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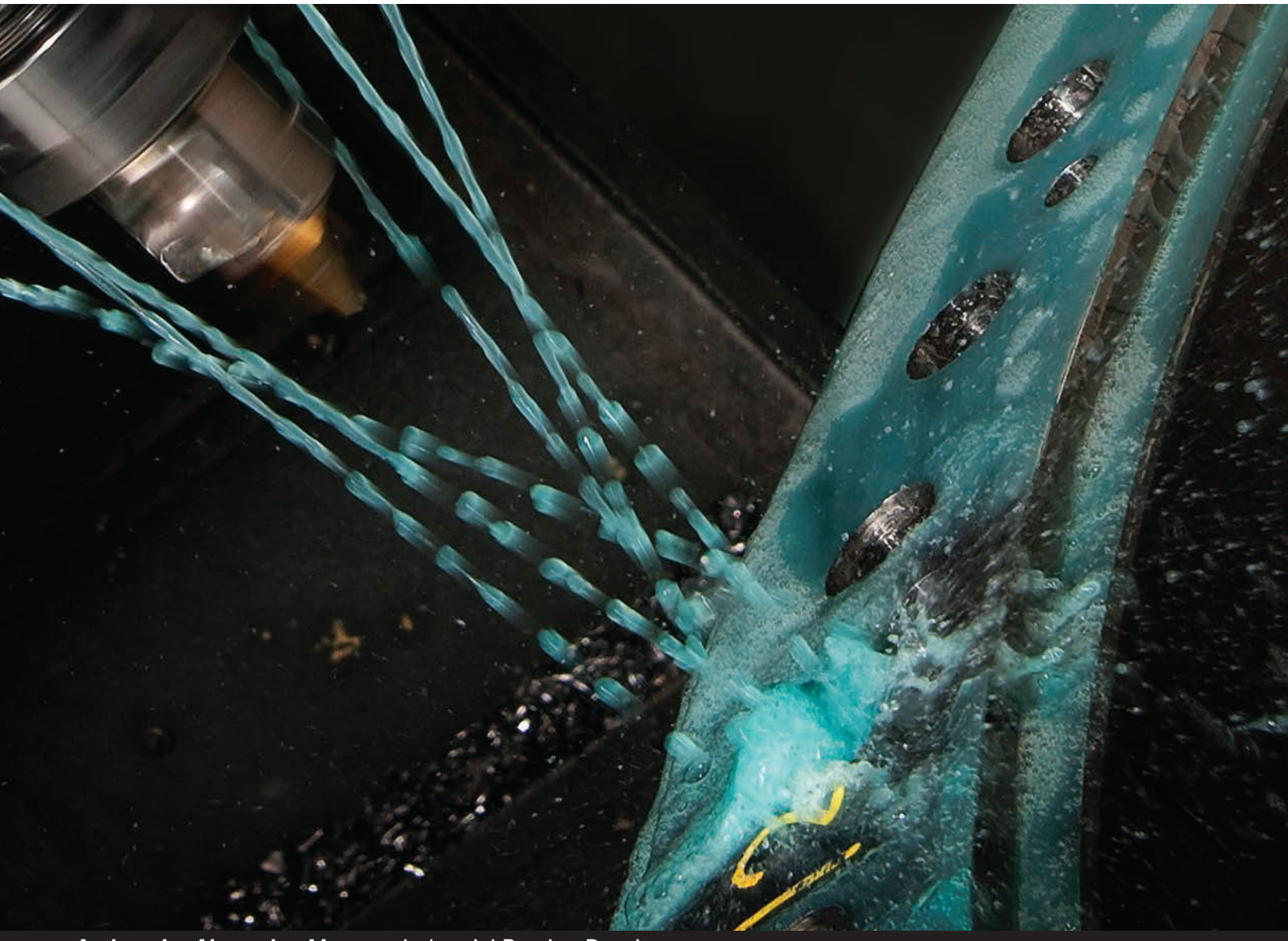
Technical Article

Using Bearing Repair To Extend Bearing Life:

For Heavy Industries



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Using Bearing Repair To Extend Bearing Life: For Heavy Industries

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Abstract

When a bearing is damaged, it is often removed from service and replaced before it reaches its full, useful and economical life. Advancements in bearing design, materials, bearing maintenance and repair methods have greatly improved the potential for and popularity of bearing repair as an effective way to extend the life of the bearing.

