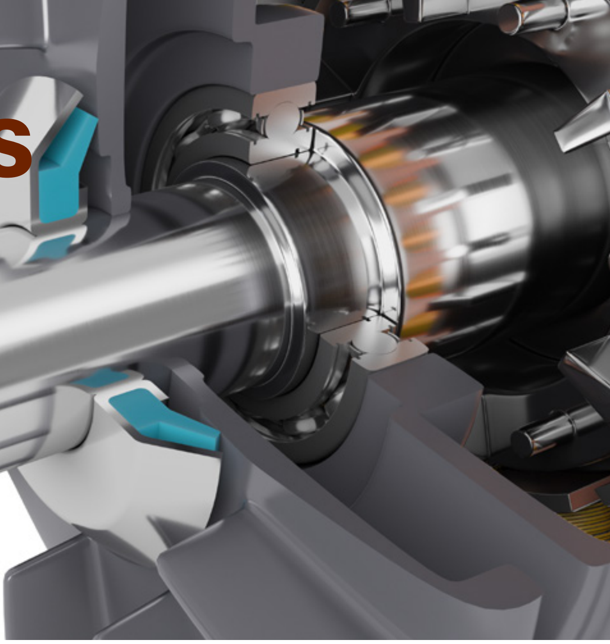
Trelleborg Shares Insights on Sealing Needs for Electric Motors



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Discussion includes radial shaft seals as well as PTFE-based seals

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From electric motors and linear actuators to robots and gearboxes, the range of equipment and machinery used to create automation in industrial applications is diverse. Each has its own set of sealing requirements and understanding these critical components requires many years of experience. In this article David Kaley, Trelleborg's global segment manager for industrial automation, shares his insights on sealing needs for electric motors. Standard, elastomer-based radial shaft seals as well as high-performing PTFE-based seals are discussed.

Q: What is an electric motor?

An electric motor is a device that converts electrical energy to mechanical energy. Most operate using the interaction of the motor's magnetic field and electrical current in a wound wire to produce torque-supplied force on the motor shaft.

Q: Tell us about the different kinds of electric motors.

There are many different types of electric motors. However, in its simplest form, an electric motor may be driven by direct current (DC) supplies, like in rectifiers or batteries, or by alternating current (AC) supplies like in power grids, electrical generators or inverters. Electric motors are categorized by their power supply type, application use, construction and type of movement output.

Standardized motors offer appropriate mechanical energy for industrial use. Applications include blowers and pumps, industrial fans, conveyors, machine tools, power tools, processing equipment, packaging machines, vehicles and more. If it moves it probably has a motor connected to it.

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Q: Can you explain more about the differences between AC and DC motors?

Alternating current motor (AC motors): Consist of a stator with a coil that is supplied with alternating current to convert electric current into mechanical power. The stator is the stationary part of the motor while the rotor is the rotating part. AC motors are a power source for a wide variety of applications due to their flexibility, efficiency and noiseless operation.

Direct current motor (DC motors): Transform electrical energy into mechanical energy by creating a magnetic field in its stator powered by direct current. The field attracts and repels magnets on the rotor making it rotate.

One of the main differences between AC and DC motors is speed control. An AC motor runs at the frequency of the AC supply and resists changes to speed even when the load changes. To change the speed of the motor, a variable frequency drive (VFD) is used to convert the AC supply to DC and back again at a different frequency. This means that AC motors are ideal for situations where the motor speed is slow to medium and remains constant while the load on the motor varies. This is why AC motors are used in heavy-duty, continuous-speed industrial applications.

DC motors can easily be speed-controlled by modifying the voltage supply. They provide a consistent amount of torque over their entire speed range but are sensitive to changes in the load. This makes them ideal for situations where fine speed control is necessary and the load does not vary significantly, such as in domestic appliances or robotics. DC motors generally cost significantly more than AC motors due to higher manufacturing costs. Also, because AC motors have such widespread use, economies of scale contribute to their relatively lower price.

