

Smarter rail

Mounting and dismounting



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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.



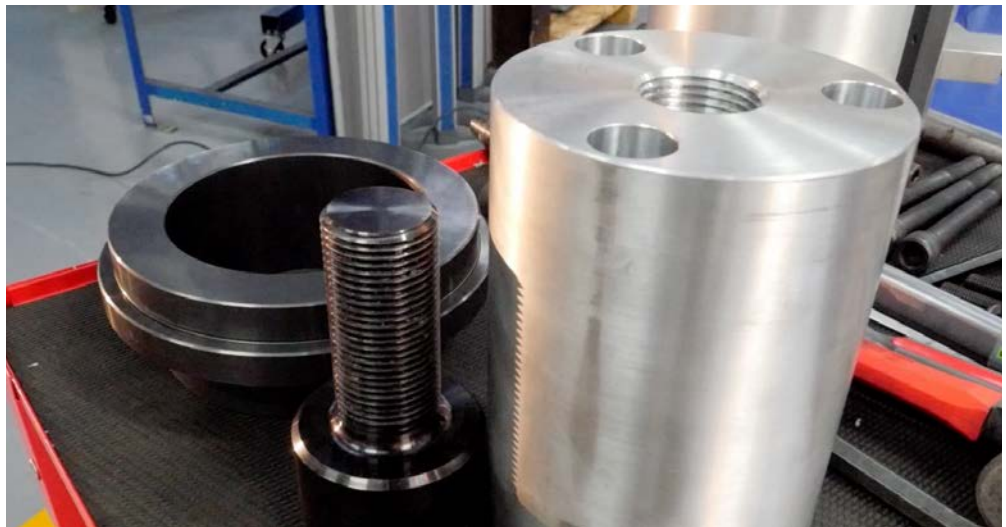
Mounting and dismounting

Handling, mounting and dismounting bearings

Dangers, damages and precautions

Railway wheelset bearings designed for railway vehicles are robust and engineered for these demanding applications. However, railway bearings can be damaged before even being put into service on the vehicle or when taken out of service for refurbishing. This can happen during transportation from the manufacturer to the customer and through incorrect handling, mounting and dismounting practices.

Generally, damage to the bearings during handling, mounting or dismounting is due to a lack of knowledge or to a lack of care in following proper procedures. Following are some of the most common issues – and steps that can be taken to prevent bearing damage.



Did you know railway bearings can be damaged before ever being put into service on a vehicle?

1. Incorrect handling during transportation and storage

Transportation

Careless storage of pallet boxes during transportation can expose them and their bearings to moisture and dirt as well as temperature variations which leads to corrosion. Vibration during transportation could expose the bearing components to vibrations causing frictional corrosion also known as wear. Rough transportation might generate impact loads forcing the rollers against the raceways and creating surface indentations. Always make sure that the packaging is strong enough to protect the bearing from impact and contamination during shipping .

Storage before mounting

During the time between delivery and mounting, the bearings must be stored in appropriate conditions. Unlike open bearings, bearing units are pre-greased by the manufacturer. This offers performance advantages for the user but it

also creates the need for special attention during storage to avoid damage to the grease.

When storing bearings and especially bearing units, the storage rules mentioned in EN12080, EN12081, EN 15313 and in the Association of American Railroads manual H II must be followed. It is also recommended that you follow the instructions of the bearing manufacturer.

Common mistakes are extended storage times or incorrect storage of bearing units that have not yet been assembled on to the wheelset journals. The main problem is the keeping the grease lubricant in good condition protected from contamination and temperature variations.

Unused grease will degrade with time and oil will start to separate out from the grease. This can cause the bearing raceways to become corroded and lead to premature failure in service.

Best practices for storing bearing units prior to mounting include:

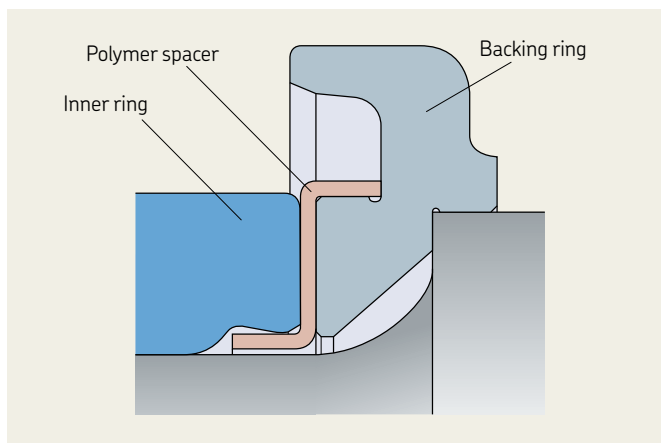
- The bearings must not be stored for more than two years.
- The bearing storage temperature should remain as constant as possible in order to avoid condensation.
- Do not store bearing units close to vibration sources.
- Handle the bearing units with care when moving them. Rough handling could generate impact loads forcing the rollers against the raceways and generating surface indentations.
- Stock rotation must be applied, first in, first out.

