Assessment of the Thermophysical Properties of Thermally Stressed RP-1 and RP-2

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RP-1 and RP-2 are widely used as the kerosene component in rocket propulsion systems. The thrust chambers in a typical kerosene/liquid oxygen fueled rocket engine can reach temperatures of ≥ 3000 K and cooling is typically accomplished via a regenerative process that utilizes the fuel as a coolant. The fuel is exposed to very high temperatures, albeit for short periods of time, during this cooling step. Since extreme temperatures can have significant effects on kerosene fuel composition, it is important to understand how changes in composition translate to changes in the thermophysical properties of the fuel. Towards that end, density, speed of sound, and viscosity have been measured for samples of RP-1 and RP-2 that were stressed for 0.5 min at 748 K and 783 K at a pressure of 17 kPa. Density and speed of sound were measured over the temperature range 278 K to 323 K for the lower temperature sample and from 278 K to 308 K for the higher temperature sample. For the viscosity measurements, the upper ends of the temperature ranges remained unchanged but the lower end extended down to 263 K for all samples. All measurements were made at atmospheric pressure (~ 83 kPa). For all three properties, the observed variability arising from the thermal stress process is presented and the results are compared to previous measurements of unstressed RP-1 and RP-2.