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We are experiencing renewed interest in steels for bearings. The past two years have seen several conferences and reviews, in addition to the special issue referred to above. The purpose here is to showcase a few outcomes that might stimulate and rejuvenate the subject.

Although bearings do not make the world go around, they feature prominently in ordinary and extraordinary life, wherever it is necessary for a part to rotate relative to another with minimal friction while transmitting loads via lubricant films. The steels from which bearings are made must sustain repeating stress pulses of 2GPa or more, arising from rolling contact. These stresses cause accumulation of damage underneath the contact surfaces, damage that ultimately limits the loading and overall life of the bearing. Bearings rotating at high speeds must account for centrifugal forces, together with any residual stress locked into the steel by the manufacturing process, or arising from fitting the bearing to a shaft. All this is well-established, and procedures have been developed to provide data that will enable engineers to ensure the probability of bearing failure is sufficiently small over the service life of the machine in which they serve.

There are, however, new challenges highlighted in, but not limited to, wind turbines where bearing failure can occur early in the calculated life, ie more frequently than expected from life estimates. Such statistically unexpected failures are costly and inconvenient. They might be associated with the ill-defined loading of wind turbines, environmental factors often attributed to hydrogen ingress, or the steel used to make the bearings. The situation is not helped by the tendency to highlight microstructural observations that indicate the onset of damage within the steel without clear experiments to distinguish cause from effect.

Hydrogen reduces the fatigue life of bearing steels. This is a fact. Focus needs to shift from tediously repetitive experiments using hydrogen-charged fatigue specimens, to innovation that cures the problem. Steels need to be designed that prevent the ingress of hydrogen and, if the hydrogen does get in, render it innocuous. It is possible that the relatively poor toughness of the type of hard steels necessary for bearings renders them more susceptible to hydrogen. Developing hard steels with enhanced toughness has to be a goal of R&D, with emphasis on both the low-concentration impurities that embrittle and the engineering of austenite grain boundaries.

Aeroengine bearings can suffer surface-initiated damage. Efficient surface engineering of bearing steels is likely to become ever more important to enhance damage tolerance. A prize would be for bearings to continue without gross failure to enable the engine to perform until grounding. The so-called dual hardening, which involves, in some cases, carburisation followed by nitriding, is an example where the hardness and performance of the surface is dramatically improved over the conventional treatment of case-hardening alone.

This is only a summary and there is much more than meets the eye, including the need for improved modelling – the field is open for metallurgists to make innovative contributions to the future of components that are vital in routine and advanced engineering.

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