

Planning Ahead

Navigating Clutch/Brake Operation in Harsh Environmental Conditions

Matthew Jaster, Senior Editor

Chemicals, saltwater, food particles, heat, dust, and electrical corrosion are just a few of the many issues that can cause clutches and brakes to fail prematurely. Nobody wants to have the conversation about lost production time, growing cost concerns, or system disruptions *after* a failure has occurred. The strength of these components is in the information collected over years of service in hazardous environments and applying this knowledge to future clutch/brake technologies.

Think About the Future

Mechanical engineers have spent careers planning for system failures. They tweak, upgrade, refurbish, and redesign mechanical systems until they get it just right for the environment in question—and then something else fails (too much exposure to heat or a contaminant, for example). Perhaps it's simply a liquid getting in the wrong place. When planning to run mechanical systems in these environments, start with the basics.

As a starting point, customers should consider exposure of the friction facings to damaging contamination.

"Damage at the friction faces

The new construction series of Mayr EAS-HT High-Torque Element Clutches convinces through its improved performance density and also stands for a substantially wider selection of possible bores.

can disable a unit immediately," said Greg Cober, training manager, Altra Industrial Motion. "Other issues to be concerned with are exposure of electrical connections to liquids or exposure of bearings to high pressure washdown. If customer's can keep friction faces clean and dry that will help them to achieve design life. Sometimes a simple shroud is sufficient, but in other cases use of an enclosed design is appropriate."

For the most part, electromagnetic clutches do not require maintenance since the armatures and rotors are designed to run as a set pair throughout the life of the clutch or brake.

The three top factors Ogura considers for harsh environments are external heat, heavy vibration, and exposure to oil or grease.



"So, 'harsh' for us means an abnormally difficult environment, such as potential for contamination/corrosion and/or heat which is the enemy for most clutches and brakes. For electromagnetic units, the best prevention is to keep chemicals or other corrosives away from the clutch and to make sure it is not exposed to a high external heat source," said Brian Mather, industrial products manager at Ogura Industrial Corp.

Clutch/Brake Considerations

Cober believes three factors to consider when installing these components in harsh environments are (1) exposure to lubricants that might damage the coefficient of friction at the friction faces, (2) exposure of friction faces to abrasive contaminants, and (3) exposure to chemicals or liquids that might affect electrical connections.

For a company like Ogura, the best thing to know when clutches or brakes are becoming worn would be simple cycle monitors.

"Every time a clutch or brake engages, wear occurs between the faces. Depending upon the inertia and the speed of engagement, we can calculate how much wear occurs. That wear rate can then be calculated into a cycle rate, so if we know the cycles that are on a clutch or brake, we know that it is coming to the end of its projected



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life. In this way, a maintenance person can then replace a clutch or brake prior to having a complete failure to engage," Mather said.

A key step in this process is working closely with the OEM on a preventative maintenance plan.

"Any time there is a failure at a customer, the clutch or brake is either sent back to their facility and reviewed there or sent directly back to our main facility and reviewed by our service department. We do a no charge analysis for each return and explain to the customer what failed and why we think it failed. This allows our OEM's to make changes to their equipment to prevent future failures and to reduce their overall maintenance, warranty and service costs," Mather said.

Operating Challenges

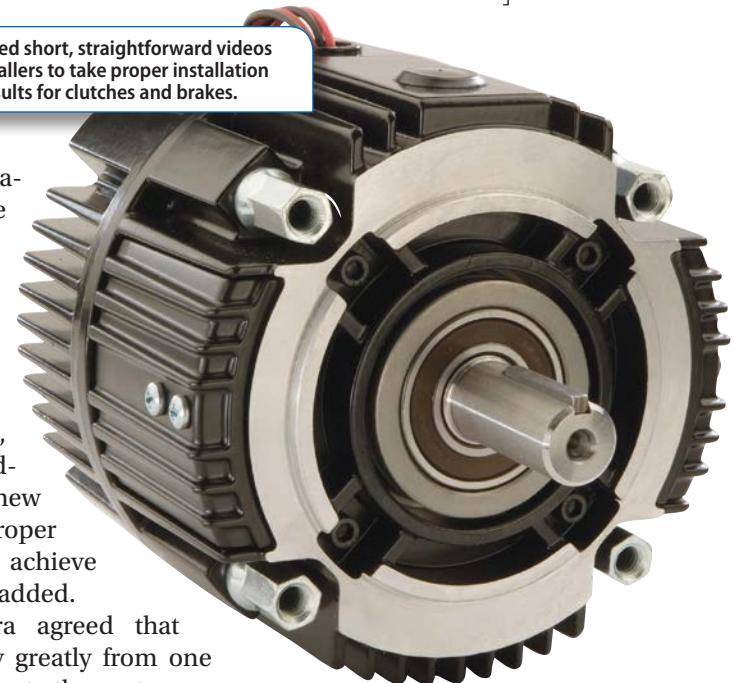
The operating challenges in these environments greatly depend upon the application itself. Just like bearings or gears, improper installation is a major operating challenge that can alter the performance of a clutch and/or brake.

