Investigation of oil leakage in a camshaft phasing system

Abstract

The following project assesses the effect of component-manufacturing tolerances upon the leakage rate of a camshaft phaser system produced by the British company Mechadyne International and used in automotive 4-stroke engines. The project is carried out in a three stage procedure. First, an initial CFD model (Computational Fluid Dynamics) of the cam-phaser is built. Second, the CFD model is validated against experimental measurements. Finally, once the CFD model is validated, it is then modified to investigate the influence of different parameters in the leakage rate of the phaser.

An initial outline of the CFD analysis is given, defining the type of mesh used, the solver chosen and other configuration parameters. The lubricating properties of the selected Mobil 1 15W-50 oil are calculated following experimental equations. The leakage capabilities of FLUENT CFD software are then tested in a micro 2D leakage test against hand calculations. A CFD 3D model of the phaser is built in a step-by-step procedure. The results are presented, highlighting that the clearances (because of the manufacturing tolerances) are a critical parameter in the global leakage of the phaser.

Subsequently the layout of the experimental testing is explained, the different configurations tested and the results shown. The computational model is then validated through a comparison between CFD results and these experimental results.

In the investigations stage, the CFD model is modified in several ways to assess the influence of parameters such as pressure, rotational movement or increased tolerances in the final leakage. In addition, the removal of some seals is simulated, as well as the introduction of new labyrinth seals. The results show that the front seal could effectively be substituted by an adequate labyrinth seal.

Additionally some seal-analysis experimental tests are carried out. The phaser is tested with the seals, without the front seal and without both seals; finding that the rear seal is a vital component, but that the front plate seal hardly improves the sealing and could be removed to reduce the friction.

The benefits from this project are various. First, the leakage areas are identified. Second, the efficiencies of the seals are assessed. Third, the performance of the phaser is enhanced by removing the front seal and introducing an economical labyrinth seal.