

Oil Blend Differentiation Using Vectron ViSmart Viscosity Sensor

SenGenuity ViSmart™ was tested on oil blend samples supplied by the 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 and for all tests the sensor was fully immersed into a beaker of the sample and then placed in the temperature controlled environmental oven. The temperature fluctuated for the tests conducted at 25° C (room temperature) as noted. For the 40° C and 60° C tests, the oven control attained the demonstrated temperature values. For the tests conducted the data was acquired after the ViSmart™ and the sample both reached the equilibrium temperature.

Data is shown in the below figures (Figure 1-15). It is displayed in acoustic viscosity (AV) units; which are equal to cP x specific gravity.

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.

The data in all probability is not similar to what is obtained in the lab due to shear thinning effects. The average reading shown in Table 1 was compiled for the entire data run, with the run terminated after 60 – 90 seconds once a steady state temperature value was obtained.

| Sample Name | Average Reading (AV) |
|----------------------------------|----------------------|
| LOT 2470301 AT 27.3° – 27.7° C | 124.06 |
| LOT 2470301 AT 40.6° C | 54.62 |
| LOT 2470301 AT 60.17° C | 22.35 |
| LOT 3460201 AT 28.1° – 27.73° C | 170.09 |
| LOT 3460201 AT 40.89° C | 76.40 |
| LOT 3460201 AT 60.22° C | 33.85 |
| LOT 2820301 AT 27.25° – 27.28° C | 110.31 |
| LOT 2820301 AT 40.89° C | 44.31 |
| LOT 2820301 AT 60.03° – 60.13° C | 15.89 |
| LOT 2870301 AT 27.17° – 27.25° C | 82.96 |
| LOT 2870301 AT 40.89° C | 32.75 |
| LOT 2870301 AT 60.2° C | 12.75 |
| LOT 0980301 AT 26.35°C | 177.52 |
| LOT 0980301 AT 41.06° C | 76.47 |
| LOT 0980301 AT 60.13° C | 31.86 |

