Designation: D 1587 – ~~94~~00

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

This standard is issued under the fixed designation D 1587; 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 Department of Defense.

1. Scope*

1.1 This practice covers a procedure for using a thin-walled metal tube to recover relatively undisturbed soil samples suitable for laboratory tests of ~~structural properties.~~ engineering properties, such as strength, compressibility, permeability, and density. Thin-walled tubes used in piston, plug, or rotary-type ~~samplers, such as the Denison or Pitcher, must~~ samplers should comply with ~~the portions~~ Section 6.3 of this practice which describes the thin-walled ~~tubes (5.3).~~ tubes.

NOTE 1—This practice does not apply to liners used within the ~~above~~ samplers.

1.2 This Practice is limited to soils that can be penetrated by the thin-walled tube. This sampling method is not recommended for sampling soils containing 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 (D 1586, D 3550, and D 6151). For information on appropriate use of other soil samplers refer to D 6169.

1.3 This practice is often used in conjunction with fluid rotary drilling (D 1452D 5783) or hollow-stem augers (D 6151). Subsurface geotechnical explorations should be reported in accordance with practice (D 5434). This practice discusses some aspects of sample preservation after the sampling event. For information on preservation and transportation process of soil samples, consult Practice D 4220. This practice does not address environmental sampling; consult D 6169 and D 6232for information on sampling for environmental investigations.

1.4 The values stated in ~~both~~ inch-pound ~~and SI~~ units are to be regarded as the standard. The SI values given in parentheses are provided for information purposes only. The tubing tolerances presented in Table 2 are from sources available in North America. Use of metric equivalent is acceptable as long as thickness and proportions are similar to those required in this standard.

1.~~3~~5 *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.*

1.6 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.

2. Referenced Documents

2.1 *ASTM Standards:*

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[1] This practice is under the jurisdiction of ASTM Committee D~~-~~18 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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***A Summary of Changes section appears at the end of this standard.**

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

Outside diameter:			
Outside diameter (D_o):			
in.	2	3	5
mm	50.8	76.2	127
Wall thickness:			
Bwg	18	16	11
in.	0.049	0.065	0.120
mm	1.24	1.65	3.05
Tube length:			
in.	36	36	54
m	0.91	0.91	1.45
Clearance ratio, %	1	1	1
Inside clearance ratio, %	<1	<1	<1

[A] The three diameters recommended in Table 1 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.

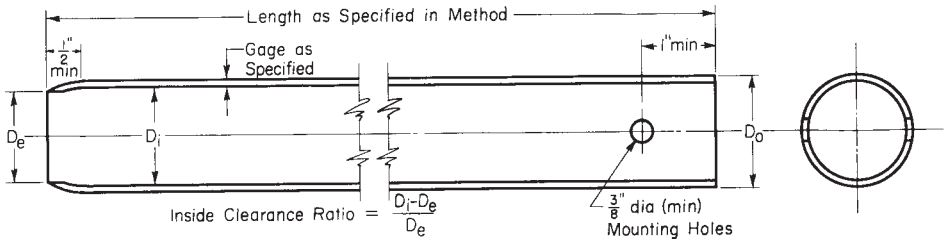
TABLE 2 Dimensional Tolerances for Thin-Walled Tubes

Nominal Tube Diameters from Table 1[A] Tolerances, in.					
Size Outside Diameter	—2 in.	—350.8 mm	—3 in.	76.2 mm	5 in.	127 mm
Outside diameter	+0.007	+0.179	+0.010	+0.254	+015	
Outside diameter, D_o	+0.007 −0.000	+0.179 −0.000	+0.010 −0.000	+0.254 Inside diameter	+0.015 -0.000	0.381 -0.000
	-0.000 +0.000 −0.007	-0.000 +0.000 −0.010	-0.000 +0.000 −0.015	-0.000	-0.000	-0.000
Inside diameter, D_i	+0.000	+0.000	+0.000 −0.015			
	Wall thickness +0.000	+0.000	+0.000			
±0.007	-0.007	-0.179	-0.010	-0.254	-0.015	-0.381
	-0.007 ±0.010	-0.179 ±0.015	-0.010 Ovality	-0.254 0.015	-0.015 0.020	-0.381 0.030
Wall thickness	±0.010	±0.015	±0.010	0.015	0.020	0.030
Straightness	0.030/ ft	0.030/ ft	0.020	0.508	0.030	0.762
Ovality	0.015	0.381	0.020	0.508	0.030	0.762
Straightness	0.030/ft	2.50/m	0.030/ft	2.50/m	0.030/ft	2.50/m
Straightness	0.030/ft	2.50/m	0.030/ft	2.50/m	0.030/ft	2.50/m

[A] Intermediate or larger diameters should be proportional. Tolerances shown are essentially standard commercial manufacturing tolerances for seamless steel mechanical tubing. Specify only two of the first three tolerances; that is, O. D_o and I. D_i, or O. D_o and Wall thickness, or I. D_i and Wall thickness.

