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# Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions[1]

This standard is issued under the fixed designation D3080/D3080M; 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*

~~1.1This test method covers the determination of the consolidated drained shear strength of a soil material in direct shear. The test is performed by deforming a specimen at a controlled strain rate on or near a single shear plane determined by the configuration of the apparatus. Generally, three or more specimens are tested, each under a different normal load, to determine the effects upon shear resistance and displacement, and strength properties such as Mohr strength envelopes.~~

~~1.2Shear stresses and displacements are nonuniformly distributed within the specimen. An appropriate height cannot be defined for calculation of shear strains. Therefore, stress-strain relationships or any associated quantity such as modulus, cannot be determined from this test.~~

1.1 This test method covers the determination of the consolidated drained shear strength of one specimen of a soil material under direct shear boundary conditions. The specimen is deformed at a controlled rate on or near a single shear plane determined by the configuration of the apparatus.

1.2 Shear stresses and displacements are nonuniformly distributed within the specimen. An appropriate height cannot be defined for calculation of shear strains. Therefore, stress-strain relationships or any associated quantity such as the shear modulus, cannot be determined from this test.



1.3 The determination of strength envelopes and the development of criteria to interpret and evaluate test results are left to the engineer or office requesting the test.



1.4 The results of the test may be affected by the presence of coarse-grained soil or rock particles, or both, (see Section 7).

~~1.5Test conditions including normal stress and moisture environment are selected which represent the field conditions being investigated. The rate of shearing should be slow enough to ensure drained conditions.~~



~~1.6There may be instances when the gap between the plates should be increased to accommodate sand sizes greater than the specified gap. Presently there is insufficient information available for specifying gap dimension based on particle size distribution.~~

~~1.7The values stated in inch-pound units are to be regarded as the standard. Within this test method the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of each other.~~





~~1.8All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice~~

1.5 Test conditions, including normal stress and moisture environment, should be selected to represent the field conditions being investigated. The rate of shearing must be slow enough to ensure drained conditions.

1.6 Generally, three or more tests are performed on specimens from one soil sample, each under a different normal load, to determine the effects upon shear resistance and displacement. Results from a test series are combined to determine strength properties such as Mohr strength envelopes. Interpretation of multiple tests requires engineering judgment and is beyond the scope of this test method. This test method pertains to the requirements for a single test.

1.7 There may be instances when the gap between the shear box halves should be increased to accommodate sand sized particles greater than the specified gap. Presently there is insufficient information available for specifying the gap dimension based on particle size distribution.

1.8 *Units*—The values stated in either inch-pound units or SI units [given 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.

1.8.1 The gravitational system of inch-pound units is used. In this system, the pound (lbf) represents a unit of force (weight), while the unit for mass is slugs. The slug unit is not given, unless dynamic (F = ma) calculations are involved.

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.05 on Strength and Compressibility of Soils.

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

1.9 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026.

~~1.8.1The~~1.9.1 The method used to specify how data are collected, calculated, or recorded in this standard is not directly related to the accuracy to which the data can be applied in design or other uses, or both. How one applies the results obtained using this standard is beyond its scope.

~~1.9~~1.10 *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]

D422 Test Method for Particle-Size Analysis of Soils

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft$^3$(600 kN-m/m$^3$))

D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft$^3$(2,700 kN-m/m$^3$))

D1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes

D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2435 Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading

D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)

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

D4318 Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing

D6026 ~~Practice for Using Significant Digits in Geotechnical Data~~ Practice for Using Significant Digits in Geotechnical Data

D6027 Practice for Calibrating Linear Displacement Transducers for Geotechnical Purposes



## 3. Terminology

3.1 *Definitions*—For definitions of common technical terms used in this test method, refer to Terminology D653.

3.2 *Description of Terms Specific to This Standard:*

3.2.1 ~~*Relative Lateral Displacement*—The horizontal displacement of the top and bottom shear box halves.~~

~~3.2.2~~*Failure*~~—The stress condition at failure for a test specimen. Failure is often taken to correspond to the maximum shear stress attained, or the shear stress at 15 to 20 percent relative lateral displacement. Depending on soil behavior and field application, other suitable criteria may be defined.~~ —The stress condition at failure for a test specimen. Failure is often taken as the maximum shear stress attained, or in the absence of a peak condition, the shear stress at 10 percent relative lateral displacement. Depending on soil behavior and field application, other suitable criteria may be defined at the direction of the requesting agency.

