Smarter rail

Save money, save resources & Upgrading your bearing

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About SKF Railway

Today, SKF solutions and services for the railway industry deliver global solutions for rail around the world.

From contributing design expertise and providing advanced axlebox bearings, to installing lubrication systems, validating reliability and safety requirements, mounting bearings and more, SKF helps increase railway vehicle safety, reliability, efficiency and service intervals

SKF offers customers unique insights into railway vehicle bogie system operations by drawing on our unmatched combination of railway bearing design and manufacturing expertise and cutting-edge condition monitoring and application knowledge.
By collecting and analyzing data throughout the operational life of the train, we're helping to enhance the next generation of railway vehicle designs in ways not previously possible.

Save money, save resources

Through bearing remanufacturing

Manufacturing, operating, maintaining and decommissioning railway vehicles are processes that can have a huge impact on the environment in terms of materials and energy consumption, pollution and waste.

Considering the number of vehicles in operation globally, and the increasing demand for rail transportation, it's essential to implement practices that can reduce this environmental impact wherever possible throughout the railway vehicle life cycle. Every decision made during this life cycle can have important implications and consequences in meeting environmental objectives.al step of the refurbishing process.

Bearings and the maintenance phase

During the maintenance phase, bearings are critical components that need to be addressed. Remanufacturing the bearings, instead of replacing them with new bearings, can significantly reduce the environmental impact from the rail vehicle life cycle.

By remanufacturing, products or components are restored to like-new condition.

The option to remanufacture the used bearings offers the possibility to reduce the number of new components to be purchased, helping in turn to save energy and raw materials, while also reducing waste and pollutants during the production process of the bearings. Additionally, it may be desirable from an economic point of view, as it is generally much cheaper to purchase a remanufactured product rather than an entirely new one.

The facts: a life cycle study

SKF has been offering wheelset bearing remanufacturing services to the railway industry for many years through our global network of state-of-the-art service centres.

In order to measure the environmental benefits of bearing remanufacturing, a study has been carried out, in which resource efficiency, waste generation and overall environmental impact for a new-manufactured bearing and a remanufactured bearing are estimated and compared thorough their life cycle. The study was performed in accordance with the ISO 14040 Life Cycle Assessment methodology. Following is an overview of that study, and details on the results.

EVERY DECISION MADE DURING THE RAILWAY VEHICLE LIFE CYCLE CAN HAVE IMPORTANT IMPLICATIONS

A life cycle perspective

Environmental profile of SKF remanufactured and new-manufactured compact tapered roller bearings

Life Cycle Assessment (LCA) is a methodological framework to assess environmental impacts associated with all the stages of a product's life from cradle to grave. These stages include raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling.

The products analysed and compared in this study were:

- the SKF new-manufactured compact tapered roller bearing
- the SKF remanufactured compact tapered roller bearing

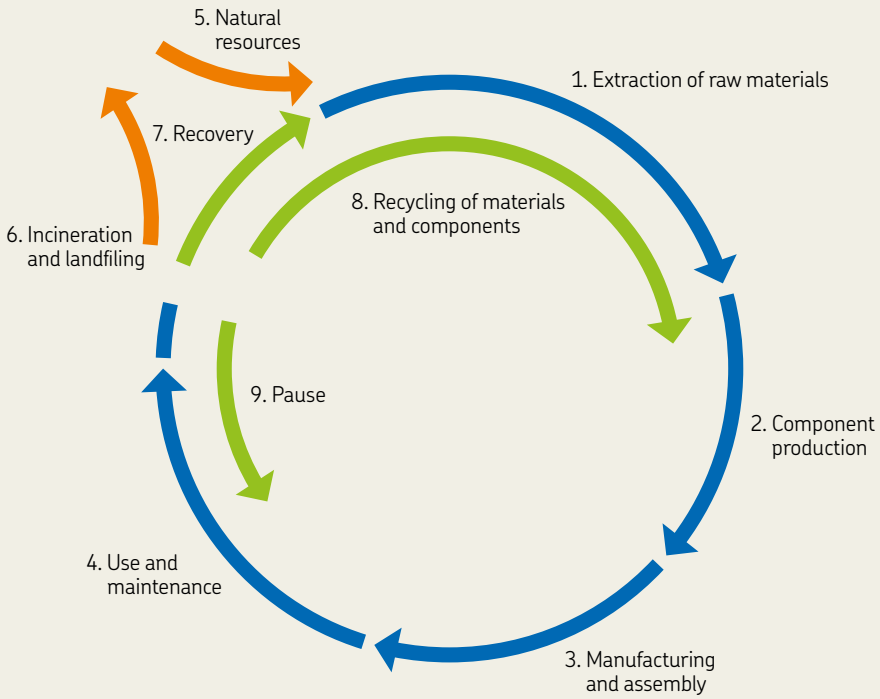
Both are wheelset bearings used on passenger rail vehicles. These bearings are one of the most important components of the vehicle, and are specially designed to run under arduous conditions and remain in service for many years.

