Designation: D1587/D1587M – 15

Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes[1]

This standard is issued under the fixed designation D1587/D1587M; 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 a procedure for using a thin-walled metal tube to recover intact soil samples suitable for laboratory tests of engineering properties, such as strength, compressibility, permeability, and density. This practice provides guidance on proper sampling equipment, procedures, and sample quality evaluation that are used to obtain intact samples suitable for laboratory testing.

1.2 This practice is limited to fine-grained soils that can be penetrated by the thin-walled tube. This sampling method is not recommended for sampling soils containing coarse sand, gravel, or larger size soil particles, cemented, or very hard soils. Other soil samplers may be used for sampling these soil types. Such samplers include driven split barrel samplers and soil coring devices (Test Methods D1586, D3550, and Practice D6151). For information on appropriate use of other soil samplers refer to Practice D6169.

1.3 This practice is often used in conjunction with rotary drilling (Practice D1452 and Guides D5783 and D6286) or hollow-stem augers (Practice D6151). Subsurface geotechnical explorations should be reported in accordance with Practice D5434. This practice discusses some aspects of sample preservation after the sampling event. For more information on preservation and transportation process of soil samples, consult Practice D4220.

1.4 This practice may not address special considerations for environmental or marine sampling; consult Practices D6169 and D3213 for information on sampling for environmental and marine explorations.

1.5 Thin-walled tubes meeting requirements of 6.3 can also be used in piston samplers, or inner liners of double tube push or rotary-type soil core samplers (Pitcher barrel, Practice D6169). Piston samplers in Practice D6519 use thin-walled tubes.

1.6 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 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 The values stated in either inch-pound units or SI 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.

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 limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A513/A513M Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

A519 Specification for Seamless Carbon and Alloy Steel Mechanical Tubing

A787 Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing

B733 Specification for Autocatalytic (Electroless) Nickel-Phosphorus Coatings on Metal

[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.

Current edition approved Nov. 15, 2015. Published December 2015. Originally approved in 1958. Last previous edition approved in 2012 as D1587 – 08 (2012)ε1. DOI: 10.1520/D1587_D1587M-15.

[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**

D653 Terminology Relating to Soil, Rock, and Contained Fluids
D1452 Practice for Soil Exploration and Sampling by Auger Borings
D1586 Test Method for Penetration Test (SPT) and Split-Barrel Sampling of Soils
D2166 Test Method for Unconfined Compressive Strength of Cohesive Soil
D2435 Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading
D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)
D2850 Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils
D3213 Practices for Handling, Storing, and Preparing Soft Intact Marine Soil
D3550 Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils (Withdrawn 2016)[3]
D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D4186 Test Method for One-Dimensional Consolidation Properties of Saturated Cohesive Soils Using Controlled-Strain Loading
D4220 Practices for Preserving and Transporting Soil Samples
D4452 Practice for X-Ray Radiography of Soil Samples
D4767 Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils
D5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock
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
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
D6282 Guide for Direct Push Soil Sampling for Environmental Site Characterizations
D6286 Guide for Selection of Drilling Methods for Environmental Site Characterization
D6519 Practice for Sampling of Soil Using the Hydraulically Operated Stationary Piston Sampler

3. Terminology

3.1 *Definitions:*

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *area ratio, A_r, %, n*—the ratio of the soil displaced by the sampler tube in proportion to the area of the sample expressed as a percentage (see Fig. 1).

3.2.2 *inside clearance ratio, C_r, %, n*—the ratio of the difference in the inside diameter of the tube, D_i, minus the inside diameter of the cutting edge, D_e, to the inside diameter of the tube, D_i expressed as a percentage (see Fig. 1).

3.2.3 *ovality, n*—the cross section of the tube that deviates from a perfect circle.

3.3 *Symbols:*

3.3.1 A_r—area ratio (see 3.2.1).

3.3.2 C_r—clearance ratio (see 3.2.2).

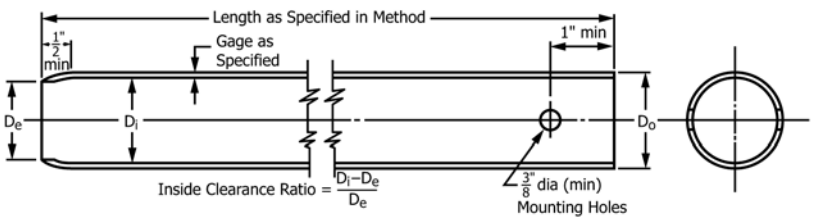
4. Summary of Practice

4.1 A relatively intact sample is obtained by pressing a thin-walled metal tube into the in-situ soil at the bottom of a boring, removing the soil-filled tube, and applying seals to the soil surfaces to prevent soil movement and moisture gain or loss.

5. Significance and Use

5.1 Thin-walled tube samples are used for obtaining intact specimens of fine-grained soils for laboratory tests to determine engineering properties of soils (strength, compressibility, permeability, and density). Fig. 2 shows the use of the sampler

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



NOTE 1—The sampling end of the tube is manufactured by rolling the end of the tube inward and then machine cutting the sampling diameter, D_e, on the inside of the rolled end of the tube.

NOTE 2—Minimum of two mounting holes on opposite sides for D_o smaller than 4 in. [100 mm]. Minimum of four mounting holes equally spaced for D_o equal to 4 in. [100 mm] and larger.

NOTE 3—Tube held with hardened set screws or other suitable means.

