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TB Wood's

Formsprag Clutch

Wichita Clutch

Marland Clutch

Industrial Clutch

Bauer Gear Motor

Svendborg Brakes

Nuttall Gear

Warner Linear

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Stieber Clutch

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*Excerpted From*

# Growing Trend: More Application-Specific Clutches and Brakes



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Excerpted From

# Growing Trend: More Application-Specific Clutches and Brakes

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*We asked several industry experts about this and other trends spurring clutch/brake innovation.*

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**What are some technological advances (yours and in general) that have improved the performance of clutches and brakes, or helped them get into new applications over the last few years?**

**Ebling:** Clutch brake friction material science continues to evolve with new materials available with higher and more consistent coefficients of friction factors with improved wear characteristics yielding much longer service life.

Advances in lower cost manufacturing of Neodymium magnets supports more common usage in safety brakes (holding, e-stop), allowing smaller and more reliable brake designs.

Improvements in magnet wire, lead wire and connection insulation systems allow higher clutch/brake operating temperatures, which yields broader application performance, longer useable life and improved reliability.

We have been working on improvements in friction material over many years. We continue to improve torque stability and service life for our clutches and brakes. These efforts have enabled us to develop more torque dense products that provide enhanced performance in high temperature applications. We employ design software to shorten the lead time needed to develop and deliver products that meet the specific application demands of our customers.

We have also been developing advanced wrap spring clutch designs that provide enhanced operation at lower speeds and loads for various new applications. This is an example of re-packing a mature technology to meet modern application requirements and tight cost constraints, enabling customers to select this technology over higher cost servo systems in certain applications.

**McConkie:** Wichita and Industrial Clutch have been focused on improvements in corrosion-resistance, friction material stability, weight, and performance tolerances. Specifically, the narrowing of minimum and maximum torques that allow the reduction of service factors.

**Travis:** Both Formsprag and Marland Clutch have seen requests for increased product monitoring and, as a result, we have added provisions for mounting both temperature and vibration probes to both our low speed backstopping clutches and the Marland clutches.

Over the last 5 years we have seen growing demands for larger backstops to meet the requirements of new conveyor drives with increased combined horsepower requirements of over 14,000 HP or 10,444 kW. As a result, in 2010, Marland introduced a low speed backstop with a torque capacity of 1,200,000 lb. ft. (1626000 Nm) and in 2012 introduced two larger sizes with torque capacities of 1,600,000 (2169000 Nm) and 2,100,000 lb.ft. (2847000 Nm) respectively.

With over 150 years of combined design and market experience, Formsprag and Marland clutches are designed with safety factors included in the torque ratings, providing a more durable product which is re-buildable thus reducing the users long term operating cost.

**What industries are spurring changes in the design of clutches and brakes? What industries are using more clutches and brakes than ever, and why do you think that is?**

**Ebling:** A number of industries have continued to push the performance envelope for clutch/brake improvements.

The Outdoor Power Equipment Industry, as a result of increased attention to safety and improved operator experience, has been driving the need for shorter mower blade stop times and improved engagement characteristics.

The Marine Industry requires extremely rugged drivetrain systems, able to survive severe impact and torque reversal loads. These are applications well suited for friction clutch brake products due to high torque transfer with slip capability to protect the drive trains.

In the Food Processing Industry, there is a constant push for more reliable food grade (washdown) capable products driving the use of more stainless steel housings and components, particularly meat processing, where clutch/brake products work with motor and gearbox drives.

In Mobile Power Industries (turf & garden, agriculture equipment, off-highway construction equipment) including hybrid vehicles, the need for low cost, high torque, relatively low cycle rate clutches and brakes continues to drive new designs. Electronic control advances in lower cost processors and smarter chips are driving the industry in general to more efficiently controlled electric clutches and brakes.

More demanding capability and flexibility of mobile power equipment often requires precise control of transmissions – starting, stopping and holding torque efficiently provided by clutches and brakes. Controlled acceleration and deceleration of operating loads continues to be an important clutch/brake function. A new brake was recently developed for a sophisticated tensioning system due to technology advances of friction materials and electronic controls.

