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Application Note: Monitoring Oil Health with *micro*VISC-m

Viscosity measurements play a critical role in determining lubricating oils' usability and quality. Excessively high viscosity leads to poor lubrication, excessive friction, and high power consumption. Excessively low viscosity causes an excessively thin oil film between moving parts, risking catastrophic failure. Each lubricating oil is therefore designed to have an optimal viscosity, within a specified range for each application.

*micro*VISC-m provides a portable, fast, and easy-to-use tool for accurately analyzing dynamic and kinematic oil viscosity. With one quick measurement at room temperature, you can use *micro*VISC-m to compare the oil to reference values at any temperature. *micro*VISC-m extrapolates these values based on well-established ASTM D341 formulas. Here is an example of *micro*VISC-m in use.

Objective:

To compare several 5W-30 oils, both new and used, to their reference viscosity values.

Using *micro*VISC-m, we first test the oils at room temperature, then compare the results to reference values at 40 °C, 80 °C, and 100 °C.[2]

Measurement Process:

Load the sample into a disposable pipette.

1. Enter an oil profile, based on reference values. The required values are kinematic viscosities at 40 °C and 100 °C, density at the test condition, and target temperature.

   Once the data is entered, *micro*VISC-m stores it with the oil I.D. for future recall. Below is a sample entry on *micro*VISC-m's display.

   PENNZOIL 5W-30

   V40: 63.4 V100:10.6

   DEN:0.860 TEMP:40

   ↑↓:View, ENT:Load ▮ 1/8

2. Press *Run* to start the viscosity measurement. *micro*VISC-m will measure dynamic viscosity, and will automatically calculate kinematic viscosity at the target temperature.

Results:

We first tested *micro*VISC-m chip with a standard reference oil (Cannon Instruments N35, lot 13301), to verify its accuracy at room temperature:

Temperature (°C)	Standard Visc (cP)	Measured Visc (cP)	% difference
24.42	57.02	56.62	-0.70

1 We could not acquire accurate manufacturer-provided reference values, therefore we collected reference values as follows: We measured the oil samples with an *hts*-VROC and an A05 chip at 40°C and 100 °C. We measured density at 40oC and 100oC using a vial of known volume and an Ohaus Explorer Pro scale. We interpolated the viscosity value at 80°C using the method described in ASTM D341.

2 For details on the equations used, please see RheoSense's "Utilizing ASTM D341 Calculations For Predictive Viscosity Measurement" application note.

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Next, we entered the reference values for Pennzoil 5W-30, and Pentosin High Performance 5W-30, into *micro*VISC-m. We then used microVISC-m to test a new sample of Pennzoil 5W-30, a used sample of Pennzoil 5W-30 (with approximately 12,000 miles of engine operation), and a new sample of Pentosin High Performance 5W-30.

*micro*VISC-m measured these samples' viscosity at room temperature. It then used the reference values, along with ASTM D341 formulas, to determine viscosity at the requested temperatures.[3] The results are shown below.

New Pennzoil 5W-30

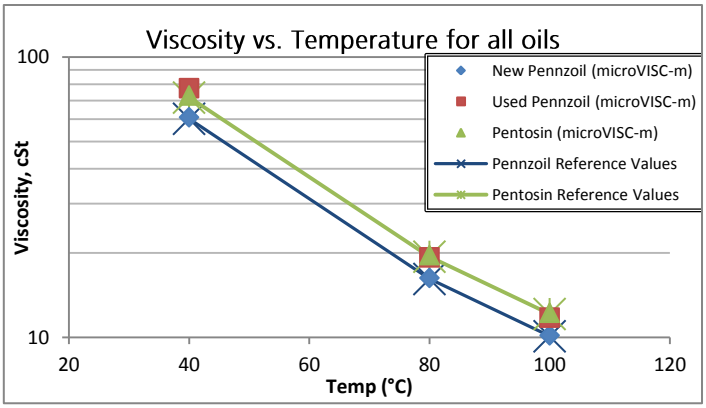
Temperature (°C)	40	80	100
Reference Visc. (cSt)	60.664	16.177	10.091
*micro*VISC-m Visc. (cSt)	60.931	16.231	10.118
% Difference	.4%	.3%	.3%

Used Pennzoil 5W-30
(Note: reference viscosity values are for new oil)

Temperature (°C)	**40**	**80**	**100**
Reference Visc. (cSt)	60.664	16.177	10.091
***micro*VISC-m Visc. (cSt)**	77.981	19.395	11.813
% Difference	28.5%	19.9%	17.1%

Pentosin High Performance 5W-30

Temperature (°C)	**40**	**80**	**100**
Reference Visc. (cSt)	73.197	19.417	12.231
***micro*VISC-m Visc. (cSt)**	72.910	19.602	12.202
% Difference	.4%	.2%	.2%



As shown in the preceding tables and graph, *micro*VISC-m could easily differentiate between the two new 5W-30 oils, and detected a large viscosity change between the new oil versus used oil. *micro*VISC-m can generate viscosity data comparable to the output of a viscometer measuring at the actual set point.

Summary:

Many conditions can affect lubrication oil quality. These conditions include soot, oxidation, additive breakdown, and dilution (by fuel, water, or refrigerant). Viscosity can be an excellent indicator or certain failure modes, such as fuel dilution, but does not precisely indicate the cause of other conditions.

Viscosity is however, the *fastest and easiest* way to confirm lubricating oils' overall health. An out-of-spec viscosity reading strongly indicates an imminent problem, which requires investigation to prevent machinery's critical failure. To that end, *micro*VISC-m provides a simple, fast, and accurate method for comparing oils to their manufacturers' specifications.[1]

If you have questions or would like more information about this product or other applications, please contact us:

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[1] Some failure modes will also change the oil's Viscosity Index (VI). This complicates the accurate determination of temperature-compensated viscosity via ASTM D341.