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Standard Practices for Handling, Storing, and Preparing Soft ~~Undisturbed~~Intact Marine Soil[1]

This standard is issued under the fixed designation D 3213; 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 cover methods for project/cruise reporting, and handling, transporting and storing soft cohesive ~~undisturbed~~intact marine soil. Procedures for preparing soil specimens for triaxial strength, and consolidation testing are also presented.

1.2 These practices may include the handling and transporting of sediment specimens contaminated with hazardous materials and samples subject to quarantine regulations.

1.3 Th~~i~~ese practices offer~~s~~ 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 the document means only that the document has been approved through the ASTM consensus process.

1.4 *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.* Specific precautionary statements are given in Sections 1, 2 and 7.

1.5 The values in acceptable SI units are to be regarded as the standard. The values given in parentheses are for information only.

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 2435~~Test Method for One-Dimensional Consolidation Properties of Soils~~[2] Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)

D 2850~~Test Method for Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression~~[2] Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

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 4186 Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading

D 4220 Practices for Preserving and Transporting Soil Samples

D 4452~~Methods~~ Practice for X-Ray Radiography of Soil Samples

3. Terminology

3.1 *Definitions*— The definitions of terms used in these practices shall be in accordance with Terminology D 653.

4. Summary of Practice

4.1 Procedures are presented for handling, transporting, storing, and preparing very soft and soft, fine-grained marine sediment

[1] These practices are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are 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* ~~, Vol 04.08.~~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.

specimens that minimize disturbance to the test specimen from the time it is initially sampled at sea to the time it is placed in a testing device in the laboratory.

5. Significance and Use

5.1 Disturbance imparted to sediments after sampling can significantly affect some geotechnical properties. Careful practices need to be followed to minimize soil fabric changes caused from handling, storing, and preparing sediment specimens for testing.

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 testing/sampling/inspection, etc. Users of this standard are cautioned that compliance with Practice D 3740 does not in itself assure reliable results. Reliable results depend on may factors; Practice D 3740 provides a means of evaluating some of those factors.

5.2 The practices presented in this document should be used with soil that has a very soft or soft shear strength (undrained shear strength less than 25 kPa (3.6 psi)) consistency.

NOTE 2—Some soils that are obtained at or just below the seafloor quickly deform under their own weight if left unsupported. This type of behavior presents special problems for some types of testing. Special handling and preparation procedures are required under those circumstances. Test are sometimes performed at sea to minimize the effect of storage time and handling on soil properties. An undrained shear strength of less than 25 kPa was selected based on Terzaghi and Peck.[3] They defined a very soft saturated clay as having undrained shear strength less than 25 kPa.

5.3 These practices shall apply to specimens of naturally formed marine soil (that may or may not be fragile or highly sensitive) that will be used for density determination, consolidation, permeability testing or shear strength testing with or without stress-strain properties and volume change measurements (see Note 3). In addition, dynamic and cyclic testing can also be performed on the sample.

NOTE 3—To help evaluate disturbance, X-Ray Radiography has proven helpful, refer to Methods D 4452.

5.4 These practices apply to fine-grained soils that do not allow the rapid drainage of pore water. Although many of the procedures can apply to coarser-grained soils, drainage may occur rapidly enough to warrant special handling procedures not covered in these practices.

5.5 These practices apply primarily to soil specimens that are obtained in thin-walled or similar coring devices that produce high-quality cores or that are obtained by pushing a thin-walled tube into cores taken with another sampling device.

5.6 These practices can be used in conjunction with soils containing gas, however, more specialized procedures and equipment that are not covered in these practices have been developed for use with such materials.

NOTE 4—For information on handling gas charged sediments, the reader is referred to papers by Johns, et al.,[4] and Lee.[5]

6. Apparatus

6.1 *Coring Device*, capable of obtaining high-quality soil specimens, including related shipboard equipment such as cable and winch. Typical coring devices used in industry are the wireline push or piston samplers.

NOTE 5—Some sampling devices, for example, box corers, obtain samples of a size or shape that are difficult to preserve. Such cores can be subsampled aboard ship by pushing a thin-walled sampler into the larger size core. This method can produce samples from soils obtained near the seafloor. The subsamples can then be handled and stored according to these practices.

6.1.1 *Metal or Plastic Liners or Barrels (Pipe or Thin-Walled Tubes*—), the soil will be obtained or stored within, or both. Short sections of the liner, sharpened on one end, may also be used to subsample larger sized cores (see Note 5). It is important to note that liners constructed of cellulose acetate butyrate (CAB) plastic are pervious to water. Polycarbonate is nearly impervious and polyvinyl chloride (PVC) is impervious to water migration.

6.2 *Equipment Required on Board Ship to Seal and Store Soil Samples*:

6.2.1 *Identification Material*—This includes the necessary writing pens, tags, and labels to properly identify the sample(s).

6.2.2 *Caps*, either plastic, rubber, or metal, to be placed over the end of thin-walled tubes, liners and rings, and sealed with tape or wax, or both.

6.2.3 *Packers*, or add wax to top and bottom of core to seal the ends of samples within thin-walled tubes.

NOTE 6—Plastic expandable packers are preferred. Metal expandable packers seal equally well; however, long-term storage using metal expandable packers may cause corrosion problems.

6.2.4 *Filler Material*, used to occupy the voids at the top and bottom of the sediment container. The material must be slightly smaller than the inside dimensions of the container and must be a light-weight, nonabsorbing, nearly incompressible substance. For example, wooden disks of various thicknesses that have been coated with a waterproofing material can be used.

