Designation: ~~D6151 – 08~~ D6151/D6151M – 15

Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling[1]

This standard is issued under the fixed designation ~~D6151;~~D6151/D6151M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. ~~Scope*~~Scope

1.1 This practice covers how to obtain soil samples using ~~hollow-stem~~ Hollow-Stem Auger (HSA) sampling systems and use of hollow-stem auger drilling methods for geotechnical exploration. This practice addresses how to obtain soil samples suitable for engineering properties testing.

1.2 In most geotechnical explorations, ~~hollow-stem auger~~ Hollow-Stem Auger (HSA) drilling is combined with other sampling methods. Split barrel penetration tests (Test Method D1586) are often performed to provide estimates of engineering properties of soils. Thin-wall tube (Practice D1587) and ring-lined barrel samples (Practice D3550) are also frequently taken. This practice discusses hole preparation for these sampling events. For information on the sampling process, consult the related standards. Other in situ tests, such as the vane shear Test Method D2573, can be performed below the base of the boring by access through the drill string. Other drilling methods are summarized in Guide D6286. Practice D1452 describes solid stem augers.

1.3 This practice does not include considerations for geoenvironmental site characterizations and installation of monitoring wells which are addressed in Guide D5784.

1.4 This practice ~~may not reflect~~ offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of ~~operations. It offers guidance on current practice but does not recommend a specific course of action. It should not be used as the sole criterion or basis of comparison, and does not replace or relieve professional judgment.~~this practice 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 practice means only that the document has been approved through the ASTM consensus process.

1.5 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this standard.

1.6 The values stated in either inch-pound units or SI units [presented in brackets] are to be regarded separately as standard. The values ~~given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered~~ stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.7 Hollow-stem auger drilling for geotechnical exploration often involves safety planning, administration, and documentation. This standard does not purport to specifically address exploration and site safety. 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 its use. *Performance of the test usually involves use of a drill rig, therefore, safety requirements as outlined in applicable safety standards, for example OSHA (Occupational Health and Safety Administration) regulations, DCDMA safety manual (***1***),*[2] drilling safety manuals, and other applicable state and local regulations must be observed.

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Evaluations.

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[2] The boldface numbers in parentheses refer to the references at the end of this practice.

***A Summary of Changes section appears at the end of this standard**

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D420 Guide to Site Characterization for Engineering Design and Construction Purposes (Withdrawn 2011)[4]
D653 Terminology Relating to Soil, Rock, and Contained Fluids
D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)
D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock
D6026 Practice for Using Significant Digits in Geotechnical Data

2.2 *Standards for Sampling of Soil and Rock:*

D1452 Practice for Soil Exploration and Sampling by Auger Borings
D1586 Test Method for Penetration Test (SPT) and Split-Barrel Sampling of Soils
D1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
D2113 Practice for Rock Core Drilling and Sampling of Rock for Site Exploration
D3550 Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils
D4220 Practices for Preserving and Transporting Soil Samples
~~D4700 Guide for Soil Sampling from the Vadose Zone~~
~~D5079 Practices for Preserving and Transporting Rock Core Samples~~

2.3 *In situ Testing:*

D2573 Test Method for Field Vane Shear Test in Cohesive Soil
D3441 Test Method for Mechanical Cone Penetration Tests of Soil (Withdrawn 2014)[4]
D4719 Test Methods for Prebored Pressuremeter Testing in Soils

2.4 *Instrument Installation and Monitoring:*

D4428/D4428M Test Methods for Crosshole Seismic Testing
~~D4750 Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well) (Withdrawn 2010)[4]~~
D5092 Practice for Design and Installation of Groundwater Monitoring Wells

2.5 *Drilling Methods:*

D5784 Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices
~~D5876~~D6286 Guide for ~~Use of Direct Rotary Wireline Casing Advancement~~ Selection of Drilling Methods for ~~Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices~~Environmental Site Characterization

3. Terminology

3.1 ~~*Definitions—*~~*Definitions:* ~~For definitions of technical terms in this standard, refer to Terminology D653 with the addition of the following (see Figs. 1-5 for typical system components):~~

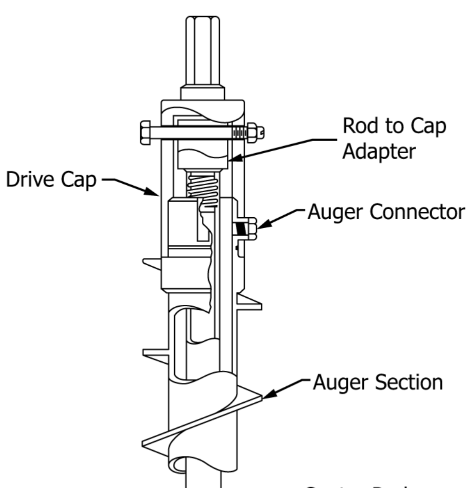
3.1.1 For common definitions of terms in this standard, refer to Terminology D653.