FIG. 1 Thin-Walled Dimensions for Measuring Tube Clearance Ratio, C_r (approximate metric equivalents not shown)

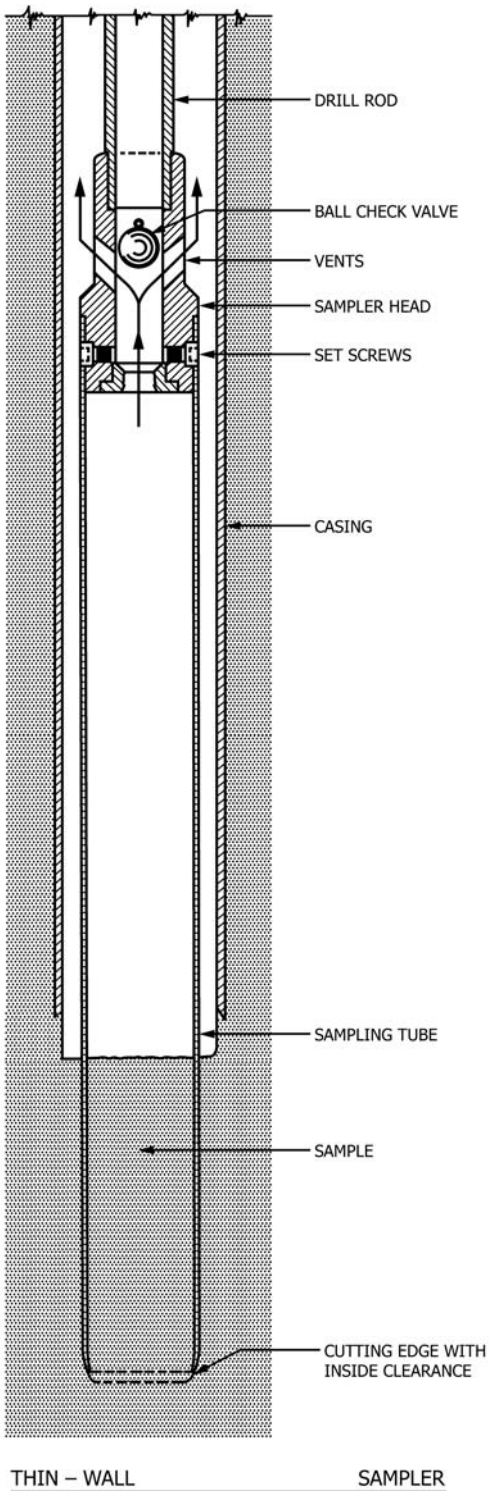


FIG. 2 Thin-Walled Tube Sampler Schematic and Operation (1)

in a drill hole. Typical sizes of thin-walled tubes are shown on Table 1. The most commonly used tube is the 3-in. [75 mm] diameter. This tube can provide intact samples for most laboratory tests; however some tests may require larger diameter tubes. Tubes with a diameter of 2 in. [50 mm] are rarely used as they often do not provide specimens of sufficient size for most laboratory testing.

TABLE 1 Suitable Thin-Walled Steel Sample Tubes[A]

Outside diameter (D_o):			
in.	2	3	5
mm	50	75	125
Wall thickness:			
Bwg	18	16	11
in.	0.049	0.065	0.120
mm	1.25	1.65	3.05
Tube length:			
in.	36	36	54
m	1.0	1.0	1.5

[A] The three diameters recommended in Table 2 are indicated for purposes of standardization, and are not intended to indicate that sampling tubes of intermediate or larger diameters are not acceptable. Lengths of tubes shown are illustrative. Proper lengths to be determined as suited to field conditions. Wall thickness may be changed (5.2.1, 6.3.2). Bwg is Birmingham Wire Gauge (Specification A513/A513M).

5.1.1 Soil samples must undergo some degree of disturbance because the process of subsurface soil sampling subjects the soil to irreversible changes in stresses during sampling, extrusion if performed, and upon removal of confining stresses. However, if this practice is used properly, soil samples suitable for laboratory testing can be procured. Soil samples inside the tubes can be readily evaluated for disturbance or other features such as presence of fissures, inclusions, layering or voids using X-ray radiography (D4452) if facilities are available. Field extrusion and inspection of the soil core can also help evaluate sample quality.

5.1.2 Experience and research has shown that larger diameter samples (5 in. [125 mm]) result in reduced disturbance and provide larger soil cores available for testing. Agencies such as the U.S Army Corps of Engineers and US Bureau of Reclamation use 5-in. [125-mm] diameter samplers on large exploration projects to acquire high quality samples (**1, 2, 3**).[4]

5.1.3 The lengths of the thin-walled tubes (tubes) typically range from 2 to 5 ft [0.5 to 1.5 m], but most are about 3 ft [1 m]. While the sample and push lengths are shorter than the tube, see 7.4.1.

5.1.4 This type of sampler is often referred to as a "Shelby Tube."

5.2 Thin-walled tubes used are of variable wall thickness (gauge), which determines the Area Ratio (A_r). The outside cutting edge of the end of the tube is machined-sharpened to a cutting angle (Fig. 1). The tubes are also usually supplied with a machine-beveled inside cutting edge which provides the Clearance Ratio (C_r). The recommended combinations of A_r, cutting angle, and C_r are given below (also see 6.3 and Appendix X1, which provides guidance on sample disturbance).

5.2.1 A_r should generally be less than 10 to 15 %. Larger A_r of up to 25 to 30 % have been used for stiffer soils to prevent buckling of the tube. Tubes of thicker gauge may be requested when re-use is anticipated (see 6.3.2).

[4] The boldface numbers in parentheses refer to a list of references at the end of this standard.