Designation: D 3550 – 01

Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils[1]

This standard is issued under the fixed designation D 3550; 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 procedure for thick wall, split barrel drive sampling of soil to obtain representative samples of soil for classification and laboratory testing. The sampler is considered to be a thick wall sampler with sharpened cutting shoe and ball check vent. The middle barrel section is often of split barrel design, but a solid barrel can be used and both may contain ring liners. The sampler is often driven, but can also be pushed in softer deposits. Penetration resistance data may be recorded. This standard uses procedures similar to Test Method D 1586 on Penetration Resistance and Split Barrel Sampling of Soils. However, in this practice, differing hammer weights, drop heights, and different size samplers are used, so the data must not be reported as conforming to Test Method D 1586 and cannot be used to determine Normalized penetration resistance data for sands in accordance with Practice D 6066.

1.2 This practice involves use of rotary drilling equipment (Guide D 5783, Practice D 6151). Other drilling and sampling procedures (Guide D 6286, Guide D 6169) are available and may be more appropriate. Considerations for hand driving or shallow sampling without boreholes are not addressed. Subsurface investigations should be recorded in accordance with practice Guide D 5434. Soil samples should be classified in accordance with Practice D 2488.

1.3 This practice may or may not provide a sample suitable for advanced laboratory tests such as shear or consolidation testing. It is up to the user to determine if the sample quality is suitable for advanced laboratory testing for engineering properties. Driven samples can be more easily disturbed than pushed samples such as the thin wall tube in accordance with Practice D 1587. However, thin wall tubes cannot be used in harder soils. In cases where it has been established that the quality of the thick wall driven sample is adequate, this practice may provide shear and consolidation specimens that can be used directly in the test apparatus without prior trimming. Some types of soils may gain or lose significant shear strength or compressibility, or both, as a result of sampling. In cases like these, suitable comparison tests should be made to evaluate the effect of sample disturbance on shear strength and compressibility.

1.4 This guide does not purport to comprehensively address all of the methods and the issues associated with soil sampling. Users should seek qualified professionals for the decisions as to the proper equipment and methods that would be most successful for their site investigation. Other methods may be available for monitoring soil sampling and qualified professionals should have flexibility to exercise judgement as to possible alternatives not covered in this guide. The practice is current at the time of issue, but new alternative and innovative methods may become available prior to revisions, therefore, users should consult with manufacturers or producers prior to specifying program requirements.

1.5 *This practice offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgement. 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.*

1.6 *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. The user must comply with prevalent regulatory codes, such as OSHA (Occupational Health and Safety Administration) guidelines while using this practice. For good safety practice, consult applicable OSHA regulations and other safety guides on drilling.*[2]

[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 Investigations.

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[2] Drilling Safety Guide, National Drilling Association, 6089 Frantz Rd. Suite 101, Dublin, Ohio, 43017.

***A Summary of Changes section appears at the end of this standard.**

2. Referenced Documents

2.1 *ASTM Standards:*

D 1586 Test Method for Penetration Test and Split-Barrel Sampling of Soils[3]

D 1587 Practice for Thin-Walled Tube Sampling of Soils[3]

D 2113 Practice for Diamond Core Drilling for Site Investigation[3]

D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass[3]

D 2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)[4]

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[3]

D 3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction[3]

D 4220 Practices for Preserving and Transporting Soil Samples[3]

D 5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock[4]

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[4]

D 6066 Practice for Determining the Normalized Penetration Resistance of Sands for Liquefaction Resistance Evaluation[4]

D 6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling[4]

D 6169 Guide for Selection of Soil and Rock Sampling Devices used with Drill Rigs for Environmental Site Characterization[4]

D 6286 Guide for Selection of Drilling Methods for Environmental Site Characterization[4]

3. Significance and Use

3.1 This practice is used for general soil investigations where samples are required for identification and testing. Disturbed samples can be classified in accordance with Practice D 2487 and can be tested for moisture content, particle size, and Atterberg limits. The sampler can be equipped with stacked ring liners, which can be used directly for other laboratory tests.

