

A Durability Assessment of Rolling Element Bearings in a Camshaft Application, Considering Sensitivity to Installation and Operating Parameters

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ABSTRACT

Concerns over greenhouse gas emissions are driving governments and the automotive industry to seek out ways of reducing vehicle CO₂ emissions. Engine friction reduction is one means of reducing CO₂ emissions, through fuel consumption improvements. One area where it is felt that friction reduction is possible is in connection with the camshaft bearings.

MAHLE has conducted experimental evaluation of rolling element bearings used to support camshafts, replacing the standard plain journal bearings. The aim of the testing was to gain an understanding of the durability of rolling element bearings, tested in a range of different operating conditions. The controlled test conditions included variations to:

- Camshaft speed
- Oil temperature
- Oil age/specification
- Oil supply method/flowrate
- Bearing journal line bore misalignment tolerance
- Bearing journal diametrical tolerance

A Design of Experiments software package was used to generate a reduced test matrix, with the aim of allowing a full understanding of the effects of each of the test variables, whilst vastly reducing the number of tests required. The testing required the creation of a rig that could test multiple bearings simultaneously in all of the different operating conditions required. This enabled a large number of tests to be accomplished within the required timescale.

The bearings were measured in a number of ways before and after testing to ascertain wear mechanisms attributable to each of the test variables. The results indicated that although there was a measurable reduction in bearing assembly weight for all bearings, there was very little measurable wear on any of the bearing contact surfaces, and therefore no operating condition can be outlined as detrimental to the bearing life. The conclusion therefore is that rolling element bearings would be suitable to support camshafts in production engines.

This paper details the approach to the testing, and discussion of the results.