Standard Method of Test for

Permeability of Granular Soils (Constant Head)

AASHTO Designation: T 215-14 (2018)

Technical Subcommittee: 1a, Soil and Unbound Recycled Materials

Release: Group 3 (July)

AASHTO

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1. SCOPE

1.1. This method describes a procedure for the determination of the permeability of water through granular (cohesionless) soils in a steady-state condition.

1.2. The determination of the coefficient of permeability, *k*, as defined in this method, was developed under the assumptions of the validity of Darcy's Law, which states that the coefficient of permeability is the ratio of the flow rate to the hydraulic gradient.

1.3. This test procedure is intended for use with disturbed granular soils containing less than 10 percent by mass of the material passing the 75-µm (No. 200) sieve. Soil materials with significant amounts of material smaller than the 75-µm (No. 200) sieve are subject to consolidation effects that may influence the outcome of the test results. Permeability of fine-grained and cohesive soils should be performed by use of a flexible wall permeameter test procedure, such as ASTM D5084.

1.4. Two methods of test, Method A and Method B, are provided. The method used is dependent on the permeameter used to complete testing.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- M 231, Weighing Devices Used in the Testing of Materials
- R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- R 61, Establishing Requirements for Equipment Calibrations, Standardizations, and Checks
- T 88, Particle Size Analysis of Soils
- T 99, Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
- T 180, Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- T 265, Laboratory Determination of Moisture Content of Soils

2.2. *ASTM Standards*:

- D5084, Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E77, Standard Test Method for Inspection and Verification of Thermometers

- E563, Standard Practice for Preparation and Use of an Ice-Point Bath as a Reference Temperature
- E1137/E1137M, Standard Specification for Industrial Platinum Resistance Thermometers
- E2251, Standard Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids

3. SIGNIFICANCE AND USE

3.1. Soil foundations with inadequate drainage capabilities can result in excess pore water pressures that may ultimately lead to pumping distress. Pumping distress, which is the forceful ejection of waterborne soil subgrade, can occur when freestanding water accumulates between a pavement surface and the subgrade of concrete pavement. Pumping distress is particularly common on high-volume roadways sustaining heavy axle loads.

4. SUMMARY OF TEST METHOD

4.1. Loose soil material is compacted into a rigid-wall permeameter. A vacuum is applied to the test sample to evacuate air from the sample. While remaining under vacuum, the specimen is slowly saturated with water from the bottom upward. Finally, the flow of water is induced through the sample. Once a stable head condition is reached, time, head, and flow measurements are taken and recorded. These measurements are used to calculate the coefficient of permeability of the soil. It is recommended that measurements be repeated at increasing heads in order to determine the region of laminar flow.

5. APPARATUS

5.1. *Apparatus Required for Method A*:

5.1.1. *Permeameter*—As shown in Figure 1 and equipped with the following:

5.1.1.1. *Specimen Cylinder*—A rigid glass, plastic, or metal. The diameter of the cylinder required is dependent on the maximum particle size of the sample to be tested, and shall conform to the minimum requirements described in Table 1.

Table 1—Minimum Cylinder Diameter Based on Maximum Particle Size

Maximum Particle Size Lies Between Sieve Openings	Minimum Cylinder Diameter			
	Less than 35% of Total Soil Retained on Sieve Opening		More than 35% of Total Soil Retained on Sieve Opening	
	2.00-mm (No. 10)	9.5-mm ($^3/_8$ in.)	2.00-mm (No. 10)	9.5-mm ($^3/_8$ in.)
2.00-mm (No. 10) and 9.5-mm ($^3/_8$ in.)	76 mm (3 in.) Methods A and B	—	114 mm (4.5 in.) Methods A and B	—
9.5-mm ($^3/_8$ in.) and 19.0-mm ($^3/_4$ in.)	—	152 mm (6 in.) Methods A and B	—	229 mm (9 in.) Methods A and B

5.1.1.2. *Porous Disks*—The bottom and top of the specimen shall be covered with a porous disk constructed of silicon carbide, aluminum oxide, or similar noncorrosive material. The porosity of the disks shall be fine enough to prevent intrusion of soil particles into the pores. The permeability