Designation: D 7015 – 04

Standard Practices for Obtaining Undisturbed Block (Cubical and Cylindrical) Samples of Soils[1]

This standard is issued under the fixed designation D 7015; 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 designation outlines the procedures for obtaining undisturbed block (cubical and cylindrical) soil samples.

1.2 Undisturbed block samples are obtained for laboratory tests to determine the strength, consolidation, permeability, and other geotechnical engineering or physical properties of the undisturbed soil.

1.3 Two sampling practices are presented. Practice A covers cubical block sampling, while Practice B covers cylindrical block sampling.

1.4 These practices usually involve test pit excavation and are limited to relatively shallow depths. Except in the case of large diameter (that is, >0.75 m) bored shafts of circular cross-section in unsaturated soils, for depths greater than about 1 to 1½ meters or depths below the water table, the cost and difficulties of excavating, cribbing, and dewatering generally make block sampling impractical and uneconomical. For these conditions, use of a thin-walled push tube soil sampler (Practice D 1587), a piston-type soil sampler (Practice D 6519), or Hollow-Stem Auger (D 6151), Dennison, or Pitcher-type soil core samplers, or freezing the soil and coring may be required. This practice does not address environmental sampling; consult Guides D 6169 and D 6232 for information on sampling for environmental investigations.

1.5 Successful sampling of granular materials requires sufficient cohesion, cementation, or apparent cohesion (due to moisture tension (suction)) of the soil for it to be isolated in a column shape without undergoing excessive deformations. Additionally, care must be exercised in the excavation, preservation and transportation of undisturbed samples (see Practice D 4220, Group D).

1.6 The values stated in SI units are to be regarded as the standard. No other units are included in this standard.

1.7 *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.*

1.8 *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 requirements prior to use.* For specific hazard statements, see Section 6.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes

D 1785 Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D 2488 Practice for Determining Unified Soil Classification (Visual Method)

D 2937 Test Method for Density of Soils in Place by the Drive-Cylinder Method

D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D 4220 Practices for Preserving and Transporting Soil Samples

D 5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock

D 6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling

D 6169 Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations

D 6232 Guide for Selection of Sampling Equipment for

[1] These practices are 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 Investigations.

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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.

Waste and Contaminated Media Data Collection Activities
D 6519 Practice for Sampling of Soil Using the Hydraulically Operated Stationary Piston Sampler

3. Terminology

3.1 *Definitions*—For definition of terms in this standard refer to Terminology D 653.

4. Significance and Use

4.1 Undisturbed block samples are suitable for laboratory tests where large-sized samples of undisturbed material are required or where such sampling is more practical than conventional tube sampling (Practices D 1587 and D 6519), or both.

4.2 This method of sampling is advantageous where the soil to be sampled is near the ground surface. This is the best available method for obtaining large undisturbed samples of very stiff and brittle soils, partially cemented soils, and some soils containing coarse gravel.

4.3 Excavating a column of soil may relieve stresses in the soil and may result in some expansion of the soil and a corresponding decrease in its unit weight (density) or increase in sampling disturbance, or both. Usually the expansion is small in magnitude because of the shallow depth. Stress changes alone can cause enough disturbances in some soils to significantly alter their engineering properties.

4.4 The chain saw has proved advantageous in sampling difficult soils, which are blocky, slickensided, or gravelly, or materials containing alternating layers of hard and soft material.[3] The chain saw uses a special carbide-tipped chain.[4]

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D 3740 are generally considered capable of competent and objective sampling. Users of this practice are cautioned that compliance with Practice D 3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D 3740 provides a means of evaluating some of those factors.

5. Apparatus

5.1 Excavating and trimming tools are required. This may include such items as backhoe, pick, shovel, chain saw, trowel, large and small knives, hacksaw blades, thin wire such as piano wire. In addition, a sample container having sufficient strength and rigidity to avoid deformations that could damage the sample.

