

Bearings for the Food & Beverage Industry

One of the most critical components required to help process the foods and beverages is mounted ball bearings.

Many of the companies associated with the food industry have implemented the seven key principles of the HACCP (Hazard Analysis and Critical Control Point) program which focuses on prevention rather than inspection.

- Principle 1: Conduct a hazard analysis.
- Principle 2: Determine the critical control points (CCPs).
- Principle 3: Establish critical limits.
- Principle 4: Establish monitoring procedures.
- Principle 5: Establish corrective actions.
- Principle 6: Establish verification procedures.
- Principle 7: Establish record-keeping and documentation procedures.

Typical food industry bearing applications

- Bakeries
 - Beef, Pork, Poultry & Fish Processing
 - Beverage Bottling
 - Dairies
 - Fruit & Vegetable Processing
 - Packaging & Processing
- The regulations mandated by the government require FDA/USDA approval of the bearings utilized in many of the food applications. This means that all of the materials, including the lubricants, must comply with all applicable federal food processing requirements.

What are the bearing choices?

Just like the menu in our favorite restaurant, the menu of food grade bearings seems to be unlimited.

Depending on the application and the preference by the customer the choices are many. The availability of housing materials are frequently mixed and matched to the available bearing insert materials. For example, some of the more popular choices available for the housings and inserts are:

- Housings:**
- Stainless Steel
 - Thermoplastic Composites
 - Cast Iron (Nickel Plated)
 - Cast Iron (Teflon Coated)
 - Polymer

- Bearing Inserts:**
- Stainless Steel
 - Thin Dense Chrome
 - Zinc Coated
 - Black Oxide

What should be used?

Housings
In many cases, the bearings are subjected to some rather harsh conditions including daily high pressure washdowns, environments saturated with moisture and contact with all

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types of caustic antibacterial cleansing solutions.

Periodically the bearings may come in contact with acids, cooking fats and other types of chemicals normally used in the processing of food and beverage products. Composite or thermoplastic housed units can help in these types of situations. They are typically lighter in weight than a cast iron housing with the added advantage that the housing will not chip or flake as compared to a plated housing. The improved technology in developing new composite materials has allowed significant improvements in the tensile strength of the composite housings and actually exceeds the static capacity of the inserts.

Higher strength cast iron units are generally a good choice for the red meat, pork and poultry sectors. Although plated housings and composite units withstand most chemicals, strong concentrations of chlorine, hydrogen peroxide and some other types of solutions could have harmful effects. This would be an excellent reason to consider using cast stainless steel units as an alternative. The housings are usually made from an AISI 300 series stainless material.

Another solution to consider is the use of nickel plated cast iron housings. Two of the more common methods used for nickel plating are either electroless nickel or the more popular CNC (copper, nickel, chrome) plating. The CNC plating provides the durability of corrosion protection with the added benefit of having a brighter, shinier appearance resembling stainless steel, as opposed to the older electroless nickel which has a dull appearance but also has good corrosion protection. The cast iron provides the strength, the nickel provides the protection and the cost is considerably less than all stainless steel. For those applications not requiring all stainless this is a very suitable alternative.

A smooth surface finish on the housings is a key characteristic. The smooth finish will permit better cleaning and allow any debris and bacteria to be easily washed away without becoming trapped in any crevices or imperfections. Solid base mounting surfaces play an important role in achieving this result.

Proper sanitation will help prevent the growth of E. coli, salmonella and staphylococcus aureus among other types of bacteria. In fact, housings are now available with anti-microbial coatings that further help prevent bacteria and fungal growth.

Bearing Inserts

Stainless steel inserts still remain one of the most popular choices for the food industry. Generally, the outer and inner rings and balls are manufactured from AISI 440C stainless. Although a popular choice, these bearings are also one of the most expensive to purchase. The obvious advantage of stainless is the high degree of corrosion resistance especially for those difficult applications.

As an alternative to stainless, inserts have been developed that now incorporate a Thin Dense Chrome (TDC) coating which has shown resistance to corrosion up to 15 times greater than normal 52100 bearing quality steel. Additionally, the surface hardness is greater than a standard bearing race because of the TDC characteristics. The result is increased wear resistance and corrosion resistance.

Zinc coated inserts have found their place in the food industry as well. These inserts provide good corrosion protection and are readily available in most sizes. The popularity continues to grow primarily because it is a very economical alternative to both stainless steel and TDC.

There are some applications which may require the bearings to operate in very severe conditions that may not allow the use of a rolling element type insert. In these circumstances, plain bearings may be required. The bushing type design could be made from a polymer material or a stainless and polymer combination. Generally the plain bearings can be installed into any mounted housing style that typically accepts the rolling element bearings.

Lubrication

Next to the housing and insert materials, lubrication plays the next major role. Food grade bearings are generally factory lubricated with an FDA/USDA approved grease classified as H1 for incidental food contact. The H1 lubricants are both odor free and tasteless without having harmful effects upon any accidental food contact. They are also designed to resist washout especially when exposed to the daily washdowns.

