

NTN-SNR expertise at the service of the vehicle manufacturers

## WEC investigated by NTN-SNR – camshaft bearings protected under real conditions

At the Bearingworld Conference held in Kaiserslautern, Germany, on 6<sup>th</sup> and 7<sup>th</sup> of March, NTN-SNR presented a paper on the risks of White Etching Cracks (WEC) on the camshaft bearings in automotive engines. Many manufacturers are making increased use of this bearing application in engines as it offers reduced fuel consumption and CO<sub>2</sub> emissions. Although several cases of WEC were observed while bench testing components, NTN-SNR showed that this failure did not occur in engines under real conditions. NTN-SNR have identified certain factors that could contribute to a WEC failure: the lubricant's condition and the static component of forces on the test bench. Those factors do not exist under real conditions, however, these studies have enable NTN-SNR to develop new projects with vehicle manufactures. NTN-SNR is a recognized expert on WEC – a subject of crucial importance to bearing manufacturers and vehicle manufacturers. Thanks to its previous work on WEC in the wind turbine sector, NTN-SNR introduced black oxide surface treatment as a countermeasure that eliminates the risk of WEC entirely.

### A thorough study and some new hypotheses

#### Studies and tests that address the manufactures concerns

NTN-SNR initiated its studies of WEC in camshaft bearings during the course of a research project with a major European vehicle manufacturer. The project revealed the presence of WECs during test bench trials. Given the scientific community's still-limited understanding of WEC formation mechanisms, NTN-SNR wanted to provide some answers for its customers. On the one hand, the goal was to understand the factors that favour the development of WECs. At the same time, it was important to confirm whether the risk exists under real conditions in the engine. These thorough studies enabled researchers to examine several hypotheses and to identify interesting new factors relative to WEC formation.

#### New hypotheses reveal the role played by the ageing of the lubricant:

First of all, the test bench trials made it possible to show a correlation between the formation of the WECs and the ageing of the lubricant, on the bench tests failure only occurs with new lubricant. When the lubricant is more than 30 hours old, the WEC does not occur. The hypothesis proposed by NTN-SNR is that the additives in the oil can play a role, specifically the dispersants

#### What is WEC?

WEC is an unusual failure of the bearing surface characterized by a network of branched white cracks with adjacent micro-structural phases (White Etching Cracks). The material is weakened, specifically by the diffusion of hydrogen atoms within, and micro-cracks form. The formation of the WECs stems from an unstable equilibrium between material, mechanical and chemical aspects.

which, by avoiding the viscous deposits, can, under certain conditions, impair protection of the bearing surface. A simple, standard anti-WEC solution cannot be established, however, because the lubricants are commercialised according to physical properties (viscosity, temperature resistance, etc.) and not chemical ones, result in an extremely wide range of product characteristics.

### **Bearings protected under real conditions**

NTN-SNR also showed that WEC occurs only when several conditions exist simultaneously, specifically static force conditions specific to test benches. NTN-SNR improved its test benches to achieve a better simulation of the dynamic forces associated with the timing belt or the actuation of the valves. After several thousand hours of testing under those conditions, along with testing under real conditions, NTN-SNR was able to confirm that no WECs formed on the camshaft bearings.

Finally, NTN-SNR successfully demonstrated that WEC never occurred in bearings treated with its black oxide surface treatment. This was true even under the least favourable conditions, specifically with static forces and lubricants identified as having caused WEC formation in other cases.

### **Camshaft bearings – new growth driver for NTN-SNR**

All these findings encourage NTN-SNR as it pursues its camshaft bearing development projects with the major automotive manufacturers. NTN-SNR is naturally well-positioned for this technology of the future, which provides significant reductions in fuel consumption and CO<sub>2</sub> emissions. Moreover, its bearings' acoustic performance has been subjected to validation testing by the vehicle manufacturers. In addition, NTN-SNR developed special bearings in terms of geometry as well as mechanical strength, in order to adapt to specific requirements of the camshaft assembly process of certain constructors and to avoid any increase in production costs.

Given NTN-SNR's expertise and its leading position on the automotive bearing market, it anticipates strong growth in this new camshaft bearing market.

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*NTN-SNR ROULEMENTS, headquartered in Annecy, France, is part of the Japan-based NTN Corporation, one of the worldwide leaders in bearing manufacturing. NTN-SNR is responsible for the management and development of all NTN activities for the EMEA region and for Brazil. As a major player that designs, develops and manufactures bearings and sub-assemblies for the automotive and aerospace industries and for general industry, NTN-SNR offers a complete product range whilst also developing services and maintenance solutions. NTN-SNR employs 4,225 people and operates nine production sites, six of which are located in France, along with 18 sales offices.*

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