, the same frame capabilities would be required for any motor solution; a lighter frame could be adapted for this motor design. This leads to both a motor and inverter design as found in the specifications in Tables 3 and 4.

Anticipated 0-60 time is about 9 seconds. Anticipated acceleration at zero speed— $3.5\text{m/s}^2$  (1/3G).

### Conclusion

While the design presented is sure to be modified to fit the specific requirements of a given application, it shows that a motor drivetrain for a hybrid car can at once be light, mechanically simple and inexpensive. When incorporated within a series hybrid sedan, a standard sedan can be developed that provides excellent performance and superb mileage without a cost premium.

*(Authors’ Note: Although this paper has not examined the overall energy flows, the Chevy Volt and Chrysler’s recent announcements have been for series hybrid vehicles that promise 45-50 mpg when using the engine—and that is with hundreds of pounds of batteries to allow for pure electric “plug-in” operation. Our design reduces vehicular weight, and so should further improve fuel efficiency.*

*Diesels are more efficient: Volkswagen’s new Golf BlueMotion diesel is listed at 62 U.S. mpg. The Golf TDI diesel hybrid is listed at 83 mpg (Euro), which AutoBlogGreen places at 69 U.S. mpg. A series hybrid approach with diesel should yield even better results, and at a competitive cost.)*

### References

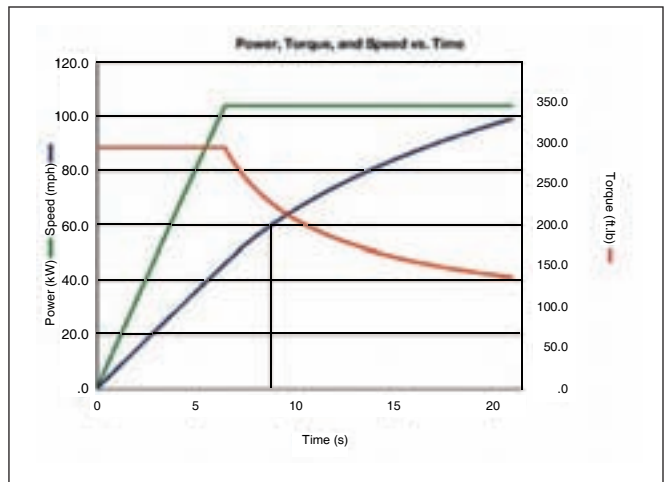
1. <http://www.magnetweb.com/Col04.htm>
2. [http://www.lynascorp.com/page.asp?category\\_id=1&page\\_id=2](http://www.lynascorp.com/page.asp?category_id=1&page_id=2)

**Table 3—Motor design.**

Dimensions	14.5" x 16" (plus 2" shaft extension)
Mass of Active Materials	135 pounds
Total Motor Mass (no cooling required)	310 pounds
Peak (30-second) Torque	295 ft-lb.
Continuous Torque	118 ft-lb.
Maximum Speed	5,000 rpm
Base Speed	2,400 rpm
Peak Power From Generator/Energy Storage	104 kW
Power Factor at Peak Torque at Rated Speed	65%

**Table 4—Inverter design.**

DC Bus	300 V
Inverter	160 kVA (30 seconds)
Inverter	110 kVA (continuous)
Inverter Phase Count	18 phases
Inverter Current per Phase	105 A



**Figure 4—Anticipated 0-60 time is about 9 seconds; anticipated acceleration at zero speed— $3.5\text{ m/s}^2$  (1/3 G).**



# Lower-Loss Technology

## FOR A STEPPING MOTOR

Yasuo Sato

*(From the Fall 2008 Technical Conference of the SMMA.  
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### Management Summary

The demand for stepping motors with high efficiency and low losses has been increasing, although the demand had been previously focused on high torque. Also, the selection of the most suitable grade of lamination for improvement in fastening of the laminated cores has reduced losses significantly at their peak, when compared to conventional stepping motors. Lowering the losses of the motor has enabled continuous operation that was previously impossible. An expansion of the stepping motor's usage into applications where another motor has been used for continuous operation and other uses—due to the heat generation problem—can now be pursued. In addition, these motors are very effective for energy saving. This paper explains the technology used for lowering the iron losses of the stepping motor.

### Introduction

The stepping motor can control the speed and the position accurately in an open-loop control mode. The stepping motor had a disadvantage of intense heat generation when rotating at high speed; and an advantage in that it can be used easily. The stepping motor has been used mainly to utilize the standstill holding brake force and the torque at low speed. But recently, another customer demand for being able to operate continuously at high speed has risen, thereby shortening the cycle equipment time. The motor loss is greatly reduced compared with the conventional stepping motor by use of a suitable lamination sheet and fastening method of the laminated iron core. This paper focuses

on lowering the losses of the stepping motor. The motor shown in Table 1 is selected for the conventional stepping motor described in this paper.

### Losses of Stepping Motor

**Classification of losses.** Figure 1 shows the losses that are classified when a motor is rotating. The total losses are divided into the driver losses generated in the driver, and the motor losses generated in the motor.

The majority of the motor losses are copper and iron losses. The copper loss is generated by the current flowing to a stator (stator winding), and the iron loss is generated by the flux change in the core. The flux in the core changes by rotation of the rotor (field) or a current change of the stator (stator winding);

therefore, the iron losses can be classified into an iron loss by the field and the other by the stator winding. Hereafter, the former is called field iron loss, and the latter is called stator winding iron loss.

The iron losses can be classified into eddy current loss and hysteresis loss, based on the magnetic generation principle. Other losses include mechanical loss and stray load loss. However, this discussion will disregard them, including those in the iron losses, because they are small enough when compared with the iron and copper losses.

**Field iron losses.** Figure 2 shows a structure of the stepping motor. A hybrid-type stepping motor uses a permanent magnet for the rotor and equips

inductors called teeth on the outer diameter of the rotor core and inner diameter of the stator core. The iron loss is generated when the rotor rotates because the teeth periodically face and the flux in the stator core changes periodically. It is called field iron loss, as stated above.

Figure 3 shows a measurement system for the field iron losses. A torque meter is set between an external driving motor and a motor to be measured, and the rotor is rotated from outside. The rotational speed and the torque are measured, and the iron loss is calculated by the equation:

$$W_o = (2\pi/60) \cdot N \cdot T \quad (1)$$

$W_o$ : Field iron loss [W]  
 $N$ : Rotating speed [r/min]  
 $T$ : Torque [N·m]

As mentioned above, the iron losses consist of the eddy current loss and the hysteresis loss, and each loss-per-unit mass is expressed as:

$$W_e = c_e \cdot B_m^2 \cdot t^2 \cdot k^2 \cdot N^2 \quad (2)$$

$$W_h = c_h \cdot B_m^{1.6} \cdot k \cdot N \quad (3)$$

- $W_e$ : Eddy current loss [W/kg]  
 $W_h$ : Hysteresis loss [W/kg]  
 $c_e, c_h$ : Iron loss constant determined by material  
 $t$ : Thickness of lamination sheet [mm]  
 $k$ : Constant by number of pole pair  
 $B_m$ : Flux density [T]  
 $N$ : Rotating speed [r/min]

From these equations, it is understood that the eddy current loss is proportional to the square of the rotational speed, and the hysteresis loss is proportional to the rotating speed. The iron loss is a sum of the eddy current loss and the hysteresis loss, and it is to be proportional to the first-to-second power of the rotational speed. Figure 4 shows a measurement result of field iron loss of the conventional motor. It is expressed by Equation 4 approximately, and is proportional to the 1.44th power of the rotational speed.

$$W_o = 7.84 \times 10^{-4} \cdot N^{1.44} \quad (4)$$

continued

Table 1—Specification of Conventional Stepping Motor	
Frame size	60 mm sq.
Length	60 mm
Phase	2 phase
Pole pair	50
Resistance	1.6 ohm
Rated current	1.7 A
Maximum holding torque	1.2 Nm

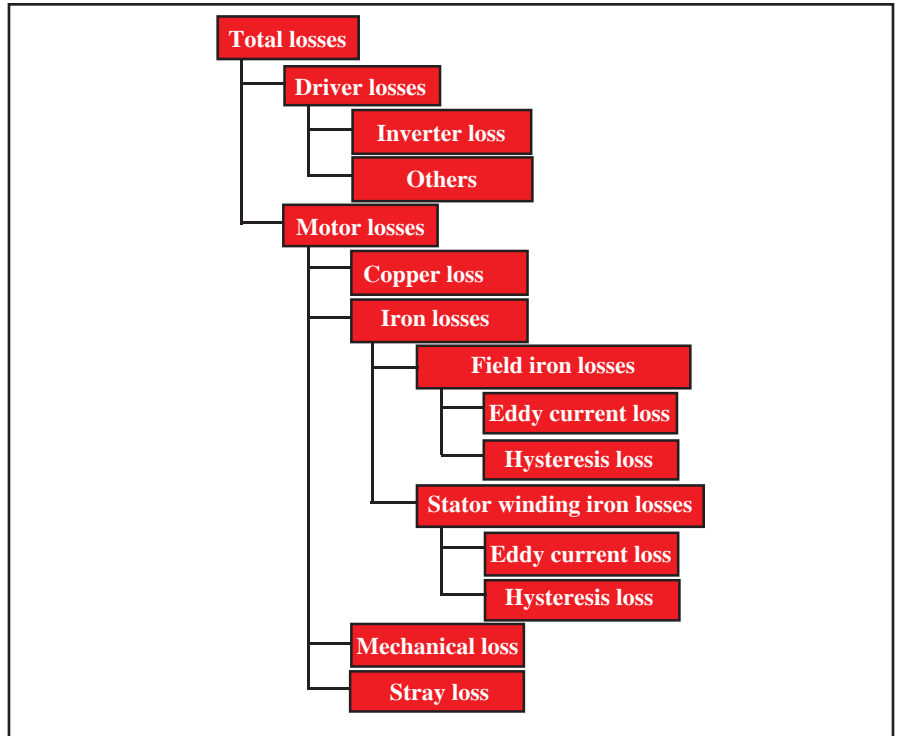


Figure 1—Classification of losses.

