

Thermal Conductivity of Common Fluids from -100°C to 300 °C Using a Single-Wire Transient Hot-Wire Sensor

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The increasing industry demand for thermophysical properties' measurements of fluids in a wide temperature range, forces the commercial and academic laboratories to investigate and extend the application range of their devices. Especially thermal conductivity measurements at temperatures below 0 °C are difficult to achieved because of the temperature instability of the temperature devices and control. In addition, the combination of systems that allow high and low temperature measurements are in many cases difficult because requires lots of devices and laboratory space.

For the present work a commercial single-wire transient hot-wire device was used to measure the thermal conductivity of the fluids from -100 °C to 300 °C under moderate pressures. The transient hot-wire sensor allows measurements from 0.01 to 2 W/m·K and pressures up to 20 bar with uncertainty of 5% and repeatability of better than 1%. The proprietary integrated temperature platform allows stable measurements from 10 to 300 °C, while a Liquid Nitrogen system connected to the device lowers the working range of the THW device to -100 °C.

To investigate the correct operation of the device through the whole temperature range Water, Heptane, Toluene, Isopropanol, Ethylene glycol, and Glycerol measured. The plotting of the thermal conductivity results shows the anomalous thermal conductivity results around the melting temperature of the fluids. Back pressure applied on the fluids allows the extend of the thermal conductivity measurements above their boiling point.

All the measurements are controlled through the THW software that allows the user to visualize the measurements quality, suggests changes and export the data for further analysis.