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M2Or1C-09: Macroflash Apparatus and Boiloff Calorimetry Method for the Measurement of Heat Transmission through Materials

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The Macroflash instrument is a flat plate boiloff calorimeter that provides effective thermal conductivity (k_{eff}) data for a wide range of materials from thermal insulation to structural composites to ceramics. This device has become an indispensable tool for NASA researchers in recent years. The apparatus and method provide a practical, standardized approach to measure heat transmission through materials under steady-state conditions at below-ambient temperatures and under different compressive loads. In addition, a unique feature of a Macroflash calorimeter is that provides data at both large and small temperature differences. Using liquid nitrogen boiloff calorimetry to directly measure the heat flow rate, the device is applicable to testing under an ambient pressure environment at a wide range of temperatures, from 77 K to 373 K. Test specimens may be isotropic or non-isotropic; homogeneous or non-homogeneous; single-layer or multi-layer. The Macroflash is currently calibrated in the range from approximately 10 mW/m-K to 1,000 mW/m-K using reference data for well-characterized materials. Test data for hundreds of test specimens including foams, powders, aerogels, plastics, composites, carbon composites, wood, glass, ceramic, metal, and multi-layered composites have been compiled from Macroflash testing. The Macroflash apparatus is described and its operation, instrumentation, and control system discussed. The calibration approach is detailed as well as analysis of key data sets of standard materials.

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