Table 1: Overview of viscosity data for the various samples

Lot 2470301 at 27.3 - 27.6C

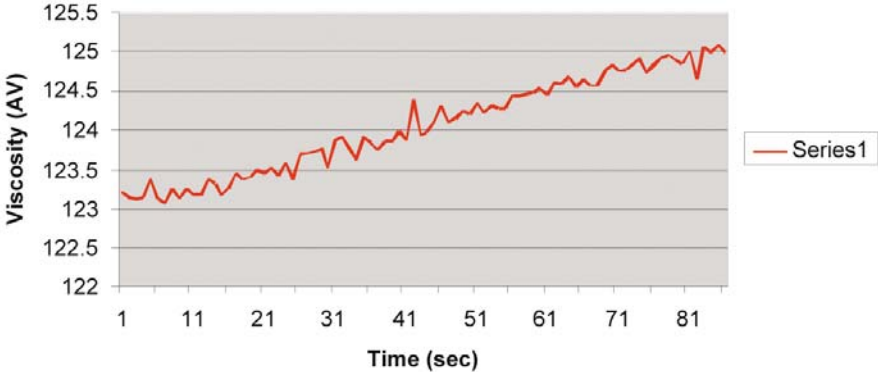


Figure 1: Lot 2470301 viscosity at room temperature

Lot 2470301 at 40.6 C

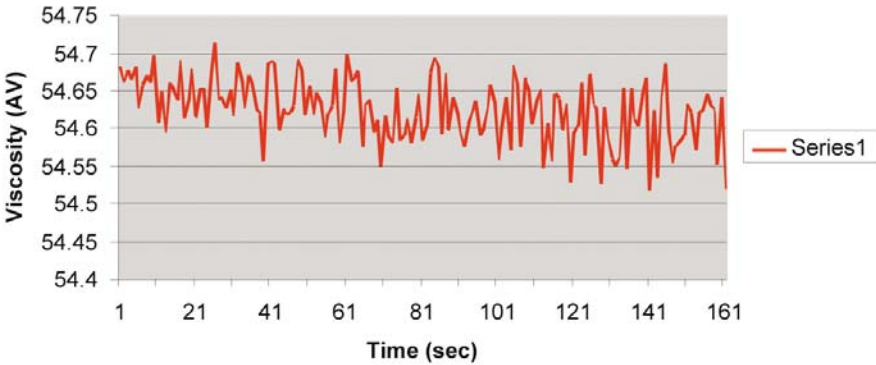


Figure 2: Lot 2470301 viscosity at 40.6° C

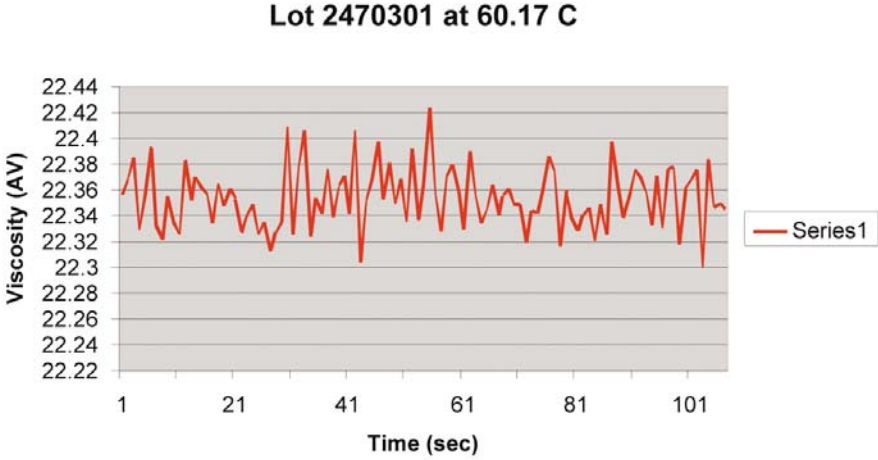


Figure 3: Lot 2470301 viscosity at 60.17° C