D 2488 Practice for Description 653 Standard Terminology Relating to Soil, Rock, and Identification of Soils (Visual-Manual Procedure) Contained Fluids[2]
D 1452 Practice for Soil Investigation and Sampling by Auger Borings[2]
D 1586 Penetration Resistance and Split Barrel Sampling of Soils[2]
D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]
D 3550 Practice for Ring-Lined Barrel Sampling of Soils[2]
D 4220 Practices 3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction[2]
D 4220 Practices for Preserving and Transporting Soil Samples[2]
D 5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock[3]
D 5783 Guide for Use of Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices[3]
D 6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling[3]
D 6169 Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations[3]

[2] *Annual Book of ASTM Standards,* Vol 04.08.
[3] *Annual Book of ASTM Standards,* Vol 04.09.



NOTE 1—Minimum of two mounting holes on opposite sides for 2 to 3 ~~in.~~ sampaller than 4 in. (101.6 mm).
NOTE 2—Minimum of four mounting holes spaced at 90° for samplers 4 in. and larger. 4 in. (101.6 mm) and larger.
NOTE 3—Tube held with hardened screws.
NOTE 4—Two-inch outside-diameter tubes are specified with an 18-gage wall thickness to comply with area ratio criteria accepted for "undisturbed samples." Users are advised that such tubing is difficult to locate and can be extremely expensive in small quantities. Sixteen-gage tubes are generally readily available.

Metric Equivalent Conversions

in.	mm
⅜	9.53
½	12.7
1	25.4
2	50.8
~~3½~~	~~88.9~~
3½	76.2
4	101.6
5	127

FIG. 1 Thin-Walled Tube for Sampling

D 6232 Guide for Selection of Sampling Equipment for Waste and Contaminated Media Data Collection Activities[4]

3. ~~Summary~~Terminology

3.1 *Definitions:*

3.1.1 For common definitions of ~~Practice~~

~~3.1 A relatively undisturbed sample is obtained by pressing a thin-walled metal tube into~~ terms in this standard, refer to Terminology D 653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *inside clearance ratio, %*—the ratio of the ~~in-situ soil, removing~~ difference in the ~~soil-filled~~ inside diameter of the tube, ~~and sealing~~ D_i, minus the inside diameter of the cutting edsge, D_e, to ~~prevent~~ the inside diameter of the tube, D_i expressed as a percentage (see Fig. 1).

3.2.2 *ovality*—the cross section of the tube that deviates from ~~being disturbed or losing moisture.~~ a perfect circle.

4. ~~Significance and Use~~

~~4.1 This practice, or Practice D 3550, is used when it is necessary to obtain a~~Summary of Practice

4.1 A relatively undisturbed ~~specimen suitable for laboratory tests of structural properties or other tests that might be influenced~~ sample is obtained by pressing a thin-walled metal tube into the in-situ soil ~~d~~ at the bottom of a boring, removing the soil-filled ~~tu~~be, and applying seals to the soil surfaces to prevent soil movement and moisture gain or loss.

5. Significance and Use

5.1 This practice, or Practice D 3550 with thin wall shoe, is used when it is necessary to obtain a relatively undisturbed specimen suitable for laboratory tests of engineering properties or other tests that might be influenced by soil disturbance.

NOTE 2—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 5740 provides a means of evaluating some of those factors.

6. Apparatus

56.1 *Drilling Equipment*—~~A~~When sampling in a boring, any drilling equipment may be used that provides a reasonably clean hole; that ~~does not disturb~~ minimizes disturbance of the soil to be sampled; and that does not hinder the penetration of the

[4] *Annual Book of ASTM Standards,* Vol 11.04.

thin-walled sampler. Open borehole diameter and the inside diameter of driven casing or hollow stem auger shall not exceed 3.5 times the outside diameter of the thin-walled tube.

