Bearing Repair Provides Valuable Alternative To

BEARING REPLACEMENT FOR HEAVY INDUSTRIES

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Introduction

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.

Common Terminology

The following is a list of common industry terms used to describe bearing service options. These terms are used interchangeably across the industry, but do not necessarily represent the same scope of work to be performed.

- *Repair*: Describes a wide range of services that can be performed on a bearing. The term "repair" is generally referred to in this paper as any level of work performed to a bearing.
- *Recertification*: Certification of a bearing for service. This generally applies to an unused product with an outdated shelf life.
- *Reconditioning*: Polishing, honing or tumbling of bearing components to remove very minor surface defects (primarily rust or corrosion) that could lead to more extensive damage if not removed.
- *Remanufacture*: Process of removing aggressive surface damage by using a grinding or hard turning process. Also includes the replacement of any unserviceable components.

Bearing repair is not a new concept, but it

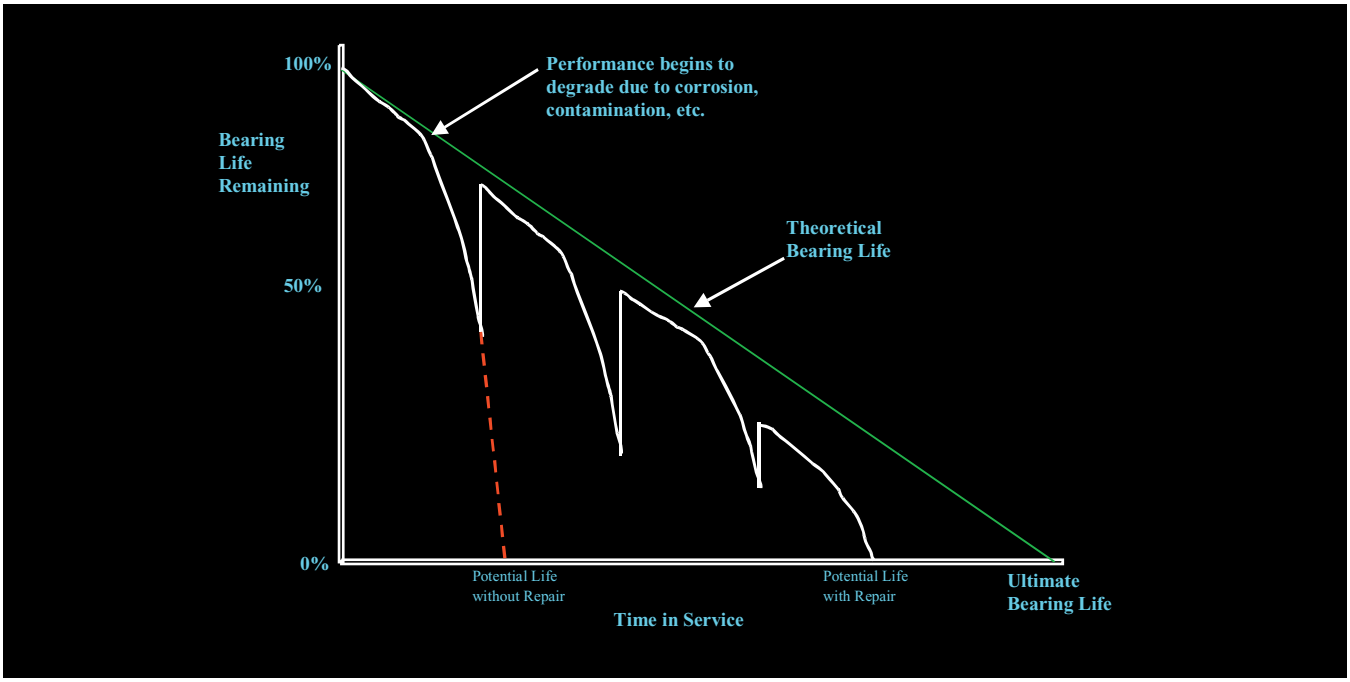


Figure 1—Time in service vs. bearing life remaining.

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 use and economic life. 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.

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-based maintenance programs, combined with economic pressures, contribute to an increased potential for successful bearing repair programs.

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. 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.