3.2 The sampler can be driven with a hammer and the penetration resistance can be recorded. Numerous combinations of hammer size and drop height have been used in practice. Hammer size and drop height should be reported. Users of this practice have derived local correlations of penetration resistance and engineering properties based on local conditions and a particular hammer system and sampler, however, the penetration resistance may differ from Test Method D 1586.

3.3 The user should evaluate sample quality. The process of driving the sample may disturb the soil and change the engineering properties. In soft soils, use of the thin wall tube sampler (Practice D 1587) will likely result in less disturbance. In harder soils, soil coring techniques may result in less disturbance; see Practice D 6151, Guide D 6169.

3.4 This standard addresses sampling in drill holes with drilling equipment. The sampler can be hand driven or driven in test pits without drilling equipment. If these special driving methods are used the sampling process should be reported.

4. Apparatus

4.1 *Drilling Equipment*—Any drilling equipment may be used that provides a reasonably clean hole before insertion of the sampler and that does not disturb the soil to be sampled (Guide D 6286). Bottom discharge bits should be avoided as they could disturb the sampling interval. Side-discharge bits are preferable.

4.2 *Drive Weight Assembly*—Any drive weight assembly that will provide penetration in the range from 1 to 100 blows per foot (0.30-m) may be used. In soft soils, if the sample is desired for laboratory testing, the sample may be pushed to reduce disturbance.

4.3 *Ring-Lined Barrel Sampling Assembly*—This shall consist of a shoe, sample barrel, and waste barrel (extension), and head with check valve, vents, and threaded connector (Head) for drill rod, as shown in Fig. 1. Typical outside diameters of the barrel are 2, 2.5, 3, and 3 in. Fig. 1 is reproduced from the Diamond Drill Core Manufacturers Association[5] to illustrate typical dimensions. Other sampler designs can be used as long as the sampler dimensions have similar proportions and are reported on the boring log. The total sampler assembly length is typically 2 ft (0.6 m). The length should be a whole number such as 2 ft (0.6 m) such that it is easy to record sampling depth intervals to the nearest 0.1 ft (5 cm).

4.4 *Ring-Lined Sampler*—Test specimens shall be obtained using a suitable split barrel or solid barrel lined on the inside with removable rings or liners. These rings or liners shall be thin-walled and shall conform to the size requirements of the particular laboratory test determinations employed. They shall fit snugly inside the sampler with no discernible free play in any direction. Rings are often brass, steel, or stainless steel, but can be made of any material of adequate strength and resistance to corrosion. The sampler may be sectionalized to allow end-to-end make-up of sections as necessary. Each section shall be designed so that addition or removal of sections will not loosen, permit movement, or otherwise adversely affect retention of the rings within the sampler. The sampler and rings shall be free of bumps, dents, scratches, rust, dirt, and corrosion.