3.2 *Definitions of Terms Specific to This Standard:* (see Figs. 1-5 for typical system components):

3.2.1 *auger cutter head*—the terminal section of the lead auger equipped with a hollow cutting head for cutting soil. ~~The cutter head is connected to the lead auger. The cutter head is equipped with abrasion-resistant cutting devices, normally with carbide surfaces. The cutter can be teeth (usually square or conical), or blades (rectangular or spade design). Cutter head designs may utilize one style cutter or a combination of cutters.~~

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[4] The last approved version of this historical standard is referenced on www.astm.org.



3.2.1.1 *Discussion—*

FIG. 1 Rod-Type Auger System With Pilot Bit

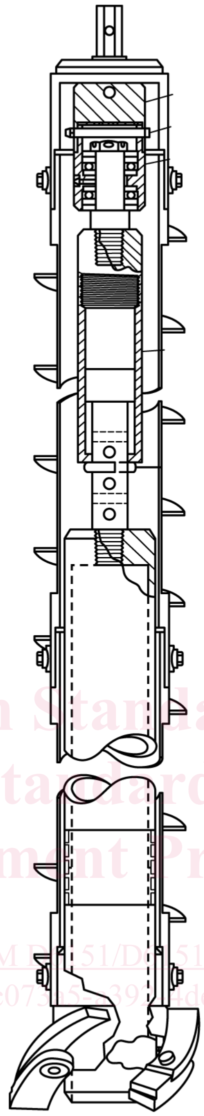


FIG. 2 Example of Rod-Type Sampling System

The cutter head is connected to the lead auger. The cutter head is equipped with abrasion-resistant cutting devices, normally with carbide surfaces. The cutter can be teeth (usually square or conical), or blades (rectangular or spade design). Cutter head designs may utilize one style cutter or a combination of cutters.

3.2.2 *bit clearance ratio*—a ratio, expressed as a percentage of the difference between the inside diameter of the sampling tube and the inside diameter of the cutting bit divided by the inside diameter of the sampling tube.

3.2.3 *blow-in*—(Practice D5092)—the inflow of groundwater and unconsolidated material into the borehole or casing caused by differential hydraulic heads; that is, caused by the presence of a greater hydraulic head outside the borehole/casing than inside. Also known as *sanding in* or *soil heave*.

3.2.4 *clean out depth*—the depth to which the end of the drill string (bit or core barrel cutting end) has reached after an interval of drilling. ~~The clean out depth (or drilled depth as it is referred to after cleaning out of any sloughed material or cuttings in the bottom of the drill hole) is normally recorded to the nearest 0.1 ft. (0.03 m).~~

3.2.4.1 *Discussion—*

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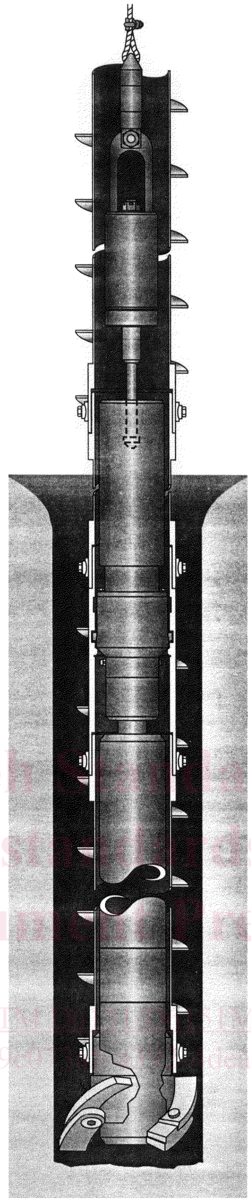

FIG. 3 Example of Wireline Sampling System

3.2.5 *continuous sampling devices*—sampling systems which continuously sample as the drilling progresses. ~~Hollow-stem sampling systems are often referred to as continuous samplers because they can be operated in that mode. Hollow-stem sampling systems are double-tube augers where barrel-type samplers fit within the lead auger of the hollow auger column. The double-tube auger operates as a soil coring system in certain subsurface conditions where the sampler barrel fills with material as the augers advance. The barrel can be removed and replaced during pauses in drilling for continuous coring.~~

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3.2.6 *double-tube auger*—an auger equipped with an inner barrel for soil sampling (soil ~~coring). If~~coring); if equipped with an inner barrel and liner, the auger system can be described as a triple-tube auger.

3.2.7 *drill hole*—a cylindrical hole advanced into the subsurface by mechanical means. Also known as borehole or boring.

