

Cat® Bearing Maintenance



Management Guide

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Bearings are critical to the safe and reliable operation of Cat® machines. Establishing and following a preventative maintenance program is a key factor in ensuring long bearing service hours and minimizing equipment downtime.

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This management guide offers information, tips, and ideas but is not intended as a technical manual or a substitute for the advice and recommendations of our parts and service experts. By referencing this manual and following the recommendations in your Operations and Maintenance Manual, you can maximize the productivity, service life, and value of your Cat machines.

Manage it well. Make it last.

This guide gives you the tools to get maximum value from your Cat bearings. Maintaining high-quality operating conditions for the bearings will minimize repair costs and downtime.

Bearings are used in every drive train and mechanical component of your Cat machine. A good bearing management program will help you keep components in top running order.



System Overview

Cat bearings provide exceptional performance, extraordinary durability, and long life.

Bearings are used in every drive train component and virtually every mechanical component of Cat machines. But because of the varying speed, power, torque, and thrust force going through the drive train, one type of bearing does not meet all the rigorous demands. Several types of bearings are needed, with each bearing being highly crafted and precisely matched to the kind of load it carries.

Bearings allow parts to move together smoothly with minimum friction, heat, and wear, often under extreme loads. Caterpillar offers two fundamental types of bearings: plain (bushing) and antifriction. This brochure will focus on antifriction bearings, which use balls and rollers as the primary elements between contacting surfaces.

Antifriction bearings consist of spherical or cylindrical elements held in races that rotate with the adjoining surfaces, preventing metal-to-metal contact and ultimately reducing friction, heat and wear. Caterpillar offers a variety of different antifriction bearings: ball bearings, straight roller bearings, tapered roller bearings, and needle bearings. All of the bearing types have similar components: rolling elements, hardened steel rings called races, and optional separators or cages, which provide spacing for the rolling elements between the races. In some applications, the rolling elements are in direct contact with the shaft or other mounting.

Bearings play a critical role in safe and reliable equipment operation. A bearing failure can cause metal particles to enter the machine's lubrication system, wearing gear teeth and ultimately damaging the components. Maintaining high-quality operating conditions for the bearings will minimize repair costs and downtime.

Lubrication

Lubrication is an important factor in bearing maintenance. Lubrication supplies an oil film for the rolling elements, reducing friction between bearing components while providing a protective coating to prevent rust. Lubrication also provides a cooling function by transporting heat away. Further, using the appropriate quality, type, and viscosity of lubricant is vital to good bearing performance and life. Over-lubricating can lead to churning, causing friction and heat, which eventually initiates premature failure. Lack of lubricant can be harmful, as not enough oil will be available to do the job. To ensure optimum bearing performance, Caterpillar offers a full line of Cat lubricants to meet your everyday needs.

In splash lubrication systems, such as in final drives, it is imperative to not only retain the right type and quantity of lubricant in the housing, but also to change the lubricant and filters at recommended intervals. Using lubricant rated for the proper temperature must also be noted. When operating at extreme temperatures, it can lead to oxidizing the oil and breaking down of additives.

Regardless of the type of lubrication system you use, be sure to understand and follow the manufacturer's recommendations to establish the right type and frequency of lubrication that is needed for your specific bearing design and application. Additionally, look into setting up an S•O•SSM oil analysis program for your machines if one has not been put in place already. This program can easily help identify abnormal wear prior to it becoming a major problem. S•O•S oil analysis is an excellent way to provide early detection of component wear.



Thorough Inspection

Caterpillar generally recommends replacing all anti friction bearings at time of component rebuild. However, there are times when a component is disassembled and rebuilt prior to completion of a normal life. In this situation, it may be possible to reuse some of the bearings. When considering bearing reuse, there are critical steps to follow.

Remove

Detecting defects and deterioration before failure involves removing, cleaning, and inspecting the bearings. Remove bearings carefully as they can easily be damaged during this removal procedure. (see page 8). Always use recommended tools and adhere to the outlined procedures in the machine's service manual. If possible, avoid harmful removal procedures, such as flame cutting inner races or shrinking outer races with weld bead. These procedures can result in uncontrolled heat that can damage housings or shafts.

Clean

When the removal process is complete, bearings should always be cleaned before inspection. Follow Caterpillar recommended guidelines to ensure the bearings are not damaged. Use only petroleum solvents that are suggested for washing. **Note:** Most solvents are flammable and toxic when inhaled or absorbed into the skin. Handle with caution.