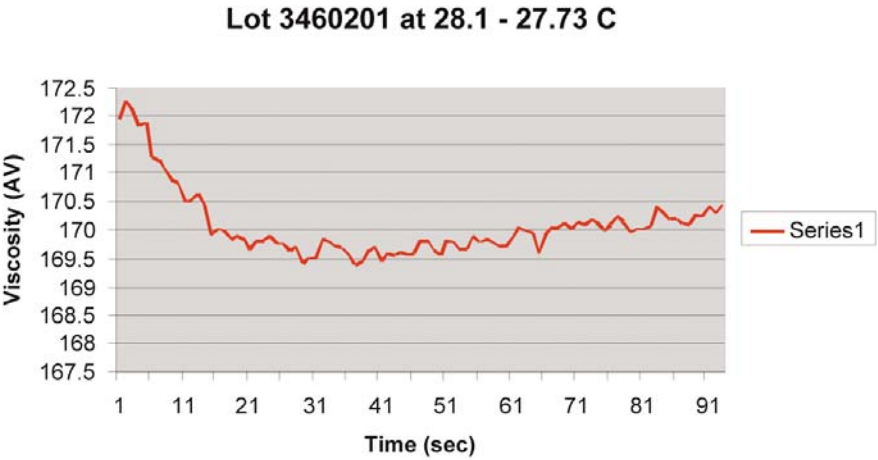


Figure 4: Lot 3460201 viscosity at room temperature

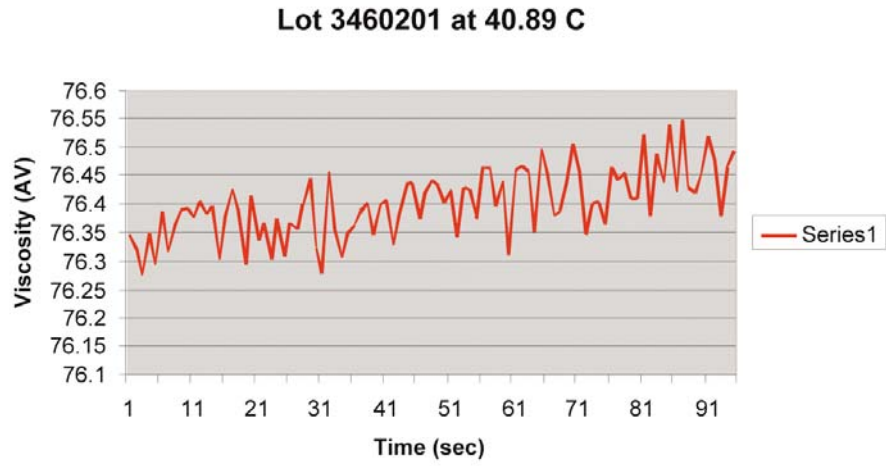


Figure 5: Lot 3460201 viscosity at 40.89° C

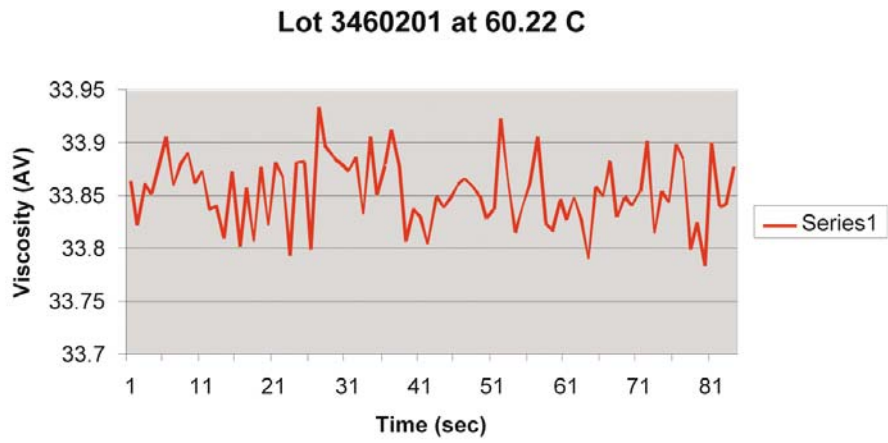


Figure 6: Lot 3460201 viscosity at 60.22° C

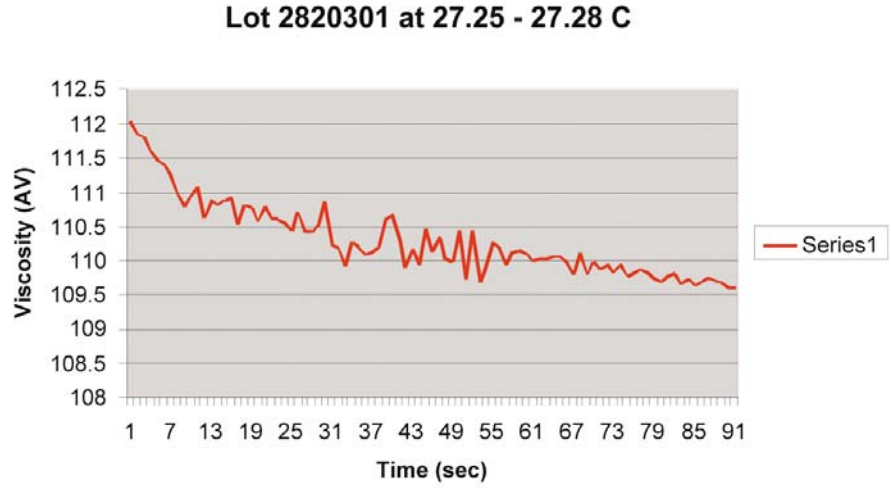


Figure 7: Lot 2820301 viscosity at room temperature

