Designation: D7015 – 13

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

This standard is issued under the fixed designation D7015; 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 These practices outline the procedures for obtaining intact block (cubical and cylindrical) soil samples.

1.2 Intact block samples are obtained for laboratory tests to determine the strength, consolidation, permeability, and other geotechnical engineering or physical properties of the intact 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, greater than ¾ m) bored shafts of circular cross-section in unsaturated soils, for depths greater than about 1 to 1½ metres 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 D1587), a piston-type soil sampler (Practice D6519), or Hollow-Stem Auger (Practice D6151), Dennison, or Pitcher-type soil core samplers, or freezing the soil and coring may be required. These practices do not address environmental sampling; consult Guides D6169 and D6232 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 intact samples (see Practice D4220, Group D).

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

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values shall conform to the guidelines for significant digits and rounding established in Practice D6026 unless superseded by this standard.

1.7.1 The procedures used to specify how data are collected/recorded or calculated in this standard are regarded as the industry standard. In addition they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of this standard to consider significant digits used in analytical methods for engineering design.

1.8 *These practices offer 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 these practices 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.*

1.9 *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]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

[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 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**

D1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
D1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)
D2937 Test Method for Density of Soil in Place by the Drive-Cylinder Method
D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D4220 Practices for Preserving and Transporting Soil Samples
D5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock
D6026 Practice for Using Significant Digits in Geotechnical Data
D6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling
D6169 Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations
D6232 Guide for Selection of Sampling Equipment for Waste and Contaminated Media Data Collection Activities
D6519 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 D653.

## 4. Significance and Use

4.1 Intact block samples are suitable for laboratory tests where large-sized samples of intact material are required or where such sampling is more practical than conventional tube sampling (Practices D1587 and D6519), or both.

4.2 The intact block method of sampling is advantageous where the soil to be sampled is near the ground surface. It is the best available method for obtaining large intact 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 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 D3740 are generally considered capable of competent and objective sampling. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

## 5. Apparatus

5.1 Excavating and trimming tools are required. They 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 450 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 vibrating or otherwise disturbing 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, 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 D1785).

NOTE 2—Experience with thin-wall push tube sampling of soils (Practice D1587) 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.

[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.

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

5.8 Personal protective equipment (PPE) shall be considered when necessary. If a chain saw is used, eye and hearing protection, gloves, chaps, long-sleeved shirt or jacket, and safety boots should also be considered. A hard hat may also be appropriate. A first aid kit should be available and an appropriate fire extinguisher must 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, and like, to all workers involved. All excavations must be constructed in accordance with applicable regulatory requirements. When using either a gas, hydraulically, or electric powered chain saw, follow safety precautions recommended by the manufacturer.

## 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 outline of a face of the block. Surface soils containing roots or other organic matter must 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 should be limited to excavation of only two or three sides of the pedestal, with the remaining side or sides excavated by chain saw or by hand methods, or both. 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 or hand methods, or both, 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 D2488, 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 shall 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.

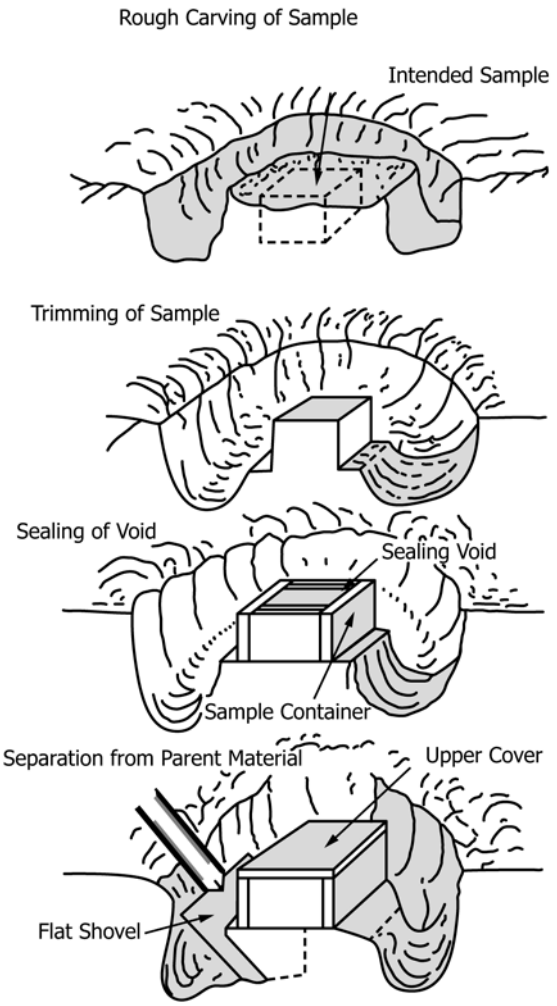


**FIG. 1 Procedure for Rectangular Block Sampling**

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.

