
Standard Practice for Conducting Geotechnical Subsurface Investigations

AASHTO Designation: R 13-22¹

Technically Revised: 2022

**Technical Subcommittee: 1b, Geotechnical Exploration,
Instrumentation, Stabilization, and Field Testing**

ASTM Designation: D420-18



**American Association of State Highway and Transportation Officials
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INTRODUCTION

Investigation and identification of subsurface materials and conducting subsurface investigations involve complex techniques that may be accomplished by many different procedures and may be variously interpreted. These studies are frequently site specific and are influenced by geological and geographical settings; by the purpose of the investigation; by the design requirements for the project proposed; and by the background, training, and experience of the investigator.

This standard practice for soil, rock, and groundwater investigation based on standard procedures will provide a more consistent, uniform, and rational methodology for site evaluations. An acceptable and consistent investigation, sampling, testing, and evaluation program will determine subsurface site conditions and thereby provide the information needed to bring about safer and more cost-effective transportation facilities.

1. SCOPE

- 1.1. This standard practice identifies recognized methods by which soil, rock, and groundwater conditions may be determined. The objective of the investigation should be to identify and locate, both horizontally and vertically, significant soil and rock types and groundwater conditions present within a given site area and to establish the characteristics of the subsurface materials by sampling and *in situ* testing. Laboratory testing of soil and rock samples is governed by other AASHTO and ASTM standards. Subsurface investigation for environmental purposes is also outside the scope of this practice.
- 1.2. *This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all safety concerns associated with its usage. It is the duty and responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

Note 1—The values stated in SI units are to be regarded as the standard.

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- M 145, Classification of Soils and Soil–Aggregate Mixtures for Highway Construction Purposes

- R 90, Sampling Aggregate Products
- T 206, Penetration Test and Split-Barrel Sampling of Soils
- T 207, Thin-Walled Tube Sampling of Soils
- T 222, Nonrepetitive Static Plate Load Test of Soils and Flexible Pavement Components for Use in Evaluation and Design of Airport and Highway Pavements
- T 223, Field Vane Shear Test in Cohesive Soil
- T 225, Diamond Core Drilling for Site Investigation
- T 306, Progressing Auger Borings for Geotechnical Explorations

2.2.

AASHTO Manual:

- AASHTO. *Manual on Subsurface Investigations*, 2nd ed. MSI-2. American Association of State Highway and Transportation Officials, Washington, DC. Publication pending in 2022.

2.3.

ASTM Standards:

- D1586/D1586 M, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
- D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)
- D2607, Classification of Peats, Mosses, Humus, and Related Products (withdrawn 1990)
- D3385, Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer
- D3550/D3550M, Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils
- D4044/D4044M, Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers
- D4083, Standard Practice for Description of Frozen Soils (Visual-Manual Procedure)
- D4220/D4220M, Standard Practices for Preserving and Transporting Soil Samples
- D4394, Standard Test Method for Determining In Situ Modulus of Deformation of Rock Mass Using Rigid Plate Loading Method
- D4395, Standard Test Method for Determining In Situ Modulus of Deformation of Rock Mass Using Flexible Plate Loading Method
- D4403, Standard Practice for Extensometers Used in Rock
- D4428/D4428M, Standard Test Method for Crosshole Seismic Testing
- D4429, Standard Test Method for CBR (California Bearing Ratio) of Soils in Place (withdrawn 2018)
- D4506, Standard Test Method for Determining In Situ Modulus of Deformation of a Rock Mass Using the Radial Jacking Test
- D4553, Standard Test Method for Determining In Situ Creep Characteristics of Rock
- D4554, Standard Test Method for In Situ Determination of Direct Shear Strength of Rock Discontinuities (withdrawn 2021)
- D4555, Standard Test Method for Determining Deformability and Strength of Weak Rock by an In Situ Uniaxial Compressive Test (withdrawn 2019)
- D4630, Standard Test Method for Determining Transmissivity and Storage Coefficient of Low-Permeability Rocks by In Situ Measurements Using the Constant Head Injection Test
- D4631, Standard Test Method for Determining Transmissivity and Storativity of Low Permeability Rocks by In Situ Measurements Using Pressure Pulse Technique