Handling prior to assembly

If the bearing units are delivered to wheelset workshops, they should not be unpacked from the transport packages until just before the assembly. This will help minimize the potential for damage.

When the shipping boxes are opened, the technician should make sure that the opened pallet box is not exposed to contamination. Handling individual bearing units can allow damage to the internal steel and polymer components so careful handling is important. Look for bearings fitted with an internal polymer seal which can be easily damaged during careless handling.

The parts in a bearing unit are usually kept together by either a cardboard triangle or by plastic straps which keep the parts in place. The triangle must remain in the bearing unit bore until the bearing unit is assembled on the mounting sleeve. At this point, the triangle should be removed. When removing the plastic straps, ensure the bearing unit parts are not free to fall apart.



Storing the mounted bearing unit

Proper storage of the bearing unit continues to be critical after the unit has been mounted on the journal. In particular, care must be taken to ensure the correct storage of wheelsets with mounted bearing units without axle boxes. As well as impact damage from adjacent wheelsets, bearings can be damaged by contamination so should be stored under cover or protected by a plastic cover.

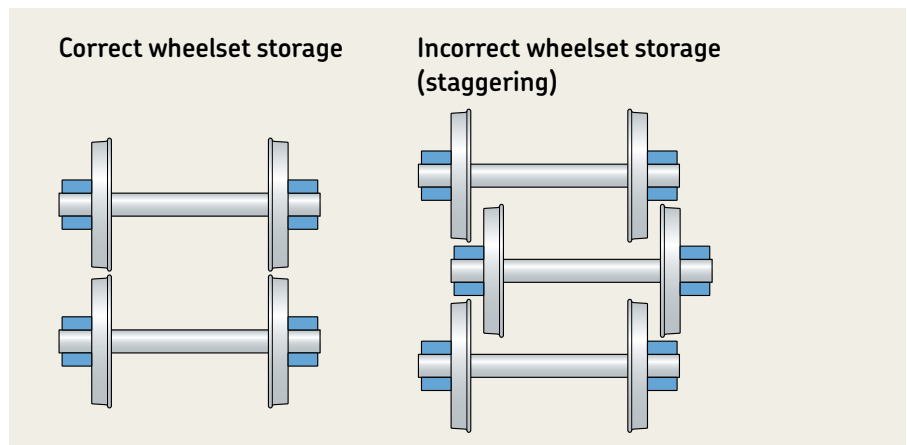
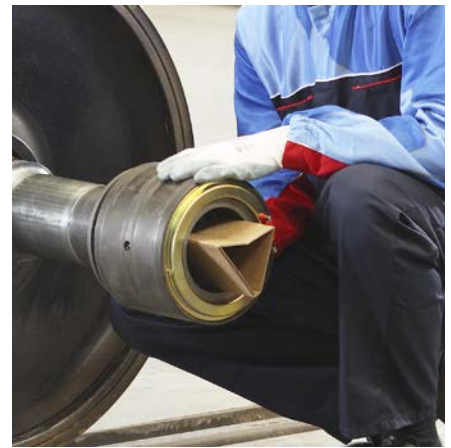
If the wheelset is stored in an inappropriate manner, the outer ring may be damaged by the impact of the adjacent wheel. This often happens when wheelsets are placed too close together in an attempt to save storage space.

Rules for the proper length of time and method of storing bearing units mounted on wheelsets or bogies are detailed in EN12080, EN12081 and EN 15313 in AAR H II manual. Two of the most important rules to follow are:

- Wheelsets with bearing units must be put into operation no later than one year after installation.
- During the storage period of the wheelset or bogies, it is necessary to rotate the bearing periodically. This will help prevent corrosion from stand still roller raceway contact and stirs the grease filling the seals to protect the bearing. If the rotation is not done and months have gone by, it will be necessary to dismount some units and have their condition checked by the manufacturer. This inspection can determine if other bearings stored in the same condition can be used or if they may need to be sent for refurbishment because the grease has deteriorated.



Mounting a wheel set bearing.



Wheelsets with bearing units must be put into operation no later than one year after installation.

