

# TECHNICAL INSIGHT

A PUBLICATION OF NSK EUROPE

## Ultra Clean Steel extends bearing life

In the commitment to produce the most durable, highest quality bearings possible, NSK has been a leader in the development of ultra-clean steels for bearing rings and rolling elements. NSK ultra-clean steel is a highly pure vacuum-degassed, high-carbon chromium steel containing a minimum of non-metallic inclusions.

Research proves that ultra-clean steel combined with the appropriate heat treatment significantly increases the rolling fatigue life of bearings. Steel used for bearing components requires the following characteristics:

- › Good hardenability
- › High purity
- › High rolling contact fatigue strength
- › High wear resistance

### Hardenability

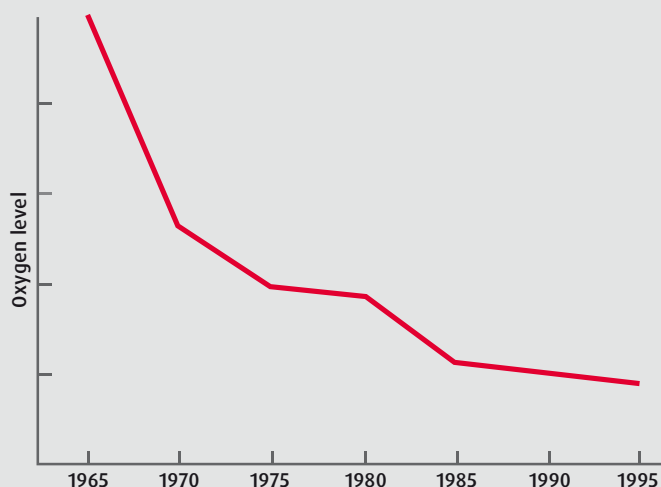
Bearings are heat treated to improve the hardness of the steel and give them greater life. In addition, alloys added to the steel/carbon mix ensure that the hardness will be uniform throughout the component. These alloys include chrome, molybdenum, and nickel.

### Purity

During the steel-making process, a number of materials can enter and combine with the steel. Contaminants found in steel include silicon, aluminum and sulfur. When combined with oxygen, they form inclusions. Each type of inclusion affects bearing fatigue differently. Oxide inclusions weaken the steel. The total amount of oxide group inclusions in steel can be represented by the amount of oxygen in the steel; the higher the oxygen content, the lower the fatigue life.

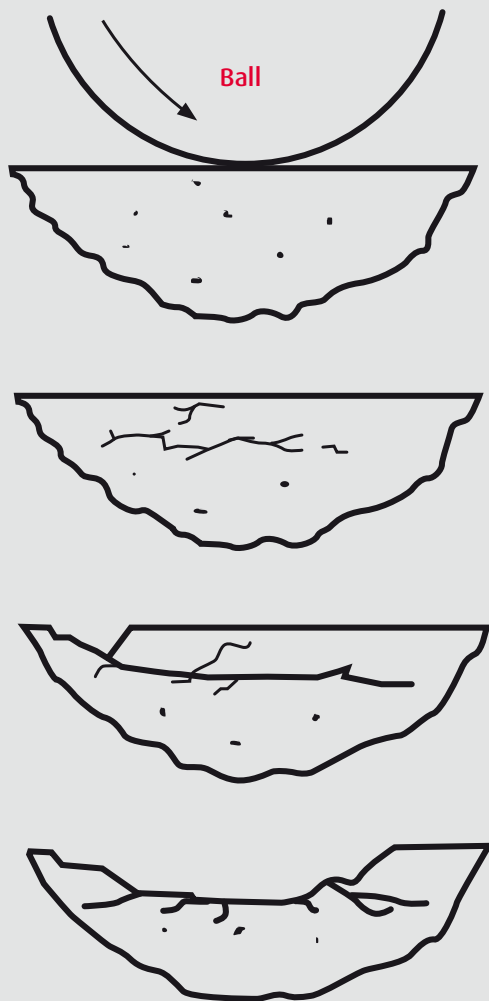
Vacuum-melt or vacuum-degassing processes control the amount of non-metallic inclusions in bearing steel. Further developments by NSK in conjunction with steel manufacturers have resulted in even lower inclusion levels to improve quality and extend fatigue life. Prior to this, bearings meeting these specifications were manufactured from aircraft-quality steel at a premium cost.

**NSK Ultra-Clean Steel Oxygen Content**



Oxygen content is a measure of contaminants in steel. Improved production methods have greatly reduced oxygen content in NSK's steel, resulting in longer bearing life.

### Progressive stages of surface-type flaking



These drawings show the progressive stages of subsurface-type flaking in relation to non-metallic inclusions. NSK uses ultra-clean steel with very low inclusion levels to improve bearing life.

### Rolling Contact Fatigue Strength

The fatigue strength of a bearing is greatly affected by the number of non-metallic inclusions in the steel. These inclusions present stress points where micro-cracks can develop. The repeated contact stress of the balls rolling over an inclusion causes additional stress in the steel surrounding the inclusion. The micro-cracks enlarge, weakening the material. Eventually these cracks break out at the surface of the raceway allowing a small piece to crack out. This is known as spalling. The reduced inclusion content of NSK steel reduces the overstressing of the material, thereby increasing its fatigue strength. Heat treating also improves the fatigue strength of the steel.

### Wear Resistance

Although there is no way to stop the process totally, heat treating increases steel's resistance to wear. For bearings, this wear resistance helps to prolong life under adverse conditions. NSK steels have the added benefit of more uniform heat treating. This ensures good hardness and excellent wear resistance.

NSK has developed ultra-clean bearing steels to greatly improve the life of NSK products. Bearings now survive much longer than those manufactured with standard degassed steels. NSK researchers are constantly working on improvements that will further extend bearing life in the future. For more information, contact your local NSK authorised distributor and ask for the bearings with the ultra-clean steel.

For more information, please visit  
[www.nskeurope.com](http://www.nskeurope.com)

Adapted from NSK Corporation Tech Talk Vol. 01 No. 6