Perhaps the most significant way power transmission is evolving is in the use of very efficient electric motor drives, such as those developed by electric hybrid vehicles. On one hand, electric vehicles tend to eliminate the need for selective drive line coupling devices. In some cases, these very efficient motor drive systems do not have adequate starting torque and require a clutch to allow the drive to achieve operating torque before it is loaded. Also, no matter how hi-tech the motor drive is, they still need some mechanical device to stop and hold position, so e-stop and holding brakes continue to be required.



In response to growing demands for larger backstops to meet the requirements of new, more powerful mine conveyors drives, Marland Clutch has introduced a low speed backstop with a torque capacity of 1,200,000 lb.ft. (1626000 Nm) and more recently introduced two larger sizes with torque capacities of 1,600,000 (2169000 Nm) and 2,100,000 lb. ft. (2847000 Nm) respectively. The BC model backstops prevent uncontrolled runback of the conveyor in the event of an unplanned power outage or mechanical failure in the drive.



In energy generation, wind in particular – the industry is driving the development of more power efficient holding brakes such as pitch brakes for wind turbine blades. Again, technology driven improvements in friction systems and control capabilities allow more use of clutches/brakes as cost effective solutions.

Safety requirements continue to evolve, which has driven the need for more controllability and responsiveness in emergency stop systems. This is often accomplished with failsafe clutch/brake products. Be it the need for absolute positioning control as in servo drives used in robots where brakes are used for emergency dynamic stopping and load holding, to sophisticated safety stop requirements of garden tractor mower blades, concrete saw blades or stump grinder cutters, improved friction and control technology serves the market needs well.

Machine safety regulations have driven growth of power-off brakes, both electromagnetic and pressure-operated. Market demand for increased automation and reduced labor costs continue to fuel requirements for lower cost, smaller package sizes, and often higher torque and faster response times. Many customers are replacing hydraulic systems with electromagnetically-operated clutches and brakes to increase fuel efficiency and avoid problems with leakage.

**McConkie:** In the oil & gas market, wide spread conversion to AC drives for many applications has increased the need for larger horsepower spring-applied e-stop and parking brakes.

**Schwär:** Over the last years, we have done several optimizations and changes to offer our customers the best solution for their specific application. In the mining industry, loads are steadily increasing but the dimensions of the drivetrain are shrinking. Power requirements are increasing to 3500 kW at 1,800 rpm in the Uninterruptible Power Supply (UPS) or Standby Generator industry.

**Aye:** We have seen an increased interest in the petrochemical market for overrunning clutch technologies. The worldwide growth of this market is resulting in greater demand for overrunning clutches to isolate multiple drivers.


**Travis:** The mining industry is requesting more performance monitoring to assist in the scheduling of clutch replacement and provide an earlier warning of major drive component premature failures. To meet these requirements, both Formsprag and Marland have incorporated mounting provisions for both temperature and vibration probes into our product designs.

**How do you think the focus on efficiency will change the use of brakes and clutches in the next decade?**

**Ebling:** Being able to easily and smoothly disconnect parasitic losses of drive systems when not needed (e.g., radiator fans, sometimes displacing viscous clutches), or connect drives when alternative power sources are needed (e.g., electric motors in hybrid powertrains) are



Air cooled, spring-set, air released AirMaKKs SSB high torque brakes by Wichita Clutch are designed to provide low speed braking assistance in applications including conveyors, cranes and drawworks where they serve as a main brake that provides both parking and e-stop braking functions. AirMaKKs brakes, featuring stainless steel torque plates, are also available for marine deck applications where sea spray and direct seawater splash are prevalent.



significant areas in many of today's drive lines to maximize system efficiency and operator experience.

Warner Electric has been instrumental in the development of higher efficiency/longer life and more controllable engagement characteristics to serve these applications. A recent example is in the use of clutches for medium- and heavy-duty truck cooling system fan controls used in many buses and utility vehicles.

