

## Oil Lube Differentiation Using Vectron ViSmart Viscosity Sensor

SenGenuity ViSmart™ was tested on oil lube samples supplied by a customer. The primary goal of the test was to verify the ability to of the ViSmart™ to measure viscosity of the different samples.

Data points were taken continuously; the sensor surface was fully covered by the sample fluid before data was acquired. For the tests at 40°C and 100°C, the sensor was fully immersed into a beaker of the sample and then placed in the temperature controlled environmental oven. For all of the tests with the exception of the last two, the temperature at which the data was taken was room temperature which fluctuated between 27° – 28°C. The temperatures noted are for the value measured in the sensor itself where the temperature chip is embedded; there is a variance between what the ViSmart™ measures and the “true” temperature of the samples due to the thermal mass of the ViSmart™. For the tests conducted at 40°C and 100°C, the data was acquired after the ViSmart™ and the sample both reached the equilibrium temperature.

Data is shown in the below figures (Figure 1-10). It is displayed in centipoises (cP) after having been converted from the native acoustic viscosity readings; acoustic viscosity (AV) units are equal to cP x specific gravity. For Sample A samples, a specific gravity of 0.85 was used; for Sample B samples, a value of 0.87 for specific gravity was utilized.

The data for indicates an artifact of employing mineral oils as the calibration standard for a high shear rate (30,000 – 3,000,000 for the various liquids tested) viscometer such as the ViSmart™. Mineral oil begins to exhibit shear thinning at these shear rates and the degree of thinning that the standards exhibit is biased into the calibration functions. Materials that exhibit more shear thinning than the specific calibration oils read differently than their expected “low shear” viscosity, while materials like water, iso-propanol, and aromatics tend to exhibit less shear thinning than oils and read higher than expected. Mineral oil is employed as the standard due to the low reactivity, high stability and ability to measure from –40°C to +140°C over the required viscosity range with a single family of chemicals.

As observed there are some shear thinning effects which result in numerical variations from the lab value. The average reading shown in Table 1 was compiled for the entire data run, with the run terminated after the data was steady for more than 10 seconds after obtaining a steady state value. "Room temperature" data indicates a process of thermal equilibration on the scale of few minutes absent a tightly controlled temperature environment (i.e. oven).

<b>Sample Name</b>	<b>Average Reading (cP)</b>
SAMPLE A 756 LOT 01-10	14.07
SAMPLE B 4460 LOT 3390	358.52
SAMPLE B 4460 LOT 2503	380.62
SAMPLE A 756 LOT 3519	5.675
SAMPLE A 756 LOT 01-14	5.684
SAMPLE A 756 LOT 2612	5.823
SAMPLE A 756 LOT 2670	5.437
SAMPLE B 4460 LOT 3311	419.53
SAMPLE A LOT 3519 AT 40° C	4.38
SAMPLE B 4460 LOT 3390 AT 100° C	12.40