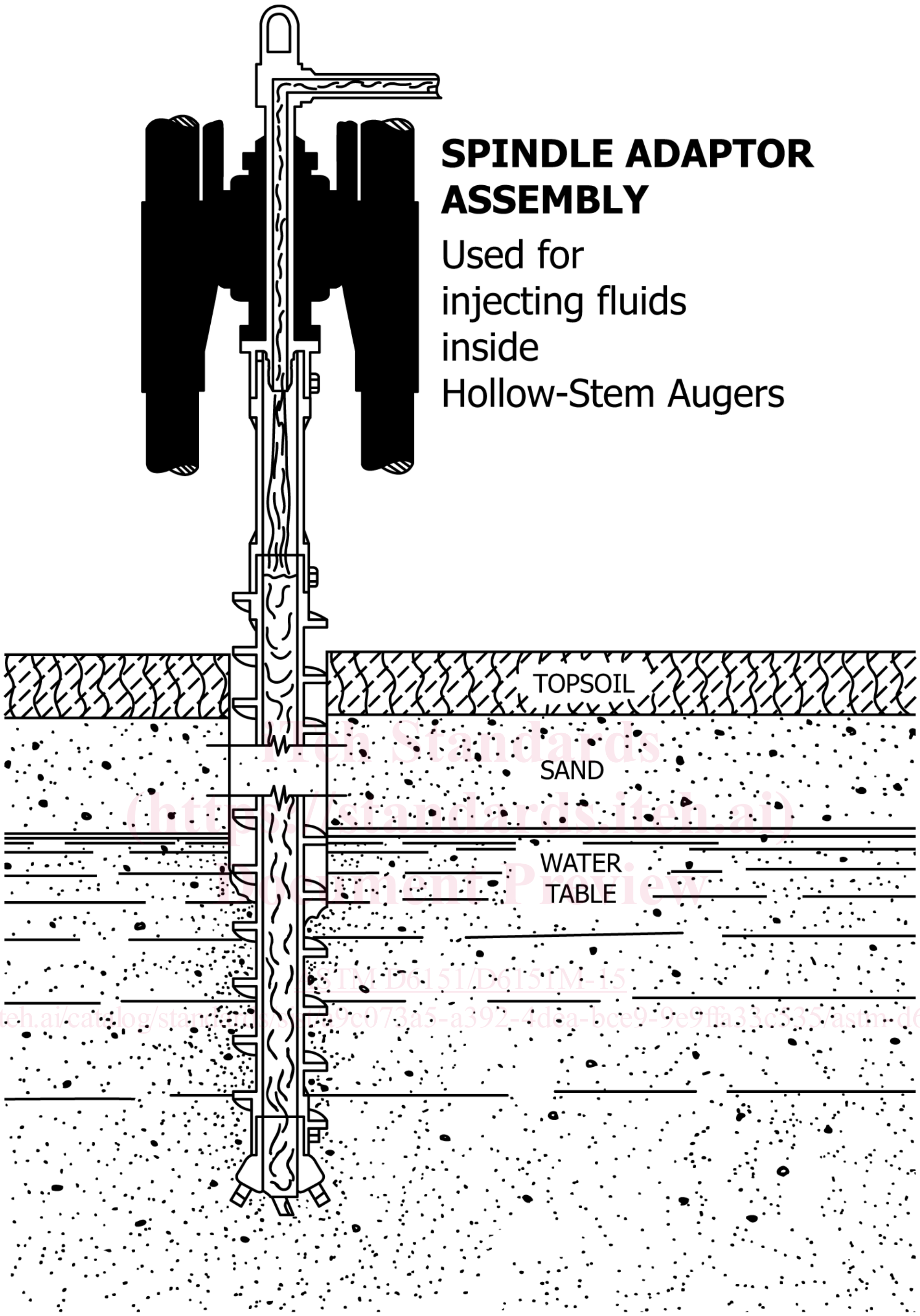

FIG. 4 Spindle Adaptor Assembly

3.2.8 *drill string*—the complete drilling assembly under rotation including augers, core barrel or pilot bit, drill rods, and connector subassemblies. ~~Drilling depth is determined by knowledge of the total length of the drill string, and by subtracting the string length above a ground surface datum.~~

3.2.8.1 *Discussion—*

Drilling depth is determined by knowledge of the total length of the drill string, and by subtracting the string length above a ground surface datum.

3.2.9 *fluid injection devices*—pumps, fittings, hose and pipe components, or drill rig attachments that may be used to inject a fluid within a hollow auger column during drilling.

