Measurement of the Thermophysical Properties of an NPL Thermal Conductivity Standard Stainless Steel 310

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Flash methods have become one of the most commonly used techniques for measuring the thermal diffusivity and thermal conductivity of various kinds of solids and liquids, such as metals, carbon materials, ceramics, and polymers. Easy sample preparation, small sample dimensions, fast measurement times, and high accuracy are only some of the advantages of this non-destructive measurement technique.

However, the accuracy of measurement and the level of uncertainty of the resulting data are becoming increasingly important for countless industrial applications. Instruments have to be analyzed to determine the uncertainty of the system at different temperature and application ranges.

One way of checking the accuracy of the results is to cross-check the unit with certified reference materials. However, there is a lack of standard materials for thermal diffusivity/thermal conductivity all over the world. Furthermore, for some available standards, the thermophysical properties are known only over a limited temperature range.

Presented in this work are thermophysical property measurements on a certified thermal conductivity standard, Stainless Steel 310. The thermal conductivity is certified between 50 and 500 °C. However, the material can be used from the low-temperature range all the way up to 1000 °C. Tests were carried out between -125 and 1000 °C. A DIL 402 C pushrod dilatometer was employed to determine the thermal expansion and density change, ñ, of the material. The specific heat, C_p, was measured using differential scanning calorimetry. The thermal diffusivity was measured employing the laser flash technique. Using the measured data, the thermal conductivity of the material was determined by multiplying the thermal diffusivity, density, and specific heat. Different samples were tested with each technique, and tests were carried out repeatability, not only to check for the thermal stability and homogeneity of the material, but also to determine the reproducibility of the test results.