- D4719, Standard Test Methods for Prebored Pressuremeter Testing in Soils
- D4729, Standard Test Method for In Situ Stress and Modulus of Deformation Using the Flat Jack Method
- D4971, Standard Test Method for Determining In Situ Modulus of Deformation of Rock Using Diametrically Loaded 76-mm (3-in) Borehole Jack
- D5079, Standard Practices for Preserving and Transporting Rock Core Samples (withdrawn 2017)
- D5093, Standard Test Method for Field Measurement of Infiltration Rate Using Double-Ring Infiltrometer with Sealed-Inner Ring
- D5753, Guide for Planning and Conducting Geotechnical Borehole Geophysical Logging
- D5777, Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation
- D5778, Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils
- D5878, Standard Guides for Using Rock-Mass Classification Systems for Engineering Purposes
- D6066, Standard Practice for Determining the Normalized Penetration Resistance of Sands for Evaluation of Liquefaction Potential (withdrawn 2020; no replacement)
- D6391, Standard Test Method for Field Measurement of Hydraulic Conductivity Using Borehole Infiltration
- D6429, Standard Guide for Selecting Surface Geophysical Methods
- D6430, Standard Guide for Using the Gravity Method for Subsurface Site Characterization
- D6431, Standard Guide for Using the Direct Current Resistivity Method for Subsurface Site Characterization
- D6432, Standard Guide for Using the Surface Ground Penetrating Radar Method for Subsurface Investigation
- D6635, Standard Test Method for Performing the Flat Plate Dilatometer
- D7046, Standard Guide for Use of the Metal Detection Method for Subsurface Exploration (withdrawn 2020)
- D7128, Standard Guide for Using the Seismic-Reflection Method for Shallow Subsurface Investigation
- D7400/D7400M, Standard Test Methods for Downhole Seismic Testing
- D8359, Standard Test Method for Determining the In Situ Rock Deformation Modulus and Other Associated Rock Properties Using a Flexible Volumetric Dilatometer
- G57, Standard Test Method for Measurement of Soil Resistivity Using the Wenner Four-Electrode Method

3. SIGNIFICANCE AND USE

- 3.1. *An adequate soil, rock, and groundwater subsurface investigation provides pertinent information for decision making on one or more of the following subjects:*
- 3.1.1. Location of the proposed construction both vertically and horizontally;
 - 3.1.2. Location and preliminary evaluation of suitable borrow and other local sources of construction material;
 - 3.1.3. Need for special excavating and dewatering techniques;
 - 3.1.4. Investigations of stability in natural slopes and cuts, and embankment foundation stability;

- 3.1.5. Conceptual selection of embankment types and hydraulic barrier requirements;
- 3.1.6. Conceptual selection of alternate foundation types and elevations of the corresponding suitable bearing strata;
- 3.1.7. Development of additional detailed subsurface investigations for specific structures or facilities;
- 3.1.8. Need for and type of subgrade or embankment foundation treatment or drainage;
- 3.1.9. Selection of roadway or area pavement type;
- 3.1.10. Assessment of the variability of geologic and subsurface conditions over the site;
- 3.1.11. Subsurface information and data intended to inform decisions for constructability and project estimates;
- 3.1.12. Need to identify areas requiring special environmental protection; and/or
- 3.1.13. Need to identify potential hazardous locations and types of hazardous materials.
- 3.2. The investigation may require the collection of sufficiently large soil and rock samples of such quality to allow adequate testing to determine the soil or rock classification or mineralogic type, or both, as well as other engineering properties pertinent to the proposed design.
- 3.3. This standard practice is not meant to be an inflexible description of investigation requirements. Other techniques may be applied as appropriate.

4. RECONNAISSANCE OF PROJECT AREA

- 4.1. Available technical data from the literature, Internet, or from personal communication should be reviewed before any field program is started. This includes, but is not limited to, topographic maps, aerial photography, satellite imagery, geologic maps, statewide or county soil surveys and mineral resource surveys, and engineering soil maps covering the proposed project area. Reports of subsurface investigations of nearby or adjacent projects should be studied.
Note 2—While some older maps and reports may be obsolete and of limited value in light of current knowledge, a comparison of the old with the new will often reveal valuable unexpected information.
- 4.1.1. The United States Geological Survey and the geological surveys of the various states are the principal sources of geologic maps and reports on mineral resources and groundwater.
- 4.1.2. The United States Department of Agriculture, Natural Resources Conservation Service (NRCS) publishes the Web Soil Survey (WSS), available on the Internet. The site is updated and maintained online. Print copies of previously published NRCS soil surveys may also be available locally. Soil Survey Reports should enable the engineer to estimate the range in soil profile characteristics to depths of 1.5 or 2.0 m (5 or 6 ft) for mapped soil units.
Note 3—Each soil type has a distinctive soil profile due to age, parent material, relief, climatic condition, and biological activity. Consideration of these factors can assist in identifying the various soil types, each requiring special engineering considerations and treatment. Similar engineering soil properties are often found where similar soil profile characteristics exist. Changes in soil properties in adjacent areas often indicate changes in parent material or relief. WSS information should not be used as a substitute for a field sampling and testing program.