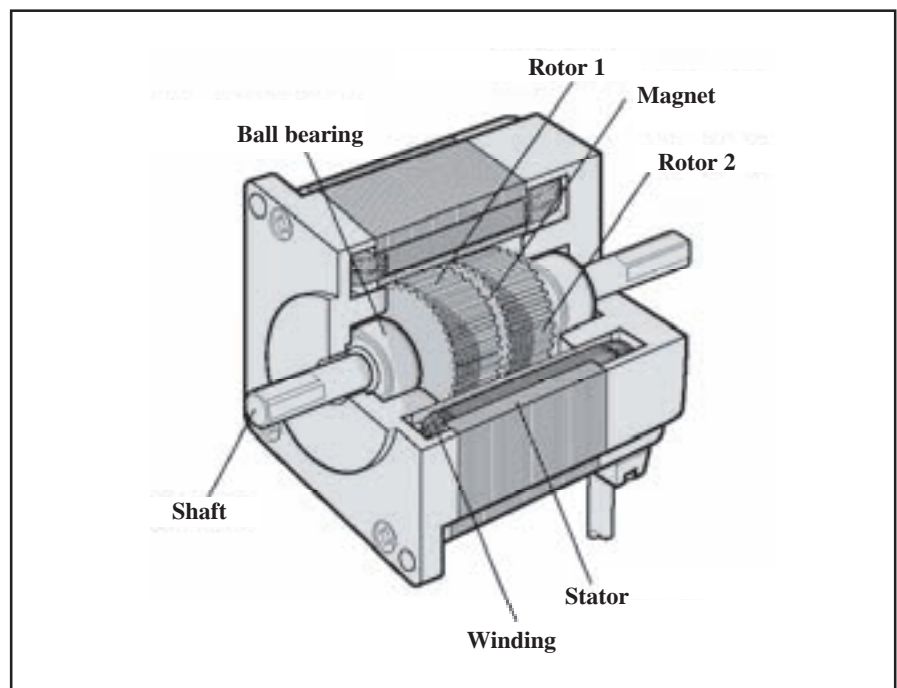


Figure 2—Structure of stepping motor.

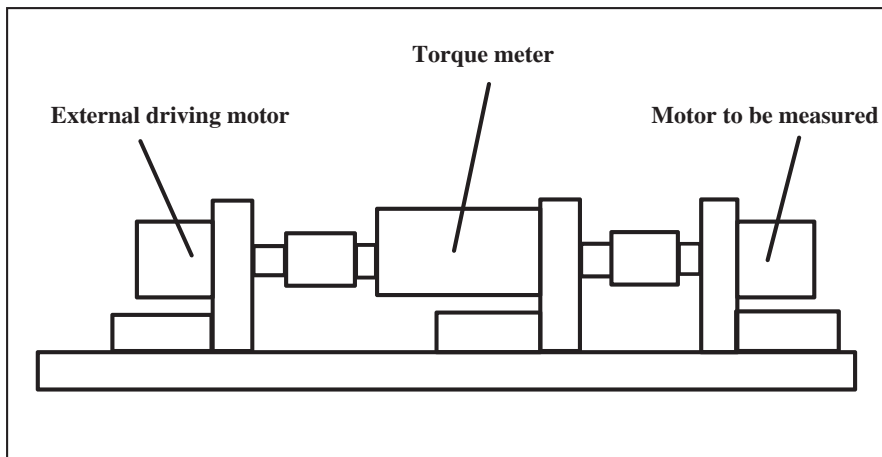


Figure 3—Measurement system of field iron losses.

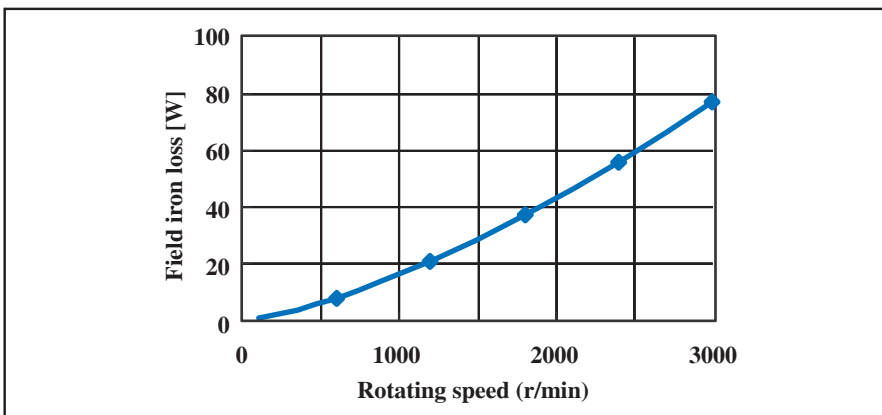


Figure 4—Field iron loss of conventional stepping motor.

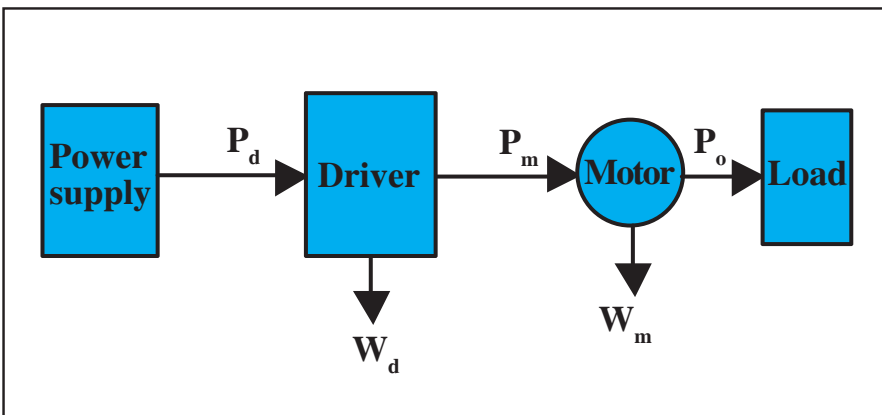


Figure 5—Configuration diagram of loss measurement.

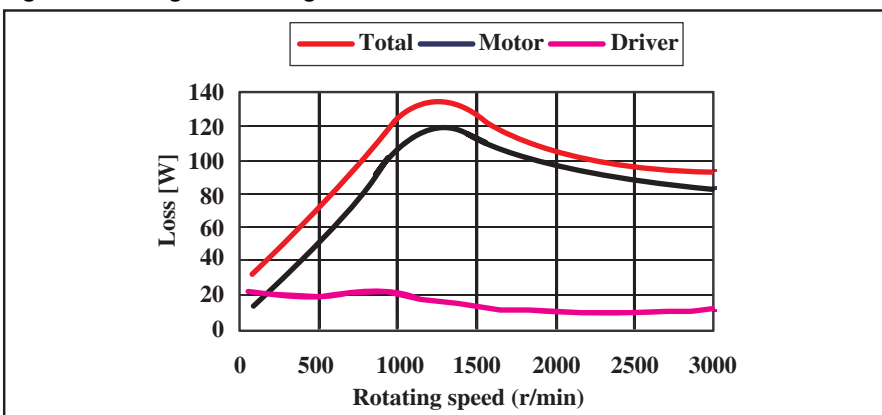


Figure 6—No-load loss of conventional stepping motor.

**Separation of motor losses.** The configuration diagram of the loss measurement is shown in Figure 5. A power meter is set between the power supply and the driver, and the driver and the motor, respectively, for measuring the power and the current.

The driver input, motor input and the output are assumed to be  $P_d$ ,  $P_m$  and  $P_o$ , respectively. The difference between the driver input and the output makes a total loss  $W_u$ , and the difference between the motor input and the output makes a motor loss  $W_m$ . Each value is expressed by the following equations:

$$W_u = P_d - P_o \quad (5)$$

$$W_m = P_m - P_o \quad (6)$$

The difference between the driver input and the motor input makes a driver loss  $W_d$ , and it is expressed by the following:

$$W_d = P_d - P_m \quad (7)$$

The stepping motor is controlled with a driver so that a constant current may flow, regardless of load. Therefore, a smaller load causes a bigger loss.

Consequently, the loss evaluation of the stepping motor with no load is the severest. When assuming  $P_o = 0$  (Eqs. 5 and 6), the whole driver input results in a total loss, and the whole motor input results in a motor loss. Figure 6 shows the no-load loss of the conventional stepping motor. It is understood that the motor loss is relatively large when compared with the driver loss.

Next explained is the separation of the motor losses. As copper loss of the motor is calculated by Equation 8,

$$W_c = n \cdot I^2 \cdot R \quad (8)$$

the iron loss follows Equation 9:

$$W_{fe} = W_m - W_c \quad (9)$$

$W_c$ : Copper loss [W]

$W_{fe}$ : Iron loss [W]

$n$ : Number of phases

$I$ : Current in RMS value [A]

$R$ : Winding resistance [ohm]



Figure 7 shows the result of separating the conventional stepping motor's loss from copper loss and iron loss. The motor current, torque and field iron loss are described for reference.

Although the current of stepping motor is controlled to be at a constant value in the fixed-current area of 1,000 r/min or less, the current decreases when at higher speed. This is because the voltage to operate the constant current control becomes insufficient due to an increase in impedance at high speed. The area where the current decreases is called constant voltage area.

Figure 7 shows the maximum motor iron loss at about 1,200 r/min. When rotating, the iron loss is usually larger than the field iron loss because the stator winding iron loss is added to the field iron loss. Therefore, the difference between the iron loss and the field iron loss is a stator winding iron loss. The stator winding iron loss decreases in the constant voltage area because the current is decreased. The conventional motor has a characteristic where the field iron loss becomes equal to the iron loss at about 3,000 r/min.