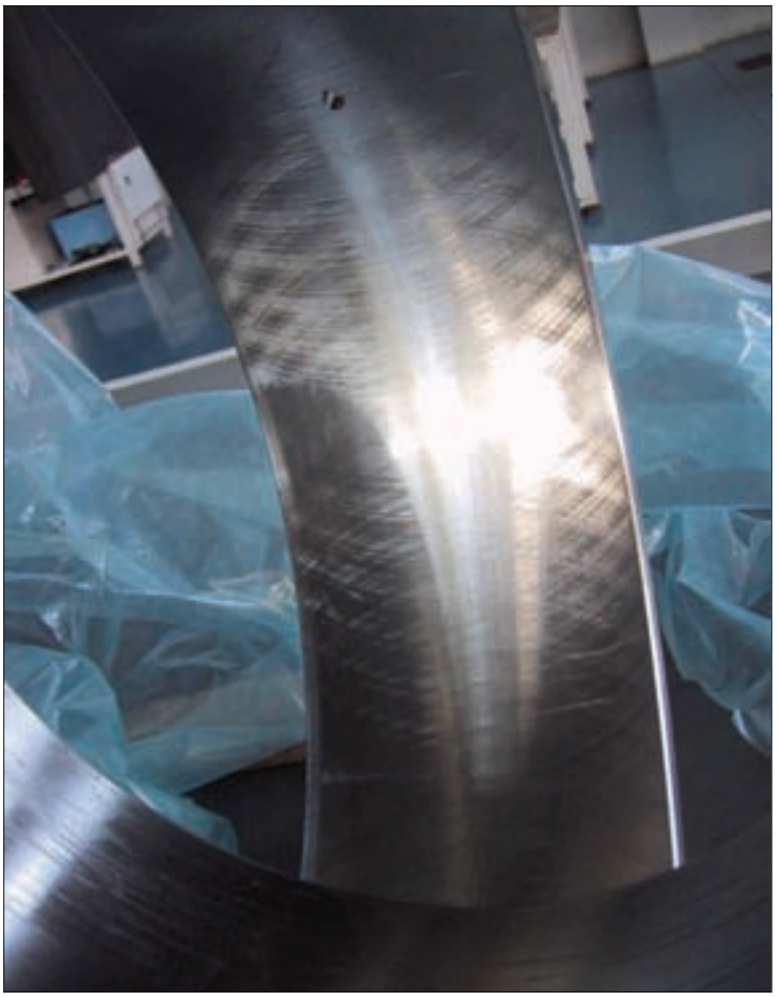
In addition to cost and time savings, bearing repair maximizes the opportunity to achieve the theoretical bearing life cycle. A common question is whether a repaired bearing will last as long as a new one. Studies performed by bearing manufacturers and independent researchers have shown that a properly 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 OEM. Any deviation from OEM specifications will increase the risk of premature failure.

Bearing Repair—What's Eligible?

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

The outer race of a spherical roller bearing in need of bearing remanufacture.



The outer race of a large spherical roller bearing after remanufacture, which includes the process of removing aggressive surface damage by using a grinding or hard turning process.

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. Nevertheless, all bearing types are eligible for repair, regardless of the original manufacturer, including tapered roller bearings; spherical roller bearings; cylindrical roller bearings; ball bearings; thrust bearings (including slew rings up to 120"); and cross roller bearings.

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° Fahrenheit
- Exposure to excessive vibration
- Sudden changes in lubrication and temperatures
- Excessive operating audible sounds
- 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:

1. Record the bearing information.
2. Record actual internal clearances.
3. Complete the disassembly and tag with unique identifiers.

Next, a detailed inspection of all the bearing components is performed and its findings are recorded. The initial inspection includes looking for major problems or damage such as fractures, major spalling or heat-induced bluing. These are red flags that the bearing may not be eligible for repair. Components also are examined to determine the scope of work required.

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 determine whether it can be repaired, and how best to do so. The level of detail supplied in this inspection report depends on the facility performing the work.

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

• *Recertify*: Clean, examine, verify internal clearances; preserve and package.

• *Reclaim*: Polish using proprietary vibratory process; preserve and package.

• *Recondition*: Combines recertify and reclaim services.

• *Remanufacture*: Clean, examine, grind raceways, manufacture new roller sets and major components as required; reset internal clearances; preserve and package.

