



Designation: D5334 – 22a

## Standard Test Method for Determination of Thermal Conductivity of Soil and Rock by Thermal Needle Probe Procedure<sup>1</sup>

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 ( $\epsilon$ ) 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 ( $\lambda$ ) of soil and rock using a transient heat method. This test method is applicable for both intact specimens of soil and rock and reconstituted soil specimens, and is effective in the lab and in the field. This test method is most suitable for homogeneous materials, but can also give a representative average value for non-homogeneous materials.

1.2 This test method is applicable to dry, unsaturated or saturated materials that can sustain a hole for the sensor. It is valid 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 near  $0^\circ\text{C}$  or  $100^\circ\text{C}$ .

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. Reporting of test results in units other than SI shall not be regarded as nonconformance with 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 procedures 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.

NOTE 1—This test method is also applicable and commonly used for determining thermal conductivity of a variety of engineered porous materials of geologic origin including concrete, Fluidized Thermal Back-fill (FTB), and thermal grout.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

- 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
- 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 and Data Records in Geotechnical Data

### 3. Terminology

3.1 *Definitions*—For definitions of common technical terms used in this standard, refer to Terminology D653.

3.2 *Definitions of Terms Specific to This Standard:*

<sup>1</sup> 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.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard