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Standard Guide for Direct-Push Groundwater Sampling for Environmental Site Characterization[1]

This standard is issued under the fixed designation D6001/D6001M; 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*

1.1 This guide covers a review of methods for sampling groundwater at discrete points or in increments by insertion of groundwater sampling devices using Direct Push Methods (D6286/D6286M, see 3.3.2). By directly pushing the sampler, the soil is displaced and helps to form an annular seal above the sampling zone. Direct-push water sampling can be one time, or multiple sampling events. Knowledge of site specific geology and hydrogeologic conditions is necessary to successfully obtain groundwater samples with these devices.

1.2 Direct-push methods of water sampling are used for groundwater quality and geohydrologic studies. Water quality and permeability may vary at different depths below the surface depending on geohydrologic conditions. Incremental sampling or sampling at discrete depths is used to determine the distribution of contaminants and to more completely characterize geohydrologic environments. These explorations are frequently advised in characterization of hazardous and toxic waste sites and for geohydrologic studies.

1.3 This guide covers several types of groundwater samplers; sealed screen samplers, profiling samplers, dual tube sampling systems, and simple exposed screen samplers. In general, sealed screen samplers driven to discrete depth provide the highest quality water samples. Profiling samplers using an exposed screen(s) which are purged between sampling events allow for more rapid sample collection at multiple depths. Simple exposed screen samplers driven to a test zone with no purging prior to sampling may result in more questionable water quality if exposed to upper contaminated zones, and in that case, would be considered screening devices.

1.4 Methods for obtaining groundwater samples for water quality analysis and detection of contaminants are presented. These methods include use of related standards such as; selection of purging and sampling devices (Guide D6452 and D6634/D6634M), sampling methods (Guide D4448 and D6771) and sampling preparation and handling (Guides D5903, D6089, D6517, D6564/D6564M, and D6911).

1.5 When appropriately installed and developed many of these devices may be used to perform pneumatic slug testing (Practice D7242/D7242M) to quantitatively evaluate formation hydraulic conductivity over discrete intervals of unconsolidated formations. These slug tests provide reliable determinations of hydraulic conductivity and can be performed after water quality sampling is completed.

1.6 Direct-push water sampling is limited to unconsolidated formations that can be penetrated with available equipment. In strong soils damage may result during insertion of the sampler from rod bending or assembly buckling. Penetration may be limited, or damage to samplers or rods can occur in certain ground conditions, some of which are discussed in 5.7. Drilling equipment such as sonic drilling (Practice D6914/D6914M) or rotary drilling (Guide D6286/D6286M) can be used to advance holes past formations difficult to penetrate using typical Direct Push equipment. Some soil formations do not yield water in a timely fashion for direct-push sampling. In the case of unyielding formations, direct-push soil sampling can be performed (Guide D6282/D6282M).

1.7 Direct push water sampling with one-time sealed screen samplers can also be performed using cone penetrometer equipment (Guide D6067/D6067M).

1.8 This guide does not address installation of permanent water sampling systems such as those presented in Practice D5092/D5092M. Direct-push monitoring wells for long term monitoring are addressed in Guide D6724/D6724M and Practice D6725/D6725M.

1.9 *Units*—The values stated in either SI units or inch-pound units [presented in brackets] are to be regarded separately as standard. The values 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 nonconformance with the standard. Reporting of test results in units other than SI shall not be regarded as nonconformance with this standard.

1.10 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] This guide is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Groundwater and Vadose Zone Investigations.

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

1.11 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.12 *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.*

1.13 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D1586/D1586M Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

D2488 Practice for Description and Identification of Soils (Visual-Manual Procedures)

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D4448 Guide for Sampling Ground-Water Monitoring Wells

D4750 Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well) (Withdrawn 2010)[3]

D5088 Practice for Decontamination of Field Equipment Used at Waste Sites

D5092/D5092M Practice for Design and Installation of Groundwater Monitoring Wells

D5314 Guide for Soil Gas Monitoring in the Vadose Zone (Withdrawn 2015)[3]

D5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock

D5521/D5521M Guide for Development of Groundwater Monitoring Wells in Granular Aquifers

D5778 Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils

D5903 Guide for Planning and Preparing for a Groundwater Sampling Event

D6026 Practice for Using Significant Digits in Geotechnical Data

D6067/D6067M Practice for Using the Electronic Piezocone Penetrometer Tests for Environmental Site Characterization and Estimation of Hydraulic Conductivity

D6089 Guide for Documenting a Groundwater Sampling Event

D6187 Practice for Cone Penetrometer Technology Characterization of Petroleum Contaminated Sites with Nitrogen Laser-Induced Fluorescence (Withdrawn 2019)[3]

D6235 Practice for Expedited Site Characterization of Vadose Zone and Groundwater Contamination at Hazardous Waste Contaminated Sites

D6452 Guide for Purging Methods for Wells Used for Ground Water Quality Investigations

D6517 Guide for Field Preservation of Ground Water Samples

D6564/D6564M Guide for Field Filtration of Groundwater Samples

D6634/D6634M Guide for Selection of Purging and Sampling Devices for Groundwater Monitoring Wells

D6724/D6724M Guide for Installation of Direct Push Groundwater Monitoring Wells

D6725/D6725M Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers

D6771 Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations

D6911 Guide for Packaging and Shipping Environmental Samples for Laboratory Analysis

D7242/D7242M Practice for Field Pneumatic Slug (Instantaneous Change in Head) Tests to Determine Hydraulic Properties of Aquifers with Direct Push Groundwater Samplers

D7352 Practice for Volatile Contaminant Logging Using a Membrane Interface Probe (MIP) in Unconsolidated Formations with Direct Push Methods

D8037/D8037M Practice for Direct Push Hydraulic Logging for Profiling Variations of Permeability in Soils

2.2 *Drilling Methods:*[2]

D5781/D5781M Guide for Use of Dual-Wall Reverse-Circulation Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water Quality Monitoring Devices

D5782 Guide for Use of Direct Air-Rotary Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

D5783 Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

D5784/D5784M Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water Quality Monitoring Devices

[2] 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.

