



Standard Test Method for Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure¹

This standard is issued under the fixed designation D5334; 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 presents a procedure for determining the thermal conductivity (λ) of soil and soft rock using a transient heat method. This test method is applicable for both intact and reconstituted soil specimens and soft rock specimens. This test method is suitable only for homogeneous materials.

1.2 This test method is applicable to dry or unsaturated materials over temperatures ranging from <0 to $>100^\circ\text{C}$, depending on the suitability of the thermal needle probe construction to temperature extremes. However, care must be taken to prevent significant error from: (1) redistribution of water due to thermal gradients resulting from heating of the needle probe; (2) redistribution of water due to hydraulic gradients (gravity drainage for high degrees of saturation or surface evaporation); (3) phase change of water in specimens with temperatures $<0^\circ\text{C}$ or $>100^\circ\text{C}$. These errors can be minimized by adding less total heat to the specimen through either minimizing power applied to the needle probe and/or minimizing the heating duration of the measurement.

1.3 *Units*—The values stated in SI units are to be regarded as the standard. No other units of measurements are included in this standard.

1.4 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice [D6026](#).

1.4.1 The procedure used to specify how data are collected/recorded or calculated in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope

of this standard to consider significant digits used in analytical methods for engineering design.

1.5 *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

[D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)

[D2216 Test Methods for Laboratory Determination of Water \(Moisture\) Content of Soil and Rock by Mass](#)

[D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction](#)

[D4439 Terminology for Geosynthetics](#)

[D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing](#)

[D6026 Practice for Using Significant Digits in Geotechnical Data](#)

3. Terminology

3.1 *Definitions*—For definitions of common technical terms, refer to Terminology standards [D653](#) and [D4439](#).

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *heat input, n*—power consumption of heater wire in watts per unit length that is assumed to be the equivalent of heat output per unit length of wire.

3.2.2 *thermal epoxy, n*—any heat conductive resin material having a value of $\lambda > 4 \text{ W/(m}\cdot\text{K)}$.

3.2.3 *thermal grease, n*—any heat conductive lubricating material having a value of $\lambda > 4 \text{ W/(m}\cdot\text{K)}$.

¹ This test method is under the jurisdiction of ASTM Committee [D18](#) on Soil and Rock and is the direct responsibility of Subcommittee [D18.12](#) on Rock Mechanics.

Current edition approved June 1, 2014. Published July 2014. Originally approved in 1992. Last previous edition approved in 2008 as D5334 – 08. DOI: 10.1520/D5334-08.14.

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.