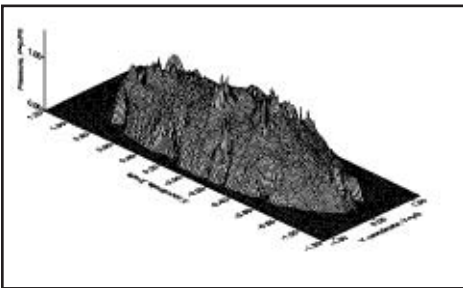


Timken® Debris-Resistant Bearings for Improving Gearbox Reliability in Wind Turbines



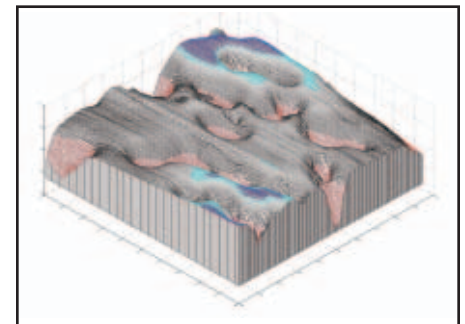
Timken® debris-resistant bearings offer superior performance and help improve system reliability in debris contaminated operating environments. Debris Signature AnalysisSM is a viable service that helps quantify the effects of debris in your system. Using computer based modeling, the system helps the gearbox designer identify the type of debris in their system.

Despite the extreme efforts used by modern wind turbine gearbox builders to ensure a clean operating environment, bearing raceways will inevitably be dented by hard particles suspended in the lubricant.



If severe enough, the macro-indentation sites become significant stress risers that modify the stress profile on the bearing raceway. In turn, the altered stress profile reduces the bearing rating and the reliability of the gearbox. This derating can be significant and lead to premature bearing damage. Understanding the effect of debris, and compensating for it with bearings that are designed to react differently in the presence of denting, is a means of preventing this unavoidable phenomenon.

Debris Signature AnalysisSM is a tool that maps a field of indentation sites on a bearing raceway and mathematically quantifies its stress modification. Testing at Timken research has confirmed the validity of using this tool for predicting the bearing life reduction.



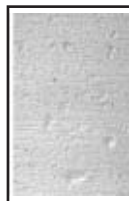
Bearing Raceway Samples



T1 = 0 hrs.



T2 = 20,000 hrs.



T3 = 40,000 hrs.

Using actual bearings that typify normal raceway surface conditions at various service intervals, the gearbox designer can conduct the appropriate Debris Signature AnalysisSM on each example at T1, T2, T3. This allows the designer to quantify the change in bearing reliability associated with typical denting over the life cycle of the wind turbine gearbox.

Compared to standard bearings, Timken debris-resistant bearings provide exceptional performance improvements in debris contaminated environments as verified by the experimental results below. Test results prove that application of Timken debris-resistant bearings will improve system reliability predictions and increase the long-term durability of the wind turbine gearbox.

Fatigue Life Test Results