Additional services available include:

• *Modification*: Special features may be added to existing or new bearing assemblies to enhance performance, retrofit to special applications or upgrade to more recent product designs.

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, consider 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.

Degrees of Damage

Specific damage modes encountered during a repair service include:

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

• *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.

• *Wear*—Contact surface degraded and worn away by mechanical action in use.

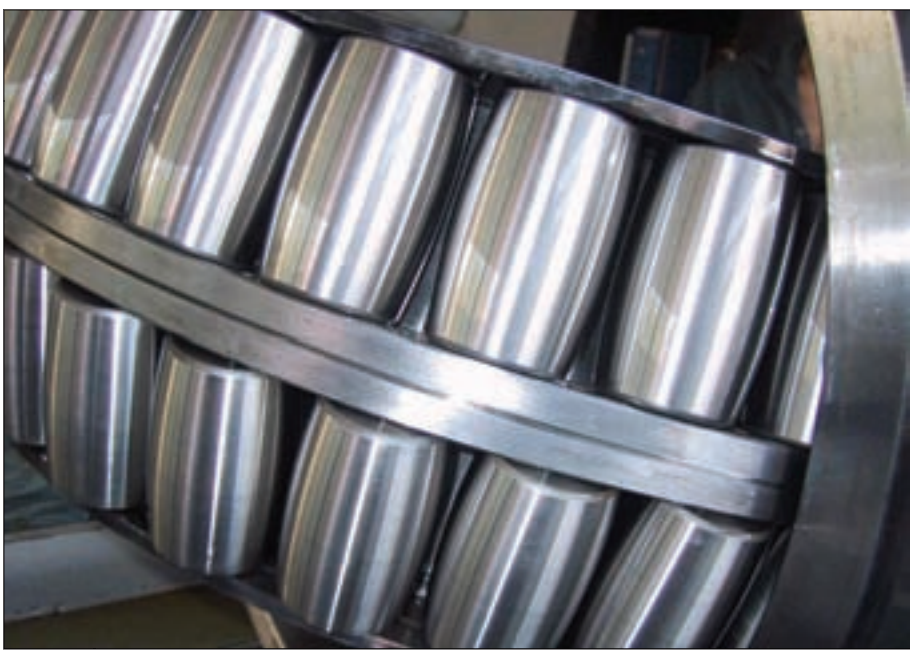
• *Corrosion/etching*—Chemical action (rust) that attacks bearing component surfaces.

• *Debris denting*—Localized surface depressions caused by debris or foreign material.

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

• *Spalling*—Breaking away of metal on raceway or rolling element in flakes or scale-like

A large spherical roller bearing and outer race showing the condition of a bearing in need of bearing repair services.



Spherical roller bearings post bearing remanufacture.

particles; also called flaking, fine-grain or course-grain spalling.

• *Heat checks*—Surface cracks caused by heat from sliding contact, usually formed in direction of motion.

• *Crack/fracture*—Significant visible surface cracks, usually caused by abuse or unusual operating conditions.

There are many publications available on assessing or interpreting rolling element bearing damage. A common topic discussed is how to identify the following damage:

• *Chemical damage*—Etching, stains, corrosion pitting, rust or fretting corrosion.