5.1.1 The chain for the chain saw is of standard design except that carbide tips are brazed to the cutting teeth. The chain saw's bar length should be greater than 457 mm.

5.2 For cubical block sampling, a cubical wooden, steel box or any relatively rigid material that can be assembled into a box 10 mm to 15 mm larger than the sample side dimensions may be used to contain the cubical block sample during the required cutting process (see 7.1.8) or transportation or both. Steel boxes should have some form of protective coating as outlined in 5.3, unless the soil is to be extruded in less than 3 days. The box should be fastened using screws, or bolts and nuts preferable before going to the field to verify that the parts fit together and can be assembled without vibration of the sample. Do not use nails or other devices that require hammering to assemble or dissemble the box.

5.3 For cylindrical block sampling, cylindrical tubes made of steel or any relatively rigid material may be used to contain the cylindrical block sample during the required cutting process (see 7.2.5) or transportation or both. Steel tubes should have some form of protective coating, unless the soil is to be extruded in less than 3 days. The type of coating to be used may vary depending upon the material to be sampled. Plating of the tubes or alternate base metals may be specified. Galvanized tubes are often used when long-term storage is required. Tubes may be protected with a light coating of lubricating oil, lacquer, epoxy, TFR fluorocarbon, or zinc oxide. One end of the tube should have a sharpened cutting edge to assist in cutting the soil. Cylindrical tubes made of PVC pipe should have a minimum sidewall thickness of no less than that of a Schedule 80 pipe (Specification D 1785).

NOTE 2—Experience with thin-wall push tube sampling of soils (Practice D 1587) indicates disturbance is minimized when the cutting edge is about 10 degrees or less. This sharp angle is possible with metal tubes, but may not be with other materials such as PVC, and a sharp angle may not be critical to hand trimmed samples.

5.4 Cheesecloth or similar cloth wrapping material.

5.5 Sealing wax, paintbrush, and melting stove or heater. Use a sealing wax that does not shrink appreciably, does not permit evaporation from the sample, and does not exhibit brittle characteristics. Microcrystalline waxes are preferable to paraffin.

5.6 Shipping containers, packing materials, labels, data forms, and other necessary supplies. Packing material may be light, resilient polystyrene plastic, sawdust, or smaller material.

5.7 Fuel for the wax melting stove or heater, and fuel and lubricating oil for the chain saw.

5.8 Personal protective equipment (PPE) should be considered when necessary. If a chain saw is used, eye and hearing protection are necessary. A hard hat may also be appropriate. A first aid kit should be available and a fire extinguisher should also be handy especially where a stove or heater is being used.

6. Hazards

6.1 *Warning Statement*—Trenching and excavation work presents serious risks, such as slope instability, ventilation, hearing etc. to all workers involved. All excavations must be constructed in accordance with applicable OSHA requirements.[5]

7. Procedure

7.1 *Practice A—Cubical Block Sampling*:

7.1.1 At the location where the block sample is to be obtained level and smooth the ground surface and mark the

[3] Tiedemann, D. A., GR-83-8, "Undisturbed Block Sampling Using a Chain Saw," Bureau of Reclamation, Denver, CO, 1983, p. 19.

[4] USBR 7100-89, "Obtaining Undisturbed Block Samples by the Hand and Chain Saw Methods," *Earth Manual—Part 2*, Bureau of Reclamation, Denver, CO, 1990, pp. 1079-1083.

[5] 29 CFR 1926 "Labor," Code of Federal Regulations, U.S. Printing office, 1991.

outline of a face of the block. Surface soils containing roots or other organic matter should be removed.

NOTE 3—The size of the sample depends upon its intended use. For most investigations, a cube about 0.3 m per side, with a mass of about 55 kg, provides sufficient material and can be handled easily.

7.1.2 Carefully excavate a trench around the sample to the required depth, removing a sufficient amount of material to provide space in which to work as shown on Fig. 1. If a backhoe is used to excavate the trench, first dig out an oversized column (pedestal) large enough that the soil to be sampled is not disturbed by the backhoe operation.

