



Designation: D3550/D3550M – 17

# Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils<sup>1</sup>

This standard is issued under the fixed designation D3550/D3550M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 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 split barrel design containing 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 D1586 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 D1586 and cannot be used to determine Normalized penetration resistance data for sands in accordance with Practice D6066.

1.2 This practice involves use of rotary drilling equipment (Guide D5783, Practice D6151). Other drilling and sampling procedures (Guide D6286, Guide D6169) are available and may be more appropriate. Considerations for hand driving or shallow sampling without boreholes are not addressed. Sub-surface explorations should be recorded in accordance with Guide D5434. Soil samples should be classified in accordance with Practice D2488.

1.3 The soil samples from this test will have some degree of disturbance because the sampler is a driven thick walled sample tube. Table 2 of Guide D6169 on Soil and Rock Sampling provides guidance for selection of soil samplers for samples that may require intact samples defined by Terminology D653 for laboratory testing. The degree of disturbance must be evaluated by the user (engineer) to determine the suitability of the sample for use in laboratory tests. If samples are not suitable for laboratory testing, other soil samplers should be used (see 4.4.1).

<sup>1</sup> 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.

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1.4 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 non-conformance with the standard

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values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this standard.

1.6 *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.*

1.6.1 This practice 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 exploration. 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 practice.

1.7 *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.*<sup>2</sup>

<sup>2</sup> 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

1.8 This international standard was developed in accordance with internationally recognized principles on standardization established in the *Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee*.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>3</sup>

- D653** Terminology Relating to Soil, Rock, and Contained Fluids
- D1586** Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
- D1587** Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes
- D2216** Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- D2487** Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D2488** Practice for Description and Identification of Soils (Visual-Manual Procedures)
- 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
- D4546** Test Methods for One-Dimensional Swell or Collapse of 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
- D6066** Practice for Determining the Normalized Penetration Resistance of Sands for Evaluation of Liquefaction Potential
- 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
- D6286** Guide for Selection of Drilling Methods for Environmental Site Characterization

## 3. Terminology

### 3.1 Definitions:

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

## 4. Significance and Use

4.1 The thick-wall ring lined drive sampler has been used for over 50 years in the arid southwest regions of the U.S.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

where unsaturated soils are too difficult to sample using the thin-walled tube (Practice **D1587**). Variations of the sampler include names such as “Dames and Moore, California, Modified California barrels” with outside barrel diameters ranging from 2.5 to 3.5 in. [60-90 mm].<sup>4</sup> In addition to the blow count, these drive samplers have the added benefit of having a ring lined specimens that can be evaluated in the laboratory. Versions of the original Dames and Moore type sampler shown in **Fig. 1** are still used, but many now use the Diamond Drill Core Manufacturers Association (DCDMA)<sup>5</sup> specification split barrel drive samplers **Fig. 2**. The ring lined samplers normally have provisions for a 6-in. [150 mm] waste barrel with or without rings in the top section of the barrel. Drilling in the unsaturated soils is performed almost exclusively with hollow-stem augers (Practice **D6151**) because it is a dry drilling method. The test can be performed in fluid rotary or other drill holes but use of fluid rotary methods are not recommended in unsaturated soils as the drill fluid may alter the sample properties. Most operators use a 140 lb [75 kg] hammer mass but other hammer masses may be used.

4.2 This practice is used for general soil explorations where samples are required for identification and testing. Disturbed samples can be classified in accordance with Practice **D2487** and can be tested for water content, particle size, and Atterberg limits.

4.3 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 **D1586**.

4.4 The sampler can be equipped with stacked ring liners, which can be used directly for other laboratory tests. The lab tests are combined with the penetration resistance data, for estimates of soil engineering properties based on engineering experience.