Q: What are some of the key considerations when it comes to electric motors?

All types of electric motors share operating priorities at some level. The main concerns for electric motor original equipment manufacturers are as follows:

- **Stator protection:** Critical for preventing damage to the stator windings which are the most vulnerable part of the motor. Stator protection helps ensure the longevity and reliability of electric motors by preventing overheating, overcurrent and other potential faults.
- **Rotor lubrication:** Rotor lubrication primarily involves the lubrication of the bearings that support the rotor. Proper lubrication is essential for reducing friction, preventing wear and ensuring smooth operation.
- **Particle and liquid ingression:** Particle and/or liquid ingression in electric motors refers to the entry of liquids, dust, dirt and other solid particles into the motor. This can significantly impact the motor's performance and longevity.
- **Shaft vibration:** Shaft vibration in electric motors refers to the oscillatory motion of the motor's shaft, which can lead to various operational issues if not properly managed.
- **Friction/heat generation:** Friction creates heat which can lead to issues impacting performance of the motor and its longevity.
- **Precision:** Precision in electric motors is crucial for applications that require high accuracy, reliability and efficiency.

  Achieving precision involves having high-quality components, tight tolerances, advanced control systems and feedback mechanisms like encoders and resolvers.

Q: What kind of critical sealing components are needed to address these challenges in electric motors?

As dry running systems, electric motors operate on reduced lubrication versus their gas-powered wet-running counterparts, requiring specific sealing solutions to manage friction and heat generation. Electric systems have fewer sealing components but still require long-lasting sealing products. The seals must protect the motor by keeping oil and grease on the rotating shaft and preventing the ingress of dust and dirt. Static seals such as O-Rings, gaskets, bonded seals and molded parts are used as sealing elements for lids, flange joints, threads and covers.

The type of rotary seal used for high-speed low-friction industrial motors depends on the complexity of the application.

Reducing power loss across the system is another function of the seal, so less energy is required to power equipment or convert into performance. Friction from the bearings and the sealing arrangement both affect power loss, so balancing sealing capabilities with the need for minimal friction is a challenge. A nitrile butadiene rubber (NBR) or fluoroelastomer (FKM) seal usually offers the best solution for reducing friction and power loss depending on the application's temperature and speed of rotation.

Elastomer radial oil seals are traditionally a primary rotary seal in standard wet-lubricated systems because they have excellent sealing performance and easy installation. However, elastomer radial oil seals struggle to stand up to the conditions of electric motors, such as increased rotary speeds, reduced lubrication or dry running conditions. Elastomer seals also create greater friction resulting in higher power loss.

Polytetrafluoroethylene (PTFE) rotary seals are an excellent alternative, featuring benefits that suit the demands of electric motors and high-speed, critical environments, including:

- Ability to withstand high speeds of up to 224 miles per hour
- Extremely low friction performance
- A wide operating temperature range (-148°F to +500°F)
- Ability to run dry
- Compatibility with most lubricants
- Inertness to most chemicals
- Low break-out force and no stick slip
- High wear resistance

Q: What unique sealing solutions can Trelleborg offer for electric motors?

Trelleborg's Varilip PDR radial oil seal is designed specifically to offer superior performance for electric motors operating at higher speeds. It is constructed from one or multiple Turcon PTFE-based sealing elements which are mechanically retained in a precision-machined metal body. The metal body gives a robust static seal against the housing, preventing changes in operating temperature caused by repeated oscillation. Meanwhile, the Turcon sealing element effectively prevents leakage while allowing for motion between the rotating and stationary parts of the motor, leading to excellent performance at high speeds. Characterized by low friction and stick-slip-free running, the seal reduces temperature generation, permits higher speeds at the outer edge of the rotor and lowers power consumption. This results in a long-service life, maximizing the time between maintenance and greater productivity.

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