Table 1: Overview of viscosity data for the various samples

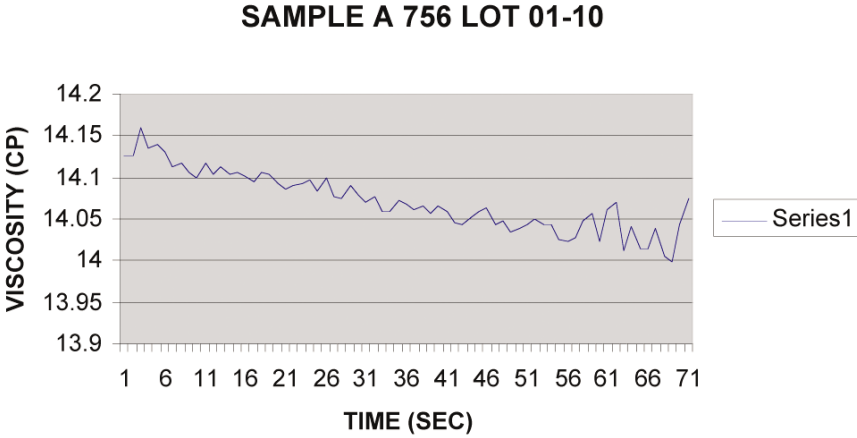


Figure 1: SAMPLE A 756 LOT 01-10 viscosity data at room temperature

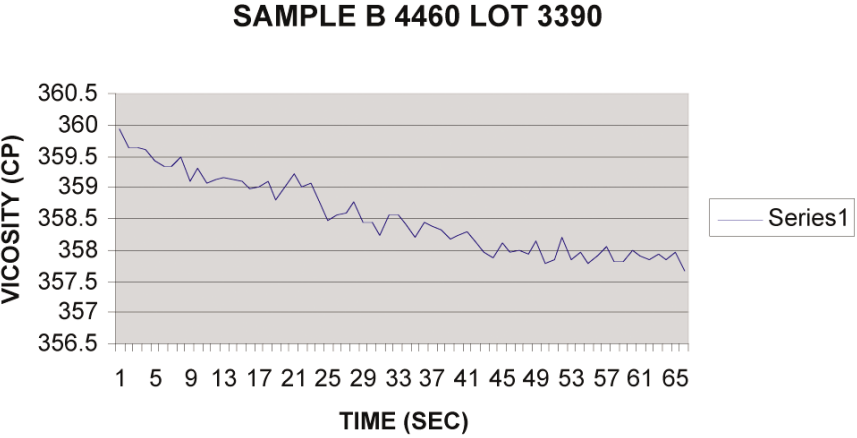


Figure 2: SAMPLE B 4460 LOT 3390 viscosity data at room temperature

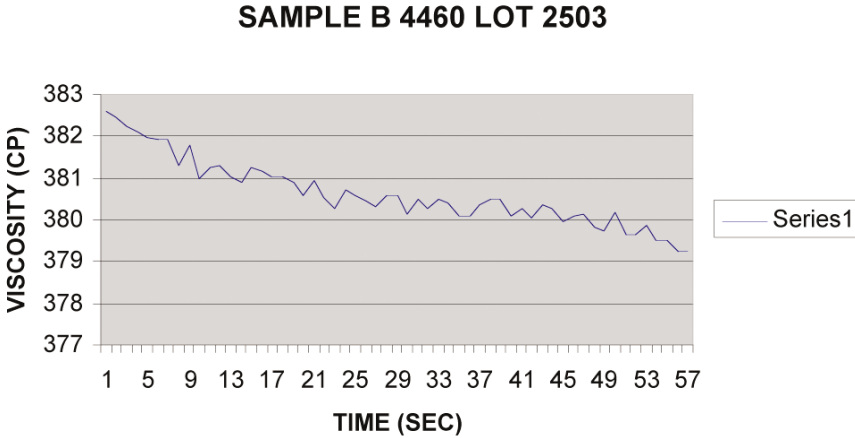


Figure 3: SAMPLE B 4460 LOT 2503 viscosity data at room temperature

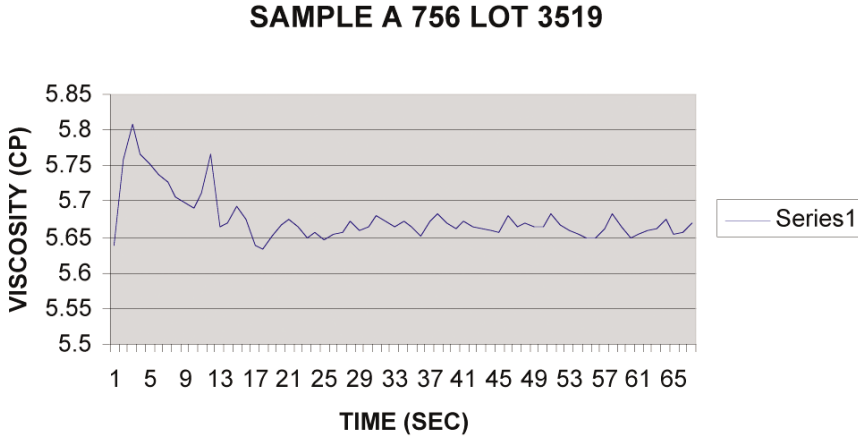


Figure 4: SAMPLE A 756 LOT 3519 viscosity data at room temperature

