TIMKEN

Technical Article

How to Maintain Bearings to Reduce Downtime

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Abstract

This article provides practical guidance for maintaining stainless steel mounted ball bearings in washdown environments to reduce unplanned downtime. It details four areas that consistently improve reliability:

1. **Shaft conditioning,** specifically, verifying hardness, diameter tolerance, and surface finish.
2. **Correct mounting,** including verifying mounting footing, free shaft passage, and proper bolt torque.
3. **Selecting proper lubrication** with consideration of factors such as water-resistant thickeners, appropriate base-oil viscosity, initial fill targets, and grease compatibility.
4. **Relubrication planning,** including tuning the amount and interval for speed, temperature, and washdown severity.

Where routine relubrication is impractical, the article outlines maintenance-free alternatives including solid-lubricated bearings, IP69K-rated lube-for-life units, and polymer plain bearings to lower maintenance burden and contamination risk without equipment redesign.

How to Maintain Bearings to Reduce Downtime

Improperly maintained equipment can lead to high costs, not only in terms of component replacement but also in terms of downtime. Bearings are no exception. This article provides a structured approach to installing and maintaining stainless steel mounted ball bearings in washdown environments.

With the objective of driving more uptime, bearing maintenance should focus on three key areas: consistent shaft conditioning, correct bearing mounting, and proper lubrication. Maintenance-free bearing solutions can also be considered for cases where reducing maintenance time is a key focus.

Important safety notes:

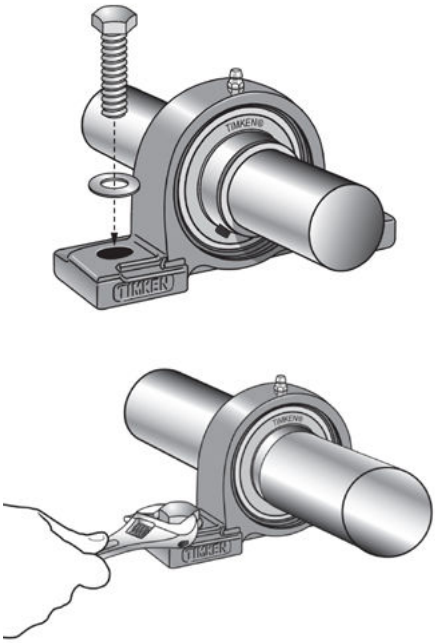
- *Use the manufacturer's installation instructions and the published mounting bolt and set screw torques for a given unit and screw size.*
- *Follow site safety procedures for lockout/tagout and guarding.*
- *Do not attempt to relubricate "lubricated for life" bearings such as IP69K or solid-lubricated bearings.*

Shaft Maintenance: The Foundation for Reducing Bearing-Related Downtime

Before mounting the bearing, it is critical to start with a shaft in proper condition. Shaft condition can determine how well the locking mechanism holds and how well aligned the bearing rotation is. First, verify that the shaft has proper hardness. Shaft hardness greater than 45 HRC can reduce the effectiveness of locking devices, especially for set screws. Second, verify that the shaft diameter meets the catalog tolerance. Undersized shafts reduce clamping force and increase the risk of fretting or even fracture, while oversized shafts can make installing the bearing difficult or impossible. Out-of-round shafts can lead to poor load distribution within the bearing and increased stress.

Third, verify that the shaft surface is consistent and free of any paint, corrosion, or burrs. A shaft surface finish below 64 µin Ra is ideal for bearing mounting. This degree of finish can be achieved using aluminum oxide polishing stones or emery cloths. For spot treatment of corrosion or burrs, use a polishing stone for more precision. For large amounts of corrosion or paint, use emery cloths or scour pads to get greater uniformity across the surface. In either case, start with a 320 to 400 grit to get uniformity in the shaft, then a 600 grit to finish. Use caution with more aggressive tools such as grinders; they do not provide a consistent finish for optimal shaft reconditioning, and too much material removal in one area may translate to shaft runout and uneven loading.

Eventually, all shafts reach the end of useful life. Retire shafts that show out-of-spec dimensions, heavy corrosion damage, or deep flats from prior set screws. This sort of damage does not “wear in” — it leads directly to premature set screw loosening, seal wear, and ultimately, shorter bearing life.



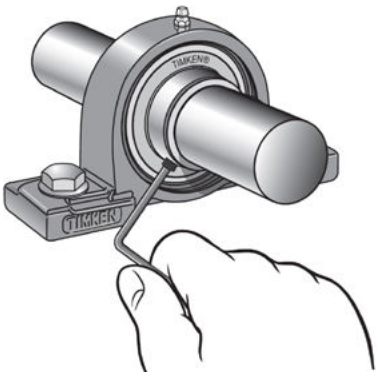
Installing housing mounting bolts (top) and tightening them down (bottom).

Bearing Mounting: Housing Placement and Insert Locking

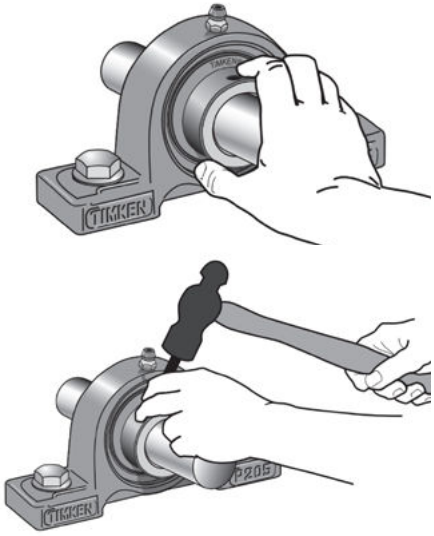
After verifying a properly conditioned shaft, the bearing unit can be mounted. It is recommended to keep bearings in their original packaging until installation to reduce risk of contamination or damage. Position the housing on a flat, rigid base clean of debris, and check if the footing is solid. If the base is uneven, repair it or shim accordingly.

While mounted bearings have self-aligning capability, this is meant to account for small inconsistencies in operation, not to compensate for grossly skewed mounting or dynamic misalignment from bent shafts. Once a solid seat is confirmed, thread in the mounting bolts and hand-tighten them evenly so the housing seats square, then confirm the shaft passes freely through the bearing bore. If the shaft resists free passage, find and correct the interference. Forcing the housing into position can damage the bearing unit and potentially introduce operational issues.

Once the shaft position is confirmed, tighten down the housing mounting bolts using the suggested catalog torque. Note that while greasing the shaft may ease mounting and eventual disassembly, it can also ease rotation between the bearing locking mechanism and shaft. For this reason, use caution when applying any form of anti-seize lubrication.



Using the short arm of a hex key to tighten down the set screws.



Placing the eccentric locking collar on the bearing inner ring (top), engaging the collar using a lightweight hammer and drift pin (middle), and using a hex key to tighten the set screw (bottom).

Next, lock the bearing insert to the shaft. For set screw-style units, tighten both set screws alternately and incrementally to the suggested catalog torque. Stainless screws are easy to over-torque, so the use of a calibrated torque wrench can provide the most consistent results. If the set screws are torqued with a hex key, using the short arm of the hex key helps avoid over-torquing and reduces the chance of distorting the inner ring.

For eccentric locking collar-style units, place the eccentric locking collar on the shaft with its cam adjacent to the cam on the end of the bearing inner ring. Turn the collar in the direction of shaft rotation to engage the cam surfaces. Using a lightweight hammer and a drift pin inserted in the blind hole, tap lightly in the direction of shaft rotation to positively engage the collar. By locking the collar in this direction, the shaft rotation will naturally keep the collar locked rather than loosening it over time. Once the collar is positively engaged, tighten the set screw to the suggested catalog torque.

If approved by the plant, thread locker can be used with caution on set screws. Stray thread locker in seals or bearings can cause damage during operation. After a brief cycle at operating speed, stop and recheck the torque of any set screws. It is common for the initial seating to relax.

Lubrication: Selection, Compatibility, and Proper Application

Lubricants are critical to bearing performance. They reduce friction, wear, heat, and corrosion while assisting with contamination control. For grease lubrication, specifically, it is important to consider the thickener type, NLGI grade, and base oil viscosity.

To stay food-safe while anticipating washdown conditions, it is recommended to select an NSF H1 grease with strong water resistance. Aluminum complex, calcium sulfonate, and polyurea thickeners are proven effective in moisture-rich washdown conditions. The NLGI grade (or relative hardness) of the grease is also important, as the thicker consistency tends to persist in the bearing contact during operation. NLGI grade 2 is the most common, with a consistency similar to that of peanut butter. Thinner consistencies, such as NLGI grade 1 or 0, may also be used in select applications.

The base oil viscosity should also be tailored to the application speeds and loads. Too high an oil viscosity can create higher operating temperatures and torques. Too low a viscosity may render the oil film insufficient for prevention of metal-to-metal contact and subsequent early bearing spalls. A base oil viscosity of 150 to 220 cSt at 40°C tends to be the most common for these applications, but it is wise to check with the equipment OEM or bearing manufacturer to help identify the proper selection.