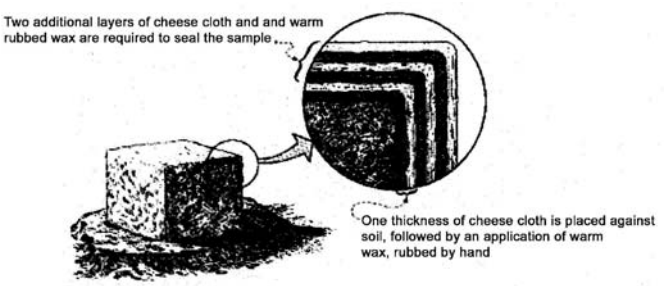


**FIG. 2 Procedure for Placing Cheesecloth and Wax**

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. The space between the sample and the box should be filled with packing material. 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 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 must be removed. Samples should 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 D1587. Another method for advancing cylindrical samples by hammer impact is the Drive-Cylinder method (Test Method D2937) (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 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 millimetres 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 D1587 or by drive cylinder (Test Method D2937).

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 D2488, 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.

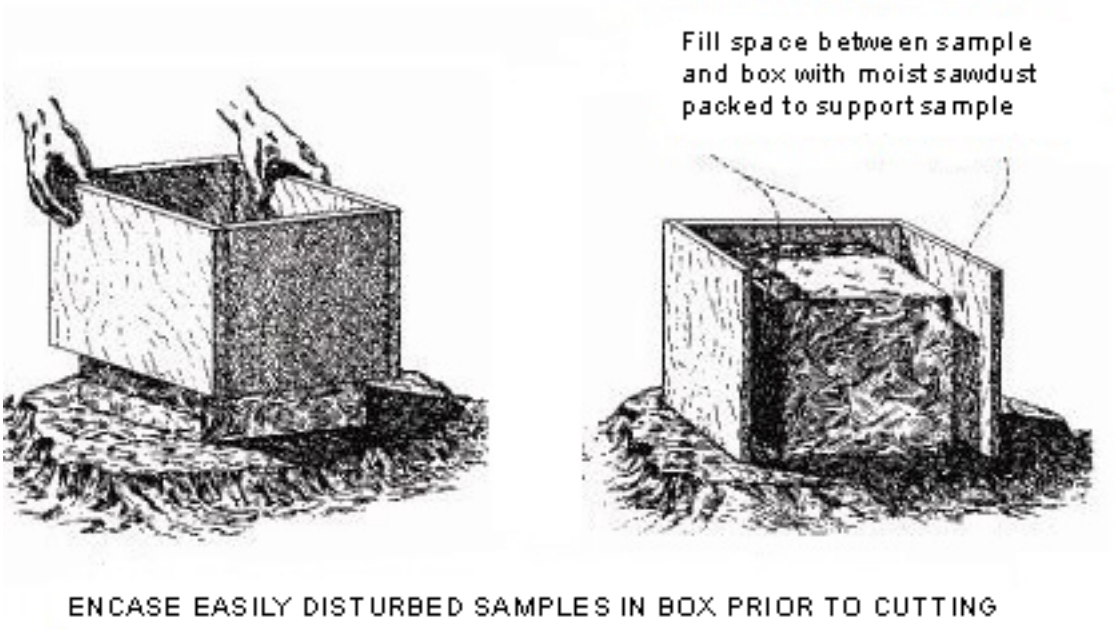


**FIG. 3 Procedure for Placing Box Around a Cubical Sample**

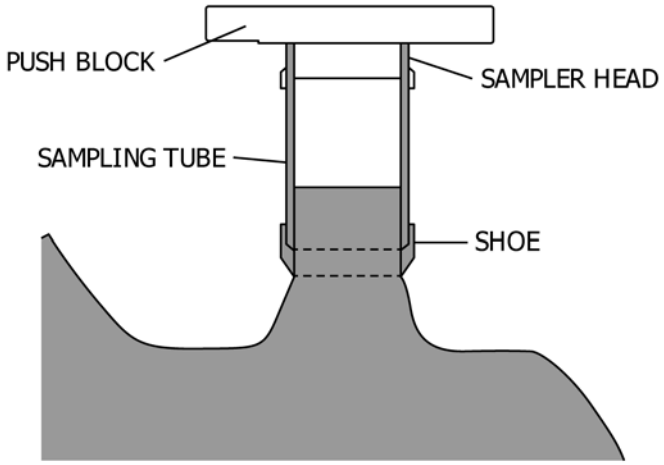


**FIG. 4 Step-Up for Obtaining a Cylindrical Sample**

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 minimum of three 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 should 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 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 must be labeled "top." Make sure that the markings or labels are adequate to survive transportation and storage in accordance with Practice D4220, Group C or D requirements. For unstable soils, the samples must be transported and stored in an upright position.

## 9. Report: Test Data Sheet(s)/Form(s)

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

9.2 Record the information required for preparing the field data sheet in general accordance to Guide D5434. 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 1 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 D2488) along with the in-place condition of the soil such as color, odor, moisture condition, consistency and structure.

9.3 Other data that should 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; intact; sampling; soil exploration; soil investigations; subsurface investigations

# APPENDIX

(Nonmandatory Information)

## X1. EXAMPLE DATA SHEET

X1.1 See Fig. X1.1.

| INTACT 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

## SUMMARY OF CHANGES

Committee D18 has identified the location of selected changes to this standard since the last issue (D7015 – 07) that may impact the use of this standard. (Approved July 1, 2013.)

*(1)* Added Practice D6026 to Sections 1 and 2.
*(2)* Revised measurement in 5.1.1.
*(3)* Revised and updated the safety statements in Section 6.
*(4)* Revised the titles of Figs. 3 and 4