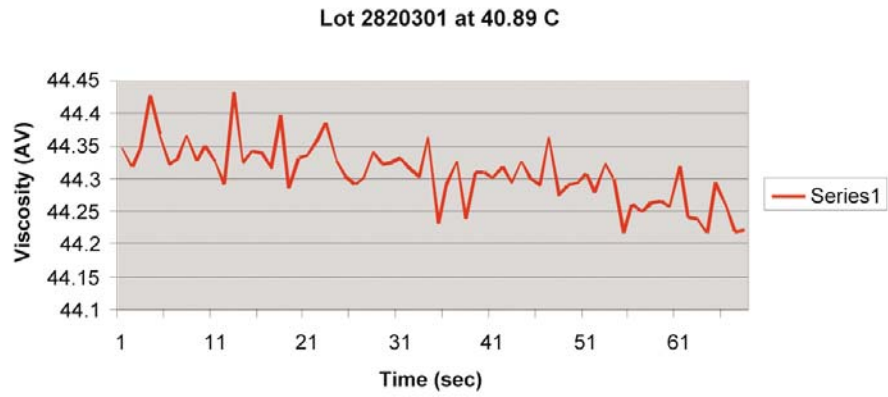


Figure 8: Lot 2820301 viscosity at 40.89° C

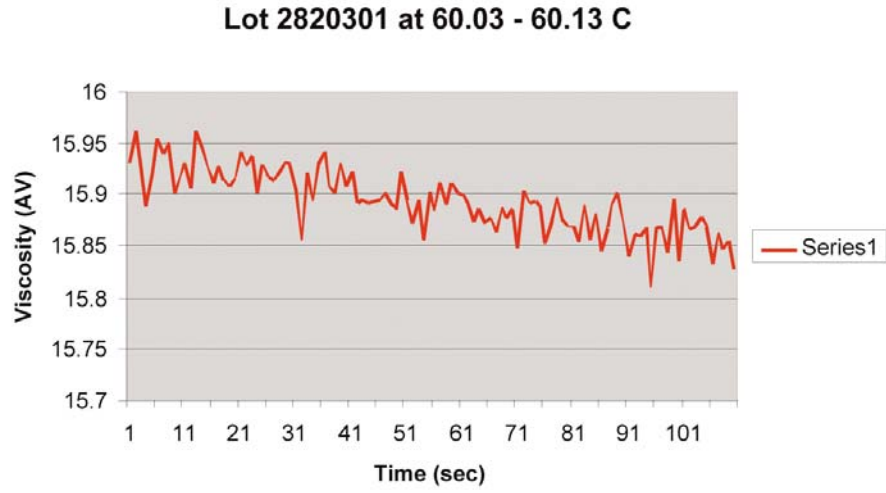


Figure 9: Lot 2820301 viscosity at 60.03° - 60.13° C

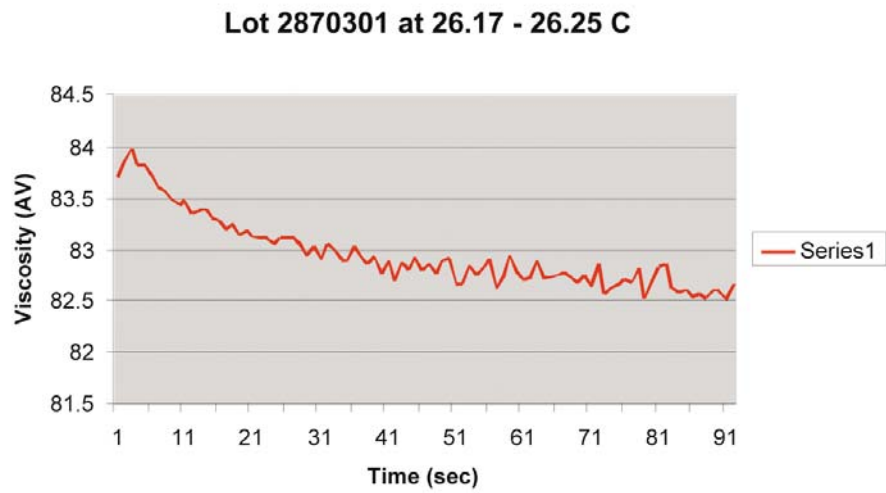


Figure 10: Lot 2870301 at room temperature

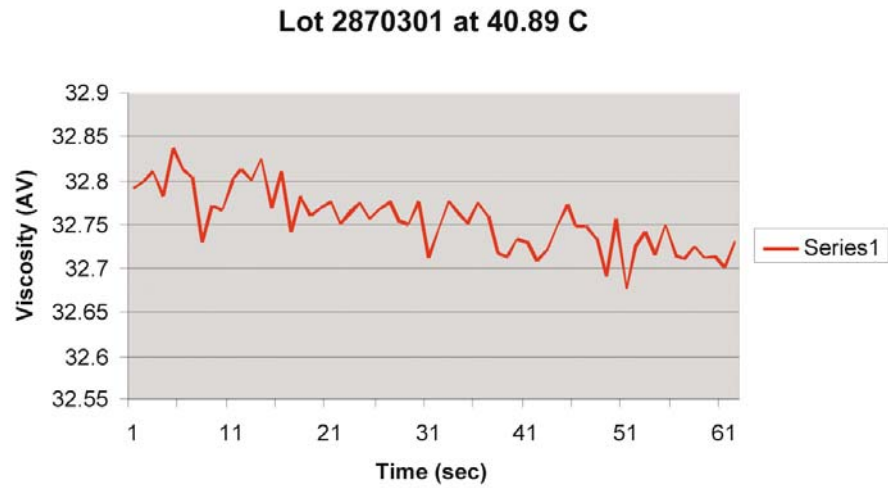


Figure 11: Lot 2870301 at 40.89° C

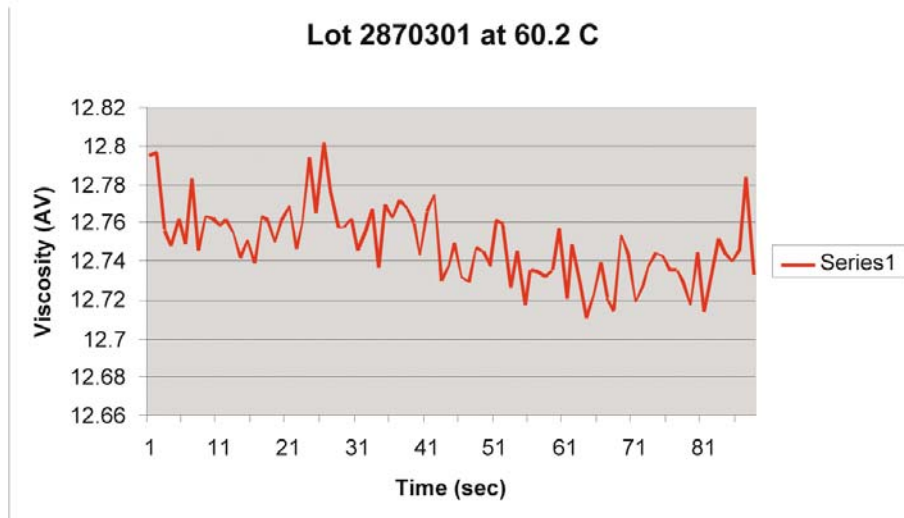


