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Standard Guide for Measuring Matric Potential in the Vadose Zone Using Tensiometers[1]

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1. Scope

1.1 This guide covers the measurement of matric potential in the vadose zone using tensiometers. The theoretical and practical considerations pertaining to successful onsite use of commercial and fabricated tensiometers are described. Measurement theory and onsite objectives are used to develop guidelines for tensiometer selection, installation, and operation.

1.2 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety problems, 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.*

1.4 *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. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *accuracy of measurement*—the difference between the value of the measurement and the true value.

2.1.2 *hysteresis*—that part of inaccuracy attributable to the tendency of a measurement device to lag in its response to environmental changes. Parameters affecting pressure-sensor hysteresis are temperature and measured pressure.

2.1.3 *precision (repeatability)*—the variability among numerous measurements of the same quantity.

2.1.4 *resolution*—the smallest division of the scale used for a measurement and it is a factor in determining precision and accuracy.

3. Summary of Guide

3.1 The measurement of matric potential in the vadose zone can be accomplished using tensiometers that create a saturated hydraulic link between the soil water and a pressure sensor. A variety of commercial and fabricated tensiometers are commonly used. A saturated porous ceramic material that forms an interface between the soil water and bulk water inside the instrument is available in many shapes, sizes, and pore diameters. A gage, manometer, or electronic pressure transducer is connected to the porous material with small- or large-diameter tubing. Selection of these components allows the user to optimize one or more characteristics, such as accuracy, versatility, response time, durability, maintenance, extent of data collection, and cost.

4. Significance and Use

4.1 Movement of water in the unsaturated zone is of considerable interest in studies of hazardous-waste sites **(1, 2, 3, 4)**[2]; recharge studies **(5, 6)**; irrigation management **(7, 8, 9)**; and civil-engineering projects **(10, 11)**. Matric-potential data alone can be used to determine direction of flow **(11)** and, in some cases, quantity of water flux can be determined using multiple tensiometer installations. In theory, this technique can be applied to almost any unsaturated-flow situation whether it is recharge, discharge, lateral flow, or combinations of these situations.

4.2 If the moisture-characteristic curve is known for a soil, matric-potential data can be used to determine the approximate water content of the soil **(10)**. The standard tensiometer is used to measure matric potential between the values of 0 and −867 cm of water; this range includes most values of saturation for many soils **(12)**.

4.3 Tensiometers directly and effectively measure soil-water tension, but they require care and attention to detail. In particular, installation needs to establish a continuous hydraulic connection between the porous material and soil, and minimal disturbance of the natural infiltration pattern are necessary for

[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 on Ground Water and Vadose Zone Investigations.

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