Development of Capacitance Based Micro-Sensors for Measurement of Lubricating Oil Film Thickness between Piston Ring-Liner Interface in an Engine Simulator

**By**

Atul Dhar

The interface between the piston rings and cylinder liner play an important role in total frictional losses and mechanical wear of internal combustion engines and is increasingly coming under scrutiny as legislated particulate emission standards are getting more and more stringent. High oil film thickness causes increased particulate emissions and low film thickness results in more frictional power loss and increased wear of the engine

There are several experimental techniques, which can be used to measure the oil film thickness before it can be controlled. Once the oil film thickness is measured with sufficient accuracy, it can be controlled by several means without running into the danger of compromising engine life. In the present research, the capacitance method is used for measurement of minimum oil film thickness. Measurement of capacitance formed between the piston ring and a probe mounted flush in the liner provides an accurate means of determining the oil film thickness provided that the region between the probe and liner is flooded with oil and dielectric constant of the oil is known.

In this study of lubricating oil film thickness, three capacitive sensors were installed at locations close to TDC, mid stroke and BDC in the liner of a non firing engine simulator. Signal conditioning circuit was developed for converting capacitance in the range of (0-200pF) into voltage of 0-10V. Capacitance to voltage relation of signal conditioning circuit was calibrated by inserting known values of capacitance in the circuit and recording the corresponding voltage change. Capacitance values were converted in distance by employing parallel plate formula. High speed data acquisition system was developed for acquiring the data from three sensors along with crank angle position from precision shaft encoder and TDC detector. Response of sensors was recorded by this high speed data acquisition system.

Lubricating oil film thickness was found to vary between 0.2μm to 8μm in the non firing engine simulator. At a particular position, lubricating oil film thickness varies significantly in upward and downward stroke of the engine due to reversal in direction of piston tilt in two directions of motion. Lubricating oil film thickness was found to increase with increasing engine speed at all positions. These sensors can now be employed in motoring and firing engine to measure the MOFT under different engine operating conditions.