A high-quality repair program also can address the challenge of determining if and when a bearing can be repaired. Regardless of original manufacturer, a wide range of services are available for all bearing types.

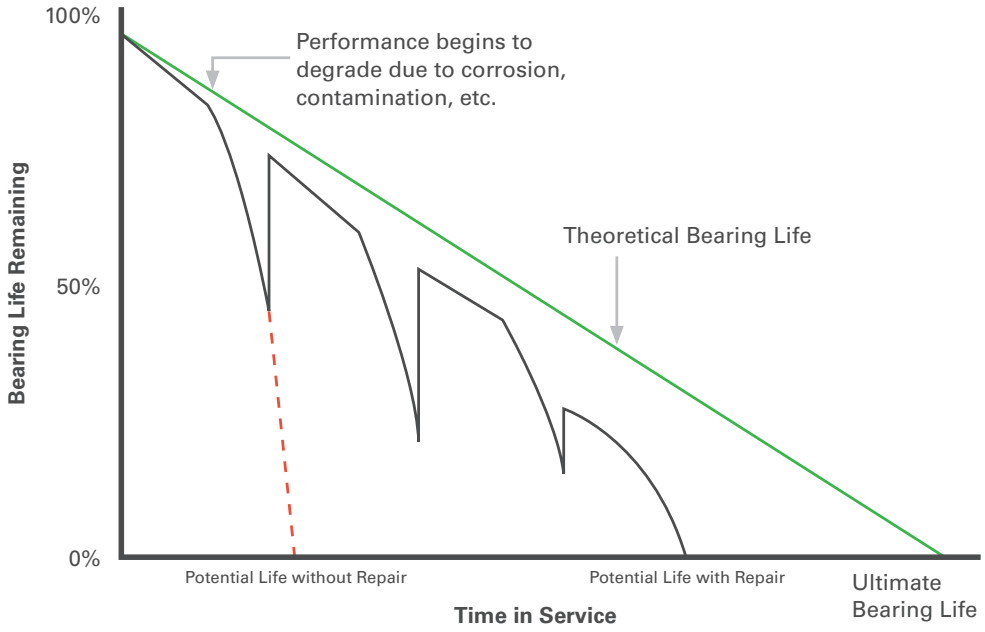
A repaired bearing, depending on the required level of service, can often be returned to like-new specifications in about one-third of the time and at a savings of up to 60 percent off the cost of a new bearing. Furthermore, experience has shown that a successfully repaired bearing can run a life cycle comparable to that of the first cycle of the bearing. Growing popularity of repair programs in heavy industries shows an increased understanding of the significant value, both in time and cost, compared to replacing bearings.

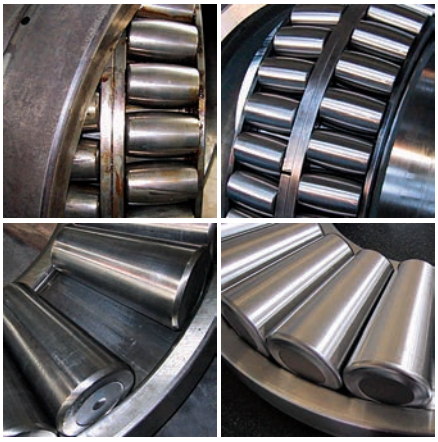
Introduction

Bearing repair is not a new concept, but it is increasing in popularity with heavy industrial customers, providing a tangible value. Advancements in bearing design, steel cleanliness, bearing maintenance and repair processes have greatly improved the potential benefits for bearing repair.

When a bearing is damaged, the entire operation will suffer, resulting in additional costs, lengthened maintenance work schedules, unnecessary downtime and extended on-time-delivery to final customers. In most heavy industrial applications, bearings are removed from service before they have reached their full useful and economic life (Figure 1). **Bearing repair can be an effective way to extend the life of the bearing further along its theoretical bearing life, making it an economical alternative to purchasing new.**

Figure 1:
Bearing Preformance.





Before After

Figure 2:
Bearing Repair.

Figure 3:
If a new bearing costs $20,000 then the cost of a bearing remanufactured by Timken could be $8,000 – a savings of $12,000, or 60 percent.

