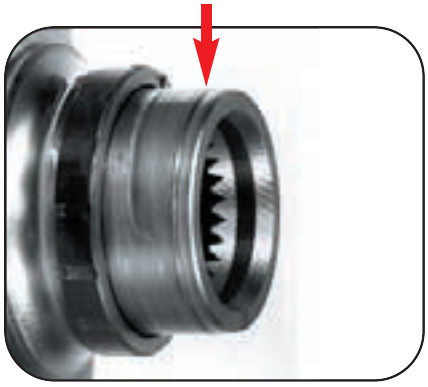
Failure analysis.

By studying wheel bearings that have failed prematurely, SKF engineers have learned a great deal about the causes of bearing failure and how to prevent it. The photographs on the following pages can help you and your mechanics learn from the mistakes of others—and avoid making them yourself.

If your customers do experience an early bearing failure, use these photographs as a guide when inspecting the components to determine the cause of the problem. It's one more valuable service you can offer.

Damage during mounting bearing shaft misalignment.

If, during mounting operation, a misalignment of the inner rings in respect to the shaft occurs, plastic deformations can take place, both on the bearings and on the surrounding components. These deformations could affect the running conditions, generating noise and flaking at a later stage.



The photo above shows the plastic deformations on the shaft caused by a misaligned mounting of the bearing.

Magnification of a raceway showing imprints due to damaged balls.

NOTE: The bearing should not be used again after having been mounted in a misaligned way (or on a damaged shaft). In fact, the rolling elements could have also been damaged, and the over-rolling on the raceway could cause imprints.

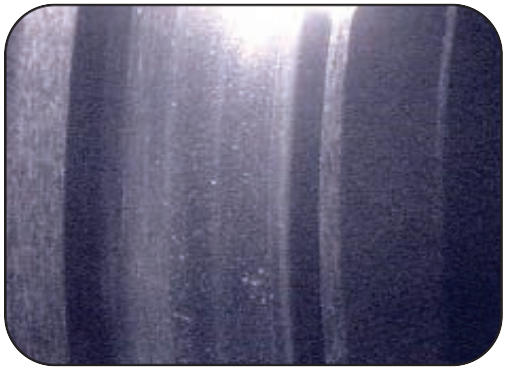
Improper clamp load.

An excessive clamp load forces the rolling elements to work in non-ideal conditions, with an excessive preload. In this running condition the temperature could increase, leading to a loss of the lubricant properties of the grease and deteriorating the surfaces of the raceways. Flaking could occur at a later stage.

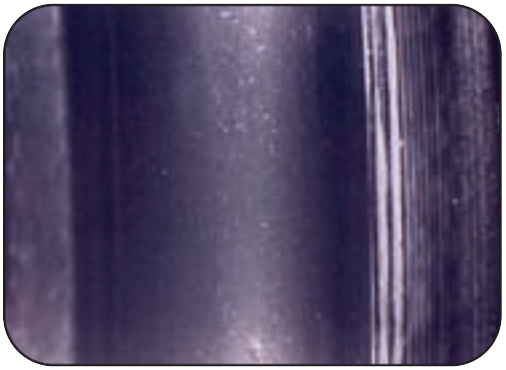
Large and colored path pattern, towards the shoulder diameter

A low clamp load allows the displacement of the inner rings, and leads the bearing to operate without the proper preload, but in conditions of high axial clearance.

During the operating life the clearance tends to increase, as shown from the large, and often double, path patterns on the raceway of the bearing.



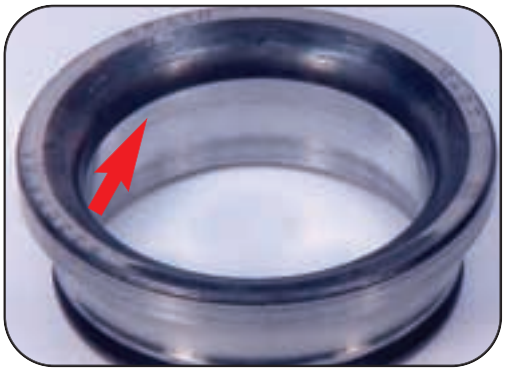
Magnification of the raceway showing a double path pattern.