3.2.2 *Nominal Normal Stress*—In the direct shear test, the applied normal (vertical) force divided by the area of the shear box. The contact area of the specimen on the imposed shear plane decreases during shear and hence the true normal stress is unknown.

3.2.3 *Nominal Shear Stress*—In the direct shear test, the applied shear force divided by the area of the shear box. The contact area of the specimen on the imposed shear plane decreases during shear and hence the true shear stress is unknown.

3.2.4 *Percent Relative Lateral Displacement*—The ratio, in percent, of the relative lateral displacement to the diameter or lateral dimension of the specimen in the direction of shear.

3.2.5 *Preshear*—In strength testing, the stage of a test after the specimen has stabilized under the consolidation loading condition and just prior to starting the shearing phase. It is used as an adjective to modify phase relations or stress conditions.

3.2.6 *Relative Lateral Displacement*—The displacement between the top and bottom shear box halves.

## 4. Summary of Test Method

4.1 This test method consists of placing the test specimen in the direct shear device, applying a predetermined normal stress, providing for wetting or draining of the test specimen, or both, consolidating the specimen under the normal stress, unlocking the ~~frames~~ shear box halves that hold the test specimen, and shearing the specimen by displacing one ~~frame horizontally~~ shear box half laterally with respect to the other at a constant rate of shearing deformation ~~and~~while measuring the shearing ~~force and horizontal displacements as the specimen is sheared~~force, relative lateral displacement, and normal displacement (Fig. 1~~).~~ ). The shearing rate must be slow enough to allow nearly complete dissipation of excess pore pressure.

[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.

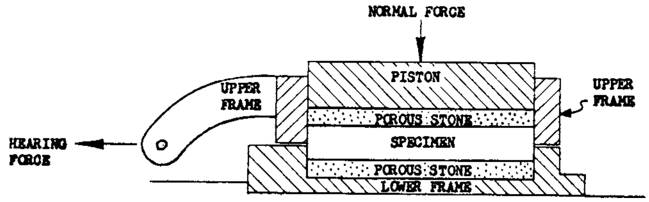


FIG. 1 Test Specimens in ~~(*a*)~~ Single ~~and (*b*) Double~~ Shear Apparatus

## 5. Significance and Use

5.1 The direct shear test is suited to the relatively rapid determination of consolidated drained strength properties because the drainage paths through the test specimen are short, ~~thereby~~ allowing excess pore pressure to ~~be dissipated~~ dissipate more rapidly than ~~with~~ other drained stress tests. The test can be made on ~~all~~ any type of soil ~~materials and undisturbed, remolded~~ material. It is applicable for testing intact, remolded, or ~~compacted materials.~~reconstituted specimens. There is however, a limitation on the maximum particle size (see ~~7.2~~6.2).

~~5.2The test results are applicable to assessing strength in a field situation where complete consolidation has occurred under the existing normal stresses. Failure is reached slowly under drained conditions so that excess pore pressures are dissipated. The results from several tests may be used to express the relationship between consolidation stress and drained shear strength.~~

~~5.3During the direct shear test, there is rotation of principal stresses, which may or may not model field conditions. Moreover, failure may not occur on the weak plane since failure is forced to occur on or near a horizontal plane at the middle of the specimen. The fixed location of the plane in the test can be an advantage in determining the shear resistance along recognizable weak planes within the soil material and for testing interfaces between dissimilar materials.~~

~~5.4Shear stresses and displacements are nonuniformly distributed within the specimen, and an appropriate height is not defined for calculating shear strains or any associated engineering quantity. The slow rate of displacement provides for dissipation of excess pore pressures, but it also permits plastic flow of soft cohesive soils. Care should be taken to ensure that the testing conditions represent those conditions being investigated.~~

~~5.5The range in normal stresses, rate of shearing, and general test conditions should be selected to approximate the specific soil conditions being investigated.~~

5.2 The test results are applicable to assessing strength in a field situation where complete consolidation has occurred under the existing normal stresses. Failure is reached slowly under drained conditions so that excess pore pressures are dissipated. The shear rate must meet the requirements of 9.10. The results from several tests may be used to express the relationship between consolidation stress and drained shear strength.

