



Standard Test Method for Thermal Conductivity and Thermal Diffusivity by Modulated Temperature Differential Scanning Calorimetry¹

This standard is issued under the fixed designation E1952; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method describes the determination of thermal conductivity of homogeneous, non-porous solid materials in the range of 0.10 to 1.0 W/(K • m) by modulated temperature differential scanning calorimeter. This range includes many polymeric, glass, and ceramic materials. Thermal diffusivity, which is related to thermal conductivity through specific heat capacity and density, may also be derived. Thermal conductivity and diffusivity can be determined at one or more temperatures over the range of 0 to 90 °C.

1.2 SI units are the standard. The values given in parentheses are provided for information purposes only.

1.3 *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:²

[E473 Terminology Relating to Thermal Analysis and Rheology](#)

[E967 Test Method for Temperature Calibration of Differential Scanning Calorimeters and Differential Thermal Analyzers](#)

[E968 Practice for Heat Flow Calibration of Differential Scanning Calorimeters](#)

[E1142 Terminology Relating to Thermophysical Properties](#)

[E1231 Practice for Calculation of Hazard Potential Figures-of-Merit for Thermally Unstable Materials](#)

[E2161 Terminology Relating to Performance Validation in Thermal Analysis](#)

3. Terminology

3.1 Definitions:

3.1.1 Specific technical terms used in this document are defined in Terminologies [E473](#), [E1142](#), [E2161](#) including *calibration*, *differential scanning calorimetry*, *heat capacity*, *modulated temperature*, *precision*, *reference material*, *relative standard deviation*, *repeatability*, *reproducibility*, *specific heat capacity*, *standard deviation*, *thermal analysis*, *thermal conductance*, and *thermal conductivity*.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *modulated temperature differential scanning calorimeter*—a version of differential scanning calorimetry that provides a sinusoidally varying temperature program to the test specimen in addition to the traditional isothermal or temperature ramp programs. Results from analysis shall include apparent and specific heat capacity.

4. Summary of Test Method

4.1 The heat capacity of a test specimen may be determined using the modulated temperature approach in which an oscillatory or periodically repeating temperature program (around an average temperature) is imposed upon a test specimen producing an oscillatory (periodic) heat flow into or out of the specimen. The heat capacity of the test specimen may be obtained from the amplitude of the resultant heat flow divided by the amplitude of the oscillatory (periodic) temperature that produces it. Specific heat capacity is obtained by normalizing the heat capacity to specimen mass.

4.1.1 The accuracy of the heat capacity thus obtained depends upon experimental conditions. When a thin test specimen encapsulated in a specimen pan of high thermal conductivity is treated with temperature oscillations of long period (low frequency), the test specimen is assumed to achieve a uniform temperature distribution and the resultant

¹ This test method is under the jurisdiction of Committee [E37](#) on Thermal Measurements and is the direct responsibility of Subcommittee [E37.10](#) on Fundamental, Statistical and Mechanical Properties.

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The process described in this test method is covered by a patent (Marcus, S. M. and Reading, M., U. S. Patent 5 335 993, 1994) held by TA Instruments, Inc., 159 Lukens Drive, New Castle DE 19720. Interested parties are invited to submit information regarding the identification of acceptable alternatives to this patented method to the Committee on Standards, ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken PA 19428-2959. Your comments will receive careful considerations at a meeting of the responsible technical committee which you may attend.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.