~~3.2.10 *HSA*—Hollow stem auger(s). See 3.2.11.~~

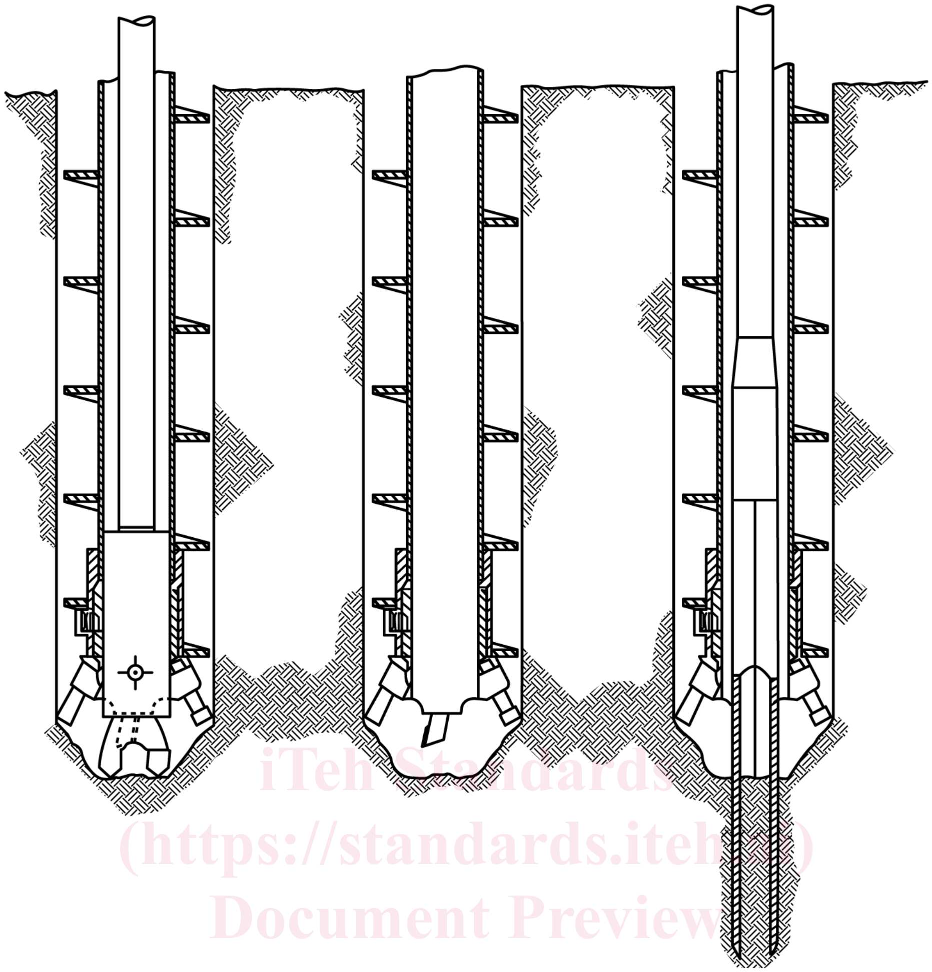

FIG. 5 Example of Drive Case Sampling Through HSA

3.2.10 *hollow stem ~~auger—~~auger (HSA)—*a cylindrical hollow tube with a continuous helical fluting/fighting on the outside, which acts as a screw conveyor to lift cuttings produced by an auger drill head or cutter head bit to the surface.

3.2.11 *in-hole-hammer*—a drop hammer for driving a soil sampling device. ~~The in-hole hammer is designed to run down-hole within the HSA column. It is usually operated with a free-fall wireline hoist capable of lifting and dropping the hammer weight to drive the sampler below the HSA column and retrieve the hammer and sampler to the surface. See Fig. 6~~

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The in-hole hammer is designed to run down-hole within the HSA column. It is usually operated with a free-fall wireline hoist capable of lifting and dropping the hammer weight to drive the sampler below the HSA column and retrieve the hammer and sampler to the surface. See Fig. 6[5]

3.2.12 *in situ testing devices*—sensors or probes, used for obtaining test data for estimation of engineering properties, that are typically pushed, rotated, or driven in advance of the hollow auger column assembly at a designated depth or advanced simultaneously with advancement of the auger column (see 2.3).

3.2.13 *intermittent sampling devices*—barrel-type samplers that may be rotated, driven, or pushed below the auger head at a designated depth prior to advancement of the auger column (see 2.2).

3.2.14 *lead auger assembly*—the first hollow stem auger to be advanced into the subsurface. ~~The end of the lead auger assembly is equipped with a cutter head for cutting. The lead auger may also contain a pilot bit assembly or sample barrel assembly housed within the hollow portion of the auger. If a wireline system is used, the lead auger assembly will have an adapter housing on top of the first auger containing a latching device for locking the pilot bit assembly or sampling core barrel into the lead auger assembly.~~

[5] Foremost Mobile, Mobile Drilling Company Inc., 3807 Madison Avenue, Indianapolis, IN.