56.2 *Sampler Insertion Equipment*, shall be adequate to provide a relatively rapid continuous penetration force. For hard formations it may be necessary, although not recommended, to drive the thin-walled tube sampler.

56.3 *Thin-Walled Tubes*, should be manufactured to the dimensions as shown in Fig. ~~1.~~ 1. They should have an outside diameter of 2 to 5 in. (50 to 130 mm) and be made of metal having adequate strength for ~~use in~~ the type of soil ~~and formation intended.~~ to be sampled. Tubes shall be clean and free of all surface irregularities including projecting weld seams. Other diameters may be used but the tube dimensions should be proportional to the tube designs presented here.

56.3.1 *Length of Tubes*—See Table 1 and ~~6~~ 7.4.1.

56.3.2 *Tolerances*, shall be within the limits shown in Table 2.

56.3.3 *Inside Clearance Ratio*, should be not greater than 1 % ~~or as~~ unless specified ~~by the engineer or geologist~~ otherwise for the type of soil ~~and formation~~ to be sampled. Generally, the inside clearance ratio used should increase with the increase in plasticity of the soil being sampled, except for sensitive soils or where local experience indicates otherwise. See 3.2.1 and Fig. 1 for definition of inside clearance ratio.

56.3.4 *Corrosion Protection*—Corrosion, whether from galvanic or chemical reaction, can damage or destroy both the thin-walled tube and the sample. Severity of damage is a function of time as well as interaction between the sample and the tube. Thin-walled tubes should have some form of protective ~~coating. Tubes which will contain samples for more than 72 h shall~~ coating, unless the soil is to be ~~coated.~~ extruded less than 3 days. The type of coating to be used may vary depending upon the material to be sampled. ~~Coatings may include a light coat of lubricating oil, lacquer, epoxy, Teflon, and others. Type of coating must be specified by the engineer or geologist if storage will exceed 72 h.~~ Plating of the tubes or alternate base metals may be ~~specified by the engineer or geologist.~~

~~5.4 *Sampler Head*, serves to couple the thin-walled tube to the insertion equipment and, together with the thin-walled tube, comprises the thin-walled tube sampler. The sampler head shall contain a suitable check valve and a venting area to the outside equal to or greater than the area through the check valve. Attachment of the head to the tube shall be concentric and coaxial to assure uniform application of force to the tube by the sampler insertion equipment.~~

~~6. Procedure~~

~~6.1 Clean out the borehole to sampling elevation using whatever method is preferred that will ensure the material to be sampled is not disturbed. If groundwater is encountered, maintain the liquid level in the borehole at or above ground water level during the sampling operation.~~

~~6.2 Bottom discharge bits~~ specified. Galvanized tubes are ~~not permitted. Side discharge bits may be used, with caution. Jetting through an open-tube sampler to clean out the borehole to sampling elevation~~ often used when long term storage is ~~not permitted. Remove loose material from the center of~~ required. Coatings may include a ~~casing or hollow stem auger as carefully as possible to avoid disturbance~~ light coat of ~~the material to be sampled.~~ lubricating oil, lacquer, epoxy, Teflon, zinc oxide, and others.

NOTE ~~2—Roller bits~~ 3—Most coating materials are ~~available in downward-jetting and diffused-jet configurations. Downward-jetting configuration rock bits are~~ not ~~acceptable. Diffuse-jet configurations are generally acceptable.~~

~~6.3 Place the sample tube so~~ resistant to scratching by soils that ~~its bottom rests on the bottom~~ contain sands. Consideration should be given for prompt testing of the ~~hole. Advance~~ sample because chemical reactions between the ~~sampler without rotation by a continuous relatively rapid motion.~~

~~6.4 Determine the length of advance by the resistance~~ metal and ~~condition of~~ the ~~formation, but the length shall never exceed~~ 5 soil sample con occur with time.