We continue to identify ways to improve the efficiency of our products by reducing current draw and the inertia of rotating components, along with product size and assembled weight. Efficiency demands from customer applications will continue to encourage the development of more efficient, and more easily applied clutches and brakes. This includes integrated circuitry.

**Schwär:** Efficiency is getting more and more important. We think that the business will evolve to more customer-specific solutions in the next decade. The requirements within an industry and application are often similar but not the same. Our goal is to offer our customers the best solution to improve the efficiency of their particular application. In torque transmission, an overrunning clutch has more than 99% efficiency.


**Aye:** The increased drive for higher efficiency Hydraulic Power Recovery Turbine (HPRTs) systems, has led us to develop larger, faster overrunning clutches to meet the demand. The associated improvements in system efficiency have made these systems more practical and advantageous.

**We see application-dedicated and fully-custom clutches and brakes proliferate as designs become more specialized (with fully enclosed designs; fully integrated feedback; specialization for vertical applications, underwater applications). Do you see the same, or do you see the industry changing in a different way?**

**Ebling:** We see a continuing trend toward more unique and custom designed products to suit customer applications. Our customers are working to differentiate themselves from their competition with unique designs, which in turn is driven down through their supplier partners. Customers are demanding more integrated features within our products to simplify assembly at their facilities and reduce the overall supplier base.

We have always focused on providing custom designs for specific applications as a way of differentiating ourselves in the marketplace. This trend is even more evident today. Customers continue pushing the envelope of productivity and efficiency, usually requiring something more than is offered in a catalog, or which is currently in production.

We are working on an increasing number of opportunities for complete drive systems that include a clutch, brake, and other power transmission components. In some cases, our customers look to us for the expertise to design and provide the complete drive package



including the motor, gearing, mechanical drive components, and couplings. We can draw upon the other 22 brands of Altra Industrial Motion to design comprehensive drivetrain solutions. This ability provides our customers with single source convenience from engineering through invoicing.

**McConkie:** We see the same changes. Almost without exception, our new market sales in the past several years have all been unique configurations tailored to specific needs of the customer. Monitoring sensors, fully enclosed housings, extreme temperature, salt water splash, calibrated torques, multiple actuation systems, redundant actuation systems, and controlled stopping are just some of the more common demands.

**Schwär:** We see the same emphasis on specialization. Together with our customers, we are developing more and more completely customized solutions. Stieber Clutch has more than 4,000 special designs which have been developed for customer-specific applications.

**Travis:** Yes, even though our Application Engineer group has developed over 3,000 overrunning clutch design variations, we still have a monthly average of over 20 new designs processed through our engineering department.

**Tell us about an application where engineers used your clutches or brakes to improve their design. What about this application is modern or unlike anything that was possible 10 years ago?**

**Ebling:** Safety, energy savings, controllability and ease of operator use are primary clutch/brake characteristics continuing to evolve in supporting requested improvements in customer's equipment. An example is the addition of a Warner Electric clutch/brake to a stump grinder. Previously, the cutter would coast to a stop when mechanically disengaged from the engine and gearbox drive. With the Warner Electric dynamic brake, the cutter head is stopped almost instantaneously, providing a much safer work environment for the equipment operator.

Recently, we provided a packaged electric brake solution to replace hydraulic brakes for several military applications. This project included the development of a power-off brake, a power-on friction clutch, a permanent magnet tooth brake, and gearing – all in one system. The transition from hydraulic to electric was driven, in part, to reduce service requirements and increase safety. The brakes were packaged with a service feature via input from Altra's gearing brands.

**McConkie:** One of the most unique was the introduction of stainless steel friction wear surfaces for a salt water splash environment. Years ago, we would have been limited to using only coatings on exposed surfaces but would have been unable to protect the actual friction wear area. Pitting and corrosion of the wear surfaces destroy the torque calibration and can cause the brake to deliver torques far above



the planned specification. Excessive torques can lead to gearbox, coupling, bearing, and cable failures. Recent breakthroughs in friction materials allowed us to design a brake with all the normal torque characteristics of a standard brake but capable of running even if occasionally submerged in salt water.