2. Incorrect mounting tools

The assembly on the journal is an important milestone in the life of the wheel set bearing. During assembling or disassembling, it is essential to use the correct measuring devices and suitable mounting tools.

Measuring gauge

Visual inspection of the journal for damage and geometry are all essential but the most important factor is control of the journal diameter.

- The optimal gauge for manual journal diameter control is a three-point gauge calibrated to 0,001 mm or 0.001" according to the journal size.

The three-point gauge ensures that the journal's maximum diameter is measured for size and roundness. Two point measuring devices such as micrometers are not acceptable for journal measurement because it is often difficult to achieve repeatable readings between operators and roundness cannot easily be seen.



Measuring before mounting

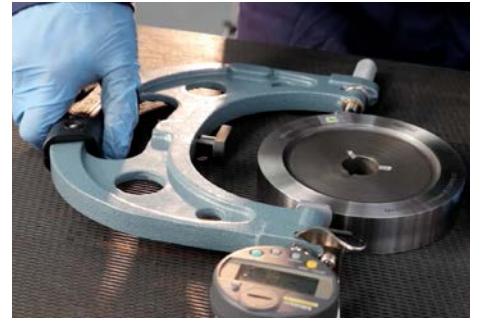


Gauge calibration

It is important to note that even when the correct type of three-point gauge is used, the gauge must be calibrated properly in order to provide an accurate measurement. The calibration should be done using a master ring certified by a certified laboratory. Verification of the master ring must be performed periodically as the dimension of this caliber can be changed by wear or, possibly, due to structural changes in the material.



Calibration tools



Tool temperature

The last important condition for successful journal checking is temperature. The axle journal, measuring gauge and master ring must be the same temperature. The best way to achieve a consistent temperature is to keep all of the mentioned parts in the same room for several hours so that their temperature is the same. Be aware that a temperature difference of only 5 °C can result in a measurement error in the order of one quarter of the tolerance of the journal diameter! It's easy to see why storing wheelsets in the sun, or in other extremely hot or cold environments, can lead to completely wrong measurement results.



Measuring the temperature

Bearing assembly tools

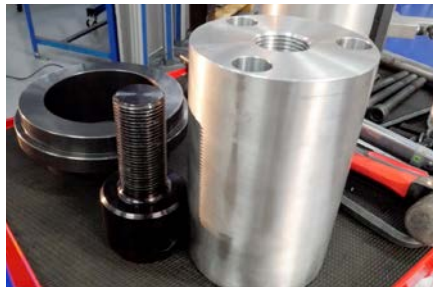
When the journal has been checked, bearing assembly can start. The assembly of axle bearing units with a portable hydraulic press gives reliable mounting by keeping the components aligned during the mounting process.

A high-quality, well-designed tool will fulfill three basic conditions:

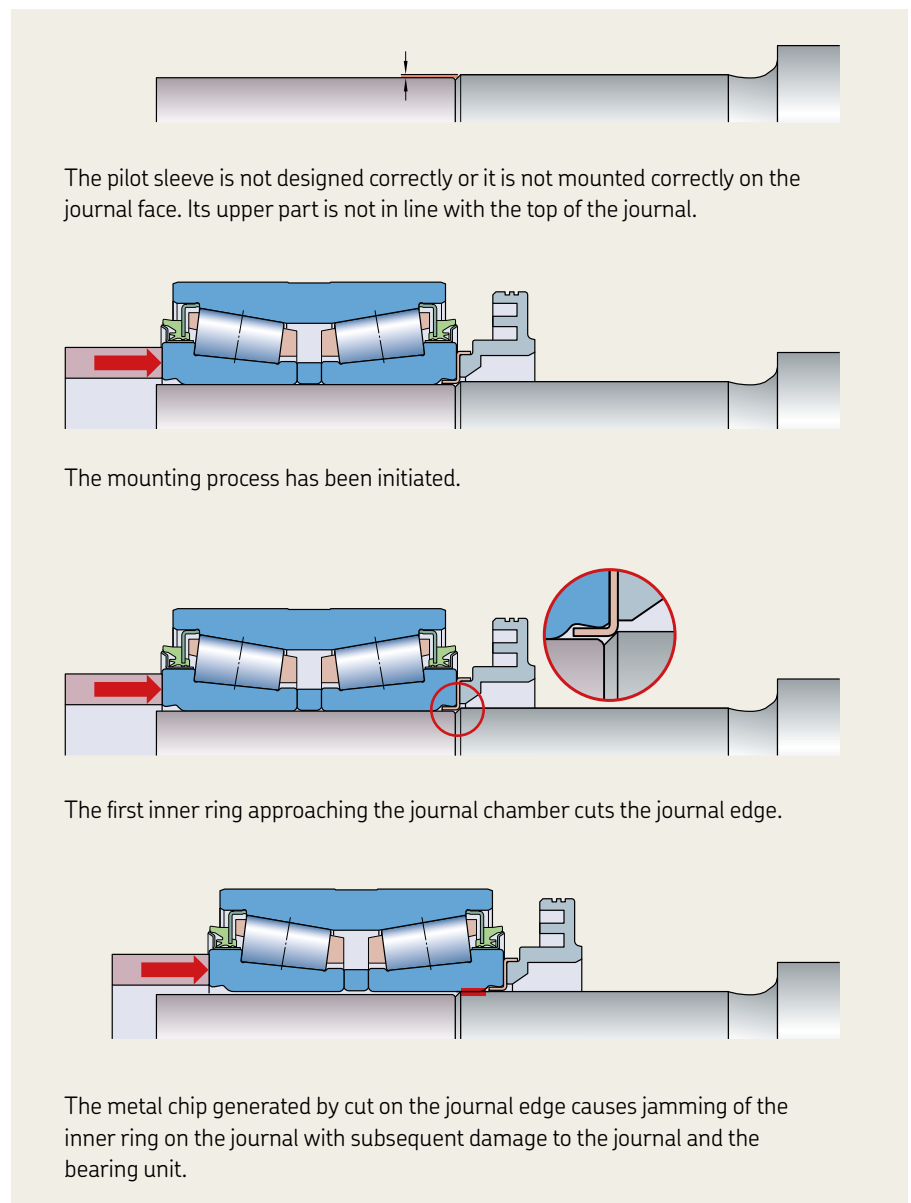
- The tool design should give a single smooth fitting action of the bearing unit from the pilot sleeve to the final position on the axle journal.

For example, if the pilot sleeve is not designed correctly with the journal, either the bearing or the axle journal can be damaged. If this happens:

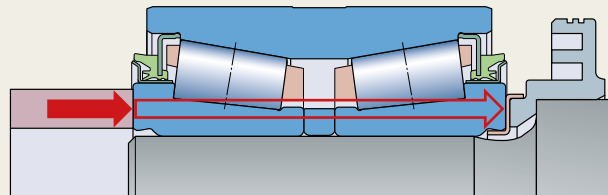
- the journal surface will be torn by the bearing creating metal debris.
- The bearing can become jammed on the journal.
- The tool must ensure the mounting force is transmitted only through the inner rings. Failure to observe this principle will result in the transfer of mounting force through the rolling elements, damaging the raceways.



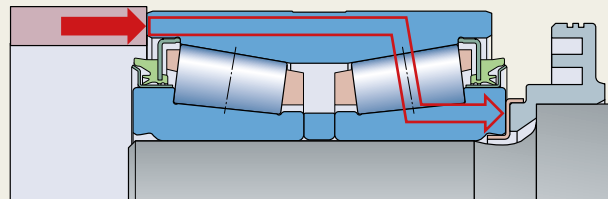
Assembly tool set.



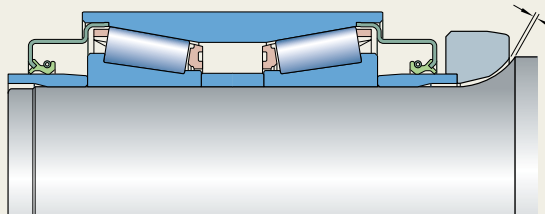
- The tool and the press must ensure that the bearing unit is pressed up to its final position on the journal against the axle shoulder. The consequences of this are explained more in detail in the following section 4.