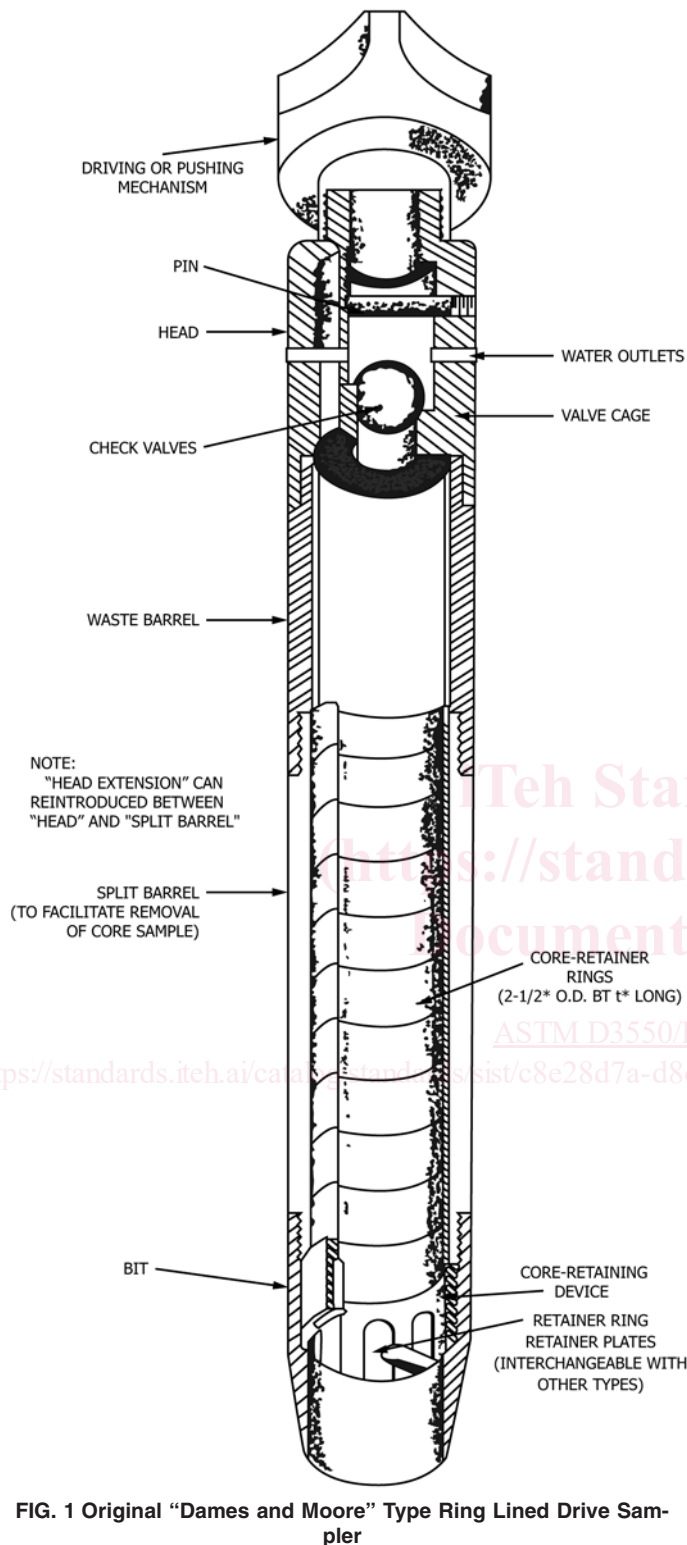
NOTE 1—The most common lab tests are one dimensional consolidation or swell or collapse with wetting, determination of trimmed density, and direct shear testing.

4.4.1 The engineer in charge of the exploration is responsible for evaluating the suitability of the samples for lab testing, evaluating the test result data quality, and for how and what data are to be used in design. If the samples and test results are not suitable, the user should specify other methods to obtain soil samples such Thin-wall Tubes (Practice **D1587**) for soft soils or rotary soil core barrels (Guide **D6169**) or hollow-stem auger soil cores (Practice **D6151**) for harder soils.

4.5 This standard addresses sampling in drill holes with drilling equipment. The sampler can be hand driven or driven

<sup>4</sup> Problems and Some Solutions in Geotechnical Sampling, H.E. Davis, <http://www.quest-ech.biz/Pages/Geotechnical%20Sampling.htm>

<sup>5</sup> DCDMA Technical Manual, National Drilling Association, 6089 Frantz Rd. Suite 101, Dublin, Ohio 43017, 1991.



ance 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.

Practice D3740 was developed for agencies engaged in the laboratory testing and/or inspection of soil and rock. As such, it is not totally applicable to agencies performing this practice. However, user of this practice should recognize that the framework of practice D3740 is appropriate for evaluating the quality of an agency performing this practice. Currently there is no known qualifying national authority that inspects agencies that perform this practice.

### 5. Apparatus

5.1 *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 D6286). The most common method for testing in unsaturated soils is to use top head drive rotary hollow-stem auger dry drilling methods (Practice D6151). If fluid rotary methods are used, bottom discharge bits should be avoided as they could disturb the sampling interval and side-discharge bits are preferable.

5.2 *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.

5.3 *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. 2. Typical outside diameters of the barrel range from 2.0 to 3.5 in. [50 to 90 mm]. Fig. 2 is reproduced from the DCDMA manual<sup>5</sup> 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 two digits or 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 [50 mm] or better.

5.4 *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 3—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.

5.5 *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

in test pits without drilling equipment. If these special driving methods are used the sampling process should be reported.

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 D3740 are generally considered capable of competent and objective sampling. Users of this practice are cautioned that compli-