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Excerpted From

Components Toughen Up

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Boston® Gear

An Altra Industrial Motion Company

Excerpted From

Components Toughen Up

by Wayne Labs
Senior Technical Editor, Food Engineering Magazine

Boston Gear stainless steel mounted bearings are designed for superior performance in high pressure food processing and packaging washdown applications. Pillow block and flanged mounted bearings feature cast stainless steel housings, synthetic lip seals and NSF H1 food grade grease.

While the power transmission industry is pretty mature, power transmission components have had to endure a lot of hardships imposed upon them by the food and beverage industry. With the ever-increasing concerns about foodborne illness and the need to kill bacteria to a 99.999 percent level, gearboxes, gears and bearings have been holding their own, while enduring the onslaught of harsh cleaning environments.

Bearings are at the heart of any power transmission system, and their makers have been toughening them up to take the pressure from hot washdowns. “Bearing manufacturers have improved the surface finish and geometric tolerance that increase bearing life and load carrying performance,” says Rick Wucherer, Boston Gear product manager. “Steel manufacturers have improved the cleanliness of the steel, which also increases bearing life.”

In washdown conditions, a better bearing does not correspond to longer life if the seals do not protect the lubrication and steel surfaces from corrosion. Upgrading to a stainless steel bearing insert increases the corrosion resistance of the steel surfaces and extends its life, according to Wucherer. Ideally, the bearing should include a shield or labyrinth to protect the rubber seal lip from damage due to high-pressure washdowns. For optimum performance, a stainless steel insert should be combined with a labyrinth-lip seal to keep the moisture out and protect the lubrication.

A correct bearing maintenance program is one method to extend lifetime, explains Wucherer. “Unfortunately, this varies significantly from application to application,” he says. If properly applied, premium lubrication will last a very long time, but it can be degraded by water, chemicals, dirt or improper mixing of lubrications. Bearing re-lubrication should be completed with a grease of the same type of thickener; otherwise, the oil may separate from the grease and cause a lubrication failure. Over-greasing at high pressure can damage the seals, but under-greasing a bearing may lead to lubrication failure, warns Wucherer.

Seals and lubricants protect gearbox systems

"Seals need to protect the lubrication and the bearing raceways, and prevent debris from entering the bearing," says Wucherer. "To minimize bacteria growth, food processors are washing their equipment more frequently and with more aggressive chemicals. Lubrication that is degraded by water and washdown chemicals will not protect the raceways and will lead to shortened bearing life. Seals need a sealing lip as well as a metal shield to protect the rubber seal lip against high-pressure washdowns and prevent water and chemicals from entering the bearing. Incorrect chemicals or high concentrations of chemicals also can damage rubber seals."

"Typical lip seals are made from rubber and are subject to time and environmental conditions," adds Boston Gear's Wucherer. "The rubber hardens with time and temperature, but it is a wear item. Premium mechanical face seals are available, but often are more expensive than a gearbox, so [processors] choose not to make the investment."

The common solution is to use a spring-loaded lip seal, but caution must be taken to protect the seals from environmental issues, says Wucherer. For example, using an undersized gearbox will make it run hot, which will affect seal life since the rubber may harden more quickly. Therefore, the rubber used in every lip seal must be matched to the total operating range of the application. Seals fail quickly at temperatures above or below their operating range, but their life will be improved with temperatures approaching their limitations, says Wucherer.

Rubber seal materials have evolved significantly over the last 20 years, providing larger temperature ranges and lower friction, but the most common failure is still application induced, adds Wucherer. Protecting seals from dust/dirt will extend seal life because of reduced shaft/seal wear.

Food applications require easy-to-clean equipment and the elimination of confined areas that might allow bacteria to breed. The design of stainless steel gearboxes and seals should take into account CIP-type guidelines. Associations such as 3-A and NSF provide guidelines and certifications to manufacturers to help them build easy-to-clean, CIP-rated gearboxes.

Stainless Steel 700 Series speed reducers from Boston Gear feature specialized design advantages when used in caustic washdown environments with corrosive chloride salts and high acid levels. A unique rounded housing made from 316 stainless steel eliminates fluid pooling on the unit. Exposed hardware is shielded by smooth-surface covers that help prevent particle and bacteria accumulation.

For decades, the food processing and packaging industries have relied on the proven technology of Boston Gear 700 Series worm gear technology for long-lasting, high-quality performance. The Stainless Steel 700 Series takes that trusted performance to new levels by providing maximum corrosion resistance in the most challenging, caustic washdown environments.

Boston Gear stainless steel, right angle helical bevel gear drives feature a 316 Series stainless steel housing with domed crown and rounded corners for superior washdown runoff in harsh environments where high-pressure caustic solvents and cleaners are utilized. A laser-marked nameplate is imperious to the effects of caustic washdowns. Stainless steel shafts and a high-pressure washdown deflector are also available.

Steps to extend the life of gearboxes

"Stainless steel gearboxes eliminate any exterior corrosion, but must be combined with stainless shafting to maximize seal performance," says Wucherer. Many good coatings are available, but making one robust enough for every chemical, chemical combination and impact it might experience in the field is very difficult, he adds.