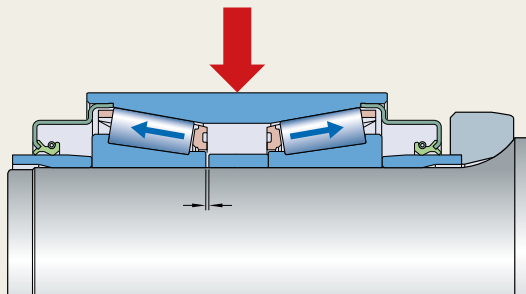
Correct



Incorrect



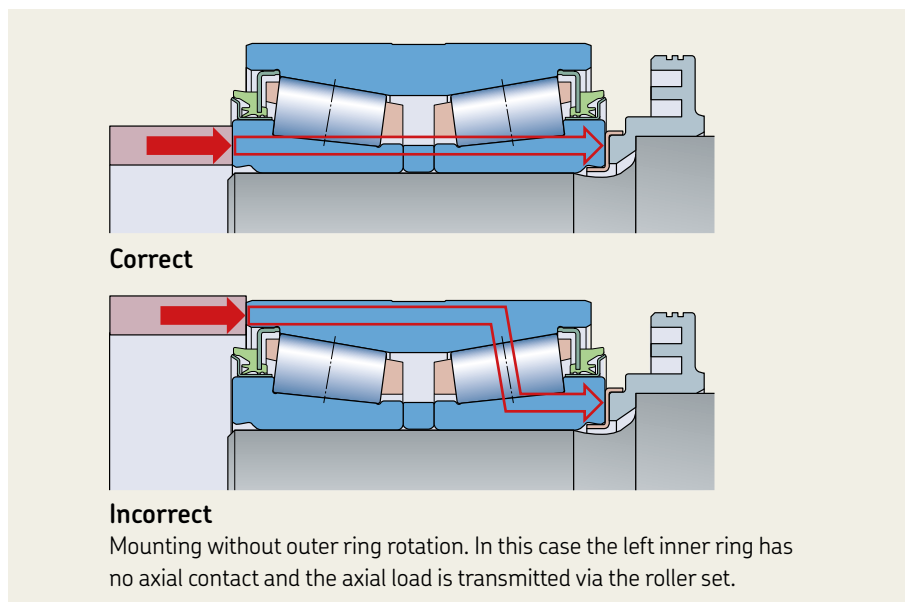
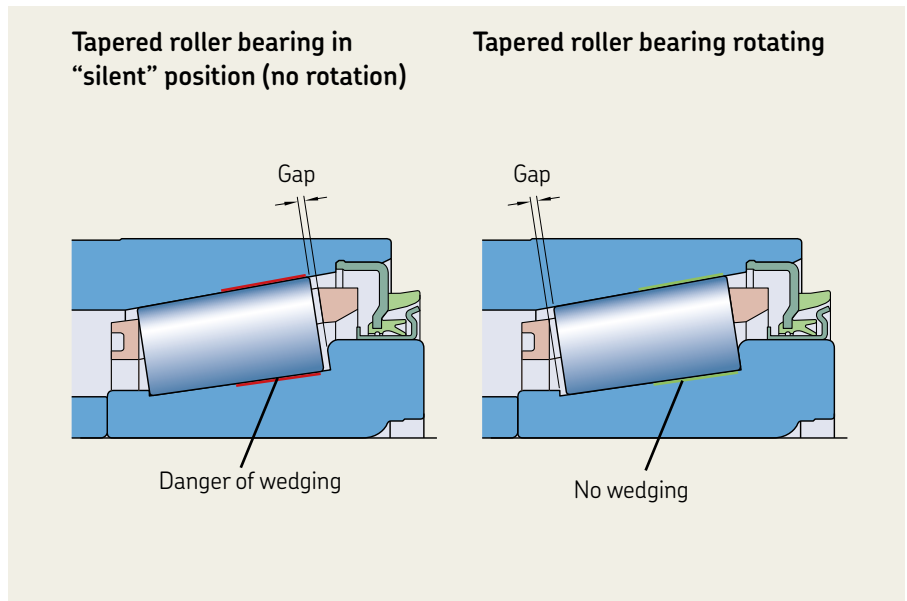
Due to incorrect tooling design the bearing unit is not pushed up to its final position on the journal. There is axial gap between the backing ring and the journal collar.



When the bearing unit is radially loaded in the application, the inboard inner ring travels towards the journal collar. And the gap appears now between the inner ring face and the central spacer.

3. Failure to rotate the TBU outer ring during assembly

When assembling a tapered roller bearing unit (TBU) on a wheelset journal using a hydraulic press, the TBU outer ring must be rotated during the process. This ensures that the bearing is free to rotate at all times so clearance inside the bearing is present. If the outer ring is not rotated during the mounting procedure, there is a risk that the axle load is transmitted via the roller set and wedging can occur.