Warner Electric has created short, straightforward videos that can enable new installers to take proper installation steps to achieve best results for clutches and brakes.

"Improper installation is definitely one of the major challenges that result in poor clutch/brake performance. To address this, Warner Electric has created short, straight forward videos that can enable new installers to take proper installation steps to achieve best results," Cober added.

Mather at Ogura agreed that the challenges vary greatly from one industrial application to the next.

"For example, you may have a micro clutch operating in a network printer that can be exposed to toner (a potential contaminant) and heat from motors, but in an outdoor application like a stump grinder where the clutch is mounted directly on the engine



shaft, you have heat and vibration from the engine to contend with as well as water and dirt," Mather said. "So, in our products, we have to modify them to meet those environments. With the micro clutches and printers, we can create shielded armatures that prevent toner getting in between the clutch faces and causing the clutch to slip. In outdoor environments, we remove friction material from the clutches so it is a steel-on-steel engagement. Also, we epoxy protect the electric coil which helps not only prevent water contamination, but also keeps the coil seated in heavy vibration."

Another challenge is keeping up with technological demands of automation. The degree of automation is increasing as humans and robots are cooperating more closely together on the factory floor. Therefore, machines and systems are increasing in performance density as well as operating speed which translates to higher demands on individual components.

Mayr Power Transmission displayed small, high-performance safety brakes like the ROBA-ServoStop construction series recently during Hannover Messe. These brakes are tailored to robotic requirements through their slim design and low weight. In addition, the company has a fluid-free linear brake in its portfolio with its ROBA-LinearStop in electromagnetic design, which has been designed to

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secure gravity-loaded vertical axes. These brakes are used in applications in which compressors or units for compressed air or oil hydraulics are not available or are unwanted, such as in medical technology or the food or pharmaceutical industry, where high hygiene standards are required.

The Mayr ROBA-Brake-Checker module also opens up new possibilities for brake monitoring in these application fields. With a new module design and thanks to even more accurate evaluation, it is now possible to also supply and monitor small brake sizes from a braking torque of 0.7 Nm.

The Environmental Aspect

Custom-made components play a pivotal role in places where the environment can cause potential failures.

Any wet environment, for example, is a challenge for friction clutches and brakes, according to Lesli Riehemann, president at Mach III.

"A wet friction disc can swell, taking up clearances and preventing proper clutch or brake function. Mach III regularly addresses the potential for fluid contamination through designing custom products with enclosed and sealed housings. An example is a slip clutch



In dusty environments, Mach III offers a cover modification by increasing the outside diameter of the cylinder and machining it to cover the open portion of the clutch-brake.

which was developed for a food processing application. Used on a machine which produces beef jerky, it is washed-down daily. In addition to being fully enclosed and sealed with O-rings, all exposed components are made from stainless steel to prevent corrosion."

Riehemann said another cause for concern is particulate contamination.

"This can also be a problem since it causes premature wear of seals and friction materials, and if abundant, can take up clearances. In dusty

environments, we often make a minor modification of a catalog design to incorporate a cover. Our combination clutch-brake is a good example of this. Both the catalog model and the modified version are shown in the photo. In this case, we simply increased the outside diameter of the cylinder and machined it to cover the open portion of the clutch-brake," Riehemann said.

Smart solutions, (clutches and brakes with condition monitoring capabilities) can offer advantages

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regarding temperature, wear and condition of the component in question.

The intelligent Mayr ROBA-Brake-Checker module, for example, works without the use of sensors. Instead, it detects the movements of the armature disk by analyzing voltage and current, and knows what condition the brake is in at all times. In addition to switching condition, temperature and wear, it also monitors the tension path or tensile force reserve, i.e. whether the magnet is still able to attract the

armature disk.

The module represents a cost-effective solution, especially for small quantities. The fact that brakes in standard design are used for monitoring with the ROBA-Brake-Checker not only offers advantages in terms of costs and delivery time, but also for example with regard to corrosion protection as the brakes can be painted over easily, quickly and safely—for example, if the corrosion risk is very high and protective measures are required in

compliance with the DIN EN ISO 12944 standard Protective Measures (C5), for example on wind power plants or on applications in the maritime sector.

Cober discussed three specific areas that might be considered harsh for clutches and brakes.