Whenever possible, relubrication is recommended to replenish the old grease supply and purge any contamination. However, there are cases where relubrication cannot be performed. New polymer solid lubricants have been developed for these types of

situations. During bearing operation, a small amount of oil is released from the solid lubricant to coat the rolling elements and raceways. These types of lubricants are known for their resistance to washout and are primarily used in hard to maintain areas. There are speed and environmental limitations with the solid lube so each application should be thoroughly analyzed before making this as a choice.

Other options

The seals used in bearing inserts serve to keep the lubricants in the bearing and the contaminants out. Seals can vary from the conventional single lip rubber type to a double lip design, both coupled with metal flingers fitted outboard the seals for extra protection. Various silicone materials are available for high temperature applications.

By adding end closures to the housed units, the life of the bearing can be prolonged because they further protect the inserts. Not only do they protect the inserts from external contamination, they act as a safety measure against the rotating parts as well. The closures are available in both an open type so that the shaft can extend through and also a closed type for a stub shaft. The external closures used in conjunction with a rear external seal that fits into the rear portion of the pillow block housing makes for a very well protected unit. Usually the covers are made from either stainless steel or a composite material for the food grade units.

Cages made from stainless steel or nylon, stainless steel set screws, stainless steel or corrosion resistant coated flingers, corrosion resistant collars, and stainless steel grease fittings, round out some of the remaining options for a complete food grade bearing assembly.

Specialty Bearings Required by the Food and Beverage Industry

Over the last 10 years, a wide variety of specialty bearings, both mounted and unmounted, have been developed specifically for the food processing industry. These bearings are intended to provide improved operating performance in the modern food-processing environment.

Typical food processing environmental concerns include:

- Wet environment—due to equipment wash down, water necessary to the process, or present in the product
- Presence of harsh chemicals—sanitation and cleaning requirements

- Excessive heat—baking, frying, etc.
- Excessive cold—freezer applications

Bearings designed to operate in these environments typically incorporate some means of protection from corrosion. This can be accomplished by using corrosion-resistant platings or coatings on the metal surfaces, or materials that inherently offer some level of corrosion resistance, such as stainless steel or polymers. Stainless steel bearings offer the greatest corrosion resistance in a wet or wash down environment and stainless steel is widely recognized—especially in meat processing plants—as the preferred material for all processing equipment including bearings.

Plated bearings provide improved corrosion resistance—though not equal to stainless steel performance—at a price level closer to standard bearings. These bearings are most suitable in plant areas that are wet but see limited chemical wash down, or where conditions are less severe.

Lubricants used in any of these bearings must be USDA approved food grade (H1 or H2) only. Many of today's higher-end food-grade greases offer lubricating qualities nearly equal to conventional petroleum greases and may incorporate other characteristics such as low-temperature operation or resistance to wash out.

Specialty bearing styles

Mounted bearings: The most common housing material combinations can be categorized into three basic families: plated or coated cast iron; polymers or composites; and stamped, cast or machined stainless steel.

Insert bearings are available in a wide variety of corrosion-resistant platings or coatings and offer varying degrees of performance. Zinc chromates, thin dense chrome (TDC) and black oxide coating are most common. Insert bearings made from stainless steel represent the high end of the spectrum both in terms of durability and corrosion resistance.

Unmounted bearings: Unmounted ball bearings are available in stainless steel and other highly corrosion-resistant materials such as high nitrogen corrosion resistant steel (HNCR). HNCR offers a higher resistance to corrosion than even the best stainless steels while maintaining a material hardness comparable to normal bearing steel. The capacity reduction inherent with stainless steel bearings is eliminated with the HNCR materials.

High Temp Bearings: Mounted bearings are now available that are designed to operate in temperature ranges in excess of 600°F. Generally, these units incorporate a graphite separator that also serves to lubricate the bearing at temperatures where conventional lubricants such as grease and oils would be ineffective. These bearings provide increased life and lower maintenance costs in difficult baking, frying and drying applications.

Plain Bearings: Plain or non-rolling-element bearings are available in several styles of housing and bearing material combinations to provide increased performance in food industry applications. Advantages of this style bearing in food processing environments include lubricant-free operation (sometimes required for sanitation reasons) and ease of cleaning. Unlike conventional ball bearings, these bearings can be completely disassembled, cleaned and reinstalled. This design feature allows these bearings to be safely used in and above the product zone where conventional rolling-element bearings are not approved.

In general, this style bearing is limited both in speed- and load-carrying capacity compared to conventional ball bearings, so care must be taken in applications to ensure adequate performance and life. Plain bearings are available in stainless steel and a wide selection of polymers suitable to various operating requirements and temperature ranges.

Conclusion

Whatever the choice, the goal is the same; eliminating costly downtime. Unexpected bearing failures and unscheduled maintenance can cause significant production delays. Many of the food and beverage processing lines are high speed meaning a shutdown interrupts the entire flow of the system with huge dollar losses. Besides the labor and repair costs there is also the possibility of food loss as well.

Remember, check the entire menu carefully and make a healthy choice.

The Educational Services Committee acknowledges with appreciation the contributions of Wendy Earle, SKF USA Inc. and Wally Budzielek, AMI Bearings, Inc.