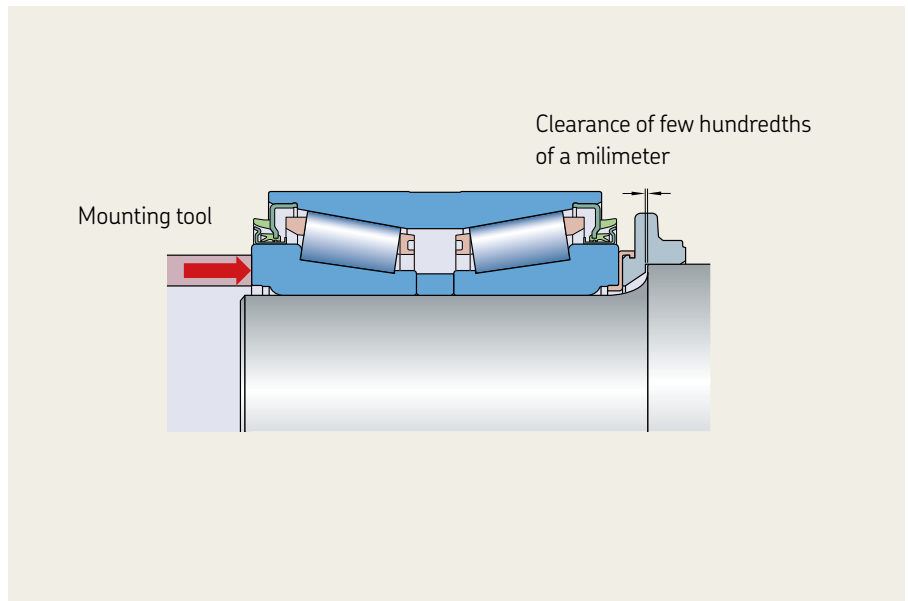
Tapered roller bearing unit outer rings must be rotated during the process.



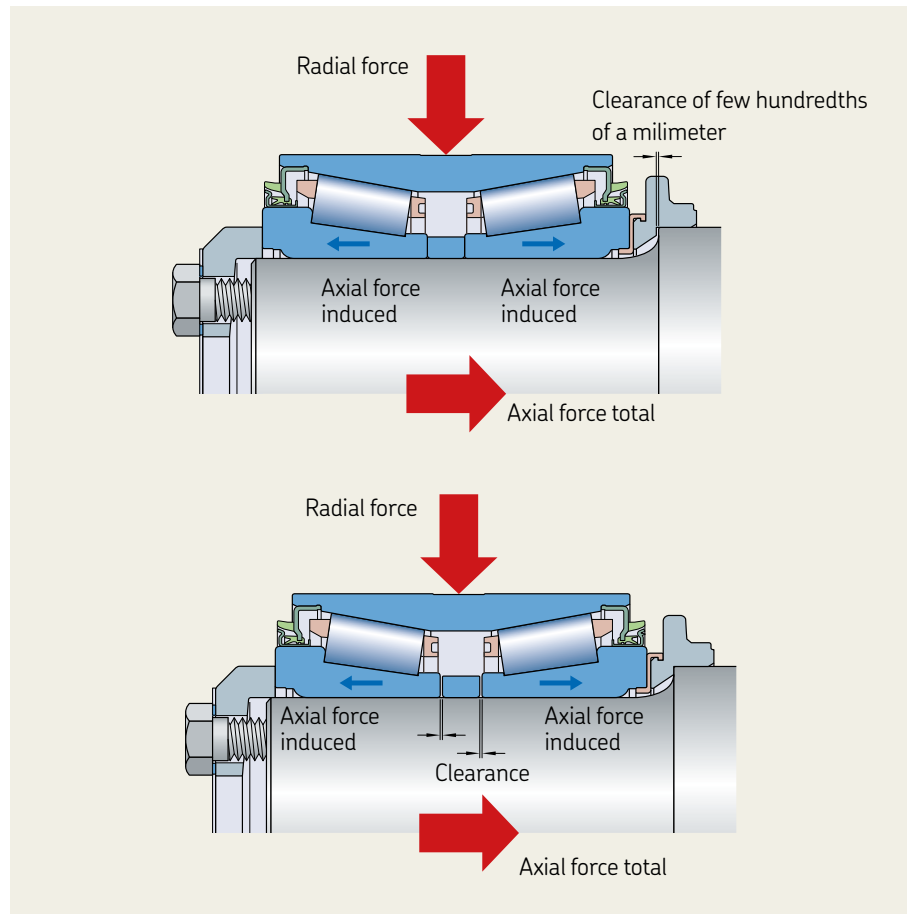
4. Omitting of TBU final seating force

Technicians know that the bearing units can be moved along the axle journals by a force lower than the final seating force specified by the manufacturer on the bearing drawing. The manufacturer's specified final seating force for the TBU bearing unit is usually twice the force needed to move the bearing along the axle. In such a situation, the following scenario may occur:

- The TBU is not mounted in its final position, being off by perhaps by only a few hundredths of a millimeter.
- When the wheel set is put into operation, the bearing unit is normally radially loaded, which naturally induces the axial forces acting on the inner rings. This force is further reinforced by the axial force generated by the bogie hunting and by the centrifugal force from passing the curves.