Heat issues

"Gearboxes that run hot typically have poor efficiencies or involve high speed," says Wucherer. In the last 10 years, gearing efficiency has improved through optimized designs and tighter manufacturing processes. Lubrication has a large impact on gearbox efficiency, but the ideal lubrication for a worm gear may not be ideal for a helical gear type. Using the optimum lubrication for each gearbox design is critical for getting the most out of the installed equipment. Simply because someone is using synthetic lubrication does not mean he/she is using the best lubrication available. Switching to a premium synthetic lubrication could increase system efficiency values by 10 percent or more, says Wucherer.

"The life of a gearbox depends on many factors such as proper lubrication, correct application sizing and the internal design and construction of the gearbox," says Wucherer. Helical bevel gearboxes typically have hardened gearing that has the potential to last forever if properly sized, lubricated, designed/manufactured and kept clean.

The optimum design of spur and helical gearing maximizes the rolling between two gears and minimizes any slippage or loss. Unfortunately, some slippage will always be present, generating heat and reducing gearbox efficiency. Any slippage between gears can cause the hardened gears to wear, and that metallic wear debris will create more wear and shorten the life of the gears, bearings and seals. "Some

gearbox manufacturers such as Boston Gear include metallic entrapment designs to remove the metallic wear debris from the oil sump, thus extending the life of the gearbox," adds Wucherer.

During the selection of new equipment, one needs to research the efficiencies of potential gearbox solutions and weigh the differences in total cost of ownership vs. installation cost, says Wucherer. "For example, Boston Gear small worm gearboxes have efficiencies well over 90 percent at low ratios." In comparison, three-stage helical bevel gearboxes have efficiencies constant throughout their ratio range, but have a higher installation cost. The monetary tradeoffs between these types of gearing require a full understanding of the intended application and exact mechanical efficiencies of each drive system, offers Wucherer.

What about maintenance?

"Many food processors ignore the recommended maintenance schedule on small gearboxes and operate with MTBF [mean time between failures] in mind," says Wucherer. "They run the gearbox right up to the time of failure and replace the unit. As the system becomes more critical and more expensive to replace, the maintenance is evaluated and a preventative maintenance schedule is often established."

While a manufacturer's recommended schedule might be adequate in some situations, it may not be ideal based on environmental conditions. Instead, a maintenance schedule should be designed to maximize gearbox life. This should include an oil chemistry evaluation to determine the optimum oil change frequency and whether any problems are developing, says Wucherer. For example, if a gearbox continuously has high water content, the root cause should be determined and a solution developed. Even low water concentrations inside a gearbox will attack typical steel shafting, bearings and gearing, and lead to shortened life.

Boston Gear Series 2000 inline helical gear drives and gear motors require very low maintenance with unique rounded housing surfaces for easier cleaning, premium acrylic paint pigmented with 316 stainless steel flake for high corrosion and abrasion resistance, and integrated O-rings for high leak and ingress resistance. Other maintenance advantages include automatic entrapment of wear debris, large diameter oil fill/drain holes and synthetic lubrication.

The engineering team at Boston Gear developed a new seal option to withstand high pressure washdowns up to 1,000 psi. The new seal option incorporates an additional stainless exterior seal for rigidity, but also has a housing modification that maintains the seal joint as well as preserving the smooth exterior of the gearbox.

The Pressures On!

For many in the chicken processing industry, the Boston Gear SS700 stainless steel worm gearbox has become a reliable solution for installations where washdown challenges exist. The unit is designed to enhance processors' sanitation efforts through the elimination of flat surfaces, holes and labels where moisture and bacteria could gather. The efficient stainless steel design includes a stainless axial face seal and food-grade lubrication. The gearbox carries NSF International certification.

For one leading chicken processing plant, however, the SS700 gearbox was not quite strong enough. Its pressurized washdowns far exceeded normal industry conditions.

After investigating the challenge, the Boston Gear engineering team developed a high-pressure seal option that could withstand the rigors of the intense washdowns. The new seal option incorporates an additional stainless exterior seal for rigidity, and has a housing modification that maintains the seal joint as well as the smooth exterior of the gearbox. This stainless cover rotates with the shaft while providing protection to the double-lipped seal in the unit.

This added protection has withstood pressures up to 1,000 psi for over 200 hours, without allowing water to damage the integrity of the oil. The new gearboxes have been installed and are successfully operating at the chicken processor's facility.

About Altra Industrial Motion

Altra Industrial Motion (NASDAQ:AIMC) is a leading multi-national designer, producer and marketer of a wide range of electromechanical power transmission products. The company brings together strong brands covering over 40 product lines with production facilities in nine countries.

Altra's leading brands include Boston Gear, Warner Electric, TB Wood's, Formsprag Clutch, Wichita Clutch, Industrial Clutch, Ameridrives Couplings, Kilian Manufacturing, Marland Clutch, Nuttall Gear, Bauer Gear Motor, Svendborg Brakes, Stieber Clutch, Twiflex Limited, Bibby Turboflex, Matrix International, Inertia Dynamics, Huco Dynatork, Lamiflex Couplings, Ameridrives Power Transmission, Guardian Couplings, Delroyd Worm Gear and Warner Linear. For information on any of these technology leaders, visit www.AltraMotion.com or call 815-389-3771.

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