A Case for Repair

Initial bearing design takes into account the use and application of the bearing and establishes a corresponding prediction for service life and fatigue life. Regardless of the design or manufacturer, bearings often deviate from these expectations due to factors such as improper installation, contamination, inadequate lubrication or misalignment. In fact, less than 10 percent of bearings used in a heavy industrial application reach their design L10 life.

Advancements in technology, materials, condition monitoring and reliability centered maintenance programs combined with economic pressures contribute to an increased potential for successful bearing repair programs.

A quality repair program can often return a bearing to like-new specifications in about one-third of the time it takes to procure a new bearing. Depending on the scope of work, a repaired bearing can save up to 60 percent off the cost of buying new. Some bearing repair sources will also offer a warranty on their service (Figure 2).

When compared to the manufacture of a new bearing, **bearing repair is considered a more environmentally friendly procedure,** requiring less energy input and reducing raw material consumption and waste (Figure 3). The majority of energy required to manufacture a new bearing – melting and refining steel, material forging and turning, heat-treatment and grinding – is conserved through bearing repair.

In addition to cost and time savings, bearing repair maximizes the opportunity to achieve the theoretical bearing life cycle. A common question is whether a repaired bearing will last as long as a new one. Studies performed by bearing manufacturers and independent researchers have shown that **a properly repaired bearing will run a second service cycle comparable to that of the first.** Repaired bearings often reuse materials that have already proved reliable in the application, therefore reducing the risk of bearing failure. It should also be stated that it is critical that replacement parts are made using materials and tolerances specified by the Original Equipment Manufacturer (OEM). Any deviation from OEM specifications will increase the risk of premature failure.

Bearing Repair Eligibility

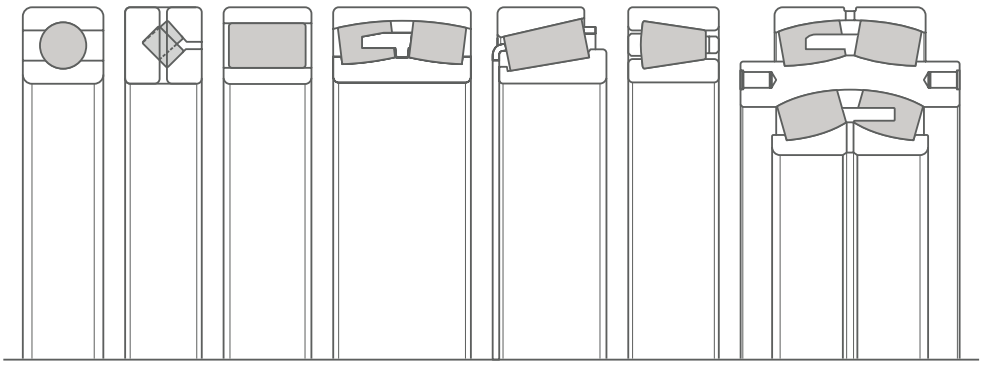
Although it offers many benefits, repair is not always the best option for a damaged bearing. The challenge of properly utilizing bearing repair services is determining if and when bearings need to be repaired and deciding which option is the best economical and long-term decision.

Depending on the repair facility, limitations exist on the minimum and maximum size of bearings and product types that can be repaired. There are many different types of repair suppliers, ranging from small facilities limited in their scope of work and knowledge to large bearing manufacturers with an unlimited range of products and services.

The scope of work also limits the size of bearing that can be repaired (Figure 4). **All bearing types are eligible for repair regardless of the original manufacturer,** including:

- Ball bearings
- Class 3 precision bearings (all types)
- Cross roller bearings
- Cylindrical roller bearings
- Spherical roller bearings
- Tapered roller bearings
- Thrust bearings (all types)
- Triple-ring bearings

Figure 4:



A critical step in any bearing repair program is to recognize potential problems through regular monitoring and inspection. Careful review of the output will help to identify the need for repair, such as:

- The bearing is nearing or has exceeded its suggested life expectancy
- Operating temperatures have exceeded 200° F
- Exposure to excessive vibration
- Sudden changes in lubrication and temperatures
- Emits excessive noise
- Loss of bearing seal integrity

Properly trained and experienced personnel involved in routine inspections serve as the first line in deciding if a bearing needs repair. Early detection of a problem through routine checks, preventive and predictive maintenance, and vibration analysis can reduce unnecessary downtime and expense, and help to capitalize on the capabilities and benefits of bearing repair.