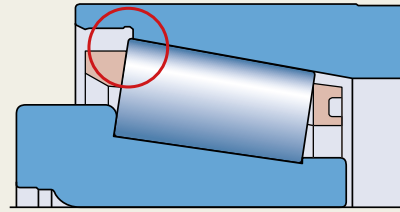


- The TBU inner ring on the end cap side is axially blocked by this end cap, so it has no problem. However, the wheel side TBU inner ring may get into trouble. If the total axial force exceeds the interference fit of the inner ring and the backing ring on the journal, the inner and labyrinth rings can move towards the wheel several hundredths of a mm previously noted. This now axially releases the TBU central spacer.
- Because the central spacer is mounted on the journal with a clearance fit, it is now free to move on the journal. The journal rotation and vibrations found in rail operations allow the bearing spacer to suffer fretting between the spacer ring and the inner ring faces. This can damage both the axle journal and grease.



Short tons vs. metric tons

The problem of non-compliance with the manufacturer's prescribed final seating force is often due to confusion with the units of measurement. American hydraulic presses use U.S. tons while European bearing manufacturers define the seating force in metric tons. The metric ton is roughly 10% higher than the U.S. ton so a technician mounting a European manufactured bearing using a U.S. hydraulic press may actually be pressing the TBU on the journal only by 90% of the prescribed final seating force. It is best practice to observe the movement of the bearing and the pressure of the mounting press together to ensure the bearing is correctly fitted against the axle shoulder.



5. Mounting temperature

Cold mounting

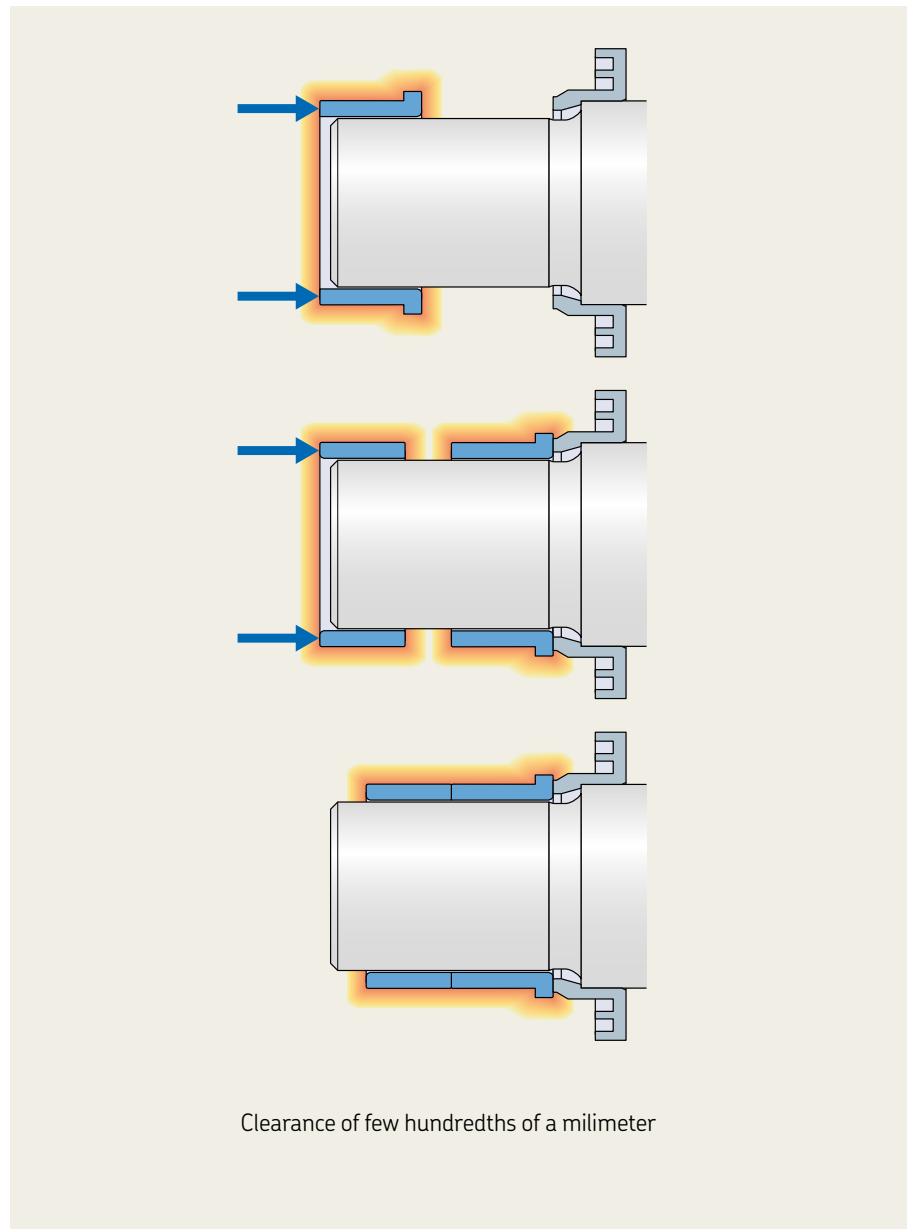
A sealed and greased tapered and cylindrical roller bearing unit must be cold mounted. This means that it must be pressed onto the journal by a hydraulic press cold without being heated to avoid damaging the grease.