The **new-manufactured compact tapered roller bearing** is a double-row bearing with one outer ring, and two inner rings with roller and cage assemblies. It is assembled with a spacer ring that provides the correct axial clearance, and two rubber-steel seals to ensure grease retention and protection against contamination. A backing ring correctly positions the unit axially on the journal.

The **remanufactured tapered roller bearing** composition is equal to a new-manufactured bearing. During the remanufacturing process, all components are inspected and some replaced by new ones, giving the remanufactured bearing the same properties and functionality as a new-manufactured unit.

The following chart shows the material composition of an SKF compact tapered roller bearing **(→ Diagram 1).**

Cycle model



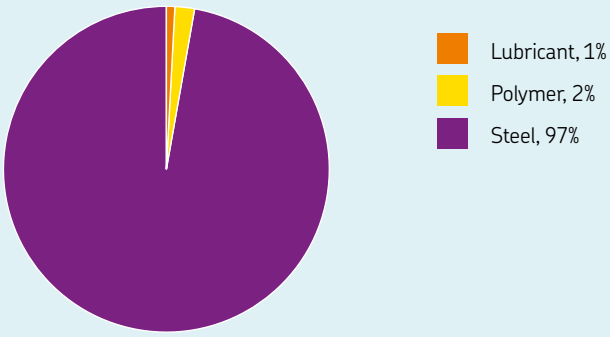
Blue
The assessment takes all stages into consideration, the extraction of raw materials (**1**), component production (**2**), manufacturing and assembly (**3**) and use-phase and maintenance (**4**).

Orange
It also considers all natural resource needed in all steps along the life-cycle (**5**) as well as how components and materials are treated at the end of life, whether incinerated or land-filled (**6**), or recovered into new raw material (**7**).

Green
The assessment of also considers the reuse of components in other application (**8**) and the remanufacturing of bearings and units which pauses the material flow and significantly extends the operating life (**9**).

Diagram 1

SKF CTBU material composition



Life cycle assessment

Resource efficiency **(diagram 2),** energy **(diagram 3),** waste generation **(diagram 4)** and six different categories of environmental impact **(diagram 5)** have all been analysed from cradle to grave. The results show that environmental impact can be reduce by 60-66%.

The analysis were based on the followingfactors:

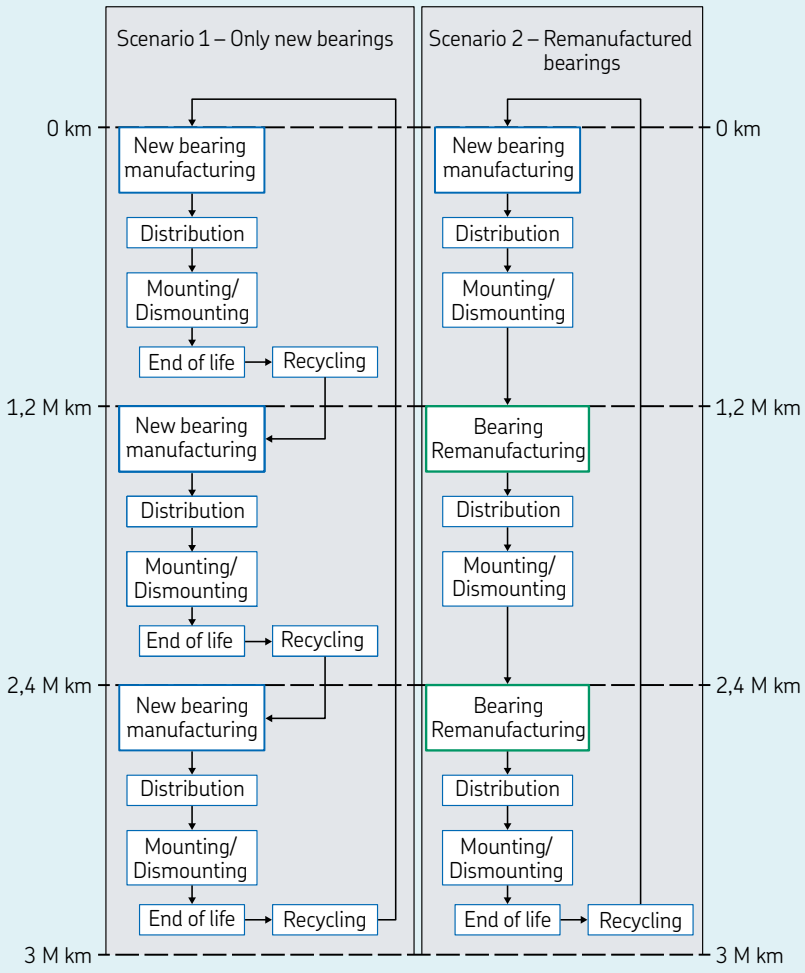
- The use of a compact tapered roller bearing on an electric passenger train for a distance of 3 000 000 km.
- The considered distance is based on the basic rating life of a bearing (L10) according to ISO 281:1990, which represents the actual bearing life before it fails.
- The bearing life depends on different factors, including lubrication condition, misalignment, etc. For this reason, the bearing needs to be maintained every 1,2 M km.

