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Supporting Data for ASTM E1461, Method of Thermal Diffusivity of Solids by the Flash Method

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Intercomparison of Diffusivity Values Obtained Using the Laser Flash Technique

(A report issued in conjunction with the Precision and Bias Statement of ASTM E37.01.16 "Thermal Diffusivity of Solids by the Flash Method)

An unique feature of the laser flash diffusivity technique is the ability to compare on-line the experimental temperature rise curve data with the well-established theoretical prediction. This comparison permits the experimenter to detect the presence of-and correct for-deviations of his actual experiment from the ideal conditions. It has been shown that the errors arising from these "non-measurement errors" can be and usually are much larger than those resulting from uncertainties in measured quantities. What this means in practice is that the same experimenter using the same equipment can obtain excellent results for one material and poor results for another material during consecutive experiments, because of problems relating to translucency, non-uniform absorption of the laser pulse, etc. However, the analysis of the transient data will reveal these difficulties and that is the primary purpose of the ASTM standard.

The results of round-robins on thermal transport properties of materials generally involve comparisons of conductivity values obtained by various techniques, including these calculated from diffusivity results. The laser flash technique has proven to be a fast and efficient method for obtaining conduc-

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tivity values and its validity was established in large intercomparison programs. For example AGARD Report No. 606, THERMOPHYSICAL PROPERTIES OF SOLID MATERIALS, Project Section II, Cooperative Measurements on Heat Transport Phenomena of Solid Materials at High Temperature, by E. Fitzer, 1973, Technical and Reproduction Ltd., Harford House, 7-9 Charlotte St., London W1P 1HD, compares the results obtained by many techniques during a program aimed at establishing conductivity standards. One of Dr. Fitzer's conclusion was, "It can be stated that the diffusvity measurements, independent of the applied methods and techniques yield more precise and corresponding data than the applied direct conductivity measurements". As a part of this effort direct comparisons of diffusivity results from a number of laboratories using the laser flash technique were obtained on a number of materials. For example, diffusivity results of AXM-5Q (POCO) graphite are attached (Table 10 and Figure 20 of AGARD No. 606). Participants No. 20, 23, 30 and 52 used the laser flash technique. The agreements are within the stated precision and bias statement of 37.01.06 except for on participant below 1000K.

An example of the same laboratory getting excellent agreement with other laboratories using the flash technique on one material and poor results on another is given in the paper "Round-Robin Testing of Thermal Conductivity Reference Materials", L.C. Hulstrom, Thermal Conductivity 19, D.W. Yarbrough,