Though the motor loss is the sum of iron loss and copper loss, the copper loss is relatively small and the motor loss is almost equal to the iron loss at high speed. The maximum loss of the conventional motor is 119W, of which iron loss is 112W—or 94% of the motor loss. Reduction of the iron loss is thought of as an effective development for lowering the loss of a stepping motor

### Lower-Loss Inducements for Stepping Motors

**Lower iron loss by suitable lamination sheet.** The following methods can be expected from Equations 2 and 3 for lowering the iron loss.:

- Material with a small iron loss constant ( $c_e, c_h$ ) is used.
- Thin lamination sheet is used.

The above are possible by changing the grade and thickness of the lamination sheet.

Iron loss per-unit-mass:

Lamination Sheet 1 > Lamination Sheet 2 > Lamination Sheet 3 > Lamination Sheet 4.

Stator cores were made for trial purposes with the above four kinds of lamination sheets, and the result of

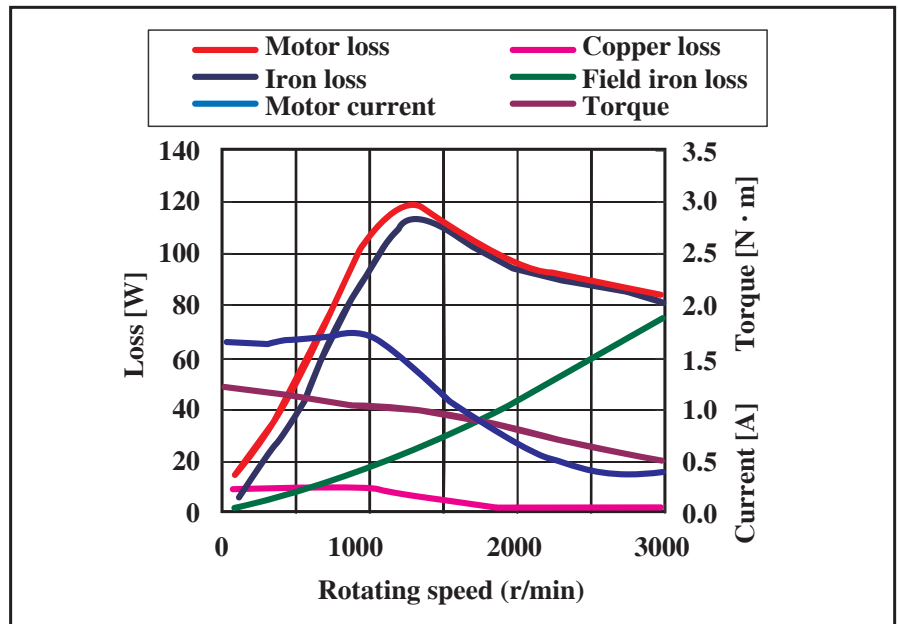


Figure 7—Motor loss of conventional stepping motor.

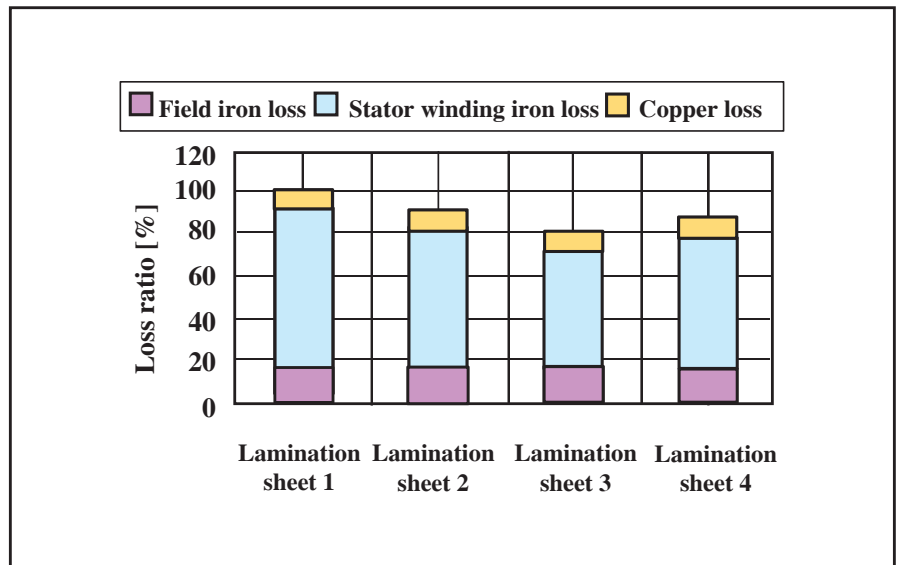


Figure 8—Relation of lamination sheet material and loss.

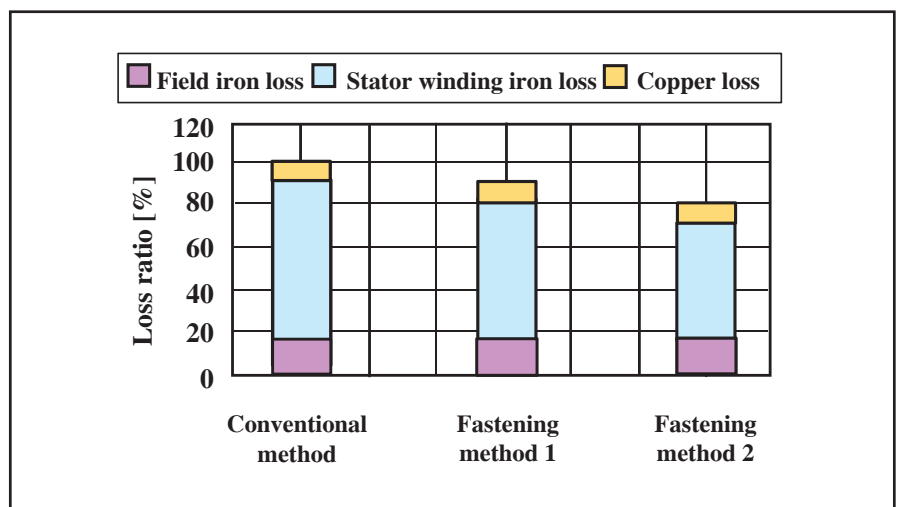


Figure 9—Relation of lamination fastening method and loss.

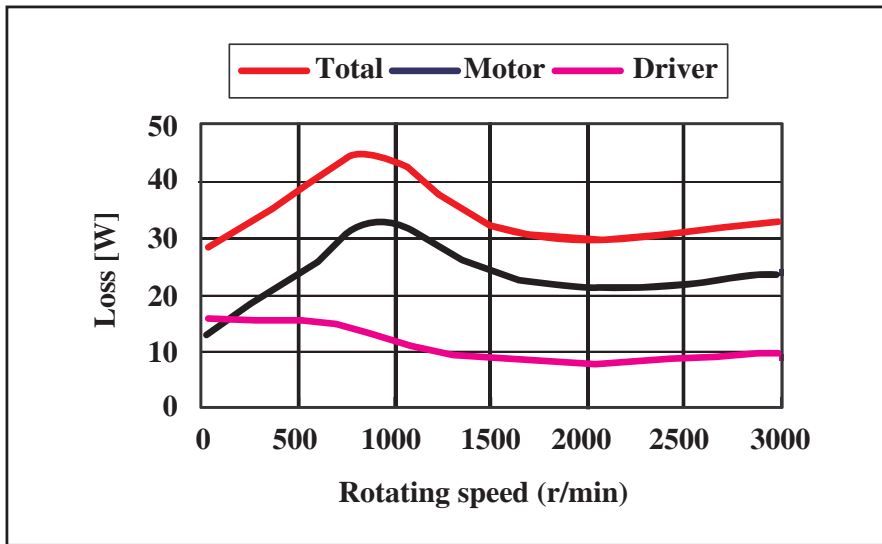


Figure 10—No-load loss of low-loss stepping motor.

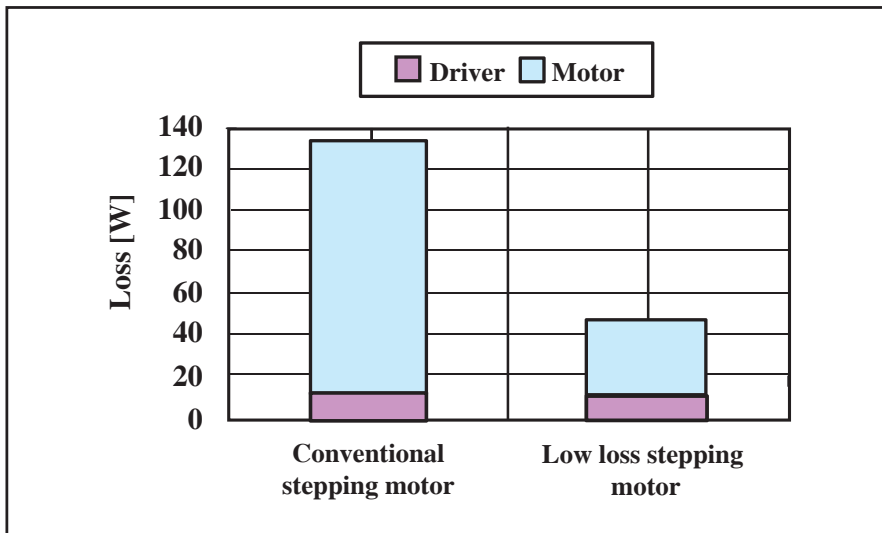


Figure 11—Comparison in loss.