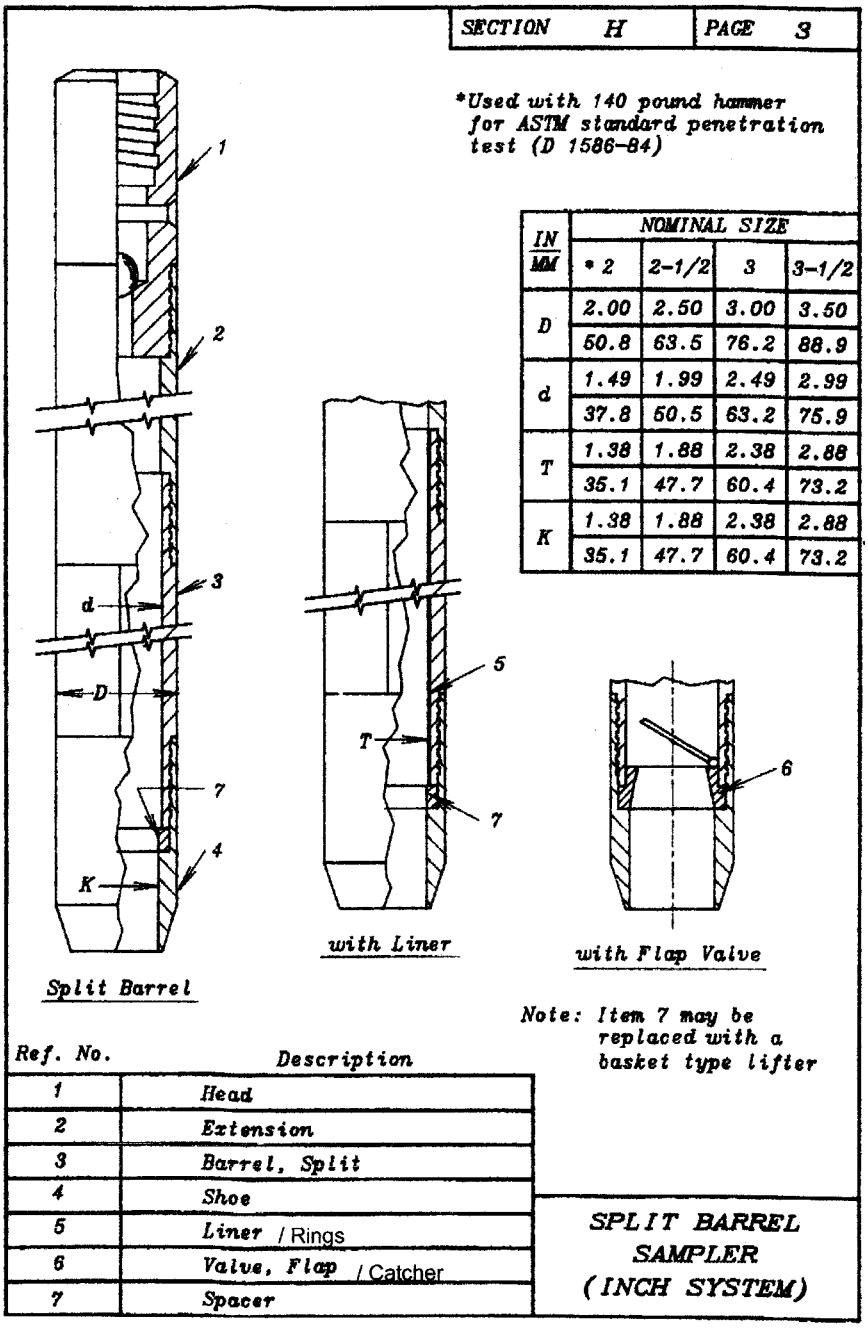
NOTE 1—It is recommended that the sampler contain at least four to twelve rings or one to two liners in order to provide samples for a variety of tests. The ring height should be equal to or less than its inside diameter.

4.5 *Waste Barrel*—A waste barrel that can be removed from the sampler in the field shall be provided to contain space for disturbed soil originally at the bottom of the hole. The length of the waste barrel shall be at least three times its interior diameter, and the inside diameter shall be the same, or slightly

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

[4] *Annual Book of ASTM Standards*, Vol 04.09.

[5] DCDMA Technical Manual, National Drilling Association, 6089 Frantz Rd. Suite 101, Dublin, Ohio 43017, 1991.



NOTE 1—Inside clearance ratio = $(D_i - D_e)/D_e$
NOTE 2—Dimensional tolerance of D_i = ±0.003 in. (±0.08 mm)

FIG. 1 Ring-Lined Barrel Sampling Assembly

larger than, the inside diameter of the rings. The waste barrel may also contain rings or liners for containment of the disturbed soil.