6.4 *Sampler Head*, serves to ~~10 diameters of~~ couple the thin-walled tube ~~in sands and 10~~ to ~~15 diameters of~~ the ~~tube in clays.~~

~~NOTE 3—Weight of sample, laboratory handling capabilities, transportation problems, and commercial availability of tubes will generally limit maximum practical lengths to those shown in Table 1.~~

~~6.5 When~~ insertion equipment and, together with the ~~formation is too hard for push-type insertion,~~ thin-walled tube, comprises the thin-walled tube ~~may be driven or Practice D 3550 may be used. Other methods, as directed by the engineer or geologist, may be used. If driving methods are used, the data regarding weight~~ sampler. The sampler head shall contain a venting area and ~~fall of~~ suitable check valve with the ~~hammer and penetration achieved must be shown in~~ venting area to the ~~report. Additionally, that tube must be prominently labeled a "driven sample."~~

~~6.6 In no case shall a length of advance be~~ outside equal to or greater than the ~~sample-tube length minus an allowance for~~ area through the ~~sampler head and~~ check valve. In some special cases, a ~~minimum of 3 in. for sludge-end cuttings.~~

~~NOTE 4—The tube~~ check valve may not be ~~rotated~~ required but venting is required to ~~shear bottom~~ avoid sample compression. Attachment of the ~~sample after pressing is complete.~~

~~6.7 Withdraw~~ head to the ~~sampler from the formation as carefully as possible in order~~ tube shall be concentric and coaxial to ~~minimize disturbance~~ assure uniform application of force to the tube by the sampler insertion equipment.

7. ~~Preparation for Shipment~~

~~7.1 Upon removal of the tube, measure the length of sample in the tube. Remove the disturbed~~Procedure

7.1 Remove loose material ~~in~~ from the ~~upper end~~ center of ~~the tube and measure the length again. Seal the upper end~~ a casing or hollow stem auger as carefully as possible to avoid disturbance of the ~~tube. Remove at least 1 in. of~~ material to be sampled. If groundwater is encountered, maintain the ~~lower end of the tube. Use this material for soil description~~ liquid level in ~~accordance with Practice D 2488. Measure~~ the ~~overall sample length. Seal~~ borehole at or above ground water level during the ~~lower end of the tube. Alternatively, after measurement, the tube~~ drilling and sampling operation.

7.2 Bottom discharge bits are not permitted. Side discharge bits may be ~~sealed without removal of soil from~~ used, with caution. Jetting through an open-tube sampler to clean out the ~~ends of the tube if so directed by the engineer or geologist.~~ borehole to sampling elevation is not permitted.

NOTE ~~5—Field extrusion~~ 4—Roller bits are available in downward-jetting and ~~p~~ diffused-jet configurations. Downward-jetting configuration rock bits are not acceptable. Diffuse-jet configurations are generally acceptable.

7.3 Lower the sampling apparatus so that the sample tube's bottom rests on the bottom of ~~extruded samples under~~ the ~~specific direction~~ hole and record depth to the bottom of the sample tube to the nearest 0.1-ft (.03 m)

7.3.1 Keep the sampling apparatus plumb during lowering, thereby preventing the cutting edge of the tube from scraping the wall of the borehole.

7.4 Advance the sampler without rotation by a ~~g~~ continuous relatively rapid downward motion and record length of advan~~i~~cement to the nearest 1 in. (25 mm).

7.4.1 Determine the leng~~i~~th of advance by the resistance and condition of the soil formation, but the length shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays. In no case shall a leng~~i~~th of advance be greater than the sample-tube length minus an allowance for the sampler head and a mi~~t~~tnimum of 3-in. (75 mm) for sludge and end cuttings.

NOTE ~~6—Tubes sealed over the ends as opposed~~ 5—The mass of sample, laboratory handling capabilities, transportation problems, and commercial availability of tubes will generally limit maximum practical lengths to those ~~sealed with expanding packers should contain end padding~~ shown in ~~end voids in order to prevent drainage~~ Table 1.

7.5 When the soil formation is too hard for push-type insertion, the tube may be driven or Practice D 3550 m~~o~~vay be used. If driving methods are used, the data regarding weight and fall of the ~~sample within the tube.~~

~~7.2 Prepare~~ hammer and ~~immediately affix labels or apply markings~~ penetration achieved must be shown in the report. Additionally, that tube must be prominently labeled a "driven sample."

7.6 Withdraw the sampler from the soil formation as ~~necessary~~ carefully as possible in order to ~~identify~~ minimize disturbance of the sample. ~~Assure that~~ The tube can be slowly rotated to shear the ~~markings or labels are adequate~~ material at the end of the tube, and to ~~survive transportation~~ relieve water and/or suction pressures and improve recovery. Where the soil formation is soft, a delay before withdra~~g~~w of the sampler (typically 5 to 30 minutes) may improve sample recovery.

