



Standard Test Method for Determining Unsaturated and Saturated Hydraulic Conductivity in Porous Media by Steady-State Centrifugation¹

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1. Scope

1.1 This test method covers the determination of the hydraulic conductivity, or the permeability relative to water, of any porous medium in the laboratory, in particular, the hydraulic conductivity for water in subsurface materials, for example, soil, sediment, rock, concrete, and ceramic, either natural or artificial, especially in relatively impermeable materials or materials under highly unsaturated conditions. This test method covers determination of these properties using any form of steady-state centrifugation (SSC) in which fluid can be applied to a specimen with a constant flux or steady flow during centrifugation of the specimen. This test method only measures advective flow on core specimens in the laboratory.

1.2 *This standard may involve hazardous materials, operations, and equipment. 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:

- D 420 Guide to Site Characterization for Engineering, Design, and Construction Purposes²
- D 653 Terminology Relating to Soil, Rock, and Contained Fluids²
- D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock²
- D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction²
- D 4753 Specification for Evaluating, Selecting, and Specifying Balances and Scales for Use in Testing Soil, Rock, and Related Construction Materials²
- D 5084 Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter³

¹ This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.

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² *Annual Book of ASTM Standards*, Vol 04.08.

³ *Annual Book of ASTM Standards*, Vol 04.09.

D 5730 Guide for Site Characterization for Environmental Purposes With Emphasis on Soil, Rock, the Vadose Zone, and Ground Water³

D 6026 Practice for Using Significant Digits in Calculating and Reporting Geotechnical Test Data³

3. Terminology

3.1 *Definitions*—For common definitions of terms in this guide, such as porosity, permeability, hydraulic conductivity, water content, and matric potential (matric suction, water suction, or water potential), refer to Terminology D 653.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *hydraulic steady state*—the condition in which the water flux density remains constant along the conducting system. This is diagnosed as the point at which both the mass and volumetric water contents of the material are no longer changing.

3.2.2 *SSCM or SSC-UFA*—Apparatus to achieve steady-state centrifugation. The SSCM (steady-state centrifugation method) uses a self-contained flow delivery-specimen system (1)⁴. The SSC-UFA (unsaturated flow apparatus) uses an external pump to deliver flow to the rotating specimen (2). This test method will describe the SSC-UFA application, but other applications are possible. Specific parts for the SSC-UFA are described in Section 6 as an example of a SSC system.

3.2.3 *steady-state centrifugation*—controlled flow of water or other fluid through a specimen while it is rotating in a centrifuge, as distinct from water retention centrifugation methods which measure drainage from a wet specimen by centrifugation with no flow into the specimen.

3.2.4 *water flux density*—the flow rate of water through a cross-sectional area per unit time, for example, 5 cm³/cm²/s, written as 5 cm/s.

3.3 Symbols:

- K = hydraulic conductivity, cm/s
- q = water flux density, cm³/cm²/s or cm/s
- r = distance from axis of rotation, cm

⁴ The boldface numbers in parentheses refer to the list of references at the end of this standard.