4.5.1 An attachment, check valve, and one or more vents is required.

4.6 *Shoe*—A shoe similar in design to that used in Test Method D 1586 is shown on Fig. 1. Fig. 1 shows typical sizes as specified by the Diamond Core Drill Manufacturers Association (DCDMA)[5]. The inside of the assembled shoe and ring-lined sampler shall be smooth, straight, and uniform. Use of a hardened steel shoe improves resistance to damage. Dented or distorted shoes should not be used.

4.6.1 In North American practice, the area ratio and cutting edge bevel have been varied. In general, it is desirable to maintain proportions similar to those in D 1586. But for hard driving conditions, the shoe may be made blunter. A cutting angle of less than 10 degrees can result in less disturbance to the soil.

4.7 *Retainer*—Various types of retainers may be required to aid in recovery. These are located in spacer area 7 shown on Fig. 1. If a retainer is used, the type used should be reported.

4.8 *Sample Extractor*—Specimen-filled rings shall be removed from the sampler by pressing them out or alternatively by the use of a split barrel. The extractor disk shall be at least 0.5 in. (13 mm) thick and shall bear solidly against the sample rings at all points. It shall slide easily inside the sampler barrel without jamming and without free play.

4.9 *Containers for Specimen-Filled Rings*—These shall be snug fitting, tightly sealed (watertight), rigid containers or caps that will not permit movement of the specimen-filled rings inside. They shall be noncorrosive.

4.10 *Miscellaneous Equipment*—This includes a pipe vise, pipe wrenches, spatulas, cleaning brushes, buckets, rags, data sheets, transporting boxes, knife for cutting sampler, indelible markers, wire brushes, etc. Water must be available for cleaning the equipment.

5. Procedure

5.1 Clean the hole to sampling elevation using whatever method is preferred that will ensure that the material to be sampled is not disturbed. In saturated sands and silts, withdraw the drill bit slowly to prevent loosening of the soil around the hole. When casing is used, it shall not be driven below sampling elevation. When drilling below the ground water level the water or drilling liquid within the boring must be maintained at all times at or above the natural ground water level. It is preferable to keep the hole filled.

5.2 Keep a careful record of drill penetration and sampler depth to ensure that the soil being sampled is the original soil at the bottom of the hole and is not contaminated by soil falling down from the sides of the hole. If there is any significant tendency for soil to fall from the sides of the hole to the bottom, use water, drilling mud, hollow-stem auger, or casing, as necessary, in order to prevent this from happening. When using casing or hollow-stem augers be sure the soil does not squeeze or flow up into the cased hole, as may happen in loose sand below the water table. The process of jetting through an open-tube sampler, or jetting heaved sand out of a casing, and then sampling when the desired depth is reached shall not be permitted. The use of bottom-discharge bits is not preferred.

5.3 Assemble and lower the sampling assembly it carefully into the hole. With the cutting edge of the shoe resting on the bottom of the hole and the water level in the boring at or above the ground water level, record the sampling start depth. Then drive or push the sampling assembly into the soil. Drive or push the assembly in far enough so that all cuttings, sludge, and soil disturbed by drilling are in the waste barrel; however, in no case drive or push the assembly farther than the total length of the shoe, sampler, and waste barrel. Take care that none of the sample is lost due to improper operation of the check valve. Record the depth of advancement.

5.4 When using a driving hammer to drive the sampling assembly, record the penetration resistance in depth increments required by the testing program. In such a case, record the hammer weight, height of drop, and number of blows, and the depth interval penetrated.

5.5 After the sampler has been advanced extract the sampler. In some cases it might be beneficial to let the sampler rest before extraction. The barrel can also be rotated to shear the base of the sample. Withdraw the sampler at a rate that will preserve the sample. If there is excessive fluid pressure in the rods above, provide vent ports to relieve fluid pressure. If sample recovery is difficult, consider use of retainers (4.7).

5.6 Carefully disassemble the sampling assembly in such a manner as to minimize soil disturbance as much as possible. Disturbed samples may be placed in any suitable container such as plastic bags or sealed jars. Label the sample container(s) in a suitable manner. Discard samples that appear to be contaminated or questionable.