8. ~~Report~~

~~8.1 The appropriate information is required as follows:~~

~~8.1.1 Name~~Sample Measurement, Sealing and ~~location~~ Labeling

8.1 Upon removal of the ~~project,~~

~~8.1.2 Boring number and precise location on project,~~

~~8.1.3 Surface elevation or reference to a datum,~~

~~8.1.4 Date and time~~ tube, remove the drill cuttings in the upper end of ~~boring—start~~ the tube and ~~finish,~~

~~8.1.5 Depth to top~~ measure the length of the soil sample recovered to the nearest 0.25 in~~d~~. (5 mm) in the tu~~m~~be. Seal the upper end of ~~sample,~~

~~8.1.6 Description~~ the tube. Remove at least 1 in. (25 mm) of ~~sampler: size, type~~ material from the lower end of ~~metal, type~~ the tube. Use this material for soil description in accordance with Practice D 2488. Measure the overall sample length. Seal the lower end of ~~coating,~~

~~8.1.7 Method~~ the tube. Alternatively, after measurement, the tube may be sealed without removal of ~~sampler insertion: push~~ soil from the ends of the tube.

8.1.1 Tubes sealed over the ends, as opposed to those sealed with expanding packers, should be provided with spacers or ~~drive,~~

~~8.1.8 Method~~ appropriate packing materials, or both prior to sealing the tube ends to provide proper confinement. Packing materials must be nonabsorbent and must maintain their properties to provide the same degree of ~~drilling, size~~ sample support with time.

8.1.2 Depending on the requirements of ~~hole, casing,~~ the investigation, field extrusion and ~~drilling fluid used,~~

~~8.1.9 Depth to groundwater level: date~~ packaging of extruded soil samples can be performed. This allows for physical examination and ~~time measured,~~

~~8.1.10 Any possible current or tidal effect on water level,~~

~~8.1.11 Soil description~~ classification of the sample. Samples are extruded in ~~accordance~~ special hydraulic jacks equipped with ~~Practice D 2488,~~

~~8.1.12 Length~~ properly sized platens to extrude the core in a continuous smooth speed. In some cases, further extrusion may cause sample disturbance reducing suitability for testing of ~~sampler advance, and~~

8.1.13 Recovery: length of engineering properties. In other cases, if damage is not significant, cores can be extruded and preserved for testing (D 4220). Bent or damaged tubes should be cut off before extruding.

8.2 Prepare and immediately affix labels or apply markings as necessary to identify the sample (see Section 9). Assure that the markings or labels are adequate to survive transportation and storage.

NOTE 6—Top end of the tube should be labeled "top".

9. PField Log

9.1 Record the information that may be required for preparing field logs in general accordance to ASTM D 5434 "Guide for Field Logging of Subsurface Explorations of Soil and Bias

9.1 This practice does not produce numerical data; therefore, Rock". This guide is used for logging explorations by drilling and sampling. Some examples of the information required include;

9.1.1 Name and location of the project,

9.1.2 Boring number,

9.1.3 Log of the soil conditions,

9.1.4 Surface elevation or reference to a p datum to the nearest foot (0.5 m) or better,

9.1.5 Locatison of the boring,

9.1.6 Method of making the borehole,

9.1.7 Name of the drilling foreman and company, and

9.1.8 Name of the drilling inspector(s).

9.1.9 Date and time of boring-start and finis sh,

9.1.10 Depth to groundwater level: date and time measured,

9.2 Recording the appropriate sampling information is required as follows:

9.2.1 Depth to top of sample to the nearest 0.1 ft. (.03 m) and number of sample,

9.2.2 Description of thin-walled tube sampler: size, type of metal, type of coating,

9.2.3 Method of sampler insertion: push or drive,

9.2.4 Method of drilling, size of hole, cabsing, and drilling fluid used,

9.2.5 Soil description in accordance with Practice D 2488,

9.2.6 Length of sampler advance (push), and

9.2.7 Recovery: length of sample obtained.

10. Keywords

10.1 geologic investigations; sampling; soil exploration; soil investigations; subsurface investigations; undisturbed

SUMMARY OF CHANGES

In accordance with committee D18 policy, this section identifies the location of changes to this standard since the last edition, 1994, which may impact the use of this standard.

(1) Editorial corrections to various sections based on comments received from Committee Balloting

(2) Added D 6232 to Section 2.

(3) Changed Note 7 to Section 8.1.2.

(4) Renumbered Note 8.