The Remanufacturing Process

Once a product is returned to a repair service center, all bearings undergo a thorough cleaning process. Next, the bearing is disassembled. During disassembly, trained repair technicians will:

- Record the bearing information
- Record actual internal clearances
- Complete the disassembly and tag with unique identifiers

Next, a detailed inspection of all the bearing components is performed and findings are recorded (Figure 5). The initial inspection includes looking for major problems or damage, such as fractures, major spalling or bluing due to heat damage. These are indicators that the bearing may not be eligible for repair. Components also are examined to determine the scope of work required to return them to a like-new condition.

In addition, technicians measure the bore, O.D. and width of the bearing, as well as record the roundness of the major race components. The type and degree of damage determines whether it can be repaired and the appropriate method of repair. The level of detail supplied in this inspection report depends on the facility performing the work.

Figure 5:
Timken technicians measure the bore, O.D. and width of the bearing, as well as record the roundness of the major race components to help determine the appropriate method of repair.

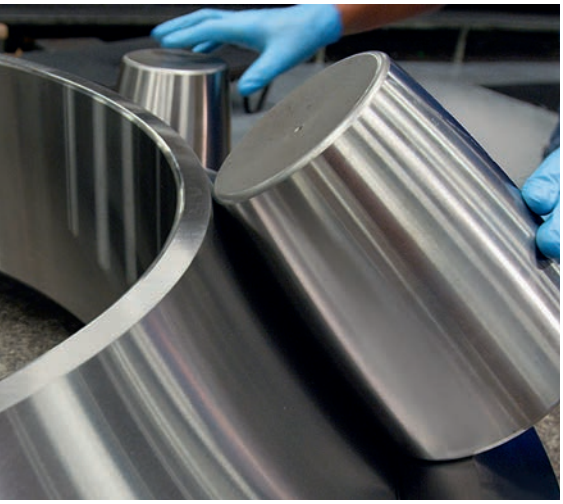


Figure 6:

A wide range of repair services/methods are available. Depending on the facility capabilities and level of damage, some repairs can be performed onsite using existing personnel or a bearing manufacturer's service personnel (Figure 6). In general, onsite programs are suited for recertification or reconditioning processes, not for the remanufacturing process. Below is a detailed description of the repair service levels.

Recertification (Type 1): Bearing assemblies cleaned, examined, measured for verification of internal clearances, inspected, preserved and packaged. This process is used to recertify a bearing for service – generally applying to an unused product with an outdated shelf life.

Reconditioning (Type 2): Bearing assemblies cleaned, examined, polished, honed or tumbled to remove minor surface defects (primarily rust or corrosion), measured for verification of internal clearances, inspected, preserved and packaged.

Remanufacturing (Type 3): Bearing assemblies cleaned, examined, raceways reground, new roller sets and major components manufactured and replaced as required, internal clearances reset, inspected, preserved and packaged.

Regrinding raceways requires the manufacture of oversized rollers to compensate for the removed material and to maintain bearing geometry and clearance where radial internal clearance is critical. When lateral clearance is critical, oversized rollers, new spacers or additional shims are provided.

Reclamation: Typically used for bearings with a 3in. - 8in. I.D. (larger, economical quantities required). Bearing assemblies cleaned, polished using our proprietary vibratory process, inspected, preserved and packaged.

Once the proper repair choice is made and the process completed, the bearings are reassembled and packaged for storage and transportation. Generally, a final inspection is performed on the bearing to ensure that it meets the assembly criteria specified by the bearing design. Again it must be stated that **different suppliers perform different levels of inspection and packaging.** Bearing manufacturers that perform bearing repair often follow the same procedures as with a new bearing.

Types of Bearing Damage

The variety of damage encountered during bearing repair service includes:

Brinelling: Permanent deformation (displaced metal, not just wear) of bearing surfaces at roller/raceway contact areas caused by excessive load or impact

Corrosion/Etching: Chemical action (rust) that attacks bearing component surfaces

Cracking/Fracturing: Significant visible surface cracks; usually caused by abuse or unusual operating conditions

Debris Denting: Localized surface depressions caused by debris or foreign material

Fretting: Usually shows up in red or black oxides of iron occurring under close-fit conditions; also called friction oxidation

Heat Checks: Surface cracks caused by heat from sliding contact; usually formed in direction of motion

Scuffing: Smearing, scoring or galling as a result of removed and transferred metal from one bearing component to another due to sliding contact

Staining: Surface discoloration without pitting, such as from oil oxidation

Spalling: Breaking away of metal on raceway or rolling element in flakes or scale-like particles; also called flaking, fine grain or course grain spalling

Wear: Contact surface degraded and worn away by mechanical action in use

Types of Damage

The types of damage discovered during bearing repair vary significantly. Damage may be evident in the form of visible corrosion, scuffs, stains and dents. Or, it may be barely noticeable, such as fine cracks or fractures that indicate the potential for more serious damage to occur (Figure 6).