5.7 If rings or liners are used, trim the soil flush with the ends of the sampling rings or liner, and cap both ends. If the specimens in rings, or liners, are to be stored for more than 72 hours, the liner or ring cap should be taped. Be certain that there is no movement of the soil inside the specimen-filled rings and that the specimen was not disturbed while being removed from the barrel. If the soil in the bottom end ring does not protrude from the ring after removing the shoe, do not use the soil in the bottom ring for tests other than soil classification and moisture content. If the top ring or rings contain voids, depressions, or any material other than the soil that is being sampled, do not use the soil in this ring (or rings) for any purpose whatsoever. The filling of depressions in the end rings with additional soil shall not be permitted.

5.8 Classify the soil sample (Practice D 2488) and examine the material for structure, consistency, color, and condition. Record these observations and include them in the report (see 6.1.8).

5.9 Describe the moisture condition of the sample (Practice D 2488). If required, determine the moisture content of a specimen taken from the shoe or bottom ring in accordance with Test Method D 2216.

5.10 Preserve and transport the sample in accordance with Practices D 4220.

6. Report

6.1 Data obtained in each boring shall be recorded in accordance with the Subsurface Logging Guide D 5434 as required by the exploration program. In addition, the following information shall be reported;

6.1.1 Name and location of job,

6.1.2 Date of boring and times of start and finish,

6.1.3 Boring number and location,

6.1.4 Surface elevation, if available,

6.1.5 Sample number and depth,

6.1.6 Method of advancing sampler, hammer weight, drop height, penetration resistance, push pressures, and recovery lengths,

6.1.7 Description and size of sampler, outside diameter, shoe type, inside diameter of shoe, rings, or split barrel. Report length of drive barrel assembly. Report type of retainer used, if any.

6.1.8 Description of soil (see Practice PracticeD 2488) and any other laboratory test results performed.

6.1.9 Describe moisture contents or results of moisture content determinations (Test Method D 2216), if performed.

6.1.10 Depth interval of layer sampled, drive interval, length of sample recovered, and recovery expressed as percent.

6.1.11 Depth to water table or depth of overlying water and time of reading, level of fluid inside borehole, if any,

6.1.12 Size of casing, depth of cased hole,
6.1.13 Type of drilling equipment—description,
6.1.14 Names of personnel: crewman, field engineer, technician, etc.,
6.1.15 Weather conditions, and
6.1.16 General remarks.

7. Precision and Bias

7.1 This practice does not produce numerical or repeatable data and therefore a precision and bias statement is not applicable.

8. Keywords

8.1 penetration resistance; ring lined; soil sampling; split barrel

SUMMARY OF CHANGES

In accordance with Committee D18 policy this section identifies the location of changes to this standard since the 84(1995)e1 edition that may impact the use of this standard.

(1) Numerous changes have been made to this standard. In the early history of development of D 3550, there was resistance within the subcommittee as to whether the thick wall sampler, equipped with rings provided specimens suitable for laboratory testing. The old standard showed a thin wall drive shoe for the thick walled sampler which was never used in practice. This practice has been using a sampler with a cutting shoe of similar proportions to the SPT sampler (D 1586). Fig. 1 will be revised to show the typical DCDMA barrels used in North America.
(2) *Scope*—Totally revised. Previous wording masked actual use in practice. Added related drilling standards. Added discussion of sample disturbance. Added standard caveat and special caveat for the sampling considerations. Safety caveat also refers to OSHA and DCDMA.
(3) *Referenced Documents*—Added related drilling practices and guides. Added subsurface logging guide.
(4) *Significance and Use*—Allow use of penetration resistance testing employed with varyious samplers and hammers.
(5) *Apparatus*—Used DCDMA Fig. 1 to show typical barrels used in North America. Added requirement to report type of retainer.
(6) *Procedure*—Required the recording of depth to sampler start, drive length, sample recovery, and penetration resistance.