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The Effect of Lubricant Choice on Valvetrain Tappet Performance

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To meet stringent vehicle emissions there is an ever-increasing demand on lubricant additive companies working together with OEMs to improve a vehicles efficiency without compromising on durability. This in turn demands a better understanding of the tribological performance of a lubricant in service. The mechanical contact between a camshaft lobe and a tappet in an engine valvetrain system is a complicated and dynamic tribological interaction consisting of both sliding and rolling friction and the choice of lubricant can affect the tribological performance of this important contact.

Keywords: valvetrain, surface roughness, engine

1. Introduction

The geometry of the engine camshaft lobe and tappet interface is such that the tappet rotates when interacting with the lobe. In order to maintain durability, it is required to constantly rotate in service. The choice of lubricant can dictate the tractive effort of the tappet and it is often difficult to understand how well a tappet has performed in test from end of test visual inspections or analytical drain analysis of elemental wear. This research study highlights the use of advanced metrology techniques to evaluate a tappets' rotational experience and how the choice of lubricant can impact its performance.

2. Experimental

A motored valvetrain tribometer was used for experimental analysis. This tribometer was equipped with a Daimler OM646LA cylinder head. The benefit of using such a tribometer is that it provides an insight into real world engine wear with experimental oils. The test oils were multigrade fully formulated lubricants of SAE 0W20 grade and doped with a 1% w/w of a soot mimic thereby improving the integrity of the test and a dynamic speed profile based on real engine data was employed. Intermediate test drains were extracted for elemental analysis and end of test components were rated in terms of wear. A Zygo 8300 series white light interferometer was used to evaluate the end of test tappet surfaces and Digital Surf Mountains Map Imaging Topography version 7.4 software was used to provide a further technical insight into how the tappet had performed during test. The surface waviness (Wq) of a tappet provided an indication of how well a tappet rotated during test.

3. Results and Discussion

Experiments were conducted with test oils that had a variety of different anti-wear chemistries to provide some insight into how anti-wear chemistries can affect the tractive effort of a tappet.

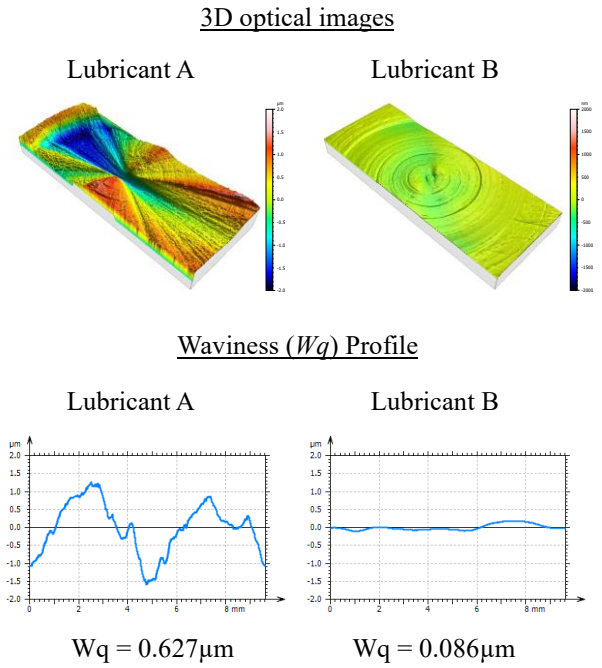

Figure 1: Surface waviness of two tappets from two different test lubricants

The mechanical contact between a camshaft lobe and a tappet in an engine valvetrain system is a complicated and dynamic tribological interaction consisting of both sliding and rolling friction. The surface waviness provides an indication of how flat a tappet has remained during test and a flatter profile indicates uninterrupted rotation has occurred which is important for valvetrain efficiency and durability. This is also evident from the 3D optical scans of the tappet, Figure 1. The tappet from the Lubricant B test has a near flat profile (low Wq value) and this tappet surface shows even rings of normal rotation wear which indicates that the tappet performance was not compromised with this lubricant and rotated as it was intended to do so. However, the same cannot be said about the tappet from the Lubricant A test which has a higher Wq value. It was found in this research study that anti-wear chemistries can change the performance of the cam lobe – tappet interface.