To prevent contamination, clean bearings in a container large enough for the bearings to be splashed around without contacting the bottom where the dirt settles. Allow the bearings to soak for an extended period of time to loosen grease and dirt, several hours or overnight. Use a short bristled brush with bristles that will not break off. After visually inspecting the bearing to see that all dirt has been removed, rinse the bearing in a container of clean solvent; next dip the bearing in oil.

When drying the bearing, do not use compressed air to spin it dry; this can cause a nonlubricated bearing surface to be damaged. To dry the bearing, hold both inner and outer races together to avoid spinning and blow air through the bearing.

Examine

After the bearing has gone through the cleaning process, examine it thoroughly for cracks in the race, dented seals, and damaged or broken separators, balls, or rollers. If a brownish-blue or bluish-black color appears, it means the bearing has been overheated. At this point, replace the bearing. If the bearing has

a seal or shield, inspect it for damage or wear. If the seals are damaged or worn, you must replace the complete bearing. A worn or damaged seal will permit dirt and moisture to enter the bearing, minimizing its wear life.

Check separable bearings for pitted, scratched or flaked balls, rollers or races. If any of these signs are visible, replace the bearing. Inspect the inner surfaces and rolling components in a non-separable bearing by shining a flashlight between the balls and rollers. If you notice any pits, scratches or surface damage replace the bearings. Scan the outer race for proper wear patterns such as wear tracks that are centered without pits or scratches.

If you do not notice any signs of wear or damage, lightly lubricate the bearing and slowly turn the outer race. Never spin it. If a clicking or sticking is observed, clean the bearing again. If the condition still exists after cleaning, you will need to replace the entire bearing. A thrust bearing or tapered roller bearing can be tested the same way, but place the bearing on a clean surface, lightly apply hand pressure, and turn the bearing.

If no signs of wear or damage are indicated and the bearing has low service hours, it can be reused after cleaning. However, if the bearing has high service hours, it is suggested to go with a replacement. This is a precaution, as the bearing might fail and destroy other critical systems.

Reuse/Replace

It may be challenging to determine if a bearing is reusable through visual inspection. Rolling contact stress fatigue originates beneath the surface and cannot be seen. When choosing whether to replace or reuse a bearing, consider the load, application, and the number of service hours. In most situations, it is more economical to replace a bearing that is in severe applications, under heavy load, or has high service hours.

If you are not planning on reinstalling the inspected bearing immediately, perform the following steps: oil the bearing, wrap it in clean, oil proof paper, place it in a box and store it in a dry, dust-free place. These precautions will help avoid corroding and shortening of the bearing life.

Replacement Hints

If you decide to replace a bearing, be sure you replace it with a genuine Cat bearing, to be assured of the proper performance and long life of your machine.

Bearings must be compatible with the machine in lubrication, fit, surface, and load carrying ability. Many times a bearing will look like an original, yet it might not be a correct replacement. Bearings that are not compatible in all areas can fail prematurely.

Cat equipment uses many specialized bearings. Some are imprinted with the manufacturer's code that supplies information on the bearing's general dimensions. Cat bearings are made specifically for Cat products, therefore, they have no stamped dimensions. In some cases, even though a bearing might portray the same identification code as a standard bearing, it might be unique and have the ability to provide longer life in certain applications. For example, a bearing could have a particular surface finish or heat treat, or include a different roller crown or cage design. It is vital to avoid using a standard bearing when a special bearing is specified. An incorrect bearing will shorten the life and can result in significant contingent damage.



Detect—Then Correct

If you correctly maintain your bearings, they will not incur premature failure; however, they will eventually fail due to rolling contact stress fatigue. A premature failure happens when bearings fail at low hours for causes beyond normal material fatigue. If you identify any signs of possible bearing failure refer to the chart below to help you determine the indicators, causes, and proper repair options. If the recommended maintenance options do not correct the problem, disassemble the bearing and try to recognize the cause again.

Determining the cause is usually easier said than done. A visual examination may identify the type of damage, but it may not

identify what is causing the problem. For example, if a bearing has scored and heat-discoloration on the roller ends, you know it is burned up and needs to be replaced.

