# REAL-TIME MEASUREMENTS OF PISTON RING AND LINER LUBRICATION AND LUBE OIL INLET VISCOSITY IN A MARINE DIESEL ENGINE USING ULTRASOUND

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**KEYWORDS**

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**ABSTRACT**

Lubrication between engine piston and liner is vital to prevent direct metal-metal contact and scuffing on the interior of liner to maintain the efficiency of a marine diesel engine. Breakdown of lubrication film results in metal-metal contact and scuffing. This can result in severe damage on interior surface of liner, can reduce engine efficiency, and an result in catestrophic failure. There are currently very few tools available to understand the efficiency of this lubrication process other than monitoring liner temperature, cylinder pressure and periodic invasive measurements of wear.

Real-time monitoring of liner lubricant film and detection of scuffing would facilitate how operating parameters affect engine performance at the critical location. A non-invasive ultrasonic measurement system has been implemented on a test engine to monitor the lubrication in-situ. Longitudinal and shear polarised sensors were mounted on the liner at Top Dead Centre. Low-frequency ultrasound was transmitted to strike the contact interface between engine liner and piston rings. Test results found the returning signals changed with engine operating conditions which suggests that lubrication characteristics can be monitored in real-time using this ultrasonic tool.

In some lube oil delivery mechanisms, the lubricant injection time and rate is dependent on viscosity of the lubricant. Measurement of the lubricant viscosity in feeding channel in-situ would thus be a valuable tool for intelligent injection control and it also provides a robust way to monitor the quality of the lubricant oil.

A bespoke in-situ viscosity sensor is developed and implemented on the lubrication oil feeding channel of a test engine using a novel ultrasonic technique. The lubricant oil is oscillated ultrasonically by a shear polarised transducer. The sensitivity is improved using an acoustically soft material sandwiched between the oil and the transducer. Tests found the ultrasonic signal varied with the engine operating conditions, which suggest that the measurement of lubricant viscosity would enable real-time feedback into injection control system.

A photograph of the in-line viscosity sensors can be seen in Figure 1.

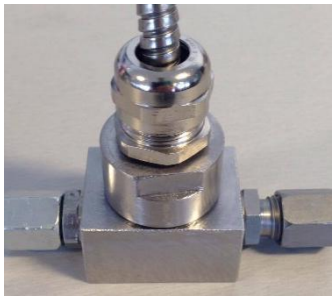

Fig.1 A photograph of the in-line viscosity sensor.