NOTE ~~1—Notwithstanding the statement on precision and bias contained in this standard: The precision of this test method is dependent on the competence of the personnel performing the test and the suitability of the equipment and facilities used. Agencies which meet the criteria of Practice~~ 1—The equipment specified in this standard method is not appropriate for performing undrained shear tests. Using a fast displacement rate without proper control of the volume of the specimen will result in partial drainage and incorrect measurements of shear parameters.

5.3 During the direct shear test, there is rotation of principal stresses, which may or may not model field conditions. Moreover, failure may not occur on the weakest plane since failure is forced to occur on or near a plane through the middle of the specimen. The fixed location of the plane in the test can be an advantage in determining the shear resistance along recognizable weak planes within the soil material and for testing interfaces between dissimilar materials.

5.4 Shear stresses and displacements are nonuniformly distributed within the specimen, and an appropriate height is not defined for calculating shear strains or any associated engineering quantity. The slow rate of displacement provides for dissipation of excess pore pressures, but it also permits plastic flow of soft cohesive soils.

5.5 The number of tests in a series normal stress level, rate of shearing, and general test conditions should be selected to approximate the specific soil conditions being investigated.

5.6 The area of the shear surface decreases during the test. This area reduction creates uncertainty in the actual value of the shear and normal stress on the shear plane but should not affect the ratio of these stresses.

NOTE 2—Notwithstanding the statement on precision and bias contained in this standard: The precision of this test method is dependent on the competence of the personnel performing the test and the suitability of the equipment and facilities used. Agencies which meet the criteria of Practice D3740 are generally considered capable of competent and objective testing. Users of this test method are cautioned that compliance with Practice D3740 does not in itself assure reliable testing. Reliable testing depends on several factors; Practice D3740 provides a means of evaluating some of these factors.

## 6. Apparatus

6.1 *Shear Device*—A device to hold the specimen securely between two porous inserts in such a way that torque is not applied to the specimen. The shear device shall provide a means of applying a normal stress to the faces of the specimen, for measuring change in thickness of the specimen, for permitting drainage of water through the porous inserts at the top and bottom boundaries of the specimen, and for submerging the specimen in water. The device shall be capable of applying a shear force to the specimen ~~in water. The device shall be capable of applying a shear force to the specimen~~ along a predetermined shear plane (single shear) parallel to the faces of the specimen. The frames that hold the specimen shall be sufficiently rigid to prevent their distortion during shearing. The various parts of the shear device shall be made of material not subject to corrosion by moisture or substances within the soil, for example, stainless steel, bronze, or aluminum, etc. Dissimilar metals, which may cause galvanic action, are not permitted.

6.2 *Shear Box,* ~~a shear box, either circular or square, made of stainless steel, bronze, or aluminum, with provisions for drainage through the top and bottom. The box is divided vertically by a horizontal plane into two halves of equal thickness which are fitted together with alignment screws. The shear box is also fitted with gap screws, which control the space (gap) between the top and bottom halves of the shear box.~~ a shear box, either circular or square, made of stainless steel, bronze, or aluminum, with provisions for drainage through the top and bottom. The box is divided by a straight plane into two halves of equal thickness which are fitted together with alignment screws. The shear box is also fitted with gap screws, which create the space (gap) between the top and bottom halves of the shear box prior to shear. The two halves should provide a bearing surface for the specimen along the shear plane during relative lateral displacement.

6.2.1 The minimum specimen diameter for circular specimens, or width for square specimens, shall be 2.0 in. [50 mm], or not less than ten (10) times the maximum particle size diameter, whichever is larger.

6.2.2 The minimum initial specimen thickness shall be 0.5 in. [13 mm], but not less than six (6) times the maximum particle diameter.

6.2.3 The minimum specimen diameter to thickness or width to thickness ratio shall be 2:1.

NOTE 3—A light coating of grease applied to the inside of the shear box may be used to reduce friction between the specimen and shear box. TFE-fluorocarbon coating may also be used on these surfaces instead of grease to reduce friction.

