Designation: D2113 – 14

Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration[1]

This standard is issued under the fixed designation D2113; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This practice covers the guidelines, requirements, and procedures for core drilling, coring, and sampling of rock for the purposes of site exploration. The borehole could be vertical, horizontal, or angled.

1.2 This practice is described in the context of obtaining data for the design, construction, or maintenance of structures, and applies to surface drilling and drilling from adits and exploratory tunnels.

1.3 This practice applies to core drilling in hard and soft rock.

1.4 This practice does not address considerations for core drilling for geo-environmental site characterization and installation of water quality monitoring devices (see Guides D5782 and D5783).

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 This practice does not purport to comprehensively address all of the methods and the issues associated with coring and sampling of rock. Users should seek qualified professionals for decisions as to the proper equipment and methods that would be most successful for their site exploration. Other methods may be available for drilling and sampling of rock, and qualified professionals should have flexibility to exercise judgment as to possible alternatives not covered in this practice. This practice is current at the time of issue, but new alternative methods may become available prior to revisions; therefore, users should consult with manufacturers or producers prior to specifying program requirements.*This practice 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 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 document means only that the document has been approved through the ASTM consensus process.*

1.7 *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 and health practices and determine the applicability of regulatory limitations prior to use.* Also, the user must comply with prevalent regulatory codes, such as OSHA (Occupational Health and Safety Administration) guidelines, while using this practice. For good safety practice, consult applicable OSHA regulations and other safety guides on drilling (**1**).

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D4380 Test Method for Density of Bentonitic Slurries

D4630 Test Method for Determining Transmissivity and Storage Coefficient of Low-Permeability Rocks by In Situ Measurements Using the Constant Head Injection Test

D5079 Practices for Preserving and Transporting Rock Core Samples

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

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

[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] 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.

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

and the Installation of Subsurface Water-Quality Monitoring Devices

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

D6032 Test Method for Determining Rock Quality Designation (RQD) of Rock Core

D6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling

2.2 *American Petroleum Institute Standard:*[3]

API RP 13B Recommended Practice Standard Procedure for Testing Drilling Fluids

2.3 *NSF Standard:*[4]

NSF/ANSI 60-1988 Drinking Water Treatment Chemicals-Health Effects

3. Terminology

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

3.2 *Definitions:*

3.2.1 *blind hole, n*—borehole that yields no fluid recovery of the drilling fluids.

3.2.2 *casing, n*—hollow tubes of steel used to support borehole walls or where fluid losses must be stopped.

3.2.3 *caving hole, n*—borehole whose walls or bottom are unstable and cave or collapse into the drilled borehole.

3.2.4 *core barrel, n*—hollow tube of steel used to collect cores of drilled rock.

3.2.5 *core bit, n*—a drill bit that cuts cylindrical rock samples and consists of one of the following: a drill bit with surface set of diamonds or impregnated diamonds in a tungsten carbide mix of hardened steel, polycrystalline bit, or tungsten carbide (TC) inserts mounted on a cylindrical bit that cuts out cylindrical rock samples.

3.2.6 *drill rig, n*—includes drilling power unit, mast or derrick, circulating pumps, and mounting platform.

3.2.7 *drill rod, n*—hollow steel tubes that are connected to the drill bit or core barrel and to the rotary head of the drilling power unit.

3.2.8 *drill platform, n*—a platform for a drilling rig.

3.2.9 *overshot, n*—a latching mechanism at the end of the hoisting line, specially designed to latch onto or release pilot bit or core barrel assemblies when using *wireline drilling*. **(D5876)**

3.2.10 *pilot bit assembly, n*—designed to lock into the end section of drill rod for *wireline drilling* without sampling. The pilot bit can be either drag, roller cone, or diamond plug types. The bit can be set to protrude from the rod coring bit depending on the formation being drilled. **(D5876)**

3.2.11 *squeezing hole, n*—borehole whose walls move into the drilled opening and squeeze on the drill rods.

3.2.12 *wireline, n*—a cable made of steel strands connected to a drum hoist, used to raise and lower the core barrel, drill rods, or other equipment as needed in the drill hole.

3.2.13 *wireline drilling, n*—a rotary drilling process using special enlarged inside diameter drilling rods with special latching pilot bits or core barrels raised or lowered inside the rods with a wireline and overshot latching mechanism. **(D5876)**

4. Summary of Practice

4.1 *Drilling:*

4.1.1 Drilling is accomplished by circulating a drilling medium through the drill bit while rotating and lowering or advancing the string of drill rods as downward force is applied to a cutting bit. The bit cuts and breaks up the material as it penetrates the formation, and the drilling medium picks up the cuttings generated by the cutting action of the bit. The drilling medium, with cuttings, then flows outward through the annular space between the drill rods and drill hole, and carries the cuttings to the ground surface, thus cleaning the hole. The string of drill rods and bit is advanced downward, deepening the hole as the operation proceeds.

4.1.1.1 Fluid drilling is accomplished by circulating water or a water-based fluid with additives. Additives such as bentonite or polymers are frequently added to water to lubricate and cool the bit and to circulate (transport) cuttings to the surface. Drill fluid can also act to prevent cave or collapse of the drill hole. After the drilling fluid reaches the surface, it flows to a ditch or effluent pipe and into a settling pit where the cuttings settle to the bottom. Cuttings are sometimes run through a shaker to remove the larger particles. From the settling pit, the drilling fluid overflows into the main pit, from which it is picked up by the suction line of the mud pump and recirculated through the drill string.