Hot mounting

The correct mounting temperature is very important for hot mounting and dismounting of open bearings like cylindrical and spherical roller bearings. In order to fit the inner rings of the cylindrical or spherical roller bearing) onto the railway journal, it is necessary to heat them to a temperature about 6X higher than the temperature of the journal. The same rule applies when dismounting the inner rings from the journal using heating devices.

Hot mounting or dismounting process recommendations and precautions:

- Never heat a bearing using an open flame such as a blowtorch. Also avoid localized or uneven overheating of the rings. For hot mounting, it is best to use an induction heater which can accurately control the heating process by temperature. At the end of the heating cycle, the ring is automatically demagnetized.
- Hot oil baths have traditionally been used to heat bearing rings. This is not recommended primarily due to health, safety and environmental considerations. This method also creates the risk of bearing contamination.



- When dismantling, an induction heater with extractor is recommended. These will heat the bearing evenly avoiding localised overheating of the bearing inner ring.
- Since the journal has a temperature of 20 °C under normal workshop conditions and the interference fit between the inner ring and the journal is about 0,070 mm, the inner ring must be heated to at least 110 °C. It is not recommended to heat the rings to more than 125 °C to avoid altering the heat treatment of the bearing rings.
- The handling of the ring heated to 110 °C requires the correct tools to align the bearing to the axle journal and avoid getting the bearing stuck in the wrong position.
- Oil should be applied to the axle journal to protect it, to stop the bearing from sticking in the wrong position and to assist with dismantling in the future.



Induction heater



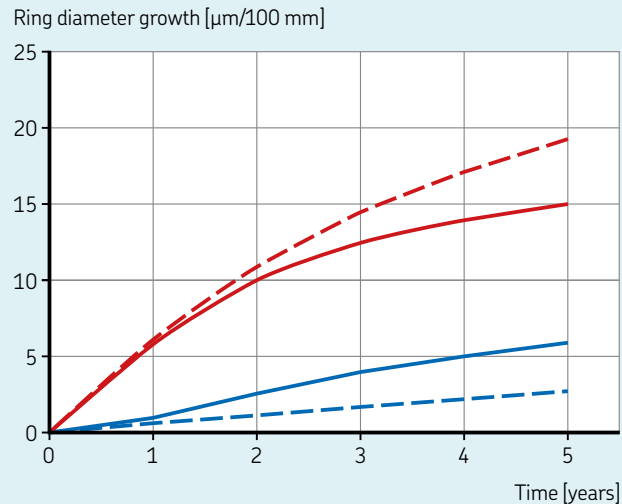
Dismounting precautions

During dismounting bearings, look for the bearing ring with an interference fit and only apply the dismounting force to that ring, usually the inner ring. This will avoid damaging the bearing during dismounting process. Bearings removed from axles should be stored wrapped in protective paper to avoid contamination and corrosion ensuring the bearings can be refurbished. Use the manufacturers original wrapping to protect and store the bearings during the dismounting and refurbishment process.

Protect your investment

Understanding and implementing best practices for bearing transportation, handling, mounting and dismounting is the best way to protect your investment, and to avoid unplanned downtime. SKF offers a broad range of assistance and support to help you take the necessary precautions to prevent bearing damage. To learn more, contact your SKF representative (cc.railways@skf.com).

Predictions compated with measured long-term stability data
Grade 3 hardened and tempered at 220 °C for 4 hours.



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