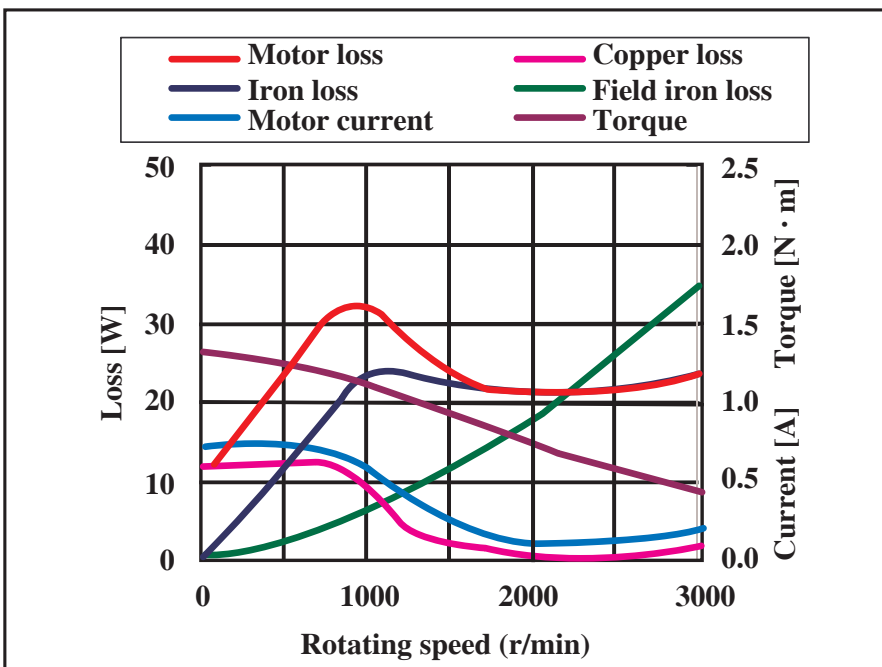


Figure 12—Motor loss of low-loss stepping motor.

their compared maximum loss is shown in Figure 8. The vertical axis shows the ratio based on the motor loss of Lamination Sheet 1. For comparing the loss by material, it was compared under the same condition of holding torque.

In general, the smaller the specified value in iron loss, the higher the grade of the lamination sheet. However, the saturation flux density tends to decrease as well when the specified value in iron loss becomes small. When it is used for the motor, the torque becomes smaller. The current was adjusted to create a uniform torque. Therefore, the smaller the specified value in iron loss from the lamination sheet, the larger the copper loss.

Also, the smaller the specified value in iron loss of the lamination sheet, the smaller the field iron loss. And yet, it doesn't necessarily follow that the specified value in iron loss of the lamination sheet is a condition of constant torque, because the stator winding iron loss depends on the current. It reverses the iron loss value in Lamination Sheets 3 and 4. The best lamination sheet was selected, considering not only the specified value in iron loss of the lamination sheet but also the torque characteristic.

**Lower iron loss by suitable fastening method.** Figure 9 shows the relationship of the fastening method and loss of the stator core (laminated core), though the stator core is made of the lamination sheets to which insulation coating is given. For now, fastening by dimples is the most common method.

The electrical insulation between the lamination sheets is broken down at the dimples. An eddy current becomes easy to flow due to this dielectric breakdown, and the eddy current loss grows more than the value calculated by Equation 2. Figure 9 shows the relationship of the fastening method and the maximum loss. The loss is different, depending on the fastening method. The low-loss stepping motor has adopted a fastening method with a small loss.

**Practical example.** Figure 10 shows the no-load loss of a low-loss stepping motor and driver. Figure 11 shows the loss comparison with the conventional stepping motor at the rotational speed where the total loss reaches its maximum value. The motor loss has decreased by 73%, and the driver loss

by 26%, when compared with the conventional stepping motor.

Figure 12 shows the result in separating the motor loss of the low-loss stepping motor into a copper loss and an iron loss. Field iron loss becomes bigger than iron loss at high speeds of more than 2,400 r/min. This means that the current weakens the magnetic field, and this condition is called field weakening.

Figure 13 shows the result in comparing the loss with the conventional stepping motor at the rotating speed that maximizes the motor loss. Though the copper loss has increased, compared with the conventional stepping motor—because the current is adjusted to make the torque uniform—the stator iron loss is reduced by 81%, the field iron loss by 73% and the motor loss by 72%, compared with the conventional stepping motor.

Figure 14 shows the temperature rise of a motor case at the speed of maximum loss. At this measurement, a heat sink equivalent to an aluminum plate of 250 x 250mm x 6mm is attached. The temperature of the conventional stepping motor rose to over 60°C in about five minutes. If rotation continued after that, the coils in the stator would burn out. On the other hand, the temperature of the low-loss stepping motor is less than 60°C. The coils will not burn out.

### Loss in Positioning Operation

When a heat sink equivalent to an aluminum plate of 250 x 250mm x 6mm is attached, the permissible dissipation of the low-loss stepping motor is about 40W at the ambient temperature. If the maximum dissipation of the low-loss stepping motor is 32W, it is possible to drive it continuously in the abovementioned condition.

However, let's look now at a loss in a positioning operation because the stepping motor is used mainly for positioning operation.

**Loss characteristic.** Figure 15 shows the relationship of the load and the rotating speed. For the stepping motor in Figure 15, the peak value of the motor loss decreases when the load increases; but the change by the load is small, and the change by the rotating speed is larger.

The loss is expressed as a func-  
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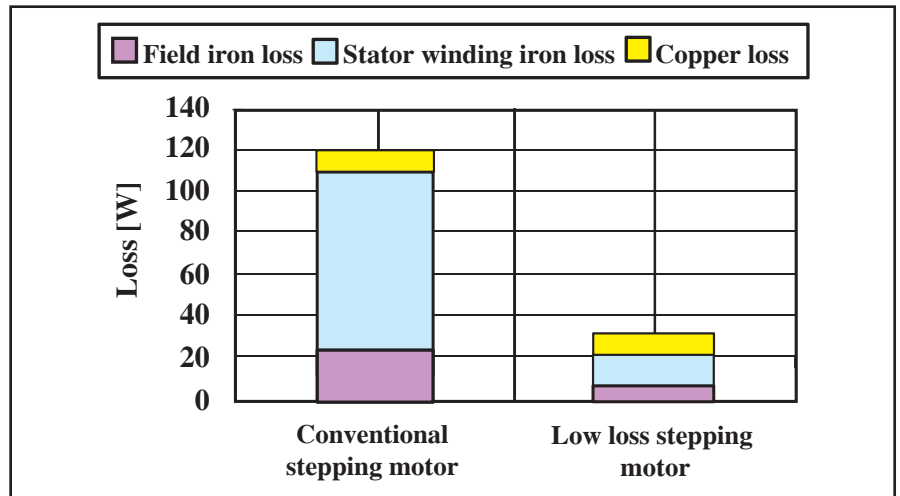


Figure 13—Comparison with conventional stepping motor.

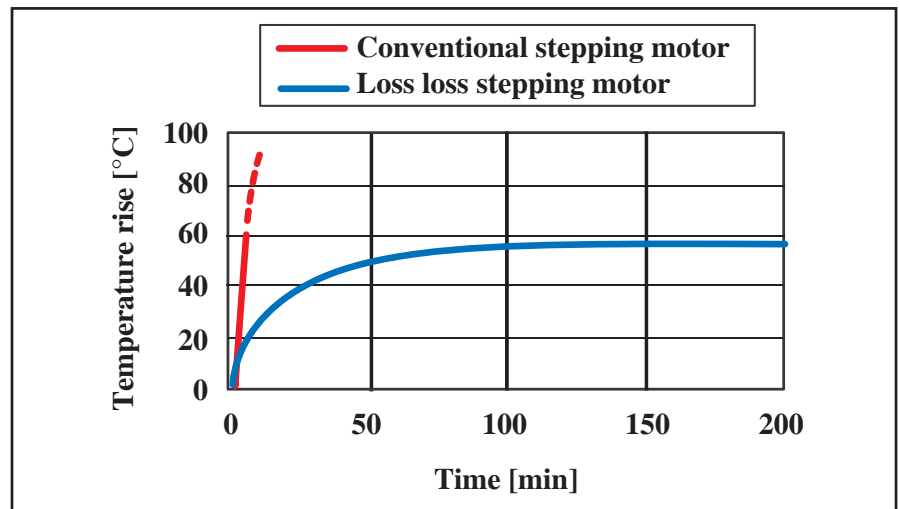


Figure 14—Temperature rise.

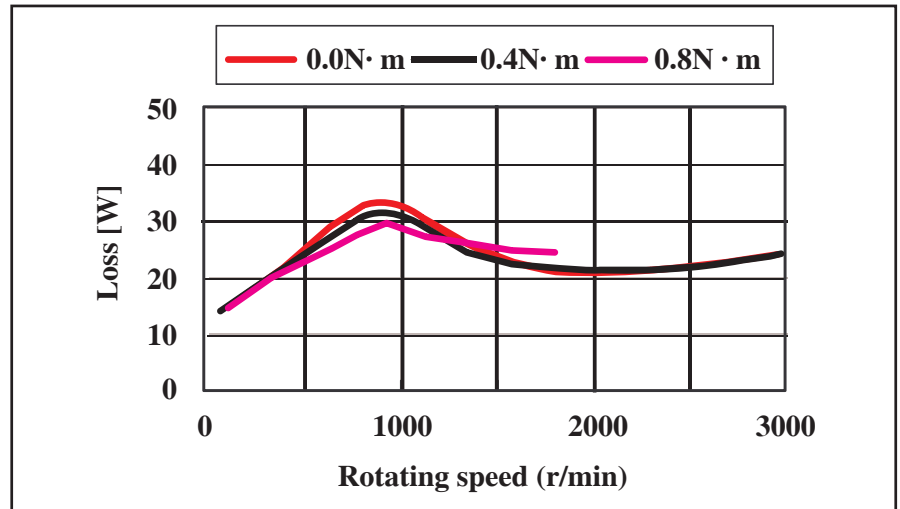


Figure 15—Loss characteristic of low-loss stepping motor.