Thickener compatibility should always be checked before switching to a new grease or putting a different grease selection into a new bearing. Mixing incompatible greases can produce mixtures that collapse, separate, or harden, all of which can drive early bearing damage. If changing thickener families, treat them as incompatible unless confirmed by testing or a lubricant specialist. In cases of potential incompatibility, purge the old grease thoroughly using a chemically compatible degreaser. Keep labeling and storage controlled by equipment location. Color-coding lubricant cartridges by area and having a grease “best practices” training can help prevent accidental mixing.

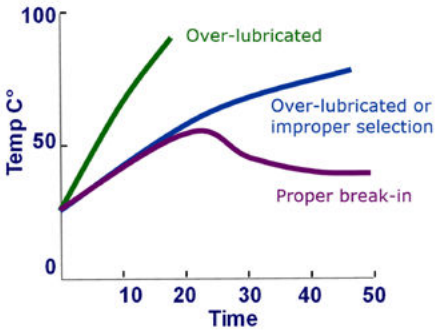
GREASE THICKENER COMPATIBILITY CHART

= Best Choice
= Compatible
= Borderline
= Incompatible

	Al Complex	Ba Complex	Ca Stearate	Ca 12 Hydroxy	Ca Complex	Ca Sulfonate	Clay Non-Soap	Li Stearate	Li 12 Hydroxy	Li Complex	Polyurea	Polyurea S S
Aluminum Complex	Best	Incompatible	Incompatible	Compatible	Incompatible	Borderline	Incompatible	Incompatible	Incompatible	Compatible	Incompatible	Compatible
Timken Food Safe	Best	Incompatible	Incompatible	Compatible	Incompatible	Borderline	Incompatible	Incompatible	Incompatible	Compatible	Incompatible	Compatible
Barium Complex	Incompatible	Best	Incompatible	Compatible	Incompatible	Compatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Borderline
Calcium Stearate	Incompatible	Incompatible	Best	Compatible	Incompatible	Compatible	Compatible	Compatible	Borderline	Compatible	Incompatible	Compatible
Calcium 12 Hydroxy	Compatible	Compatible	Compatible	Best	Borderline	Borderline	Compatible	Compatible	Compatible	Compatible	Incompatible	Compatible
Calcium Complex	Incompatible	Incompatible	Incompatible	Borderline	Best	Incompatible	Incompatible	Incompatible	Incompatible	Compatible	Compatible	Compatible
Calcium Sulfonate	Borderline	Compatible	Compatible	Borderline	Incompatible	Best	Incompatible	Borderline	Borderline	Compatible	Incompatible	Compatible
Timken Premium Mill Timken Heavy-Duty Moly	Borderline	Compatible	Compatible	Borderline	Incompatible	Best	Incompatible	Borderline	Borderline	Compatible	Incompatible	Compatible
Clay Non-Soap	Incompatible	Incompatible	Compatible	Compatible	Incompatible	Incompatible	Best	Incompatible	Incompatible	Incompatible	Incompatible	Borderline
Lithium Stearate	Incompatible	Incompatible	Compatible	Compatible	Incompatible	Borderline	Incompatible	Best	Compatible	Compatible	Incompatible	Borderline
Lithium 12 Hydroxy	Incompatible	Incompatible	Borderline	Compatible	Incompatible	Borderline	Incompatible	Compatible	Best	Compatible	Incompatible	Borderline
Lithium Complex	Compatible	Incompatible	Compatible	Compatible	Compatible	Compatible	Incompatible	Compatible	Compatible	Best	Incompatible	Borderline
Polyurea Conventional	Incompatible	Incompatible	Incompatible	Incompatible	Compatible	Incompatible	Incompatible	Incompatible	Incompatible	Incompatible	Best	Borderline
Polyurea Shear Stable	Compatible	Borderline	Compatible	Compatible	Compatible	Compatible	Borderline	Compatible	Compatible	Compatible	Compatible	Best
Timken Multi-Use	Incompatible	Incompatible	Borderline	Compatible	Incompatible	Borderline	Incompatible	Compatible	Best	Compatible	Incompatible	Compatible
Timken All-Purpose Timken Synthetic	Compatible	Incompatible	Compatible	Compatible	Compatible	Compatible	Incompatible	Compatible	Compatible	Best	Incompatible	Compatible
Timken Pillow Block	Compatible	Borderline	Compatible	Compatible	Compatible	Compatible	Borderline	Compatible	Compatible	Compatible	Compatible	Best

NOTE

Mixing greases can result in improper bearing lubrication.
Always follow the specific lubrication instructions of your equipment supplier.



Bearing temperature over time with different levels of lubrication.