Yet, the cause could be linked to various factors, such as insufficient or improper lubrication, improper adjustment or any combination of these factors. For this instance, you should carefully investigate the mounting, installation and parts affecting the bearing operation to decipher the cause of the damage. Remember, if you merely replace the failed bearing without finding and fixing the root cause, the replacement bearing will most likely endure the same wear and damage as the original.

Problem Indicators	Causes	Options
Excessive Noise and Vibration	Insufficient lubrication	Fill with correct amount of proper lubricant.
	Incorrect lubricant	Use recommended lubricant.
	Defective bearing	Replace bearing.
	Dirt	Replace bearing.
	Corrosion	Replace bearing. Use lubricant that resists corrosion.
	Improper Load	Adjust to specification.
	Misalignment	Determine what is misaligned: housing, shaft, or bores.
		Shaft may be bent or housing bores not aligned.
		Replace shaft or housing.
	Bearings fit too loose	Chrome plate or metalize shaft or bore and regrind to specification, replace bearing if seating surfaces are worn.
		Replace bearing. Correct installation/mounting problem.
	Improper mounting	
Excessive Heat	Insufficient lubrication	Fill with correct amount of proper lubricant.
	Incorrect lubricant	Use recommended lubricant.
	Improper setting	Adjust to specification.
	Misalignment	Determine what is misaligned: housing, shaft, or bores.
		Shaft may be bent or housing bores not aligned.
		Replace shaft or housing.
	Lubricant churning	Use less lubricant or use a lower viscosity lubricant.
		Be sure to use recommended lubricant.
	Spinning race	Either inner or outer race is sliding around its seated surface.
		Use proper sized components.
Lubricant Loss	Too much grease	Grease to proper level.
	Improper lubricant	Use high-temperature grease.
	Leakage through seal	Replace seal.
		Check shaft for scratches or burrs that may have damaged seal.
Shaft Resistant to Turning	Incorrect lubricant	Use recommended lubricant.
	Dirt	Clean bearing. Replace seals and bearing if damaged.
	Corrosion	Replace bearing. Use lubricant that resists corrosion.
	Improper setting	Adjust to specification.
	Lack of lubrication	Add proper lubricant. Check for damage.
	Seal tight	Use proper size and type of seal.
	Bearing cocked	If new installation, remove bearing and clean all mating surfaces.
		Reinstall bearing if not damaged.
		Replace gasket.
	Leakage between bearings	
	caps and housing	

Elements of Proper Maintenance

Tools

You should always work with clean, recommended or approved tools. Do not use a wooden mallet. Also work in clean surroundings, such as on a metal or metal-covered bench.

Handling

Always handle the bearings with clean, dry hands or even clean canvas gloves. Never hold a bearing with dirty or moist hands, as contamination can easily be transmitted to the bearing. When you are finished handling the bearing, lay the bearing out on a clean surface.

Cleaning

To clean a bearing you should use uncontaminated solvents and flushing oils. If it is necessary to wipe the bearing, only use clean lint-free rags. Never use cotton waste or dirty rags to wipe a bearing. Further, never use the same container for both cleaning and final rinse of used bearings.

Drying

To dry a bearing, hold both the inner and outer races together and blow air through the bearing. You should never spin any bearing with compressed air.

Storing

When storing a bearing, the most important factor is protecting the bearing from dirt and moisture. Be sure to keep the bearing wrapped in oilproof paper. Be sure that you do not scratch or nick bearing surfaces while handling and storing the bearing.

Installing

Install a new bearing as it comes from the package, without washing if it was received in a clean container. When installing used bearings, thoroughly clean the inside of the housing before installation.

Lubricants

Lubricants are a critical aspect of bearing maintenance. It is vital to always keep lubricants clean when applying them, and cover the containers when not in use. Always use the correct type and amount of lubrication, as this will play a key role in bearing wear life.



Ten Factors Causing Premature Failure

1. Overloading



Overloading is an especially common factor in premature bearing failure. Overloading causes the oil to generate heat, which affects the oil viscosity. Heat will cause the oil viscosity to

decrease and make the lube film thin, allowing contact between the rolling components and raceway. The contact can cause damage similar to the damage caused by insufficient lubrication.

Caterpillar Solution: Cat bearings are designed as an integral part of the total machine system. By always using genuine Cat parts, you will ensure the integrity of those systems and provide high performance and long life, especially under high load applications.

2. Improper Lubrication



As mentioned before, proper lubrication is vital to high-quality bearing performance and service life. Insufficient lubrication allows for metal-to-metal contact of the major elements and

especially of the roller end against the rib, producing scoring in these areas. Heat has the ability to turn various elements and roller ends dark blue, or perhaps in extreme cases, black.