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[3] Terzaghi, K. and Peck, R. B., *Soil Mechanics in Engineering Practice*, 2nd ed., Wiley, 1967, p. 729.

[4] Johns, M. W., Taylor, E., and Bryant, W. R., "Geotechnical Sampling and Testing of Gas-Charged Marine Sediments at In Situ Pressures," *Geo-Marine Letters*, Vol 2, 1982, pp. 231–236.

[5] Lee, H. J., "State of the Art: Laboratory Determination of the Strength of Marine Soils," *Strength Testing of Marine Sediments, ASTM STP 883*, ASTM, 1985, pp. 181–250.

6.2.5 *Tape*, either waterproof electrical or duct tape.

6.2.6 *Cheesecloth or Aluminum Foil* , to be used in conjunction with wax for block sample.

6.2.7 *Sealing Wax*, non-shrinking, non-cracking wax, includes microcrystalline wax, beeswax, ceresine, carnaubawax, or combination thereof.

NOTE 7—The wax must be able to adhere to the container and be ductile enough not to chip or flake off during handling at cold temperatures. Microcrystalline wax alone or in combination with other waxes has been shown to be satisfactory in sealing the ends of cores stored at low temperatures.

6.2.8 *Plastic Wrap*, used to prevent the wax from adhering to other objects and providing additional protection against soil moisture loss.

6.2.9 *Core Storage Boxes*.

6.2.10 *Rope, Cord, or Chains*, used to immobilize containers, boxes, or other core storage fixtures aboard ship.

6.2.11 *Shipboard Refrigeration Equipment* , when geochemical, or gas charged sediments are present or other special use. Refrigeration may not be needed under some circumstances, such as coring in shallow water in the tropics.

6.3 *Equipment for Transporting Cores*, used from the ship to a shore-based laboratory facility.

6.3.1 *Packing*—Material to protect against vibration and shock, includes foam rubber.

6.3.2 *Insulation*, if refrigeration is not used, either granule (bead) sheet, or foam type, to resist temperature change of soil or to prevent freezing.

6.3.3 *Shipping Containers*, either box or cylindrical type and of proper construction to protect against vibration, shock, and the elements. Refer to Practices D 4220.

NOTE 8—The length, girth, and weight restrictions for commercial transportation must be considered.

6.4 *Equipment for Storing Cores* , used at the shore-based laboratory facility.

6.4.1 *Refrigeration Unit*, capable of maintaining a temperature close to the in situ condition, see 6.2.11.

6.4.2 *Core Storage Boxes or Racks* , capable of supporting all cores in the vertical orientation in which they were obtained.

NOTE 9—An environment that is close to 100 % relative humidity may be required to minimize sediment water loss during storage of samples obtained within cellulose acetate butyrate (CAB) liners unless they are totally coated with impervious wax and plastic wrap. Other liner materials, such as polycarbonate or polyvinyl chloride (PVC) may be more suitable for sample storage because of their low water transmissibility.

6.5 *Equipment for Preparing Specimens* , used for laboratory testing.

6.5.1 *Thin-Walled Rings*, made of stainless steel or other noncorrosive metal or material, used to obtain samples for consolidation or permeability testing.

NOTE 10—The sampling ring may also be used as the test confining ring. For size and deformation requirements of consolidation test rings refer to Test Methods D 2435 and D 4186. Because of the small height to diameter ratio of consolidation samples and due to the nature of consolidation testing, the inside clearance ratio as specified by Practice D 1587 can be reduced from 1 % to zero. The ring area ratio, A_r, equal to $[(Do^2 - Di^2)/Di^2] \times 100$ (terms are defined in Practice D 1587) should be less than 13 % to minimize subsampling disturbance.[6]

6.5.2 *Thin-Walled Piston Subsampler* , used to obtain triaxial test specimens from soil that quickly deforms under its own weight if left unsupported (see Fig. 1).

NOTE 11—To minimize soil disturbance, the sampler wall thickness should be the thinnest possible that will adequately obtain a test specimen. The area ratio (see Note 10) should be less than 10 % and the inside clearance ratio (refer to Practice D 1587) should be zero.

7. Hazards

7.1 Preserving and transporting soil samples may involve personnel contact with hazardous materials, operations, and equipment. It is the responsibility of whoever uses these practices to consult and establish appropriate safety and health practices and to determine the applicability of regulatory limitations and requirements prior to use.

7.2 Special instructions, descriptions, and marking of containers must accompany and be affixed to any sample container that may include radioactive material, toxic chemicals, or other hazardous materials.

7.3 Interstate transportation, containment, storage, and disposal of soil samples obtained from certain areas within the United States and the transportation of foreign soils into or through the United States are subject to regulations established by the U.S. Department of Agriculture, Animal and Plant Health Service, Plant Protection, and Quarantine Programs, and possibly to regulations of other federal, state, or local agencies.

8. Procedure

8.1 *Shipboard Handling of Soil Cores not Requiring Subsampling*:

8.1.1 Carefully bring soil sampling or coring device aboard ship, avoid contact with either the side of the ship or moon pole, or dropping the device onto the deck during this process. For drop corers, have an end cap available to prevent material from dropping out.

[6] International Society for Soil Mechanics and Foundation Engineering, *International Manual for the Sampling of Soft Cohesive Soils*, Tokai University Press, Tokyo, 1981, p. 129.