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VANDERBILT *Report*

VANLUBE® 0401 Lubricant Additive

ANTIOXIDANT - FRICTION REDUCER - ANTIWEAR AGENT

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VANLUBE® 0401

Lubricant Additive

ANTIOXIDANT

FRICITION REDUCER

ANTIWEAR AGENT

Typical Properties

Composition:	Additive blend
Physical State:	Dark liquid
Color, ASTM D 1500, 1% in oil:	1.0
Density at 15.6°C, Mg/m ³ :	1.01
Viscosity at 40 °C, cSt:	15.1
Viscosity at 100 °C, cSt:	351
Flash Point, PMCC, °C:	> 200
Molybdenum Content, %:	2.1
Zinc Content, %:	1.7

VANLUBE 0401 is a phosphorus-free synergistic blend of additives recommended for engine oils in order to control high temperature deposits, reduce friction and provide excellent wear and oxidation protection. It is an ideal lubricant additive for the formulation of energy-conserving low phosphorus engine oils.

Table 1 shows the capacity of **VANLUBE 0401** to reduce high temperature deposits and improve the oxidation stability of low phosphorus engine oil. TEOST[®]-MHT and TFOUT tests were performed on a low phosphorus engine oil before and after treatment with **VANLUBE 0401**. The low phosphorus engine oil without **VANLUBE 0401** did not meet the GF-4, TEOST-MHT maximum specification limit of 35 mg total deposits. The addition of **VANLUBE 0401** reduced total deposits significantly below the GF-4 specification limit.

The ability of **VANLUBE 0401** to reduce friction and prevent wear is demonstrated by experiments using the Optimol[®] High Frequency, Linear-Oscillation (SRV[®]) test machine, which may simulate the conditions encountered at piston ring and cylinder bore interfaces. In these tests, a ball is oscillated on a disk at a frequency of 40 Hz, an applied load of 120 N, and a stroke length of 4 mm, for seven hours. Figure 1 compares the friction coefficient versus time plot for a low phosphorus engine oil (SRV Test No. 1) with that for the same oil treated with 3.39 mass percent of **VANLUBE 0401** (SRV Test No. 2).

Table 1

	<u>1</u> Low Phosphorus Engine Oil (0.05 mass percent P)	<u>2</u> <u>1</u> + 3.39 mass percent VANLUBE 0401
Thermo-Oxidation Engine Oil Simulation Test – Moderate High Temperature TEOST-MHT ¹ (ASTM D 7097) Total Deposits, mg	66.5	24.9
Oxidation Stability of Gasoline Automotive Engine Oils by Thin Film Oxygen Uptake TFOUT (ASTM D 4742), Minutes		
Test No. 1	167.5	> 300
Test No. 2	172.5	> 300

¹ The GF-4 Specification allows a maximum of 35 mg total deposits.

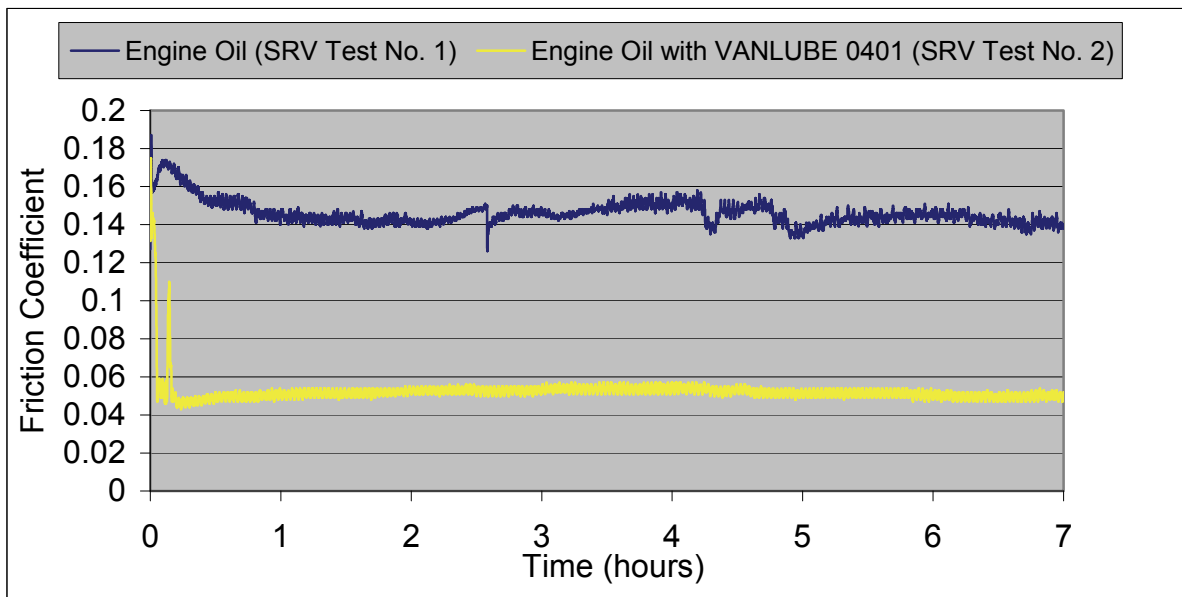


Figure 1. Test Parameters: ball on disk; 120N; 40 Hz; 4.00 mm stroke; 7 hours. The engine oil is 5W-30 grade containing 0.05 mass percent of phosphorus.

Visual inspection of the wear scars demonstrates the wear-reducing capability of **VANLUBE 0401**. In Figure 2, the scar from Test No. 1 indicates polishing wear, as evidenced by the bright mirror finish of the scar and the removal of the surface features of the disk. In Figure 3, the scar from Test No. 2 shows that the surface features of the disk are intact, due to the formation of a protective surface film. This film is indicated by the dark coloration on the scar.



Figure 2. Image of the wear scar on disk for SRV Test No. 1. The mirror finish and the removal of the surface features of the disk, i.e. the deep etching marks, are evidence of polishing wear.

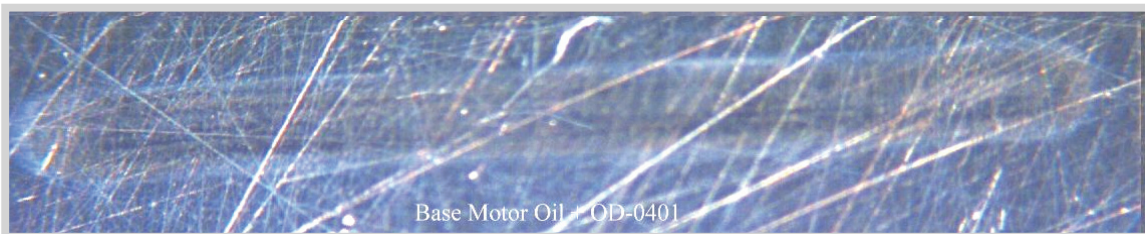


Figure 3. Image of the wear scar on disk for SRV Test No. 2. The surface features of the disk are intact; the dark coloration indicates the protective surface film.

Storage and Handling Suggestions

Unloading pumping temperature:	30 °C
Unloading maximum temperature:	60 °C
Storage temperature:	Room temperature

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OPTIMOL and SRV are registered trademarks of Optimol Instruments Prueftechnik GmbH.

TEOST is a registered trademark of Savant, Inc.

VANLUBE 0401 is part of U. S. Patent 6,806,241 "Antioxidant additive compositions and lubricating compositions containing the same".

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