Caterpillar Solution: In applications where inadequate lubrication is a concern, Caterpillar uses a proprietary bearing technology called “textured” bearings. Texturing allows for better oil retention on the contact surfaces, which leads to longer bearing life, especially in high load, slow speed applications.

3. Contamination

Contamination is any foreign substance that has the ability to damage a bearing. Moisture, dirt, sand, or any type of abrasive material will cause premature bearing breakdown. It is important to be able to recognize symptoms of contamination, such as scratching, scoring, brushing, pitting, grooving, bruising, matte or



particles and contaminated lubricant.

satin finish, or rust. Several causes of contamination involve debris manufactured into the system, cracked housings or hoses, dirt access through failed seals, minute metal

Caterpillar Solution: When contamination is an issue, Caterpillar offers “debris resistant” bearings. These bearings use a combination of specialized material and heat treat to produce bearings that are extremely resilient to debris and contaminants in the oil.



4. Distortion

When the housing or shaft is out of round, the bearing roller components are forced together where there is a minimum amount of

clearance. The heightened pressure can result in the race and other rolling elements to incur surface flaking, something that typically happens with normal fatigue.

Caterpillar Solution: See #6 Improper Fit, page 11.



5. Misalignment

To maximize bearing life, the supporting seats and shoulders must meet manufacturer’s specific limits. If the misalignment is beyond those particular limits,

the load on the bearing will be intense on only a segment of the roller and races, causing excessive stress and premature failure at that single point.

Caterpillar Solution: The Caterpillar specialized roller profile provides optimum load distribution across the bearing, even when misalignment is present. This serves to minimize stress in the bearing and maximize bearing life.

Ten Factors Causing Premature Failure

6. Improper Fit



Proper bearing fit is essential to bearing performance and life. A variety of improper fits can cause significant damage, including forcing a bearing onto a shaft that is too large

for the inside diameter of the bearing race, fitting an outer race insecurely (too loose) in its housing and having a loose fit between the shaft and the inside bore of the bearing. These inadequate fits can cause split races, fretting corrosion and creep wear.

Caterpillar Solution: Cat bearings are made with specialized tolerances for precise fit of the bearing to the shaft or housing and to ensure exact positioning of related parts.

7. Vibration Damage



Anti-friction bearings must roll while under a load. Subsequently, subjecting a bearing to vibration while it remains immobile can cause depressions on the race from fretting.

Caterpillar Solution: In Cat bearings, eliminating vibration is a prime factor in determining the type of bearing cage required. Brass cages and nonmetallic bearing cages are two types which minimize vibration and provide maximum life in harsh applications.

8. Defects in Material



Defects in antifriction bearings are particularly rare, especially when it comes to the material, forming, machining, heat treat, grinding, and assembly difficulties.

The minimization of defects is a result of the extreme cleanliness of bearing steels and stringent quality control measures used in manufacturing

facilities that supply Cat bearings. Note that usually only a metallurgist can characterize these types of defects from other causes of premature failures.

Caterpillar Solution: Cat bearings are manufactured to the highest material quality standards in the industry and will always provide optimum performance and component life of our machines.

9. Improper Servicing Techniques



It is critical to always follow the manufacturer's recommendations summarized in your service manual and to use the proper tools. Using inappropriate tools and procedures when

removing, installing, and handling bearings can cause damage and possibly failure.

Caterpillar Solution: Always refer to your Cat equipment's Operation and Maintenance Manual and other service literature for proper procedures and servicing techniques.

10. Electrical Current



Bearings pass electrical currents that initiate an arcing and burning at the points of contact between the races and rollers. This may produce a single burn or multiple grooves called "fluting."

A burned bearing allows for excessive noise and will need to be replaced.

Caterpillar Solution: Be sure to find and repair the root cause of the electrical ground to avoid damage to the new bearing.

Expect more from the experts

Maximize the life of your bearings

To get the most out of your investment, it pays to keep your bearings operating at peak performance. Following the information and maintenance practices outlined in this guide can help you eliminate bearing problems before they begin.

Your Cat dealer is ready to help—with parts and service solutions, or just some advice along the way. We're built to put you in control.

Call your Cat dealer with questions about system operation, maintenance, or service.

BUILT FOR IT.™



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