Figure 12: Lot 2870301 at 60.2° C

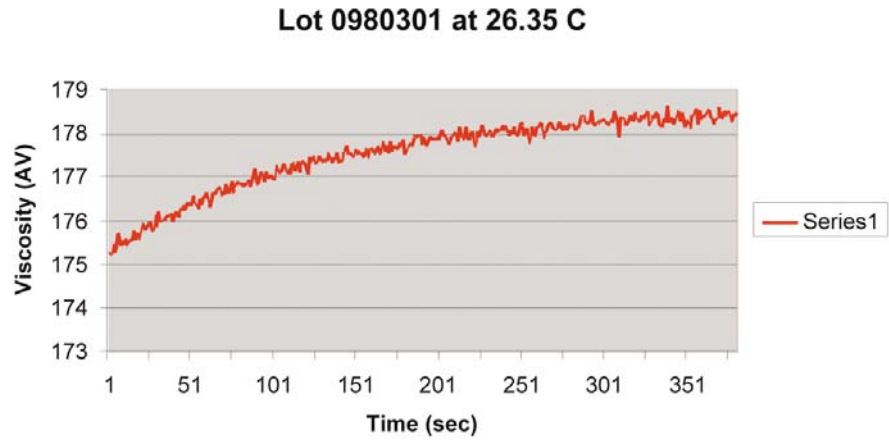


Figure 13: Lot 0980301 at room temperature

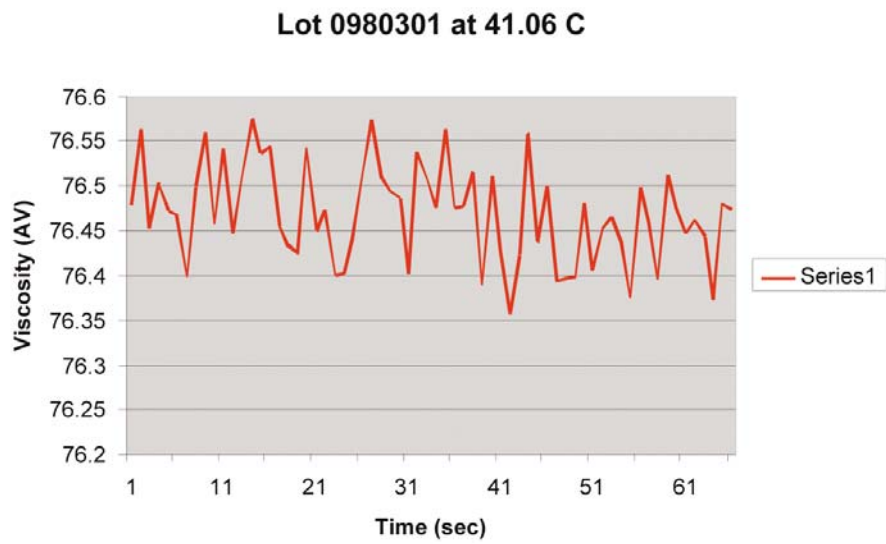


Figure 14: Lot 0980301 at 41.06° C

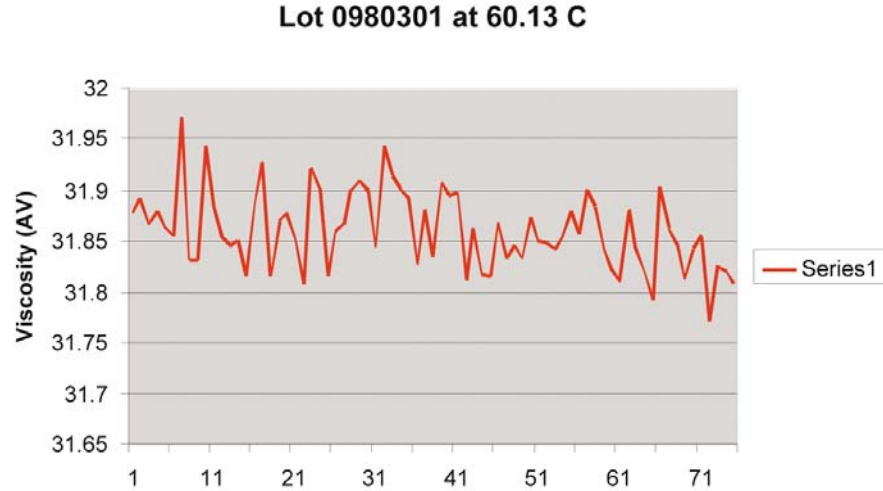


Figure 15: Lot 0980301 at 60.13° C

The data acquired clearly indicates the following:

1. The ViSmart™ shows the shear thinning effects at the high shear rates that it is measuring at.
2. The data can easily be cross-referenced with the current measurement values at the customer to ascertain if the percentage difference in samples is similar in trend and magnitude.
3. The ViSmart™ can measure various degrees of viscosity of the samples submitted.

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