Motors and More: Achieving Greater Efficiency in Industrial Automation Applications

Industrial automation is highly beneficial because it decreases production times, improves quality and increases productivity in a world where customers expect quick turnaround times. An Original Equipment Manufacturer (OEM) brings the benefits of industrial automation to its customers even as it applies automation best practices to the machines it builds. Consider this: Electric motors are important elements in automation, increasing efficiency and improving sustainability in the industrial sector and the seals within electric motors are key for achieving optimal efficiency in automated systems. Since most motors do not operate at steady speeds OEMs need low friction sealing materials and designs that increase efficiency and help prevent downtime.

Motor facts and efficiency

According to the US Environmental Protection Agency, the industrial sector was responsible for 23% of US greenhouse gas (GHG) emissions in 2021 and the US Energy Information Administration says that manufacturing accounts for more than half of electricity use. Realizing energy efficiencies in industrial automation

is a foundational decarbonization strategy and a cost-effective option for reducing GHG emissions in the short term.

Motors convert one-third of all electricity into motion and the number of these motors is expected to double by 2040. This demand is causing more manufacturers to focus on achieving IE5 motor efficiency. Currently, there are five International Efficiency class ratings, IE1 to IE5, with each level seeing a reduction in energy loss in motor operation by 10-20%. Governments do not require anything higher than IE3, so an IE5 rating is a strong differentiator.

A balancing act

An OEM must balance shaft size, revolutions per minute (RPM), seal type and material, and lubrication to make the most efficient motor. The friction of seals with the motor impeding the shaft spinning is the main cause of energy wastage. A type of parasitic energy loss, seals are responsible for small amounts of energy loss accumulating over time due to friction, reducing efficiency.

When looking at a seal and its impact on the motor, a consideration is that most motors do not operate at steady speeds. They start and stop and every time a motor restarts it must overcome stiction, the initial friction or start up torque of the seal; the force needed for an object to move from a position at rest, referred to as variable speed drive efficiency.

Industrial motors are at their highest efficiency when they are running at full speed. The best performing low-friction radial oil seals help maintain efficiency at both ends of the speed spectrum, while keeping the shaft cool, lubricants in and contaminants out.

This friction challenge is even greater in aggressive environments, such as

washdown applications in food and beverage or dust resistance in flour milling applications, as the torque of the seal onto the shaft needs to be higher to maintain ingress protection ratings.

Considerations for optimal efficiency

Motor maintenance and downtime. As seals experience friction they wear and become less effective. Replacing seals and bearings is the number one cause of downtime for industrial equipment and motors. Low-friction seals last longer and need less maintenance, resulting in less downtime.

A component partner like Trelleborg offers an extensive portfolio of low-friction materials and seal designs that can assist OEMs with decarbonization and efficiency efforts for electric motors, linear actuators and robotics. Trelleborg also offers finite element analysis capabilities that help with planning preventative maintenance, reducing unexpected downtime.

Advanced elastomer materials. As previously mentioned, seal material is a key consideration for achieving optimal efficiency in industrial motors for automated systems. OEMs can collaborate with their sealing partner to select one of the following compounds that best suits their needs:

- Nitrile Butadiene Rubber (NBR) is primarily used with mineral-based oils and greases, providing good mechanical and temperature resistance.
- Hydrogenated Nitrile Butadiene Rubber **(**HNBR) is often used in high-temperature applications and demonstrates excellent abrasion resistance and mechanical properties.
- Fluoroelastomer (FKM) is known for its non-flammability, low gas permeability and excellent resistance to ozone, weathering and aging. Suitably formulated FKM operates down to -35 ˚C/-31 ˚F and meets

requirements for mineral-based oils and greases at high temperatures.

- Silicone Rubber (VMQ) has very good heat resistance, low-temperature flexibility and electrical properties, and excellent resistance to weather, ozone and UV rays. Specific VMQ formulations are resistant to aliphatic engine and gear box oils, water up to +100 ˚C/+212 ˚F and high molecular chlorinated hydrocarbons.
- Trelleborg's TURCON materials are based on premium-grade Polytetrafluoroethylene (PTFE). They demonstrate low friction, with minimized wear in dynamic and even high-speed applications. They are compatible with virtually all media, even at elevated temperatures, and are resistant to aging.
- Trelleborg's ZURCON engineered polyurethane-based materials exhibit outstanding friction characteristics. The new Zurcon Z13 material is specially developed to cope with pressures up to 50 MPa/7,250 psi at both sides of the seal and at temperatures up to +120 °C/+248 °F

Lightweight industrial robots. As industrial automation continues to evolve, robotics OEMs will look to reduce the weight of industrial robots to increase their efficiency and market competitiveness. Seal manufacturers like Trelleborg will help OEMs on their weight-reduction quest by creating mini and nano radial oil seals with extremely small profiles. Smaller radial oil seals reduce the amount of metal and therefore weight, supporting lighter robots requiring less energy to operate and contributing to greater efficiency.

Conclusion

An OEM can improve quality, efficiency and productivity, as well as help meet decarbonization and sustainability goals by considering all aspects of electric motors, linear actuators and robotics. Collaborating with a sealing partner to find the best low-friction materials and seal designs can help.