NOTE 4—Generally, a pedestal 0.9 or 1.2 m on a side and 0.9 to 1.2 m high is adequate. If the soil is fragile and easily broken, backhoe usage may be limited to excavation of only two or three sides of the pedestal, with the remaining side or sides excavated by chain saw and/or by hand methods. In addition, if the soil is fragile and easily broken, the cylindrical block sampling procedure (see 7.2) should be considered, provided the "pushing in one continuous motion" or "drive-cylinder" methods are not used.

7.1.3 Gradually remove excess soil on the sides of the block using the chain saw and/or hand methods until a pedestal of the desired size is obtained.

7.1.4 Measure and record the elevation (or depth below the ground surface) to the top of the sample and depth to water level if encountered.

7.1.5 Visually classify the soil(s) in the sample based on the trimmings and exposed surfaces of the block in accordance with Practice D 2488, and describe the in-place condition of the soil, such as color, odor, moisture condition, consistency, cementation and structure. Record the soil's classification and in-place condition on a data sheet, see Section 9. Photographs of the block location (before and after trimming around the block) are desirable.

7.1.6 Cover the freshly exposed faces of the sample (pedestal) with cheesecloth and paint with melted wax as shown in Fig. 2. Apply additional layers of cheesecloth and wax to form a total of three (minimum) layers. Hot wax should not be poured directly over the sample. If the soil is fragile, apply cheesecloth and then wax to individual faces of the sample as they are exposed.

7.1.7 Identify the sample (number, location, elevation, etc.), and mark the top of sample and the north orientation. A piece of heavy paper showing this information should be waxed to the top of the sample and if applicable, add a second copy to the top of the box containing the block sample, see Section 8.

7.1.8 To remove the cubical block sample, carefully cut or shear the base of the sample from the underlying soil using a thin wire such as piano wire if in clayey soils, or with either a chain saw, shovels, or knives if in other soil types. If the soil is disturbed easily, a sturdy box with both ends removed should be placed over the sample, and fill the space between the sample and the box with packing material and attach the top to the box with screws, or with bolts and nuts prior to removing the base of the sample (see Fig. 3).

7.1.9 Carefully tilt the sample on one side. Add appropriate packing materials to minimize any voids between the box and sample. Cover the exposed bottom face with at least three layers of cheesecloth and wax as described in 7.1.6.

7.1.10 Record all necessary information on a data sheet as specified in Section 9. A copy of a sample data sheet is included in Appendix X1.

7.2 *Practice B—Cylindrical Block Sampling*:

7.2.1 At the location where the cylindrical sample is to be obtained, level and smooth the ground surface. Surface soils containing roots or other organic matter should be removed. Samples may be obtained from the bottom or the side of a test pit as shown on Fig. 1. Pushing in one continuous motion without hand trimming can be performed in accordance with Practice D 1587. Another method for advancing cylindrical samples by hammer impact is the Drive-Cylinder method (Test Method D 2937) (see Notes 5 and 6).

7.2.2 Carefully excavate a trench around the sample to the required depth, removing a sufficient amount of material to provide space in which to work. If a backhoe is used to