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

D5875/D5875M Guide for Use of Cable-Tool Drilling and Sampling Methods for Geoenvironmental Exploration and Installation of Subsurface Water Quality Monitoring Devices

D5876/D5876M Guide for Use of Direct Rotary Wireline Casing Advancement Drilling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices

D6286/D6286M Guide for Selection of Drilling and Direct Push Methods for Geotechnical and Environmental Subsurface Site Characterization

D6914/D6914M Practice for Sonic Drilling for Site Characterization and the Installation of Subsurface Monitoring Devices

2.3 *Soil Sampling:*[2]

D6282/D6282M Guide for Direct Push Soil Sampling for Environmental Site Characterizations

3. Terminology

3.1 *Definitions:*

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

3.2 *The definitions below are in Terminology D653, and as adopted from Practice D5092/D5092M on installation of monitoring wells.*

3.2.1 *bailer, n—in wells*, a hollow tubular receptacle used to facilitate removal of fluid from a well or borehole.

3.2.2 *borehole, n—in drilling*, an open or uncased subsurface hole, generally circular in plain view, created by drilling.

3.2.2.1 *Discussion*—Normally, a borehole is advanced using an auger, a drill, or casing with or without drilling fluid, but for this standard it is made using direct push methods (3.3.2).

3.2.3 *casing, n—in drilling*, pipe, finished in sections with either threaded connections or beveled edges to be field welded, which is installed temporarily or permanently to counteract caving, to advance the borehole, or to isolate the zone being monitored, or combination thereof.

3.2.4 *caving; sloughing, v—in drilling*, the inflow of unconsolidated material into a borehole that occurs when the borehole walls lose their cohesive strength.

3.2.5 *centralizer, n—in drilling*, a device that assists in the centering of a casing or riser within a borehole or another casing.

3.2.6 *PTFE tape, n—in drilling*, joint sealing tape composed of polytetrafluorethylene.

3.2.6.1 *Discussion*—For sampling of (PFAS, 3.3.11), PTFE tape may not be used in well assembly due to the potential for cross contamination.

3.2.7 *slot, n—in well screen opening*, slot openings have been designated by numbers which correspond to the width of the openings in thousandths of an inch.

3.2.7.1 *Discussion*—A No. 10 slot screen, for example, is an opening of 0.25 mm [0.010 in.].

3.2.8 *well screen, n—in wells*, a device used to retain the primary or natural filter pack; usually a cylindrical pipe with openings of uniform width, orientation, and spacing.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *assembly length, n*—length of sampler body and riser pipes.

3.3.2 *direct-push (DP) method, v*—a subsurface exploration method by which drive rod, casing tube, sampling, and logging devices are pushed, driven, or vibrated into soils or unconsolidated formations to be sampled or logged without rotary drilling and removal of cuttings.

3.3.2.1 *Discussion*—For the purposes of this guide, a subsurface exploration method that uses hand-held percussion driving devices, or hydraulic percussion, quasi static push, or vibratory drive systems that are mounted to a truck, van, all-terrain vehicle, trailer, skid, or drill rig.

3.3.3 *direct-push groundwater sampler, n*—a sampler specially designed for use with direct push methods to collect groundwater from relatively pervious soils (aquifers).

3.3.4 *exposed screen sampler, n—in drilling*, a sampler with an exposed screen driven to the sampling depth that may be exposed to cross contamination prior to the sampling.

3.3.5 *exposed screen length, n*—the length of a screen open or exposed to water bearing strata.

3.3.5.1 *Discussion*—In some DP groundwater sampling devices only a portion of the screen may be exposed to the formation to target a discrete zone for sampling.

3.3.6 *effective seal length, n*—the length of soil above the sampler screen that is in intimate contact with the riser pipe and prevents connection of the screen with groundwater from overlying zones.

3.3.7 *grab groundwater sampling, v—in groundwater*, the process of rapidly collecting a water sample with minimal purging or development using simple equipment like bailers or pumps at a specific time, location, and depth.

3.3.7.1 *Discussion*—Grab sampling is a rapid sampling event with little or no purging or development of the test zone, often using simple devices like a bailer or inertial pumps.

3.3.8 *incremental drilling and sampling, n—in drilling*, insertion method where rotary drilling and sampling events are alternated for incremental sampling. Incremental drilling is often needed to penetrate harder or deeper formations.

3.3.9 *groundwater profiling, v*—the method of advancing a groundwater sampling device incrementally and collecting discrete samples of groundwater at each depth interval.

3.3.10 *percussion driving, v*—insertion method where rapid hammer impacts are performed to insert the sampling device and the percussion is normally accompanied with application of static down force.

3.3.11 *PFAS, n*—polyfluorinated alkyl substances: includes PFOS (perfluorooctane sulfonate) and PFOA (perfluorooctanoate acid) that have very low detection levels, in parts per trillion for combined concentration in drinking water.

3.3.11.1 *Discussion*—PFAS includes hundreds of poly fluorinated compounds, many of which are components of aqueous fire-fighting foams (AFFF) previously used at military and commercial airports. PFAS compounds have been used in