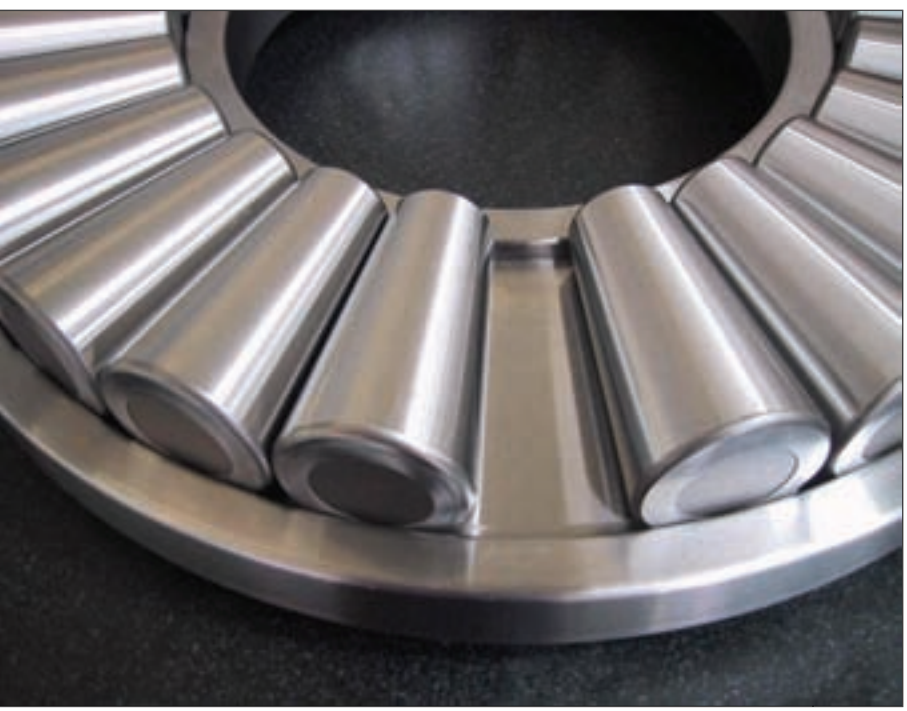
• *Heat damage*—Discoloration or checks.

• *Electrical damage*—Burns, fluting or pitting.

• *Mechanical damage*—Fatigue flaking; cracks and spalling; fracture; nicks; peeling or smearing; brinelling; indentation; scoring; abrasive wear; installation damage; misalignment or lubrication failure.

Most resource manuals describe the damage and may help to eliminate the causes, but they rarely venture into the relationship between damage and repairability. It is always recommended to contact a bearing service technician to assist in any damage assessment or repair feasibility.

Thrust roller bearings and outer race before the bearing repair process.



Thrust roller bearings and outer race after the bearing repair process.

Repair Options/Methods

Various industries and applications may demand different scopes of repair service, but generally, repair service tends to fall into three types:

Type I service generally describes the recertification or clean-and-inspection repair process.

Type II generally applies to the reconditioning or polishing repair process.

Type III service is for bearings with more extensive damage, typically requiring remanufacturing.

Note that Type III involves extensive processes, such as regrinding of races, replacement of rollers or cage components and may even include replacement of a bearing race. Often, the regrinding of raceways will require the manufacture of oversize rollers in order to maintain bearing geometry and clearance in bearings where radial internal clearance is critically held. In cases where lateral clearance is held, oversize rollers, new spacers or additional shims would be provided.

These levels of repair have traditionally been suited for bearings with a bore size of eight inches O.D. and greater, but bearings as small as three inches in O.D are fair game. Smaller bearings that were often thrown away can now be handled, if received in large quantities, and returned to service. Cleaning, inspection and the application of a polishing finish can return these used bearings to like-new condition for a fraction of the cost of replacement. It is always good practice to have a bearing service technician review product before it is returned to a repair center to make sure it is economically feasible to repair.

Turnaround time on reconditioning and re-

pairs can be as short as two to four weeks, depending on the need and scope of work required. Companies utilizing bearing repair should always request a complete, itemized quote that includes cost and estimated repair time when requesting any type of repair service.

Repair Limitations and Expectations

Although bearing repair has proven to be a cost-effective solution, it is, like any service, 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. The Timken Company's standards suggest that the maximum stock removal on any race should be .025"of the diameter, and the roller size should not exceed .015" in diameter from the original equipment manufacturer standard size. These recommendations help reduce the risk associated with altering the design integrity of the bearing. Please note that Timken's guidelines are not industry-standard rules. In fact, some repair centers have no stated limitations on design alterations.

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. 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; 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.

Conclusion

The growing popularity of bearing repair demonstrates the increased understanding of the benefits and value it offers. A high-quality bearing repair program and supplier is one that provides: wide-range of service options; outstanding service; detailed explanation of the work scope to be performed; significant experience with bearings; replacement of any component back to OEM standard; product that matches the performance of a new bearing; good warranty and the service to back it; sound quality assurance documentation; and an ability to service any product type and make.

A quality bearing repair program can provide significant savings compared to discarding and purchasing new bearings. And, of perhaps equal importance, lead time for repair is substantially less than that of a new bearing.

For more additional information:

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