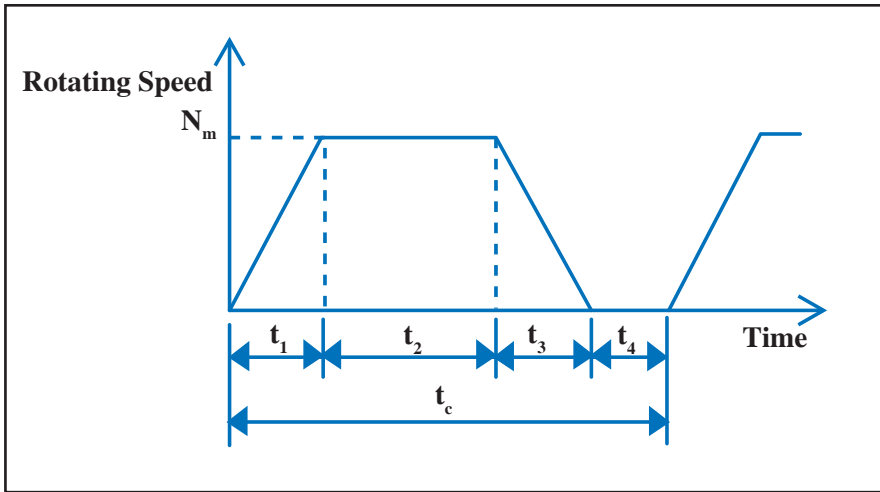


Figure 16—Speed pattern in positioning operation.

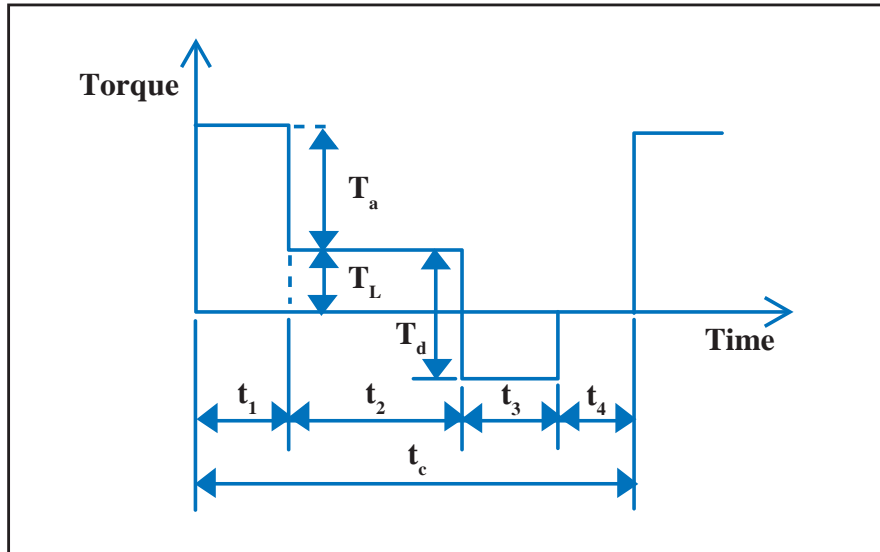


Figure 17—Torque pattern in positioning operation.

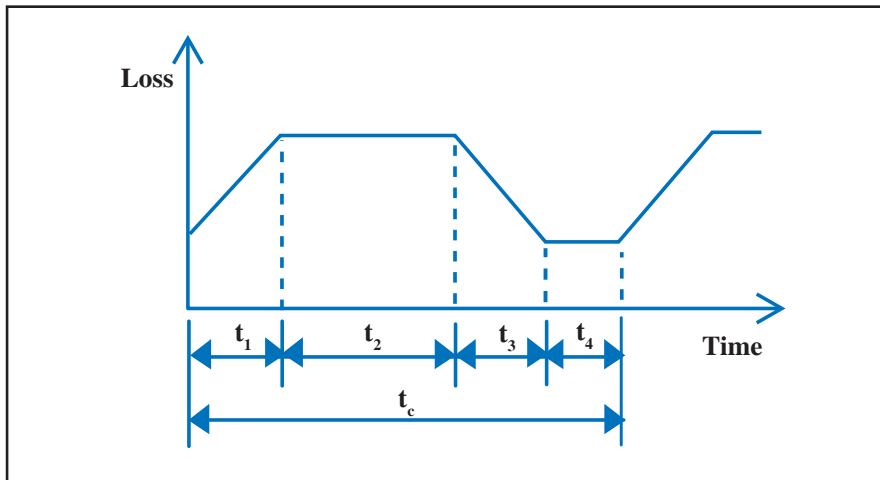


Figure 18—Loss pattern in positioning operation.

tion of the rotating speed and the load torque. Therefore, the loss can be calculated from the torque and the rotating speed.

**Loss calculation.** Figure 16 shows the speed pattern in a typical positioning operation. This operation pattern accelerates up to a rotational speed  $N_m$  in acceleration time  $t_1$ , then rotates at a constant speed over time  $t_2$ , and decelerates in deceleration time  $t_3$ , and stops. This operation pattern is called a trapezoidal drive, and the area of trapezoid shows the rotation amount. Usually, applications such as inspection and assembly, etc., are done in the stop time  $t_4$  after the completion of positioning, and the following operation is begun. Time  $t_c$  is from a start-up to the following start-up and is called cycle time. When heat generation is large, it is necessary to set a longer stop time for cooling down.

Figure 17 shows the torque pattern when it is driven by the speed pattern in Figure 16. Torque  $T_L$  for the load torque component is necessary during a constant speed time, and acceleration torque  $T_a$  and deceleration torque  $T_d$  are necessary during an acceleration/deceleration time.

As described above, the stepping motor losses depend on the rotating speed, and the loss pattern is shown in Figure 18.

When the instantaneous maximum value of the loss is assumed to be  $w(t)$ , the average value of the loss-per-cycle is calculated by the following:

$$W_a = \frac{1}{t_c} \int_0^{t_c} w(t) dt \quad (10)$$

**Calculation result.** The motor loss is calculated when the shortest positioning operation is done with an inertial load of  $J=2.5 \times 10^{-4} \text{kg} \cdot \text{m}^2$  (90 mm in outside diameter, 5 mm in thickness and material of iron) attached. Table 2 results were gained by calculating the operation pattern of which positioning time is the shortest in consideration of the safety rate.

From Equation 10, the loss in each operation pattern is calculated, and Figure 19 shows a calculation result of the speed pattern and the loss when the rotation amount is, for example, two rotations.

Figure 20 shows the relationship

between the rotation amount and the motor loss. When the rotation amount is 0.1, the difference of the loss is not so much. But when rotation amount is increased, the difference becomes large.

For the conventional stepping motor, intermittent operation or fan cooling is needed, even when a positioning operation is conducted, because the loss increases to about 80W when the rotation amount is increased. For the low-loss motor, a stop time for cooling is unnecessary because the losses are only about 24W, even when the rotation amount is increased. Therefore, a continuous positioning operation is achieved for any rotation amount.

**Conclusion**

Though the conventional stepping motor had a problem with extensive heat generation, the loss of the stepping motor will be reduced greatly by the lower-loss technology. It has become possible to use a stepping motor in applications that require continuous motion at a constant speed, something not possible until now. The number of applications that a stepping motor may be suitable for will certainly increase. In application, these motors are very effective for energy savings.

Table 2—Operation Pattern			
Rotation amount [Rotation]	Acceleration/ deceleration time [ms]	Rotating speed [r/min]	Positioning time[ms]
0.1	14	400	29
0.5	30	800	68
1	40	1000	100
2	59	1300	152
5	100	1800	267
10	146	2200	419

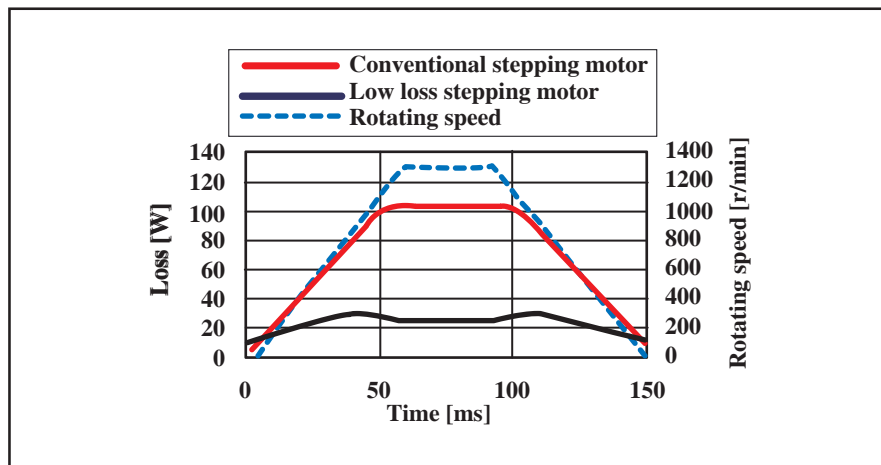


Figure 19—Calculation example.

