



Standard Guide for Comparison of Field Methods for Determining Hydraulic Conductivity in the Vadose Zone¹

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€¹ NOTE—Paragraph 1.8 was editorially added in October 1998.

1. Scope

1.1 This guide provides a review of the test methods for determining hydraulic conductivity in unsaturated soils and sediments. Test methods for determining both field-saturated and unsaturated hydraulic conductivity are described.

1.2 Measurement of hydraulic conductivity in the field is used for estimating the rate of water movement through clay liners to determine if they are a barrier to water flux, for characterizing water movement below waste disposal sites to predict contaminant movement, and to measure infiltration and drainage in soils and sediment for a variety of applications. Test methods are needed for measuring hydraulic conductivity ranging from 1×10^{-2} to 1×10^{-8} cm/s, for both surface and subsurface layers, and for both field-saturated and unsaturated flow.

1.3 For these field test methods a distinction must be made between “saturated” (K_s) and “field-saturated” (K_{fs}) hydraulic conductivity. True saturated conditions seldom occur in the vadose zone except where impermeable layers result in the presence of perched water tables. During infiltration events or in the event of a leak from a lined pond, a “field-saturated” condition develops. True saturation does not occur due to entrapped air (1).² The entrapped air prevents water from moving in air-filled pores that, in turn, may reduce the hydraulic conductivity measured in the field by as much as a factor of two compared to conditions when trapped air is not present (2). Field test methods should simulate the “field-saturated” condition.

1.4 Field test methods commonly used to determine field-saturated hydraulic conductivity include various double-ring infiltrometer test methods, air-entry permeameter test methods, and borehole permeameter tests. Many empirical test methods are used for calculating hydraulic conductivity from data obtained with each test method. A general description of each

test method, and special characteristics affecting applicability is provided.

1.5 Field test methods used to determine unsaturated hydraulic conductivity in the field include direct measurement techniques and various estimation methods. Direct measurement techniques for determining unsaturated hydraulic conductivity include the instantaneous profile (IP) test method, and the gypsum crust method. Estimation techniques have been developed using borehole permeameter data, and using data obtained from desorption curves (a curve relating water content to matric potential).

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

1.7 *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.*

1.8 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word “Standard” in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 ASTM Standards:

D 653 Terms and Symbols Relating to Soil and Rock³

D 2434 Test Method for Permeability of Granular Soils (Constant Head)³

D 3385 Test Method for Infiltration Rate of Soils in the Field Using Double-Ring Infiltrometers³

D 4643 Test Method for Determination of Water (Moisture)

¹ This guide is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21.02 on Vadose Zone Monitoring.

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² The boldface numbers in parentheses refer to a list of references at the end of the text.

³ *Annual Book of ASTM Standards*, Vol 04.08.