Two different scenarios were considered in the study:

Scenario 1 – new bearings:
The first scenario considered the use of only new-manufactured wheelset bearings within the defined life cycle. So, the bearing is exchanged by another new-manufactured bearing, scrapping the used one, every 1,2 M km until reaching 3 M km.

Scenario 2 – remanufactured bearings:
The second scenario considered the remanufacturing of the wheelset bearing. The bearing is reused after its remanufacturing every 1,2 M km, and the bearing is scrapped when it reaches 3 M km.

Two life cycle scenarios



The use-phase of the bearing, which would include the energy lost during the operation of the train due to the bearing friction, was not included in this study.

Energy and materials use

The results of the study allowed us to determine that 62% more resources were utilised in **Scenario 1** (new bearings), in comparison with **Scenario 2** (remanufactured bearings).

Almost 100% of the steel used in the bearing production is produced from recycled steel. This reduces the amount of non-renewable resources used in the process. A comparison of the different renewable and non-renewable resources used in the two scenarios is detailed in the following chart **(→ Diagram 2).**

The total energy used in **Scenario 1** was 63% higher than the one used in **Scenario 2.**

For both scenarios the major part of this energy was provided by non-renewable resources, which represent 95% of the total **(→ Diagram 3).**

Diagram 2

Resource use - material

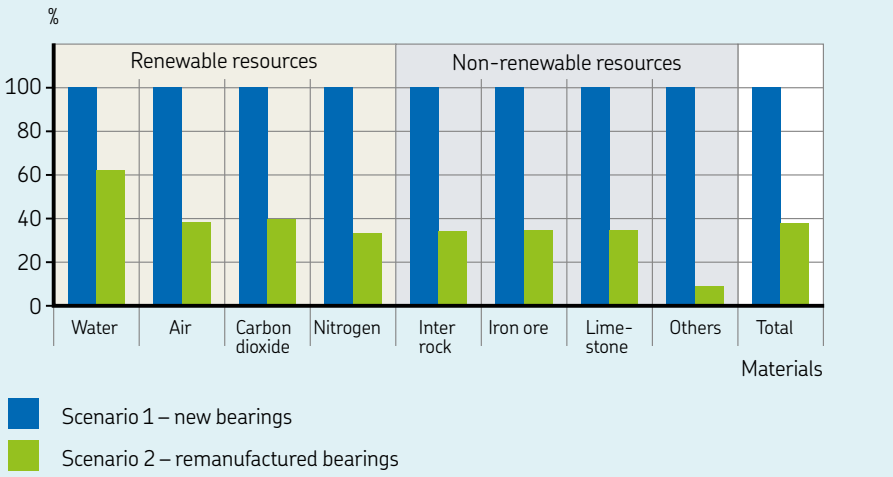
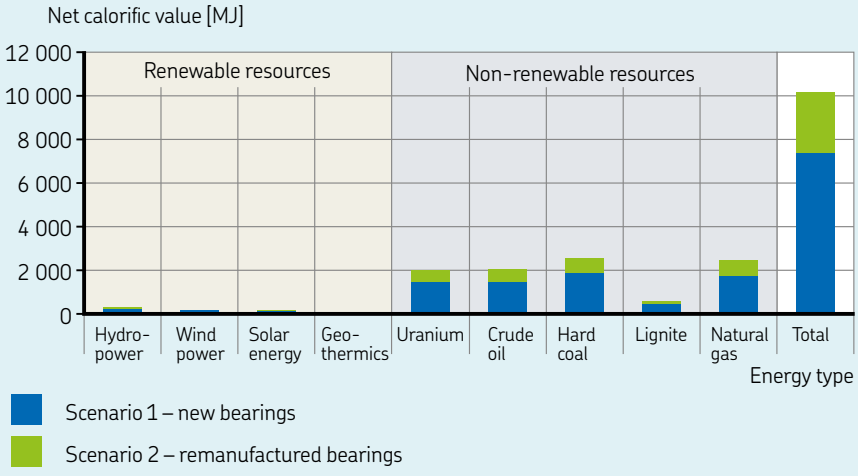