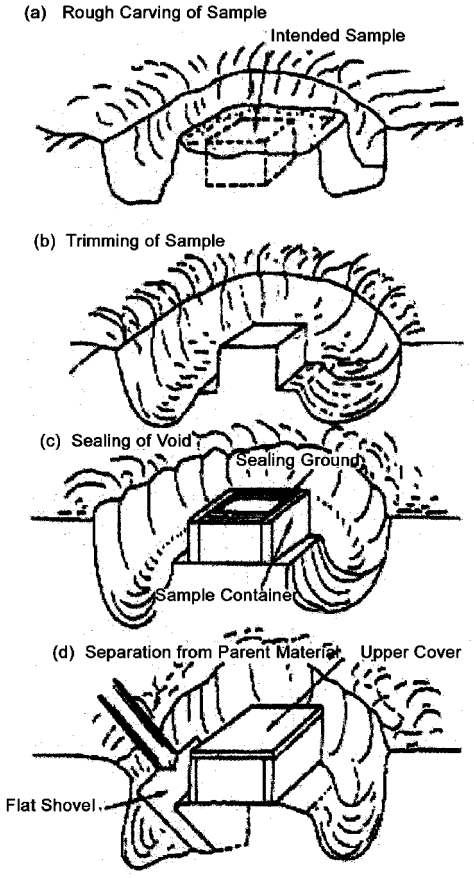


FIG. 1 Procedure for Rectangular Block Sampling

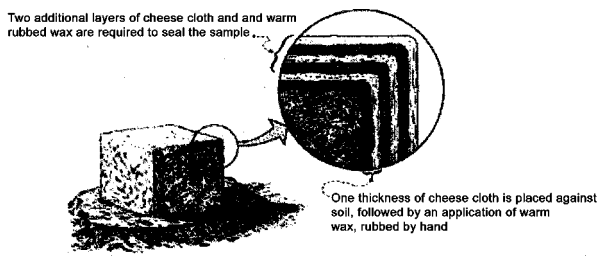
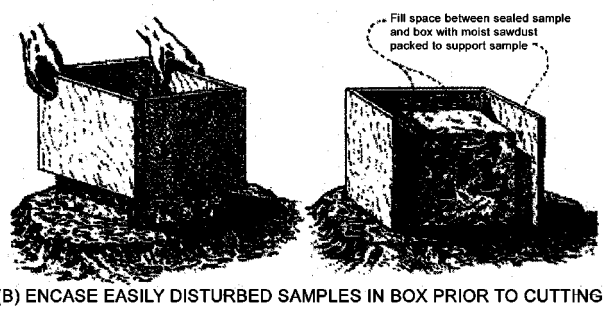


FIG. 2 Procedure for Placing Cheesecloth and Wax



(B) ENCASE EASILY DISTURBED SAMPLES IN BOX PRIOR TO CUTTING

FIG. 3 Procedure for Placing Box Around R

excavate the trench, first dig out an oversized column (pedestal) large enough that the soil to be sampled is not disturbed by the backhoe operation.

7.2.3 Place the sample container on the surface and gradually remove excess soil around the perimeter of the container using a tool like a cutter knife to a diameter several millimeters larger than the inner diameter of the sampling tube until 5 to 6 mm of soil is exposed.

7.2.4 Gently push down vertically and uniformly to retain the sample. Repeat the above cutting and pushing procedures until the surface of the sample extends above the sampling tube by approximately 3 cm (see Fig. 4).

NOTE 5—For soft soil and soils wet of optimum compaction, the tube can be pushed without any hand trimming using a thin-walled tube as described in Practice D 1587 or by drive cylinder (Test Method D 2937).

NOTE 6—For sensitive, fragile or brittle soils, there could be disturbance from pushing or hammering and if disturbance is suspected, consider using smaller trimming and pushing increments as covered in 7.2.4 .

7.2.5 After filling the sample container, the bottom is separated from the ground as described in 7.1.8, and the upper and lower ends of the separated sample are trimmed.

7.2.6 Measure and record the elevation (or depth below the ground surface) to the top of the sample and depth to water level, if encountered.

7.2.7 Visually classify soils in the sample in accordance with Practice D 2488, and describe the in-place condition of the soil and record information on data sheet, see Section 9. Photographs of the block location (before and after trimming around the block) are desirable.

7.2.8 Trim the sample ends flush with the ends of the cylinder. If the volume and mass of the cylinder is known, the mass and density of the specimen can be determined. Water content of the specimen can be determined from the trimmings and the dry density of sample can be calculated.