Magnification of the raceway showing a large path pattern.

In addition, the inner rings could also rotate in respect to the shaft, as shown by the shiny surfaces of the bore diameters.

The improper running conditions can create flaking on the raceways, that generate noise during rotation.



Sign of rotation on the inner ring bore diameter (shiny surface).

Final flaking on an outer ring.

Damage during mounting.

Water ingress.

Flinger misalignment on an inner ring.

Oxidation takes place when water or corrosive elements reach the inside of the bearing in such quantities that the lubricant is not able to provide protection for the steel surfaces. The consequence of this process is the formation of corrosion pits, with finally spalling of the surfaces, particularly in the contact areas between the rings and the rolling elements.

A shock load applied on a sealing component can remarkably affect its function, leading to an improper contact between the seal lips and the flinger surfaces, reducing in this way the sealing properties. In these conditions the ingress of water and/or other contaminants (dirt, dust) may occur.

Effects of the water ingress showing oxidation on a raceway.

Thread damage.

Section of a damaged threaded hole

View of a damaged threaded hole

Thread damages occur on bearings with flanged rings (HBU2 & HBU3) during the screwing/unscrewing operation, when a misalignment between the nut and the hole axis takes place.

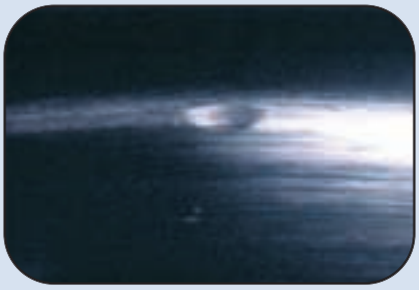
Plastic deformation.

Plastic deformations on a bearing raceway

Plastic deformation occurs whenever the yield strength of the material is exceeded. Overloading by static or shock loads, leads to plastic deformations with the formation of surface depressions on the bearing's raceways, at rolling element pitch. These plastic deformations of the raceway at intervals corresponding to the rolling elements pitch can lead to subsequent flaking by over-rolling at a later stage.

Magnification of an indentation on one ball

Raceways and rolling elements may become dented if the mounting force is applied to the wrong ring so that it passes through the rolling elements. Overloading can also occur by excessive preloading, damaging in this case not only the balls but even the other components.



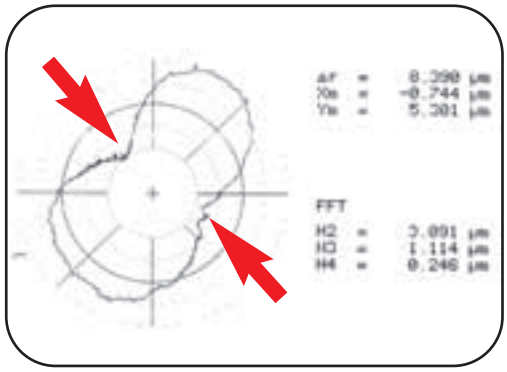
Magnification of a raceway: imprint due to the over-rolling of a damaged ball

Imprints on the raceways can be generated by the over-rolling of damaged rolling elements. Flaking can subsequently occur at a later stage.

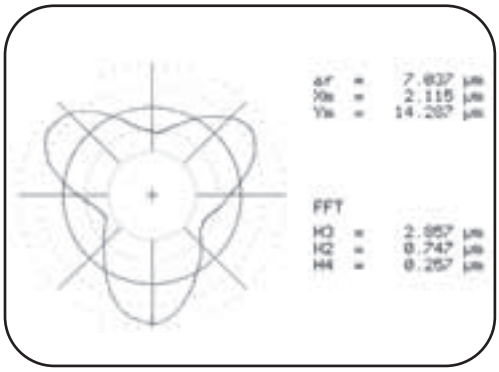
Mating components quality.