Diagram 3

Resource use - Energy [MJ]



Waste generation

Scenario 1 generated 65% more waste than **Scenario 2.** Hazardous waste was negligible, representing 1% of the total generated in both scenarios.

In both scenarios, the major part of the waste was generated during the raw material extraction and processing, and the components production **(→ Diagram 4).**

Environmental impact categories

A comparison of the different environmental impacts in both scenarios is shown in the chart below.

Carbon footprint - Greenhouse gas emissions (GHG) are considered to be one of the most harmful emissions due to their implication on global warming.

The results of the study showed that the total amounts of GHG emissions is 414 for **scenario 1** and 145 kg-CO2 for scenario 2.

These results, obtained from the CML 2001 impact assessment method, show how the carbon footprint related to the use of wheelset bearings can be significantly reduced by 63% through remanufacturing, during the life cycle of the rail vehicle **(→ Diagram 5).**

Diagram 4

Waste generation

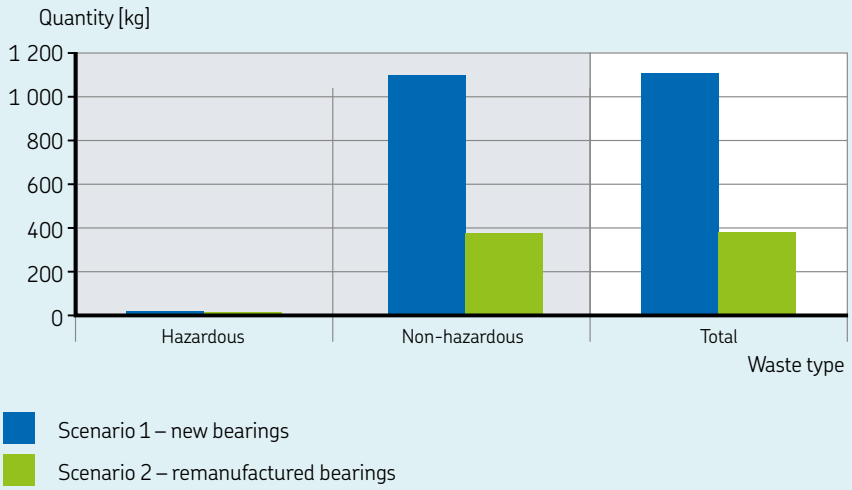
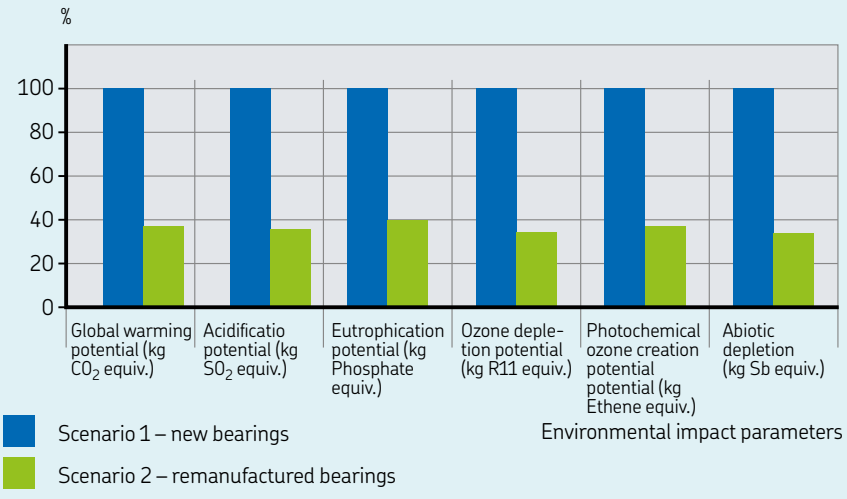


Diagram 5

Environmental impact categories (normalised results)



The positive impact of remanufacturing

Our study of the environmental benefits of new vs. remanufactured bearings is convincing. It shows that many environmental impacts can be reduced by 60% – 66% through remanufacturing. This compelling evidence can help SKF and our customers in making good decisions for the environment – and for business – during the making phase of the railway life cycle.

Upgrading your bearing

– an opportunity for component upgrades

Designed to save energy, improve performance and extend maintenance intervals in high speed rail applications.

The typical challenge when designing bearing seals is to balance friction and contamination exclusion. On the one hand you want to avoid friction for mainly two reasons; to save energy, and to reduce operating temperature in the bearing. Lower operating temperatures means longer grease life which has a direct correlation to maintenance needs – the longer the grease life, the longer maintenance interval. On the other hand you need to make sure that contamination is properly excluded from entering the bearing.

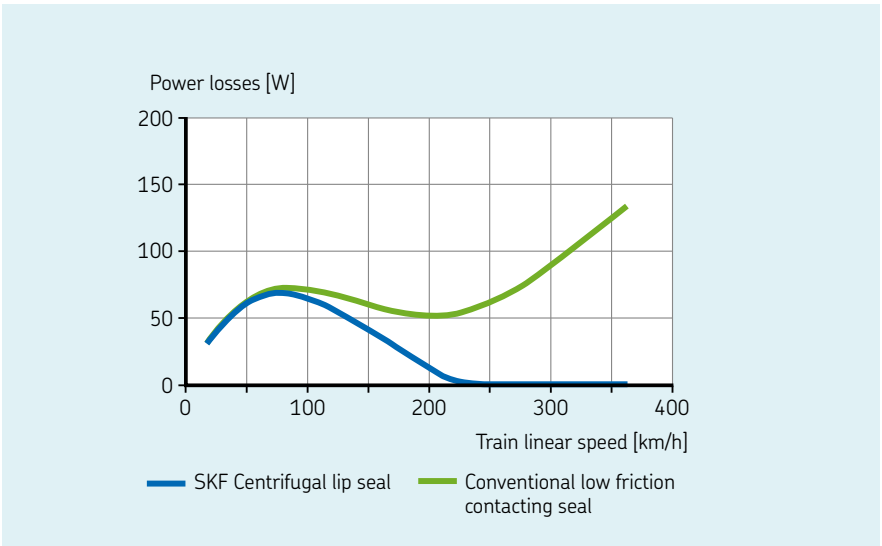
The traditional seals used in wheelset bearings today are either of a contacting lip seal design or labyrinth design. The contacting lip seal design implies that there is a lip.... This solution is effective for contamination exclusion in all speeds but has the disadvantage of creating friction torque due to the contacting surfaces. The labyrinth seal design does not have contacting surfaces and is therefore effective from a friction torque perspective but has the disadvantage of less effective contamination exclusion at lower speeds.

However, now there is a solution available that combines the pros and avoids the cons with both these designs. It is called SKF Centrifugal Lip Seal. This design is a contacting lip seal at lower speeds but turns in to a labyrinth seal at higher speeds.

"The SKF Centrifugal Lip Seal has been developed specifically to overcome the traditional sealing quandary manufacturers face with high speed train wheelset bearing units," Maurizio Martinetti, Senior Project Manager at SKF Product Development, said. "No lip contact at low speeds meant there was a risk of contamination, while contact at high speeds led to energy-consuming friction and its other associated problems, such as excessive operating temperatures and the need for frequent maintenance. However, this new seal eliminates all of these issues for consistently efficient and high performance operation."

When the vehicle is standing still or travelling at low speed, the contacting lip is closed, effectively excluding con tamination from the bearing. While the speed is increasing the pressure and the friction torque are progressively reduced and above a certain speed the lip opens and it becomes a zero friction seal, with centrifugal force preventing the ingress of pollution.

This means that the SKF Centrifugal Lip Seal allows for an optimised friction pattern throughout the operation cycle of high speed trains. As a result, the unit can operate at a low temperature and extended maintenance intervals can be realised to cut the cost of servicing and improve the reliability of the application through cleaner grease. The significantly enhanced efficiency and energy savings can also lead to a reduction in the environmental impact of high speed rail.



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