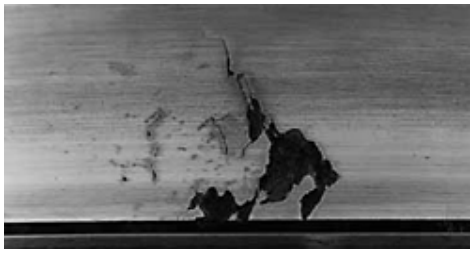
Typical bearing damage falls into the following categories (see the **Types of Bearing Damage** sidebar for more detailed definitions):

- Chemical Damage: etching, stains, corrosion pitting, rust or fretting corrosion
- Heat Damage: discoloration or checks
- Electrical Damage: burns, fluting or pitting
- Mechanical Damage: fatigue flaking, cracks, spalling, fractures, nicks, peeling or smearing, brinelling, indentation, scoring, abrasive wear, installation damage, misalignment or lubrication failure

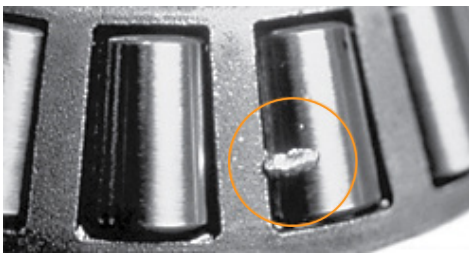
Most resource manuals describe the above types of damage and offer methods to help eliminate their causes. However, resource manuals often fail to mention that, with the exceptions of torch heat damage, extreme spalling, fractures and heavy etching, **most damage conditions are repairable**. Therefore, it's recommended to contact a bearing service technician to provide a damage assessment and determine the feasibility of a repair.

Brinelling

Debris Denting



Spalling



Wear

Figure 7:
Types of bearing damage.

Repair Limitations

Although bearing repair has proven to be a cost-effective solution, like any service, it is subject to limitations.

Bearings can be repaired, often more than once, but not indefinitely. A general rule of thumb is that bearings should not have more than three regrinds. Regrinding removes surface material, so it needs to be done carefully.

If done correctly, repaired bearings offer like-new performance. However, it is important to recognize and understand how repair options address damage modes. For example, polishing can address a variety of damage modes but is not effective for the removal of debris indentations or wear. Therefore, in such cases, do not expect like-new performance if the bearing is only polished since that does not repair all damage.

It is recommended to consult with a bearing manufacturer representative and/or application engineer to help determine the cause, extent and suggested repair of the damage. It also is critical to have any bearing repair performed by properly trained and experienced personnel because unnecessary repairs can lead to additional damage and limited bearing life. Common repair mistakes include:

- Improper polishing techniques that cause changes to geometry and/or profiles that do not correct worn geometry and contact conditions
- Improper grinding techniques and processes that can cause surface cracks and damage or improper geometry and/or profiles
- Mixing of preset components
- Improper profile, internal geometry, finishes and clearance settings that can cause bearing failure. In addition to expertise, proper equipment is required to fix the problem and ensure damage has been reviewed and properly removed. The appropriate measuring equipment, such as laser tracing and profiling equipment, CMM and precise measuring machines, are essential to perform thorough inspections on repaired product.

Choosing Bearing Repair

When a bearing is damaged, the entire operation will suffer, resulting in additional costs, lengthened maintenance work schedules, unnecessary downtime and extended delivery times to final customers. To reduce these undesirable circumstances, **bearing repair offers a fast and economical option to extend the life of a bearing further along its theoretical life line.**

A quality bearing repair program can result in significant time and cost savings compared to discarding and purchasing new bearings. In addition, the lead time for repair is substantially less than that of a new bearing.

For additional information on Timken bearing repair services, visit www.timken.com/bearingrepair.

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