Areas where units are exposed to lubricants either as a mist or as the result of spatter from roller chain or leaks from damaged gearbox seals. Metal bending, forming or die cutting processes often require lubricants to facilitate their processes. Many conveyors use roller chain drives connected to clutch/brakes and lubricant from chain can migrate from the chain onto the friction faces of clutch/brakes.

A second would be environments with high levels of ambient contamination such as grit or dust that might be found in a foundry or mine, according to Cober. This contamination might serve to increase wear rates on clutch/brakes in foundries and mills that are used primarily in conveying processes.

"Lastly, high moisture that can damage friction faces or creates corrosion at electrical connections. High moisture levels are not uncommon in food processing facilities where wash-downs are a routine part of their process. Industrial product cleaning and degreasing can also negatively impact clutch/brakes used on conveyor drives," Cober said.

Mather at Ogura returned to the topic of heat when discussing challenges for

For Ogura electromagnetic units the best prevention is to keep chemicals or other corrosives away from the clutch and to make sure it is not exposed to a high external heat source.

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clutches and brakes.

"Heat is the main one because every time a clutch or brake engages, it generates heat. That heat has to be dissipated. If too many cycles occur, a clutch or brake cannot dissipate the heat properly and will then burn up. Also, with electromagnetic clutches, if a constant current power supply is not used, then flux can degrade as temperature increases. It is therefore important to keep environmental heat away from a clutch or brake to also help it maintain maximum torque," Mather added.

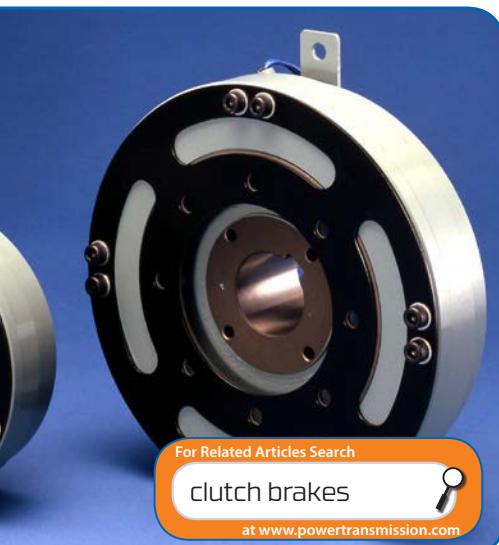
Another area Mather notes as a concern is the effect that vibration has on the bearings in clutches (most brakes do not contain bearings).

"In some applications, there can be long periods of time where there is no rotation between bearing rings. If this happens under heavy vibration, false brinelling can occur in the bearing races, which over time will cause grooves and cause the bearings to be noisy," Mather said.

"The industries that cause us the most challenges are anywhere a clutch is mounted directly on an engine shaft. In an outdoor power equipment application, any or all of the above can occur. We have made adaptations to handle many of these, but it is still much more challenging than putting a clutch on a piece of office equipment," he added.

Future Tech

Mather said that advances in electrical controls will continue to help make



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electromagnetic clutches or brakes better.

"In recent years, we have utilized a soft start control that helps clutches engage more smoothly, reducing initial shock. This helps reduce the shock of other components like drive belts in our customers machines and in some cases, has doubled the life of the belts," Mather said. "We are also working on controls that integrate a slip detector which will tell the clutch or brake that it is slipping in excess which will prevent it from burning out, saving the customer downtime and replacement costs."

In addition to safety brakes and the associated control and monitoring modules, Mayr has for decades developed and manufactured its tried and tested torque limiters and shaft couplings, and represents reliable complete solutions from a single source. Products such as the new construction series of EAS-HT High-Torque Element Clutches or EAS-Compact Overload Clutches cater to the increasing demands put on speed and dynamics. Future production procedures will ensure favorable prices and shorter lead times.

"There has also been some migration from roller chain to synchronous belt drives in recent years. Since this eliminates a source of contamination by lubricants (chain needs to be lubricated, belts do not) it eliminates a source of failure," Cober said. "In mobile applications there has been a trend of OEMs requesting that Warner Electric create and deliver completely assembled product solutions, where in the past the OEMs did much of the assembly integration."

The more control you have of the system, the more knowledge you have of how the components will operate under different environmental conditions. **PTE**

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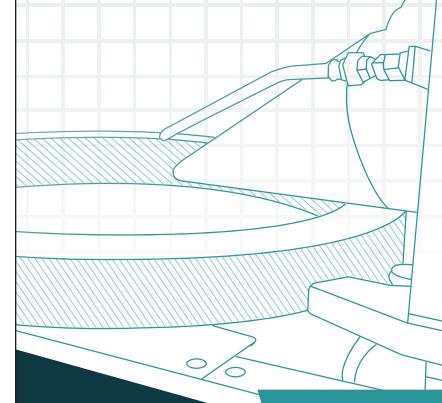
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