In addition to proper grease selection, the amount of grease within the bearing matters. Most rolling bearings perform best with 35–50% of their free volume filled by grease. Many bearing suppliers have online grease lubrication calculator tools to help determine the right amount of grease to achieve this fill volume. Overfilling can lead to excessive grease churn within the bearing, which translates to higher operating temperatures. A small spike in operating temperature after regreasing is normal: As the rollers create a path through the grease, the temperature will then start to decrease. However, if the operating temperature does not decrease after that early temperature rise, this may indicate that the bearing cavity was overfilled.

Underfilling can also be a concern. If a bearing that has not been recently lubricated begins running warmer than usual, safely attempt to add lubricant. If the bearing temperature decreases, this is a signal that it was under-lubricated.

Relubrication Intervals: Define and Tune

Relubrication intervals and amounts should be defined based on the bearing's operating conditions. Start by establishing a baseline based on bearing size and type, operating temperature, and speed. Then adjust for environment: washdown frequency, sealing effectiveness, contamination level, and duty cycle.

To define and tune the relubrication procedure, first use a bearing supplier's online grease lubrication calculator to generate a baseline quantity and interval for the unit. Document the inputs (speed, temperature, grease type, seal type). Apply multipliers for the particular environment; for example, halve the interval for heavy, daily washdowns and marginal sealing. Next, tune with field data. If the post-relubrication temperature spike does not decrease after a short operation interval, reduce the amount of grease. If noise, vibration, or temperature increases before the planned relubrication, decrease the interval.

Aim for smaller amounts more frequently rather than large amounts infrequently. In cases where staffing is limited or the bearings are hard to reach, automatic lubricators can help maintain cadence while reducing the maintenance personnel load.

When Relubrication is the Constraint: Maintenance-Free Solutions

Cutaway of stainless steel mounted ball bearing insert with graphite solid lube.

There are some applications and situations where the most reliable decision is to take relubrication off the task list. Some maintenance-free solutions include solid lubricated bearings, IP69K-rated mounted units, and plain bearings.

Solid lubricated bearings replace free grease with a solid matrix that meters lubricant to raceways and resists washout. Polymer solid lube is a versatile and effective choice for many food plant applications. Graphite solid lube can be used in low-speed applications that require low running torque or are exposed to elevated temperatures. Both options can be specified with NSF H1 food-grade compliance. In both cases, the benefit is consistent lubrication with reduced maintenance intervals, which can reduce downtime and free up time for maintenance personnel.

Cutaway of stainless steel mounted ball bearing with IP69K-rated seals.

Exploded view of Timken Poly-Round® mounted polymer plain bearing.

IP69K-rated mounted units provide a robustly sealed lube-for-life design for harsh conditions. By utilizing a multi-lip seal design, these units are designed to withstand fine particles and high-pressure, high-temperature washdowns with minimal ingress. With such a robust seal design, these units do not require regreasing since contaminants are kept out while grease is kept in. Eliminating the need for regreasing while utilizing food contact-rated seals makes for a hygienic, maintenance-free option.

Plain bearings are a zero-grease option for slow-speed, light-to-moderate load applications in harsh washdown and other unique environments. Inserts can be manufactured from engineered polymer and dimensionally interchangeable with many standard ball bearing inserts. They offer predictable wear and improved hygienics, often being used in unique applications like submersion in fry oil. The elimination of relubrication requirements helps free up personnel and saves on maintenance costs.

By eliminating regreasing, each of these solutions reduces the maintenance burden and lowers contamination risk, improving plant uptime and hygienics.

Conclusion: Improve Uptime Through Proper Maintenance

Consistent uptime can be achieved by standardizing installation and maintenance practices. Ensure a solid foundation by installing the bearing on a properly conditioned shaft and solid base with correct torque and a post-cycle recheck. Specify position-appropriate NSF H1 greases and maintain a compatibility chart in the shop. Calculate initial relubrication intervals from speed, temperature, and environment, then tune with field data and document the cadence in a preventive maintenance plan.

When bearings are hard to reach, maintenance is inconsistent, or environments are harsh, move targeted positions to solid lubricant, IP69K, or plain bearings to remove routine greasing and improve overall system reliability.

If you need technical assistance in establishing your maintenance procedure, please reach out to your local Timken Company representative to speak with an application or service engineer.

All images courtesy of The Timken Company.

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The Timken team applies their know-how to improve the reliability and performance of machinery in diverse markets worldwide. The company designs, makes and markets bearings, gear drives, automated lubrication systems, belts, brakes, clutches, chain, couplings, linear motion products and related industrial motion rebuild and repair services.

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