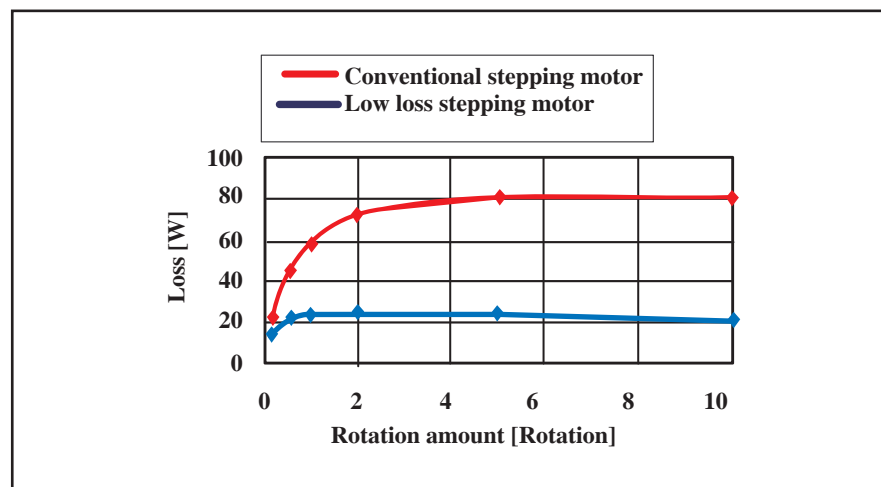


Figure 20—Relation of rotation amount and motor loss.

**Yasuo Sato** received his Master's in electrical engineering from Akita University in Japan. He joined Oriental Motor in 1993 as motor design engineer to develop stepping motors. In 1996, he was transferred to the Boston Technology Group of Oriental Motor USA to research the basic factors of a stepping motor. Since returning to Japan in 2000, he has focused on developing closed-loop stepping motors and brushless DC motors.

# Historic Danish Theatre



## G E T S   A   F A C E L I F T



Visual Act's Touring Desk control panel is one of four portable control desks (courtesy of Sprint Electric).

The Royal Danish Theatre has occupied the heart of Copenhagen for centuries and recently upgraded to a new control system featuring Sprint Electric DC drives to extend the lives of the existing motors, keeping replacement costs down. The Swedish stage design and technology company Visual Act retained most of the original motors and mechanics while providing a much-needed face-lift to the stage.

The refurbishing project included control electronics for 36 fly bar hoists driven by DC motors; a stage control system with four portable control desks and redundant servers; upgrading six lighting bridges to increase lifting capacity; installation of four manually portable point hoists; and the upgrade of the old revolving stage driven by DC motors.

"The refurbishing process at the Royal Danish Theatre in Copenhagen was in many ways special and in some ways unique," says Niklas Philipson, design engineer for Visual Act. "We could build on the experience gained in upgrading the flying system at the Norwegian Theatre in Oslo (where Sprint Electric DC drives helped save eight tons of cable).

"Often the old DC motors are exchanged for AC motors, but we have good experience in keeping them. It is

a cost efficient way, as the DC motor drives have very good capacity and durability," Philipson says.

The 36 fly bar winches, which serve as a counterweight system for hovering scenery, received new drives and electronics for their control. A new position-monitoring arrangement featuring an angular gear, absolute encoder and limit switch was mounted to each winch, or hoist. A Profibus communication channel was provided for the drives and another for the absolute encoders and safety I/O. A closed positioning loop was integrated by Sprint Electric specifically for Visual Act's purposes, and the on-board software modules of the PLX drives helped facilitate the entire system.

"On this occasion, the physical size of the drives was crucial due to the retrofitting requirement; they had to fit in the space left by the earlier drives," says Gary Keen, sales director for Sprint Electric. "Profibus communication was a requirement, and this is easily incorporated as an option in the drives. Also, this is not the first theater where these drives have been used successfully, so familiarization and speed of commissioning was of paramount importance as the window for installing and setting up the drives was narrow."



Motors, gearboxes and brakes were replaced in the six lighting bridges to increase load capacity to 800 kg. Angular gear arrangements similar to the ones used on the fly bars were installed for the light bridge encoders, slack wire detection was included to increase safety, and electrical cabinets with servo amplifiers and electronics were installed.

The revolving stage received new encoders and four movable point hoists. The point hoists are connected to the control system through Profibus, and they have individual control cabinets similar to those in the light bridges.

The control system commands every movement in the theater through a network combining Profibus and Ethernet. A double redundant ring is the basis of the Ethernet. Several hot-swap terminal boxes for the control desks are placed throughout the stage area. The system is capable of stopping all motion by a double emergency stop circuit connected in series through the e-stop switches.

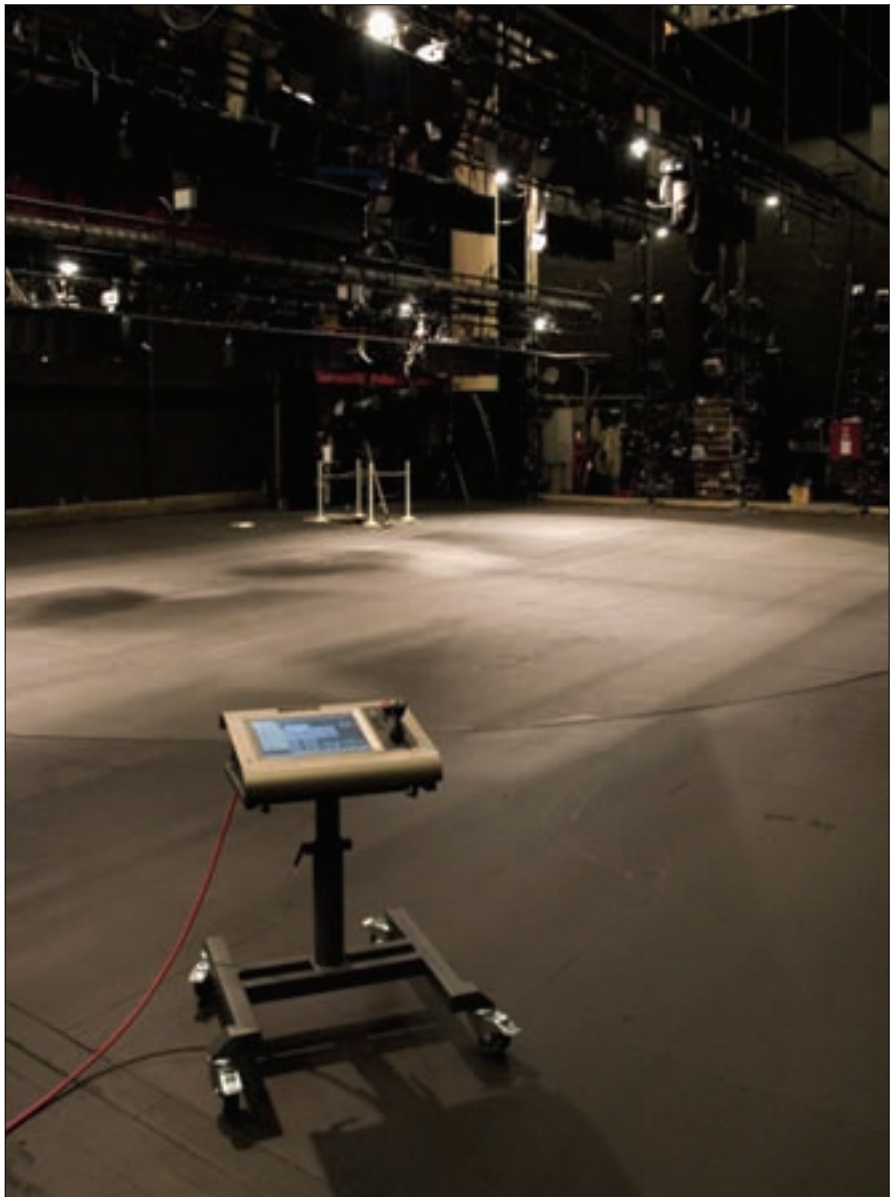
A total of 39 Sprint Electric PLX 4 Q DC drives were used in the project for the fly bar hoists and the revolving stage. Sizes ranged between 5 kW (12 amps) and 30 kW (72 amps). “The PLX range of drives are very versatile digital DC drives that offer excellent diagnostic facilities and are easily commissioned using (their) 40-character, two-line English text display and onboard MMI, or via a link to a Windows based program, all supplied free of charge with the drive,” Keen says. “One of the drive’s main advantages is its extensive built-in library of programmable software functions and high number of I/O connections, making complex tasks easily achievable within the drive itself.”

The PLX drives include two- and four-quadrant DC drives designed to be powerful, flexible and easy to program. Center winding macros, spindle orientation and a controllable field allow the motors to manage a range of industrial applications. They are used in many applications where DC drives provide advantages over AC drives. According to Keen, “The PLX range of drives are used extensively in the manufacturing and

**continued**




**A total of 39 Sprint Electric DC drives were installed to extend the lives of the theatre’s existing motors (courtesy of Sprint Electric).**



**Several hot-swap terminal boxes for the control desks are placed throughout the stage for versatile mobility (courtesy of Sprint Electric).**



converting industries, primarily plastics, steel, paper, wire and cable, cranes, printing and countless other traditional industries.”

Since the Royal Danish Theatre upgrade, Sprint Electric increased the PLX drives’ power to 1,850 Amps. “This is great news for our customers working in heavy industry,” Keen says. “We can now work with larger applications in the steel, plastics, rubber and paper industries.” 

### For more information:

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New slack wire detection was installed to increase safety (courtesy of Sprint Electric).



The PLX drives come in two- and four- quadrant models, and they’re designed to be powerful, flexible and easy to program (courtesy of Sprint Electric).



# Run Like the Wind

WINDPOWER CONFERENCE HEADS TO CHICAGO THIS YEAR



Windpower 2008 had a record-breaking 776 exhibitors and 13,000 registrants (courtesy of Bruce Bennett).

Wind is the talk of the town. It has become especially relevant to the power transmission community where bearings, gears, couplings, motors and gearboxes are providing the equipment for this thriving alternative energy industry. It comes as no surprise that the Windpower 2009 Conference and Exhibition, arriving in Chicago from May 4–7, will be the largest gathering of wind energy professionals and technologies to date.

Exhibitors like Advanced Motors & Drives, Brad Foote Gear Works, Comer Industries, Hansen Transmission, KTR Corp., Moventas, NTN Bearing Corp., SKF, Timken and WEG are just a few of the companies that will be on hand to support the wind energy market.

