Designation: D 6913 – 04$^{\epsilon 1}$

Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis[1]

This standard is issued under the fixed designation D 6913; 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.

ϵ^1 NOTE—Editorial corrections were made throughout in January 2005.

INTRODUCTION

Although this test method has been used for many years, there are vast testing variations required due to soil types and conditions. The test is more complicated and complex than would be expected. Multiple procedures are being presented along with new terminology. Although these procedures are not new, they will now be defined and explained. Some examples of these new terms are composite sieving, designated separating sieve and subspecimen. This test method outlines the majority of conditions and procedures but does not cover every conceivable variation or contingency. The table of contents in the Scope section is added to enable the user to easily find a specific topic or requirement. Only sections/subsections with titles are presented. Therefore, numbered subsections will not be continuous in some cases, as indicated in the Scope section.

1. Scope

1.1 Soils consist of particles with various shapes and sizes. This test method is used to separate particles into size ranges and to determine quantitatively the mass of particles in each range. These data are combined to determine the particle-size distribution (gradation). This test method uses a square opening sieve criterion in determining the gradation of soil between the 3-in. (75-mm) and No. 200 (75-µm) sieves.

1.2 The terms, soils and material, are used interchangeably throughout the standard.

1.3 In cases where the gradation of particles larger than 3 in. (75 mm) sieve is required, Test Method D 5519 may be used.

1.4 In cases where the gradation of particles smaller than No. 200 (75-µm) sieve is required, Test Method D 422[2] may be used.

1.5 Typically, if the maximum particle size is equal to or less than 4.75 mm (No. 4 sieve), then single-set sieving is applicable. Furthermore, if the maximum particle size is greater than 4.75 mm (No. 4 sieve) and equal to or less than 9.5 mm (3⁄8-in sieve), then either single-set sieving or composite sieving is applicable. Finally, if the maximum particle size is equal to or greater than 19.0 mm (3⁄4-in sieve), composite sieving is applicable. For special conditions see 10.3.

1.6 Two test methods are provided in this standard. The methods differ in the significant digits recorded and the size of the specimen (mass) required. The method to be used may be specified by the requesting authority; otherwise Method A shall be performed.

1.6.1 *Method A*—The percentage (by mass) passing each sieve size is recorded to the nearest 1 %. This method must be used when performing composite sieving. For cases of disputes, Method A is the referee method.

1.6.2 *Method B*—The percentage (by mass) passing each sieve size is recorded to the nearest 0.1 %. This method is only applicable for single sieve-set sieving and when the maximum particle size is equal to or less than the No. 4 (4.75-mm) sieve.

1.7 This test method does not cover, in any detail, procurement of the sample. It is assumed that the sample is obtained using appropriate methods and is representative.

1.8 *Sample Processing*—Three procedures (moist, air dry, and oven dry) are provided to process the sample to obtain a specimen. The procedure selected will depend on the type of sample, the maximum particle-size in the sample, the range of particle sizes, the initial conditions of the material, the plasticity of the material, the efficiency, and the need for other testing on the sample. The procedure may be specified by the requesting authority; otherwise the guidance given in Section 10 shall be followed.

1.9 This test method typically requires two or three days to complete, depending on the type and size of the sample and soil type.

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.03 on Texture, Plasticity, and Density Characteristics of Soils.

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[2] Currently Subcommittee D18.03 is preparing a new test method (Hydrometer Analysis or Combined Sieve and Hydrometer Analysis) to replace D 422.

1.10 This test method is ***not*** applicable for the following soils:

1.10.1 Soils containing fibrous peat that will change in particle size during the drying, washing, or sieving procedure.

1.10.2 Soils containing extraneous matter, such as organic solvents, oil, asphalt, wood fragments, or similar items. Such extraneous matter can affect the washing and sieving procedures.

1.10.3 Materials that contain cementitious components, such as cement, fly ash, lime, or other stabilization admixtures.

1.11 This test method may not produce consistent test results within and between laboratories for the following soils and the precision statement does not apply to them.

1.11.1 Friable soils in which the sieving processes change the gradation of the soil. Typical examples of these soils are some residual soils, most weathered shales and some weakly cemented soils such as hardpan, caliche or coquina.

1.11.2 Soils that will not readily disperse such as glauconitic clays or some dried plastic clays.

1.11.3 To test these soils, this test method must be adapted, or altered, and these alterations documented. Depending on the design considerations, a specialized gradation-testing program could be performed. The alterations could require the washing and sieving procedures to be standardized such that each specimen would be processed in a similar manner.

