

Popular Marine Engine Manufacturer uses MTI Capacitive Sensors to Precisely Measure Engine Oil Film Thickness



Introduction

Marine engine manufacturers are faced with the constant and difficult challenge of designing and building engines to operate under the most severe environments, engines that must be long lasting, extremely reliable and perform flawlessly even under less than ideal operating conditions. Unlike an automobile engine, marine engines are constantly under strain, even when cruising at low speeds. Harsh exposure to the elements such as salt spray, heat and cold, as well as constantly changing loads and operating conditions contribute to the problem.

The Problem

MTI was challenged by a top marine engine manufacturer to design a non-contact sensor to measure the microscopic oil film layer between the engine cylinder wall and the piston ring. Oil film thickness is an important parameter in engine development, and directly relates to oil consumption and engine life as well as efficient engine performance and emissions reduction. Engine testing is typically performed at high RPM's with piston linear speeds approaching 500 inches/second. A measuring system with high frequency response and small sensor size was required to keep engine machining to a minimum, and not change the engine operating characteristics along with the ability to obtain dynamic measurement data as the piston ring passes the sensor face.

The Solution

MTI engineers arrived at a unique miniature sensor design with a diameter of 5.5-mm, measurement range of 50 microns, resolution better than 0.25 μm and a response time of 20 kHz. The sensor was threaded to offer ease of mounting into the cylinder bore and precisely machined to allow the sensor face to be flush or slightly recessed into the cylinder bore. Accumeasure™ capacitive sensors measure the minute capacitance change due to the oil thickness variation and convert this change into a thickness measurement. The sensor offered a rectangular 0.12-mm x 1.25-mm sensing area and the resulting footprint was designed to be considerably smaller than the piston ring width to allow it to measure only the piston ring oil film thickness. High temperature epoxy and materials were used in the probe fabrication to enable it to operate at temperatures as high as 285 C (545 F) and to withstand high pressure.

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The Equipment

MTI's proven Accumeasure 5000 precision high frequency dual channel amplifier with 20 kHz response time proved an ideal choice for the task. Because of the high frequency response required for the application, MTI engineers designed a custom amplifier filter, which eliminated signal overshoot and resulted in minimal phase delay in the electronics.



Other Applications

MTI Accumeasure sensors can also be used in other applications such as determining the ratio of oil/air present in an engine passage. The Accumeasure equipment provides a distinct voltage output, depending upon whether oil, air or a mixture of both (foam) is present. The system works equally well in transmission research to determine the amount of cavitation in the fluid. Any foaming of the fluid indicates air is present in the mixture and will cause a noticeable change in the output signal. This type of data proves to be invaluable in determining the effect of mixing various additives into transmission fluids and the resultant knowledge helps researchers in designing a superior, longer lasting product.

Benefits

If you have a demanding noncontact sensing requirement contact MTI's team of experienced application specialists who will thoroughly and accurately analyze your requirements and provide you a practical, yet cost effective solution.