Due to the enormous growth of both exhibitors and attendees, the American Wind Energy Association (AWEA) had no choice but to move the conference from Minneapolis to Chicago in 2009. There was simply not enough room to support the growing number of interested participants, a nice problem to have according to many of the exhibitors PTE spoke with.

“Wind energy is the greatest growth industry in the world, specifically in the United States,” says Todd Franiuk, marketing specialist at NTN Bearing Corporation of America. “To not be a part of this exhibition would be a mistake.”

Exhibiting at booth #3121, NTN is featuring main shaft, **continued**



(Courtesy of Bruce Bennett).



# events

gearbox and generator application bearing displays. Franiuk says NTN benefits from Windpower 2009 by receiving greater name recognition and the ability to meet with potential customers/clients they may not have had the chance to in the past.

“With so many new companies finding their niche in this market, the possibilities of finding new ways to use our product to serve this market continue to grow. Exhibiting at Windpower 2009 is a good way to meet and understand some of this potential.” Franiuk says.

At booth #5138, Comer Industries will display its pitch and yaw drives. The company’s range of planetary drives for nacelles rotation and orientation as well as blade positioning is suitable for wind generators up to 5 MW and more.

Arlin Perry, president at Comer, says the company is currently supplying products to many of the market leaders in the industry. Comer has exhibited at the Windpower Conference in the past and finds it an excellent opportunity to increase the awareness of its product lines.

“We see an increased focus in the United States with tremendous growth potential as the U.S. government embraces alternative energy as part of a new energy policy,” Perry says.

Advanced Motors and Drives (AMD) will promote its design, technology and manufacturing resources at booth #1868 with a product line that includes yaw motors, pitch motors and cable hoists.

“Windpower 2009 provides a cost-effective opportunity to showcase our capabilities,” says Mike Arnold, sales engineer at AMD. “At a time when some events show diminishing returns for our investment, the growth and excitement surrounding Windpower 2009 is refreshing.”

AMD, along with its sister operating companies within Kinetek, will be developing products and solutions for a variety of commercial and industrial markets, but will be paying close attention to wind turbine manufacturers.

“Our strategic operating plans include significant sales



**Windpower 2008 was nearly twice the size of the 2007 exhibition. 2009 will be the largest conference to date (courtesy of Bruce Bennett).**

targets in the wind energy industry, and equally significant capital resources that we anticipate allocating toward meeting our sales and manufacturing goals,” Arnold says. “Plus, we are pleased that our new president has identified wind energy as a priority for his administration and our country.”

The Windpower conference was listed in *Tradeshow Week* magazine as one of the 50 fastest growing shows in North America. It has been held previously in Chicago, Houston, Los Angeles and Minneapolis. The 2010 conference is tentatively scheduled to take place in Salt Lake City. This year’s conference is returning to Chicago for the first time since 2004.

“We’re excited about coming back to Chicago,” said AWEA executive director, Randy Swisher in a press release. “The ‘windy city’ offers an ideal mix of hospitality and exhibition facilities in a vibrant downtown setting. We are grateful to officials in Chicago’s hospitality sector, as well as the office of Mayor Richard Daley for their efforts to accommodate the show.”

Windpower 2009 will feature more than 300 speakers and moderators, 150 poster presentation and 50 sessions on wind energy topics focusing on policy, business and technical subjects. More than 13,000 attendees and 776 exhibitors are scheduled to participate in the conference. The theme of the conference in 2009 is “Wind Power: Securing America’s Energy Future.”

While the AWEA recognizes that organizing an event of this size can ultimately result in negative impacts on the environment, members are working each year to promote green initiatives throughout the duration of the show. Some of the highlights in 2009 include:

- Online registration and a digital brochure are available to limit hard copy mailings.
- An online abstract submittal and review process is in place for the conference programs.
- Conference badges and bags will be collected at the end of the conference and recycled.
- A green travel program is in place for attendees that want to reduce the environmental impact of their air or car travel to the conference.
- Partnering with Community Energy, Inc. to offset the energy use at McCormick Place.
- The exhibitor manual was provided online as well as in CD-ROM format versus sending out hard copy kits.
- Coordinating with the convention center catering company to provide an environmentally-friendly disposable service for food as well as plastic products.
- An onsite environmental survey will be incorporated into the site selection process for future host cities.

For more information on Windpower 2009, e-mail [exhibition@awea.org](mailto:exhibition@awea.org) or visit [www.windpowerexpo.com](http://www.windpowerexpo.com).

# calendar

## May 3–6—International Electric Machines and Drives Conference.

Hilton Miami Downtown, Miami, FL. IEMDC is a venue for users, designers, manufacturers and analysts of electric machines and drives and their related power electronics and controls including all varieties and sizes of electric machinery. Practical applications, operations, maintenance, and the development and harmonizing of international standards related to electric machines and drives are also of interest. The conference is jointly sponsored by the IEEE Power and Energy, Industrial Electronics, Industry Applications, and Power Electronics Societies. Several tutorials in the form of full-day and half-day short courses will be offered on May 3, 2009. The conference features papers and plenary presentations by industry experts who highlight aspects of electric machines and drives, such as automotive and renewable and alternative energy applications. For more information, email [secretariat@iemdc2009.org](mailto:secretariat@iemdc2009.org) or [chair@iemdc2009.org](mailto:chair@iemdc2009.org), or visit [www.iemdc2009.org](http://www.iemdc2009.org).

## May 4–7—AISTech.

America's Center, St. Louis, MO. The Iron & Steel Technology Conference and Exposition 2009 is co-located with the Asia-Pacific Partnership Technology Showcase 2009. AISTech 2009 will feature international technologies, allowing steel producers to compete in today's global market. Those involved in the steel industry can take advantage of this opportunity to discover ways to make the job easier and improve productivity. For more information, visit [www.aist.org/aistech/index.htm](http://www.aist.org/aistech/index.htm).

## May 12–14—Plant Maintenance and Design Engineering Show.

Place Bonaventure, Montreal, Canada. PMDS is the leading event for manufacturing professionals from throughout Quebec to find the products, services and information they need to stay competitive. Companies from Quebec and beyond present solutions for plant and facility maintenance and equipment and systems design with products and services for automation, electronics, assembly, robotics, bar coding and process control. The Society of Manufacturing Engineers (SME) in cooperation with its Quebec partners presents a comprehensive conference program including technical sessions, an industry keynote address and an interactive town hall panel discussion. For more information, visit <http://www.sme.org/cgi-bin/get-event.pl?--001764-00007-home--SME->, or call (888) 322-7333.

## May 12–14—Rolling Element Bearings Technical Workshop.

Ayres Hotel, Hawthorne, CA. Sponsored by the ASTM International Committee F34 on rolling element bearings and Northrop Grumman Space Technology (NGST), this workshop includes a tour of the NGST facility and is held in conjunction with the standards development meetings of the committee. Anyone with interest in rolling element bearings, their application, analysis, testing and lessons learned is invited to attend. ASTM membership is not required, and the

workshop is free. Online registration opens eight weeks prior to the workshop until May 5. Pre-registration is required for the tour. For more information, visit [www.astm.org/MEETINGS/COMMIT/f34symp0509](http://www.astm.org/MEETINGS/COMMIT/f34symp0509), or contact Dr. Yoshimi Takeuchi at [yoshimi.r.takeuchi@aero.org](mailto:yoshimi.r.takeuchi@aero.org) or (310) 336-1427.

## June 8–10—Sensors Expo and Conference.

Donald E. Stephens Convention Center, Rosemont, IL. The leading event for sensing technology and solutions features an expanded conference program in 2009 with 18 tracks focusing on data acquisition, data analysis, wireless and communications. Over 200 vendors showcase the latest technologies for improving industrial automation and more efficient, cost-effective enterprise management. A new feature on the show floor is the Energy Harvesting Pavilion, which will present solutions for capturing, converting, storing and delivering energy adequately and efficiently. The International Robots, Vision & Motion Control Show and Fastener Tech are co-located. For more information, visit [www.sensorsexpo.com](http://www.sensorsexpo.com).

## June 8–11—Fluid Power Conference and Expo.

Las Vegas Convention Center, Las Vegas. This show features over 40 educational sessions on a variety of topics from fluid power fundamentals to compressed air preparation and motion control basics to hydraulic systems filtration. This year is co-located with Waste Expo. For more information, visit [www.fluidpowerexpo.com](http://www.fluidpowerexpo.com).

## June 8–12—ASME Turbo Expo.

World Center Marriott Resort and Convention Center in Orlando, FL. The Gas Turbine Technical Congress and Exposition brings together engineers, research scientists, educators and other professionals involved in the design, operation, and maintenance of aero engines and stationary power turbines. "Gas Turbine Technologies: Meeting Complex Global Challenges," will be the theme of the keynote session at ASME Turbo Expo 2009. The technical program for the conference will cover a range of subjects, including engine design, materials, cogeneration, alternative fuels, combustion diagnostics and micro-turbines. For more information, visit [www.asmeconferences.org/te09](http://www.asmeconferences.org/te09).

## June 8–11—ATX East.

Jacob K. Javits Convention Center, New York, NY. Locate East Coast suppliers and see the latest technology, equipment and materials in adhesives/dispensing equipment, assembly systems, custom automation, control software/hardware, end-of-line packaging equipment, materials handling and conveyors, motion control, robotics, sensors and more. Co-located events include MD&M East, EastPack, Atlantic Design and Manufacturing and Green Manufacturing Expo. For more information, visit [www.devicelink.com/expo/atxe09/](http://www.devicelink.com/expo/atxe09/).