**Schwär:** A major gearbox OEM needed a compact, load-sharing, releasable backstop solution for use on a new incline conveyor system at a coal mine in Pennsylvania. Unlike other backstop designs that offer limited reverse rotation after being engaged, the new solution needed to allow a controlled release under load and to be able to rotate backwards for maintenance and clearing work.

To meet the application requirements, Stieber Clutch provided newly developed RDBK high-speed backstops. The RDBK features an internal torque limiter which is especially designed for use on the high-speed or intermediate shaft of the driving unit in multi-drive systems, such as in large inclined conveyors, where two or more backstops share the reverse load.

RDBK units also feature a releasable function which helps to reduce downtime once the backstop has been engaged in the event of a blockage, belt jam or overload. Through the use of an internal hydraulic system, the RDBK is capable of performing as many reverse rotations as needed to completely unload a conveyor prior to maintenance work.

With a maximum torque capacity of 180,000 Nm, a unique, compact design gives the RDBK up to 3.5 times more torque capacity than backstops of traditional design; with up to 15 times more energy dissipation. The friction linings work in an oil bath to make sure that the unit remains functional after long periods of inaction.

**Travis:** The Fan Market has experienced a problem with wind milling, the act of fans rotating in the wrong direction due to wind currents when the fan is un-powered. In response to the problem, Formsprag engineers developed a low-cost, no-maintenance fan backstop that did not require any controls and positively prevented the fan from rotating in the wrong direction. The unique design was further improved so that it did not require a shaft key, which simplified installation and met OEM cost targets.

### **Has the manufacture or distribution of clutches and brakes changed over the last few years? If so, how?**

**Ebling:** The advent of 3D solid modeling, lean manufacturing concepts and overall globalization of suppliers have each contributed to the evolution of clutch/brake products and applications for their use. Our ability to efficiently design & simulate magnetic circuits with computer aided magnet analysis has expedited our ability to redesign critical components to accommodate more efficient and cost effective manufacturing designs (e.g., large 2- and 4-pole one piece slotted rotors). Years ago, we tended to standardize on stampings and consolidated designs to have the volume to justify the capital expense to do so.



The Stieber Clutch RDBK is a centrifugal lift-off sprag high-speed backstop equipped with an integral torque limiter. The unit is designed to be used mostly as a backstop in multidrive systems, such as on large inclined conveyors, where two or more backstops share the reverse load. RDBK units feature a releasable function which helps to reduce downtime once the backstop has been engaged in the event of a blockage, belt jam or overload. Through the use of an internal hydraulic system, the RDBK is capable of performing as many reverse rotations as needed to completely unload a conveyor prior to maintenance work.

Today, rapid 3D design and 3D manufacturing technologies allow the use of unique machined parts to satisfy specific customer needs with less capital investment. Together with quick set up practices and single-piece flow assembly methods, part “volume” consideration is mostly irrelevant.

A recent example of this is a mud boat driveline application where Warner Electric worked together with the customer to develop a new, low cost brake for a mud boat drive line reversing mechanism. The application is unique as it takes advantage of a relatively low-cost, high volume clutch product, reengineered into a custom brake configuration, used to produce a reversing function for a relatively low volume driveline. Use of 3D tools in design and manufacturing, in combination with single-piece flow assembly operations yielded a cost effective solution.

At Altra Industrial Motion, we are making extensive use of lean manufacturing principles in all our manufacturing operations to reduce customer lead times, provide highly reliable delivery, and reduce inventory.

**Travis:** Yes, we see inventory pressures in all sales channel segments as the market is looking for shorter manufacturing lead times to help in keeping inventory down. In response, Formsprag and Marland Clutch have used lean manufacturing techniques to reduce lead times for overrunning clutches, by more than 50% over the last three years.



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