6.3 *Porous Inserts,* Porous inserts function to allow drainage from the soil specimen along the top and bottom boundaries. They also function to transfer ~~horizontal~~ shear stress from the insert to the top and bottom boundaries of the specimen. Porous inserts shall consist of silicon carbide, aluminum oxide, or metal which is not subject to corrosion by soil substances or soil moisture. The proper grade of insert depends on the soil being tested. The ~~permeability~~ hydraulic conductivity of the insert should be substantially greater than that of the soil, but should be textured fine enough to prevent excessive intrusion of the soil into the pores of the insert. The diameter or width of the top porous insert or plate shall be 0.01 to 0.02 in. (0.2 to 0.5 mm) less than that of the inside of the ~~ring. If the~~shear box. The insert functions to transfer the ~~horizontal~~shear stress to the ~~soil, it~~soil and must be sufficiently coarse to develop interlock. Sandblasting or tooling the insert may help, but the surface of the insert should not be so irregular as to cause substantial stress concentrations in the soil. Porous inserts should be checked for clogging on a regular basis.

NOTE ~~2—Exact~~ 4—Exact criteria for insert texture and ~~permeability~~ hydraulic conductivity have not been established. For normal soil testing, medium grade inserts with a ~~permeability~~ hydraulic conductivity of about 0.5 to 1.0 × 10 $^3$ ~~ft/yr (5.0×10~~ ft/yr [5.0 × 10$^{-4}$ to 1.0 × 10$^{-3}$ ~~cm/s)~~cm/s] are appropriate for testing silts and clays, and coarse grade inserts with a ~~permeability~~ hydraulic conductivity of about 0.5 to 1.0 × 10$^5$ ~~ft/yr (0.05 to 0.10 cm/s) are appropriate for sands. It is important that the permeability of the porous insert is not reduced by the collection of soil particles in the pores of the insert; hence frequent checking and cleaning (by flushing and boiling, or by ultrasonic cleaning) are required to ensure the necessary permeability.~~ ft/yr [0.05 to 0.10 cm/s] are appropriate for sands. It is important that the hydraulic conductivity of the porous insert is not reduced by the collection of soil particles in the pores of the insert. Storing the porous inserts in a water filled container between uses will slow clogging. The inserts can be cleaned by flushing, boiling, or ultrasonic agitation.

6.4 *Loading Devices*:

6.4.1 ~~*Device for Applying and Measuring the Normal Force*—The normal force is applied by a lever loading yoke which is activated by dead weights (masses) or by a pneumatic loading device. The device shall be capable of maintaining the normal force to within ±1 percent of the specified force quickly without exceeding it.~~ Device for Applying the Normal Force—The normal force is typically applied by dead weights, a lever loading yoke activated by dead weights (masses), a pneumatic force cylinder, or a screw driven actuator. The device shall be capable of maintaining the normal force to within ± 1 percent of the specified force. It should apply the load quickly without significantly exceeding the steady value. Dead weight systems should be checked on a regular schedule. All systems with adjustable force application (e.g. pneumatic regulator or motor driven screw) require a force indicating device such as a proving ring, load cell, or pressure sensor.

6.4.2 *Device for Shearing the Specimen*~~—The device shall be capable of shearing the specimen at a uniform rate of displacement, with less than ±5 percent deviation, and should permit adjustment of the rate of displacement from 0.0001 to 0.04 in./min (.0025 to 1.0 mm/min). The rate to be applied depends upon the consolidation characteristics of the soils (see 9.12). The rate is usually maintained with an electric motor and gear box arrangement and the shear force is determined by a load indicating device such as a proving ring or load cell.~~

~~6.4.3The weight of the top shear box shall be less than 1 percent of the applied normal force during shear: this will most likely require that the top shear box be supported by a counter force, the equipment modified or the specimen sheared under a greater applied normal force.~~ —The device shall be capable of shearing the specimen at a uniform rate of displacement, with less than ±5 percent deviation. The rate to be applied depends upon the consolidation characteristics of the test material as specified in 9.10. The rate is usually maintained with an electric motor and gear box arrangement and the shear force is determined by a force indicating device such as a proving ring or load cell.

~~NOTE3—Shearing the test specimen at a rate greater than specified may produce partially drained shear results that will differ from the drained strength~~

of the material. 5—In order to test a wide range of soils the apparatus should permit adjustment of the rate of displacement from 0.0001 to 0.04 in./min [0.0025 to 1.0 mm/min].

NOTE 6—Shearing the test specimen at a rate greater than specified may produce partially drained shear results that will differ from the drained strength of the material. The specimen must be sheared slowly enough to allow pore pressures to dissipate.

6.4.3 *Top Half of Shear Box*—The weight of the top half of shear box supported by the specimen shall be less than 1 percent of the applied normal force during shear: this will most likely require that the top shear box be supported by a counter force, the equipment modified or the specimen sheared under a greater applied normal force.

