



Standard Test Method for Thermal Diffusivity by the Flash Method¹

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1. Scope

1.1 This test method covers the determination of the thermal diffusivity of primarily homogeneous isotropic solid materials. Thermal diffusivity values ranging from 10^{-7} to 10^{-3} m²/s are readily measurable by this test method from about 75 to 2800 K.

1.2 This test method is a more detailed form of Test Method C 714, but has applicability to much wider ranges of materials, applications, and temperatures, with improved accuracy of measurements.

1.3 This test method is applicable to the measurements performed on materials opaque to the spectrum of the energy pulse, but with special precautions can be used on fully or partially transparent materials (see Appendix X1).

1.4 This test method is intended to allow a wide variety of apparatus designs. It is not practical in a test method of this type to establish details of construction and procedures to cover all contingencies that might offer difficulties to a person without pertinent technical knowledge, or to stop or restrict research and development for improvements in the basic technique.

1.5 This test method is applicable to the measurements performed on essentially fully dense materials; however, in some cases it has shown to produce acceptable results when used with porous samples. Since the magnitude of porosity, pore shapes, sizes and parameters of pore distribution influence the behavior of the thermal diffusivity, extreme caution must be exercised when analyzing data. Special caution is advised when other properties, such as thermal conductivity, are derived from thermal diffusivity obtained by this method.

1.6 This test method can be considered an absolute (or primary) method of measurement, since no reference standards are required. It is advisable to use reference materials to verify the performance of the instrument used.

1.7 This method is applicable only for homogeneous solid materials, in the strictest sense; however, in some cases it has shown to produce data which may be useful in certain applications.

1.7.1 *Testing of Composite Materials*—When substantial inhomogeneity and anisotropy is present in a material, the

thermal diffusivity data obtained with this method may be substantially in error. Nevertheless, such data, while usually lacking absolute accuracy, may be useful in comparing materials of similar structure. Extreme caution must be exercised when related properties, such as thermal conductivity, are derived, as composites may have heat flow patterns substantially different than uniaxial.

1.7.2 *Testing Liquids*—This method has found an especially useful application in determining thermal diffusivity of molten materials. For this technique, specially constructed sample enclosures must be used.

1.7.3 *Testing Layered Materials*—This method has also been extended to test certain layered structures made of dissimilar materials, where one of the layers is considered unknown. In some cases, contact conductance of the interface may also be determined.

1.8 The values stated in SI units are to be regarded as the standard.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

C 714 Test Method for Thermal Diffusivity of Carbon and Graphite by a Thermal Pulse Method²

E 230 Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples³

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *thermal conductivity, λ , of a solid material*—the time rate of steady heat flow through unit thickness of an infinite slab of a homogeneous material in a direction perpendicular to the surface, induced by unit temperature difference. The property must be identified with a specific mean temperature, since it varies with temperature.

3.1.2 *thermal diffusivity, α , of a solid material*—the property given by the thermal conductivity divided by the product of the density and heat capacity per unit mass.

¹ This test method is under the jurisdiction of ASTM Committee E37 on Thermal Measurements and is the direct responsibility of Subcommittee E37.05 on Thermophysical Properties.

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² *Annual Book of ASTM Standards*, Vol 05.05.

³ *Annual Book of ASTM Standards*, Vol 14.03.