Housing ovality/taper and defective shaft shape

When the outer ring is fitted in a defective housing (oval or taper), plastic deformations take place, causing damages to the raceways, that could lead to spalling at a later stage. The deformations that occurred are clearly visible if a roundness measurement of the ring raceway is performed (see picture below). The spallings are located where the squeezing effect of the surrounding component is maximum, forcing the raceway diameter to be minimum.

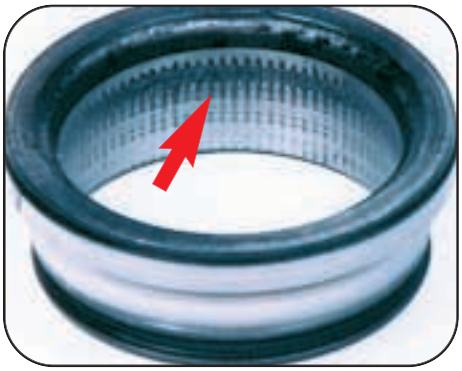


This graph shows the deformed form of the raceway due to the defective housing. The red arrows point out the two palled areas, corresponding to the sectors of minimum diameter.

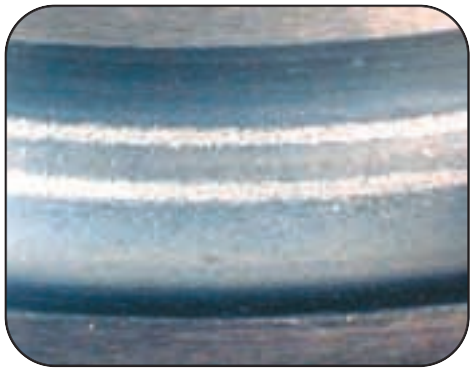


This graph shows the deformed form of the raceway due to the defective shape of the shaft. The measurement was performed with the inner ring still fitted on the hub.

When the inner rings are fitted in a defective shaft, plastic deformations can take place, affecting the operating conditions. The fitting in a taper shaft can lead to heavy damages to the raceways, forcing the rolling elements to roll in defined pattern, with higher contact pressure.



Indication that the raceway has suffered damage from a vibrating shaft within the inner ring bore diameter.



Magnification of a raceway showing signs of damages due to high contact pressure.

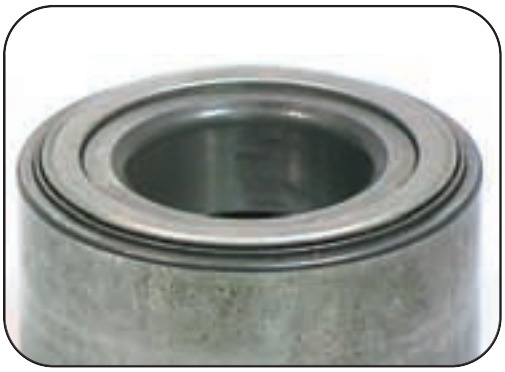
Hub sealing problems.

The function of the seal is to keep the grease inside the bearing and to avoid the entrance of water, dust and dirt, which will cause corrosion and premature bearing failure.

Appearance of a moderate amount of grease leakage is acceptable—this helps protect the seal lips from external agents such as dirt.

Appearance of a new bearing in conformance with drawing specifications.

Seal in an oblique position due to wrong fitting during mounting into the knuckle.



Seal standing out from inner and outer ring due to wrong fitting.

Detail of picture at left showing grease leakage.

Impact damage.

All bearings are sensitive to shock and impact. You should **never use a hammer** in fitting a bearing. SKF recommends only proper fitting tools be used.

Remember, the wheel bearing is a safety component!

Also, before re-fitting the bearing in a knuckle, be sure that the bearing seat is clean and lightly lubricated.

The wrong position of the seal flinger is due to improper fitting on the knuckle and spindle. Always verify lineup of the inner and outer rings.

Close-up showing damage to the spindle and incomplete fitting of the inner ring to the spindle.

ABS sensor ring broken as a result of an external agent while car is running.

ABS cup is broken due to incorrect handling or improper fitting.