Application of SRV Test System in Scuffing Load Test & Cliff Test Operations in Automobiles

Tahseen Tabassum[1], Dr. Raj Shah[1], Christoph Baumann[2]

[1]Koehler Instrument Company, 85 Corporate Drive, Holtsville, NY, [2]Optimol Instruments Prüftechnik GmbH, Germany

Abstract

The Schwing-Reib-Verschleiss (SRV®) test system - meaning oscillation, friction and wear in German – provides a diverse model test environment for evaluating the friction and wear properties of lubricants, greases and materials. Due to its versatile application this test system is appealing to be adopted by the industry to test their components in setups with high practical relevance and in conjunction with lubricants, materials and layers. In this study, a reciprocal model test has been applied that reproduces the real load situation of the contact of piston ring and cylinder linear at Fired Top Dead Center (FTDC) of internal combustion engines. Friction, wear, and load carrying capacity (LCC) were analyzed as a function of temperature, oil supply rate, and normal force for grey cast iron and spray coated cylinder liners, different piston ring coatings and engine oils. The test results show a significant dependency of the LCC on changing temperature and oil supply rate corresponding to different cylindrical pressures. Furthermore, the SRV® technology was tested for compliance using ASTM testing standards developed by the SRV® Cliff Testing work group.

Application

SRV® measures the following in the test system:

- The physical interactions between a lubricant and two specimens in a loaded contact in either rotational or linear oscillatory motion.
- The upper specimen oscillates in a linear path on the lower stationary specimen at a specified frequency, stroke length, load, temperature, and test duration. Most importantly, all parameters are programmable to change during the test [2].
- The normal force imparted to the lower specimen is measured continually and the coefficient of friction (COF) is automatically calculated and recorded throughout the test.
- If both specimens are metallic, the electrical resistance between the two can be measured as an indication of the film strength of the lubricant.
- After testing, the specimens can be examined under a microscope and the wear scars measured. Nonmetallic specimens including various plastics and ceramic materials can also be tested on the SRV®.

SRV® Test System

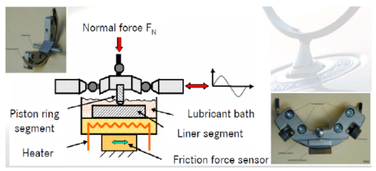

Figure 1: Piston Ring/Cylinder Liner Testing with the Scuffing load test [1, 3]

Normal Force [N]	10-2.000
Test temperature [°C]	130
Stroke [mm]	3
Oscillating Frequency [Hz]	20
Test duration [h]	3
Lubrication	Oil bath immersion

Table 1: Exemplary Test Conditions

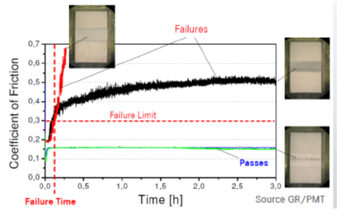

Figure 2: Traces of friction resulting in the test evenly distributed over the width of the raceway segment [1, 3]

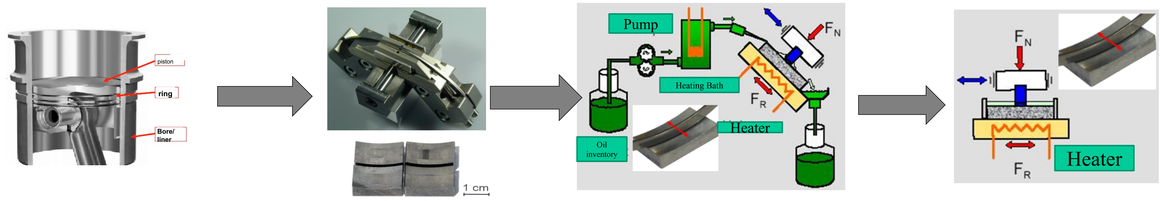

Figure 3: Piston ring/cylinder linear testing with the new test procedure [1, 3]

Load Carrying Capacity of Al-Si-Cylinder in Scuffing Load SRV® Test [1]

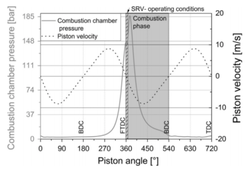

Figure 4: Combustion chamber pressure and piston velocity versus piston angle of the piston assembly from simulation of an actual Mercedes 4-cylinder passenger car diesel engine (147kW) at 1600 rpm and full load [1]

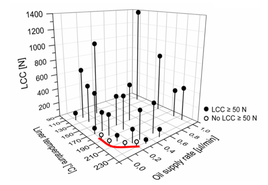

Figure 5 :LCC dependency on liner temperature and oil supply rate [1]

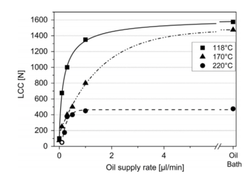

Figure 6 :LCC for three different linear temperatures of 118 C, 170 C and 220 C [1]

ASTM D6425 At 150°c (Oil Samples From Sequence IIIGA Test) [2]

In engine or gear tests, “Cliff“ testing aims to identify the induction time or off-set point (“cliff“) after which wear and friction increased or failure occurred. Explanations for friction and wear increased as well as failures, which occurred during engine tests, can be derived from SRV® testing of oil samples taken or collected at different engine test times and correlating these with their friction, wear and EP data in respect to depleting curves for specific additives or other oil properties

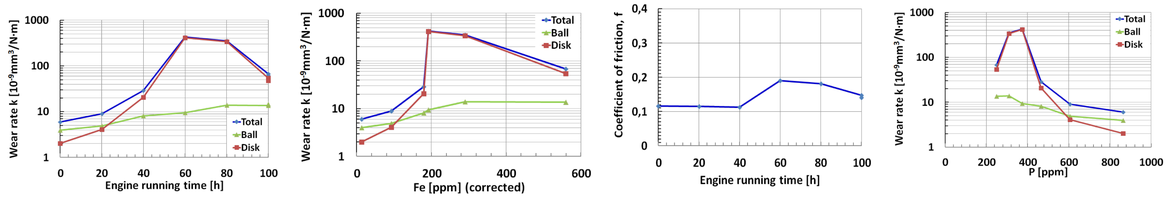

Figure 7: The chemical analysis of oil samples from engine testing versus SRV® test results [2]

The developed test can be used as a method to evaluate wear, scuffing, and friction behavior of different combinations of ring coatings, linear materials, honings, and engine oils. The test parameters need to be adjusted very carefully to the real engine situation where the temperature and oil supply rates are reflected in the real engine (twice as much real engine)

References

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Koehler Instrument Company, Inc. 85 Corporate Drive Holtsville, NY 11742 631-589-3800

Optimol Instruments Prüftechnik GmbH, Germany

Tahseen Tabassum: ttabassum@koehlerinstrument.com

Raj Shah: rshah@koehlerinstrument.com

Christoph Baumann: christoph.baumann@optimol-instruments.de