6.5 *Normal Force Measurement Device*—A proving ring or load cell (or calibrated pressure sensor when using a pneumatic loading system) accurate to 0.5 lbf [2.5 N], or 1 percent of the normal force during shear, whichever is greater, is required when using anything but dead weights to apply the normal force.

6.6 *Shear Force Measurement Device*—A proving ring or load cell accurate to 0.5 lbf (2.5 *N*), or 1 percent of the shear force at failure, whichever is greater.

6.6*Shear Box Bowl*—A metallic box which supports the shear box and provides either a reaction against which one half of the shear box is restrained, or a solid base with provisions for aligning one half of the shear box, which is free to move coincident with applied shear force in a horizontal plane.

6.7 *Controlled High Humidity Room,* if required, for preparing specimens, such that water content gain or loss during specimen preparation is minimized. Deformation Indicators—Either dial gauges or displacement transducers capable of measuring the change in thickness (normal displacement) of the specimen, with a readability of at least 0.0001 in. [0.002 mm] and to measure relative lateral displacement with readability of at least 0.001 in. [0.02 mm]. D6027 provides details on the evaluation of displacement transducers.

6.8 *Shear Box Bowl*—A metallic box which supports the shear box and provides either a reaction against which one half of the shear box is restrained, or a solid base with provisions for aligning one half of the shear box, which is free to move coincident with applied shear force along a plane. The bowl also serves as the container for the test water used to submerge the specimen.

6.9 *Controlled High Humidity Environment*—if required, for preparing specimens, such that water content gain or loss during specimen preparation is minimized.

6.10 *Test Water*—Water is necessary to saturate the porous stones and fill the submersion reservoir. Ideally, this water would be similar in composition to the specimen pore fluid. Options include extracted pore water from the field, potable tap water, demineralized water, or saline water. The requesting agency should specify the water option. In the absence of a specification, the test should be performed with potable tap water.

6.11 *Trimmer or Cutting Ring,* for trimming oversized samples to the inside dimensions of the shear box with a minimum of disturbance. An exterior jig may be needed to maintain the shear box alignment.

6.9

6.12 *Balances*—a balance or scale conforming to the requirements of Specification D4753 readable (with no estimate) to 0.1% or better.



6.10*Deformation Indicators*—Either dial gages or displacement transformers capable of measuring the change in thickness of the specimen, with a sensitivity of at least 0.0001 in. (0.0025 mm) and to measure horizontal displacement with sensitivity of at least 0.001 in. (0.025 mm).

6.11*Apparatus for Determination of Water Content,* as specified in Test Method

6.13 *Apparatus for Determination of Water Content*—as specified in Test Method D2216.

6.12*Equipment for Remolding or Compacting Specimens,* if applicable.

6.13Miscellaneous Equipment, including timing device with a second hand, distilled or demineralized water, spatulas, knives, straightedge, wire saws, etc., used in preparing the specimen.

**7.Test Specimen**

7.1The sample used for specimen preparation should be sufficiently large so that a minimum of three similar specimens can be prepared. Prepare the specimens in a controlled temperature and humidity environment to minimize moisture loss or gain.

7.1.1Extreme care shall be taken in preparing undisturbed specimens of sensitive soils to prevent disturbance to the natural soil structure. Determine the initial mass of the wet specimen for use in calculating the initial water content and unit weight of the specimen.

7.2The minimum specimen diameter for circular specimens, or width for square specimens, shall be 2.0 in. (50 mm), or not less than 10 times the maximum particle size diameter, whichever is larger, and conform to the width to thickness ratio specified in 7.4

6.14 *Equipment for Compacting Specimens*—if applicable, as specified in Test Methods D698 or D1557.

7.3The minimum initial specimen thickness shall be 0.5 in. (12 mm), but not less than six times the maximum particle diameter.

7.4The minimum specimen diameter to thickness or width to thickness ratio shall be 2:1.

6.15 *Miscellaneous Equipment*—including timing device with a second hand, distilled or demineralized water, spatulas, knives, straightedge, wire saws, etc., used in preparing the specimen.