## EPTDA

### ELECTS NEW BOARD OF DIRECTORS



**Left to right: Roberto Cugnaschi, Manfred Beitel, John Westerling, Mehmet Ali Ülgen, David Harrow and Dick Winkelhuis.**

The European Power Transmission Distributors Association (EPTDA) has a new board of directors, elected by the general assembly of members at the 10-year anniversary and annual convention held in Brussels.

Manfred Beitel of WLB Antriebselemente Handelsgesellschaft mbH, Germany is now the association's president for the next two years. Before joining the EPTDA in 2001, he was a member of the U.S. affiliate organization, the PTDA. "I am keen on leading this successful association into its new decade," Beitel says. "After 10 years of existence, EPTDA can be proud of its exceptional development and growth. I trust that, together with the board of directors and the continuous support of our members, EPTDA has a bright future ahead."

The new board of directors includes David Bassas Del Rey of Tecnotrans, Spain as the first vice president; John Westerling of S&N Osakeyhtiö, Finland as treasurer; and Karl Weindinger of ContiTech Antriebssysteme GmbH, Germany as manufacturer council chair. As directors at large, the general assembly appointed David Harrow of Godiva Bearings, U.K.; Henrik Göpert of AB Sverull, Sweden; Mehmet Ali Ülgen of Silkar Otomotiv Sanayi ve Ticaret A.S., Turkey; and Dick Winkelhuis of Spruit Transmissies, the Netherlands.

Roberto Cugnaschi, the immediate past president of EPTDA, says "EPTDA aims to stand as the voice of the PT/MC industry and offers a unique, strong and steady platform for networking, exchanging ideas and seeking support in difficult times."

## Bishop-Wisecarver President

### JOINS CMTA BOARD

The California Manufacturers and Technology Association (CMTA) extended an invitation to Pamela Kan, president of Bishop-Wisecarver Corporation, to join the board of directors. The CMTA works to enhance the business conditions for the 30,000 manufacturing processing and technology based companies in California.



**Pamela Kan**

The association collaborates with the state government to develop balanced laws, effective regulations and sound public policies to stimulate economic growth and create jobs while safeguarding California's environmental policies.

"My father [founder, Bud Wisecarver] started a long tradition of community involvement, on the state and local level, for Bishop-Wisecarver and its executives," Kan says. "Joining this group of dedicated individuals focused on critical issues faced by California manufacturers is an honor, but also a responsibility. It is clear that industry must be more involved to affect changes in government policy."

## Hydraulic Institute

### GROWS BY SIX

Six companies joined the Hydraulic Institute (HI) in 2008 as members and associate members.

The new members include: Smith & Loveless, Inc., Crane Pumps & Systems and Warren Rupp. The new associate members are Emerson Control Techniques, Graphite Metallizing Corporation and ASCO Power Technologies.

Hydraulic Institute members participate in creating ANSI-approved standards and collaborate to achieve the HI goal of being a global authority on pumps and pumping systems.



## Convex

### JOINS SYNQNET PARTNERSHIP PROGRAM

Danaher Motion Performance Controls recently announced that Korean control system specialist, Convex, has become a member of the SynqNet Partner Program. The partnership program is available to qualified vendors that develop and distribute complementary, commercially available products that integrate with SynqNet network products and ensure ongoing compatibility for growth.

"We are deeply pleased to join the SynqNet network with our servo drive," says Eun Seok Kim, precision control center director at Convex. "Motion networks based on Ethernet technology have proven significant in the Korean market as demands for real-time control dictate. In recent years, we have experienced increased demand for network motion systems with simple cabling and cost savings in industrial automation equipment manufacturing."

Ross McMillan, director of engineering at Danaher, is pleased to welcome Convex to the SynqNet partner community. "The partnership enables us to offer OEMs affordable, low-power, single- and multi-axis drive platforms to support their high-performance and cost-critical motion system applications," McMillan says.

## Master Distributors

### EXPANDS CYNERGY3 PARTNERSHIP

The complete range of products by Cynergy3 Components, including reed relays and liquid level sensors, are now offered by Master Distributors due to an expanded partnership between the two companies.

"We are pleased to be partnered with a company like Master Distributors that understands the importance of holding high levels of stock for immediate delivery, provides excellent support and has a great online market presence," says John Mason, Cynergy3 sales manager. "We know we can rely on Master Distributors to service the customers well, whether they need new product design-ins or spares and replacements."

Cynergy3's reed relays are used in applications such as high frequency radio equipment, high voltage power supplies and medical and test instrumentation. The company's liquid level and flow sensors are used in applications that include

continued



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“We are excited to distribute Cynergy3’s well-respected and comprehensive product line,” says Ike Nizam, president of Master Distributors. “Cynergy3’s product offering has a wide range of applications and provides our customers with high quality choices.”

## Rotork Valve Actuators

ORDERED FOR  
MAJOR CHINESE REFINERY



**Rotork IQPro valve actuators were installed in a processing area of the Qinzhou Refinery.**

Over 1,000 Rotork intelligent electric valve actuators were ordered for installation in the Qinzhou Refinery, a \$1.6 billion project in South China. The PetroChina-owned refinery is designed to improve the energy supply across southwest China.

The Rotork IQPro intelligent actuators with Pakscan P3 network control systems are being installed in the following areas: crude oil, LPG, petroleum and diesel tank farms, processing and water purifying plants and wastewater treatment works.

Rotork’s office in Guangzhou—in the Guangdong Province—is coordinating and supporting the actuation contracts. Other recent Rotork projects in the Chinese oil and gas industries include the 4,000 km West to East Natural Gas Pipeline, for which over 700 Rotork IQ electric actuators were ordered.

## Air-Operated Transporters Manufacturer

CELEBRATES 25 YEARS

Vibro Industries celebrates the 25th anniversary of its line of Air-Operated Transporter Conveying Systems. Since the product’s introduction in 1984, it has been reengineered to function without lubrication and has been field tested under actual manufacturing conditions at New Standard Corporation in York, PA.

The transporter uses two pneumatic cylinders instead of springs to operate on air pressure to move a product tray using oscillating conveying. It consumes .09 CFM at 60 PSI, a low level of air consumption, and it operates without oil. The Vibro Air-Operated Transporter is used in applications to remove scrap from beneath machine tools, materials handling operations, pharmaceutical and other processing applications. The product line includes seven units of various capacities.

“Our 24-year success is based on the longevity of our transporters and the customer service that we provide,” says Leroy Johnson, president of Vibro Industries. “Our transporters are found in leading manufacturing companies worldwide.”



**The Vibro Air-Operated transporter, since its first introduction 25 years ago, has been re-engineered to operate without lubrication.**

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## TURNING BROWNFIELDS GREEN

### Green Building Projects in Michigan and Minnesota Spur Adaptive Reuse

The new energy economy is making some headway in the manufacturing community. Organizations are coming up with creative strategies to convert old industrial plants into green manufacturing hubs or simply cost-effective renovation projects. It's another sign that the country is taking sustainability and environmental awareness seriously.

The idea of adaptive reuse itself is a fundamentally green act, according to Anthony Flint, an author on urban trends at the Lincoln Institute of Land Policy in Cambridge, MA.

"Developers are expending energy to renovate, but not wasting the embodied energy in the building and not building from scratch, thus requiring new materials. There is also much less demolition waste. A huge portion of energy consumption, waste and emissions can be traced to buildings and development," Flint says.

After closing the doors at Detroit Electro Coatings, a plant that originally supplied parts to automakers in Detroit, Christos Moisesides and Michael Sinanis reopened the facility as 23rd Street Studios ([www.23rdstreetstudios.com](http://www.23rdstreetstudios.com)). The facility will offer filmmakers studio space, equipment rental and production offices. Sinanis hopes to convert the site into a full film studio sometime in 2009. In a state full of empty factories and warehouses, it's commendable to see business owners looking outside the auto industry to create new jobs in Michigan.

"It's a no-brainer to provide film production services in a facility like this," says Sinanis. "We've got 18 acres, the perfect size and layout for film production. We have cranes, heavy flooring and rail capabilities as well."

In addition, Sinanis is emphasizing green manufacturing on all the new construction as well as the warehouse conversion aspects of

the project. "We want to be as eco-friendly as possible, everything from the waste to the oil as well as the material we're buying," Sinanis says. "Leadership in Energy and Environmental Design (LEED) practices will help us reach our sustainability and energy efficient goals."



**The former Detroit Electro Coatings plant is being converted into a film studio in an effort to create more jobs in Michigan (Courtesy 23rd Street Studios).**



**Construction on 23rd Street Studios will include LEED practices that focus on green manufacturing initiatives (Courtesy 23rd Street Studios).**

In Minnesota, a coalition between student organizations at McAllister University and Local UAW 879 has recently proposed plans to convert the Ford Twin Cities Assembly Plant in St. Paul, MN into a green manufacturing hub once the plant shuts down in 2011. The Arise Project, one of several initiatives currently being considered for the Ford site, is a development strategy that would bring retail businesses to the lower levels of the plant with residential units above. Rooftop restaurants and bars would be connected to gardens with beautiful views along the Mississippi River.

"The city of St. Paul is open and receptive to what many of these organizations want to do," says Merritt Clapp-Smith, department of planning and economic development for the city of St. Paul. "We're in the process of hiring a consultant to look over many of these green manufacturing opportunities to see what might be the best fit."

Green manufacturing concepts in Los Angeles, New York, Boston and Chicago are paving the way for more green renovation projects in the future. Community colleges and environmental task

forces are working daily to find new areas to promote such growth. Flint at the Lincoln Institute sees many advantages to redevelopment projects with green manufacturing in mind.

"I suppose a manufacturing facility that made machine parts that was converted into a wind turbine facility with energy efficient windows, lighting, heating, cooling, a green roof and was also near a transit station—now that would be the ultimate in green."

For more information on adaptive reuse projects visit [www.lincolnst.edu](http://www.lincolinst.edu) or [www.adaptivereuse.org](http://www.adaptivereuse.org).

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