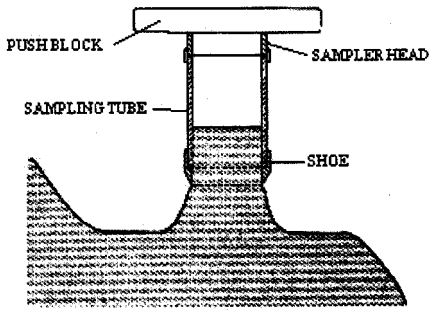


FIG. 4

7.2.9 Cover the freshly exposed faces of the sample with cheesecloth and paint with melted wax. Apply additional layers of cheesecloth and wax to form a total of three (minimum) layers. Hot wax should not be poured over the sample. If the exposed faces are fragile, apply cheesecloth and wax to individual faces as they are exposed. Alternatively, after measurement, the sample may be sealed with plastic caps and tape on the ends of the sample.

7.2.10 Identify the sample (number, location, elevation, etc.), and mark the top of sample and the north orientation. A piece of heavy paper showing this information should be waxed to the top of the sample and if applicable, add a second copy to the top of the box containing the block sample, see Section 8.

7.2.11 Record all necessary information on a data sheet as specified in Section 9. A copy of a sample data sheet is included in Appendix X1.

8. Preparation for Shipment

8.1 Prepare and immediately affix labels or apply markings as necessary to identify the sample (see Section 7). Top end of the sample container should be labeled “top.” Assure that the markings or labels are adequate to survive transportation and storage in accordance with Practice D 4220, Group C or D requirements. For unstable soils, the samples should be transported and stored in an upright position.

9. Report

9.1 An example of a sample data sheet is included in Appendix X1.

9.2 Record the information that may be required for preparing the field data sheet in general accordance to Guide D 5434. Record as a minimum the following information (data):

9.2.1 Project information, such as Project No. or name.

9.2.2 Sampling information, such as:

9.2.2.1 General location or referenced to site map,

9.2.2.2 Procedure—Practice A (cubical block sampling) or Practice B (cylindrical block sampling),

9.2.2.3 Date and time of sampling,

9.2.2.4 Name of sampling personnel and their affiliation and inspector, as appropriate and

9.2.2.5 Any weather conditions that could affect the sampling process such as raining, snowing, freezing or unusually hot temperatures, and very windy.

9.2.3 Sample data, such as:

9.2.3.1 Sample number,

9.2.3.2 Depth to top of sample to the nearest 0.2 m or better,

9.2.3.3 Dimensions to the nearest cm or better,

9.2.3.4 Orientation (north arrow on sample’s top), see 7.1.7 or 7.2.10 and

9.2.3.5 Visual description of the soil(s) contained in the sample (Practice D 2488) along with the in-place condition of the soil such as color, odor, moisture condition, consistency and structure.

9.3 Other data that may be required include:

9.3.1 Surface elevation or reference to a datum to the nearest 0.5 m or better, and

9.3.2 Depth of groundwater, if encountered.

10. Keywords

10.1 block sample; block sampling; cylindrical sampling; geologic investigations; sampling; soil exploration; soil investigations; subsurface investigations; undisturbed

APPENDIX

(Nonmandatory Information)

X1. EXAMPLE DATA SHEET

UNDISTURBED BLOCK SAMPLE		
SAMPLE NO.	**PROJECT NO.**	**FEATURE**
TEST PIT	**LOCATION**	**DEPTH/ELEVATION**
SAMPLED BY	**DATE**	**CHECKED BY**
SAMPLING PRACTICE: A- CUBICAL OR **B-**CYLINDRICAL		
LOCATION DRAWING OR SITE MAP		**SAMPLE DRAWING** Sample Dimensions
SAMPLE VISUAL CLASSIFICATION:		
DEPTH OF GROUNDWATER:		
IN-PLACE CONDITION		
REMARKS		

FIG. X1.1 Example Data Sheet