## 7. Test Specimen Preparation

7.1 *Intact Specimens*—Prepare intact specimens from large intact samples or from samples secured in accordance with Practice D1587, or other intact tube sampling procedures. Intact samples shall be preserved and transported as outlined for Group C or D samples in Practice D4220. Handle specimens carefully to minimize disturbance, changes in cross section, or loss of water content. If compression or any type of noticeable disturbance would be caused by the extrusion device, split the sample tube lengthwise or cut off a small section to facilitate removal of the sample with minimum disturbance. Prepare trimmed specimens, whenever possible, in an environment which will minimize the gain or loss of specimen moisture.

7.1.1 The sample selected for testing should be sufficiently large so that a minimum of three specimens can be prepared from similar material. While this standard test method applies to the measurements on one specimen, the requesting agency will typically specify a series of tests which cover a range of stress levels. The series should be performed on similar material.

7.1.2 Extreme care shall be taken in preparing intact specimens of sensitive soils to prevent disturbance to the natural soil structure.

7.1.3 Assemble the shear box halves and determine the mass of the empty box. Trim the lateral dimensions of the specimen to fit snuggly into the shear box using either a shape cutting shoe or a miter box. With the specimen in the shear box, trim the top and bottom surface of the specimen to be flat and parallel.

7.1.4 Determine and record the initial mass of the box plus specimen and height of the wet specimen for use in calculating the initial water content and total mass density of the material.

NOTE 4—If 7—If large soil particles are found in the soil after testing, a particle size analysis should be performed in accordance with Method D422 to confirm the visual observations, and the result should be provided with the test report.

7.5 *Specimen Preparation*:

7.5.1 *Undisturbed Specimens*—Prepare undisturbed specimens from large undisturbed samples or from samples secured in accordance with Practice D1587, or other undisturbed tube sampling procedures. Undisturbed samples shall be preserved and transported as outlined for Group C or D samples in Practice D4220. Handle specimens carefully to minimize disturbance, changes in cross section, or loss of water content. If compression or any type of noticeable disturbance would be caused by the extrusion device, split the sample tube lengthwise or cut it off in small sections to facilitate removal of the specimen with minimum disturbance. Prepare trimmed specimens, whenever possible, in an environment which will minimize the gain or loss of specimen moisture.

NOTE 5—A controlled high-humidity room is desirable for this purpose.

7.5.2 *Compacted Specimens*—Specimens shall be prepared using the compaction method, water content, and unit weight prescribed by the individual assigning the test. Assemble and secure the shear box. Place a moist porous insert in the bottom of the shear box. Specimens may be molded by either kneading or tamping each layer until the accumulative mass of the soil placed in the shear box is compacted to a known volume, or by adjusting the number of layers, the number of tamps per layer, and the force per tamp. The top of each layer shall be scarified prior to the addition of material for the next layer. The compacted layer boundaries shall be positioned so they are not coincident with the shear plane defined by the shear box halves, unless this is the stated purpose for a particular test. The tamper used to compact the material shall have an area in contact with the soil equal to or less than ½ the area of the mold. Determine the mass of wet soil required for a single compacted lift and place it in the shear box. Compact the soil until the desired unit weight is obtained. Continue placing and compacting soil until the entire specimen is compacted.

NOTE 6—The required thickness of the compacted lift may be determined by directly measuring the thickness of the lift, or from the marks on the tamping rod which correspond to the thickness of the lift being placed.

7.6 Material required for the specimen shall be batched by thoroughly mixing soil with sufficient water to produce the desired water content. Allow the specimen to stand prior to compaction in accordance with the following guide: 8—A controlled high-humidity room or laboratory glove box provides an appropriate atmosphere for trimming the specimen.

7.2 *Laboratory Fabricated Specimens*—Test specimens can be fabricated by reconstitution (7.3) or compaction (7.4). Acquire enough material to conduct the required series of tests. Blend the material to produce a uniform batch and if necessary divide into appropriate quantities for each required water content. Mix the soil with sufficient water to produce the desired water content. Allow the moist material to stand prior to specimen preparation in accordance with the following guide:

| Classification USCS Classification (D2487) | Minimum Standing Time, h |
|---|---|
| SW, SP | No Requirement |
| M | 3 |
| SW-SM, SP_SM, SM (>5% fines) | 3 |
| SC, ML, CL | 18 |
| SC, ML, CL, SP-SC | 18 |
| MH, CH | 36 |

7.7 Compacted specimens may also be prepared by compacting soil using the procedures and equipment used to determine moisture-density relationships of soils (Test Methods D698

7.3 *Reconstituted Specimens*—Specimens shall be prepared using the compaction method, water content, and mass density