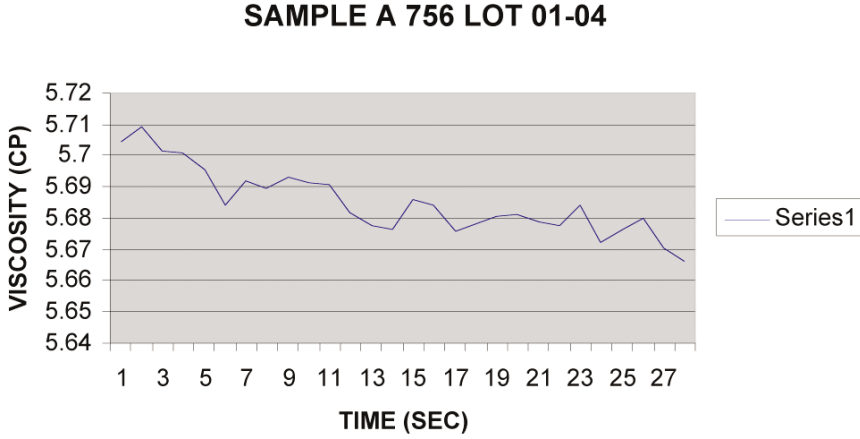


Figure 5: SAMPLE A 756 LOT 01-04 viscosity data at room temperature

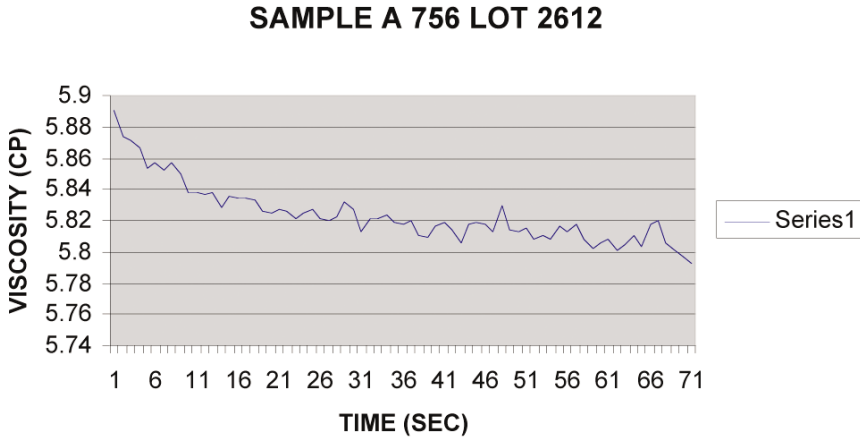


Figure 6: SAMPLE A 756 LOT 2612 viscosity data at room temperature

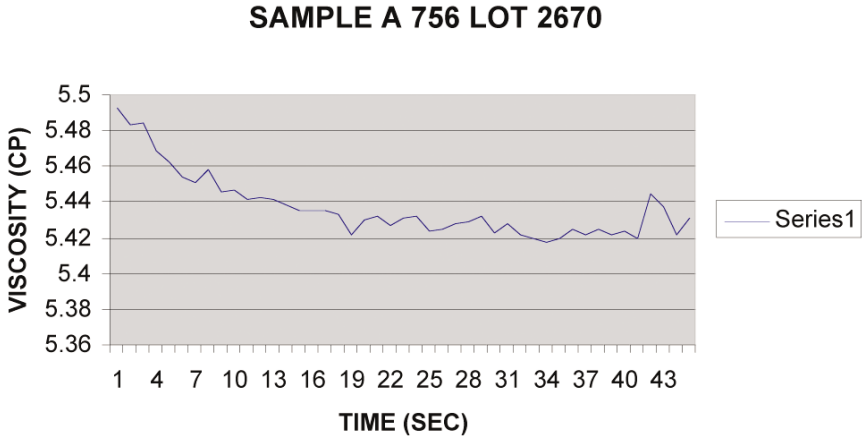


Figure 7: SAMPLE A 756 LOT 2670 viscosity data at room temperature

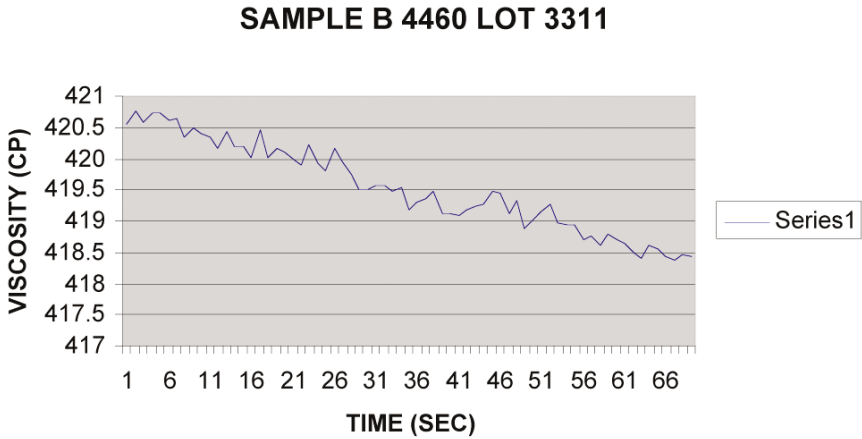


Figure 8: SAMPLE B 4460 LOT 3311 viscosity data at room temperature