NOTE 1—The decrease of mud velocity upon entering the mud pit may cause gelling of the mud and prevent cuttings from settling. Agitation of the mud in the pit can remedy the problem.

4.1.1.2 Air drilling is performed where introduction of fluids is undesirable. Air rotary drilling requires use of an air compressor with volume displacement large enough to develop sufficient air velocity to remove cuttings. Cuttings can be collected at the surface in cyclone separators. Sometimes a small amount of water or foam may be added to the air to enhance return of cuttings. Air drilling may not be satisfactory in unconsolidated and cohesionless soils under the groundwater table.

4.2 *Coring:*

4.2.1 Coring is the process of recovering cylindrical cores of rock by means of rotating a hollow steel tube (core barrel) equipped with a coring bit. The drilled core is carefully collected in the core barrel as the drilling progresses.

4.3 *Sampling:*

4.3.1 Once the core has been cut and the core barrel is full, the drill rods or overshot assembly are pulled and the core retrieved. Samples are packaged and shipped for testing (see Practices D5079).

[3] Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, http://www.api.org.

[4] Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, http://www.nsf.org.

5. Significance and Use

5.1 Rock cores are samples of record of the existing subsurface conditions at given borehole locations. The samples are expected to provide indications about the geological, physical, and engineering nature of the subsurface for use in the design and construction of an engineered structure. The core samples need to be preserved using specific procedures for a stipulated time (Practices D5079). The period of storage depends upon the nature and significance of the engineered structure.

5.2 Rock cores always need to be handled such that their properties are not altered in any way due to mechanical damage or changes in ambient conditions of moisture and temperature or other environmental factors.

6. Apparatus

6.1 *General*—Fig. 1 shows the schematic of a typical rock core drill setup (**2**). Essential components of the drilling equipment include the drilling rig with rotary power, hoisting systems, casing, rods, core barrels, including bits and liners, and pumps with circulating system. In addition, equipment should include necessary tools for hoisting and coupling and uncoupling the drill string and other miscellaneous items such as prefabricated mud pits and racks for rod stacking and layout. Normally, a drilling platform of planking is built up around the drilling site.

NOTE 2—This standard is a practice and while the apparatus given is the most common type, this does not preclude the use of other current or future drilling technologies.

6.1.1 Rock coring operations can proceed at high rotation rates. It is imperative the drill rig, rods, and core barrels are straight and have a balanced center of gravity to avoid whipping and resulting damage to cores and expensive bits.

6.2 *Drilling Rig*— The drill rig provides the rotary power and downward (or advance) force or hold-back force on the core barrel to core the rock. The preferred diamond drill coring equipment are designs with hydraulic or gear-driven variable speed hollow spindle rotary drill heads, although some core

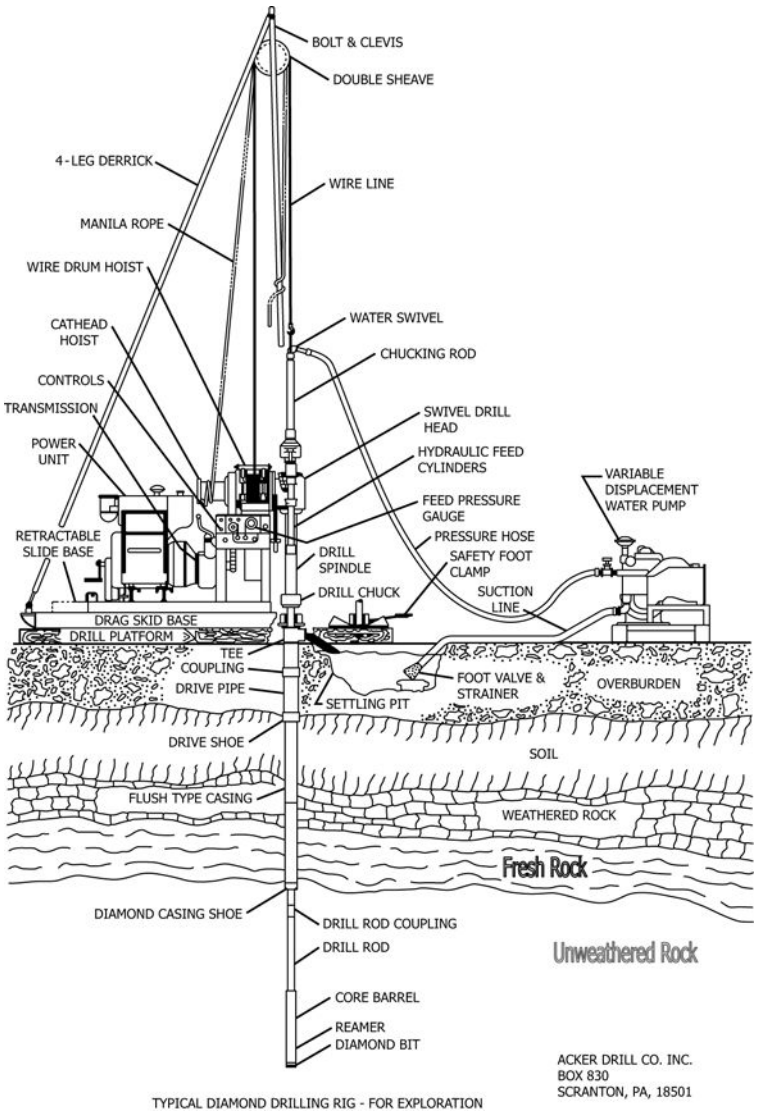

FIG. 1 Schematic of Typical Diamond Core Drill Set-up (2)