1.12 Some materials that are not soils, but are made up of particles may be tested using this method. However, the applicable sections above should be used in applying this standard.

1.13 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D 6026, unless superseded by this test method.

1.13.1 The procedures used to specify how data are collected/recorded and calculated in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of these test methods to consider significant digits used in analysis methods for engineering design.

1.14 *Units*—The dimensional values stated in either SI units or inch-pound units are to be regarded as standard, such as 200-mm or 8-in. diameter sieve. Except, the sieve designations are typically identified using the "alternative" system in accordance with Practice E 11, such as 3 in. and No. 200, instead of the "standard" system of 75 mm and 75 µm, respectively. Only the SI units are used for mass determinations, calculations and reported results. However, the use of balances or scales recording pounds of mass (lbm) shall not be regarded as nonconformance with this standard.

1.15 A summary of the symbols used in this test method is given in Annex A1.

1.16 *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.*

1.17 *Table of Contents*—All tables and figures appear at the end of this standard.

2. Referenced Documents

2.1 *ASTM Standards:* [3]

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregate

C 702 Practice for Reducing Samples of Aggregate to Testing Size

D 422 Test Method for Particle Size Analysis of Soils[2]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft/lbf/ft^3 (600 kN-m/m^3))

D 1140 Test Method for Amount of Material in Soils Finer Than the No. 200 (75-µm) Sieve

D 1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft/lbf/ft^3 (2,700 kN-m/m^3))

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[3] 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.

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

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

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

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

D 4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

D 4753 Specification for Evaluating, Selecting, and Specifying Balances and Scales for Use in Soil, Rock, and Related Construction Materials Testing

D 5519 Test Method for Particle Size Analysis of Natural and Man-Made Riprap Materials

D 6026 Practice for Using Significant Digits in Geotechnical Data

E 11 Specification for Wire-Cloth Sieves for Testing Purposes

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *General*:

3.1.1 An overview of terms used in the sieving processes is presented in Fig. 1(a) using a tabular format and in Fig. 1(b) using a flowchart format. In addition, Fig. 1(a) includes symbols used in the sieving processes.

3.1.2 There are two types of definitions in the following sections. There are definitions that are general (see 3.2) and others that are specific to this standard (see 3.3). To locate a definition, it may be necessary to review both sections. The definitions are in alphabetical order.

3.2 *Definitions:*

3.2.1 For definitions of general terms used in this test method, refer to Terminology D 653.

3.2.2 *composite sieving*, *v—in sieving*, the process of separating a large specimen on a designated separating sieve to obtain coarser and finer particle-size portions. The coarser portion is sieved using the coarser sieve set. The finer portion is subsampled to obtain a subspecimen of manageable size (mass) and this subspecimen is sieved using the finer sieve set. The results of both sieve sets (coarser and finer) are combined mathematically to determine the gradation of the large specimen.

3.2.2.1 *Discussion*—In some cases the subspecimen may require another separation; i.e., using a 2nd designated separating sieve and resulting in a 2nd coarser portion and 2nd subspecimen obtained from the 2nd finer portion.

3.2.3 *cumulative material retained (cumulative retained material or cumulative mass retained)*, *n—in sieving*, the mass of material retained on an individual sieve plus the masses of material retained on all the coarser sieves in a given stack/set of sieves.

3.2.4 *cumulative percent retained*, *n—in sieving*, the ratio of cumulative material retained on a given sieve to the mass of the specimen, expressed in percent.

3.2.5 *designated separating sieve*, *n—in composite sieving*, the sieve selected to separate the specimen into coarser and finer portions for composite sieving.

3.2.5.1 *Discussion*—The designated separating sieve size is a standard sieve size typically ranging from the ¾- in. (19.0-mm) sieve to the No. 10 (2.00-mm) sieve. There can be two designated separating sieves used in composite sieving, that is the 1st subspecimen can be separated on a 2nd designated separating sieve to obtain a 2nd coarser portion and a 2ndsubspecimen obtained from the 2nd finer portion.

3.2.6 *fractional cumulative material retained*, *n—in composite sieving*, when sieving a subspecimen, the mass of material retained on an individual sieve plus the masses of material retained on all the coarser sieves in a given sieve set.

3.2.7 *fractional cumulative percent retained*, *n—in composite sieving*, the ratio of fractional cumulative material retained on a given sieve to the mass of the subspecimen, expressed in percent.

3.2.8 *fractional material retained*, *n—in composite sieving*, when sieving a subspecimen, the mass of material retained on an individual sieve.

3.2.9 *fractional percent passing*, *n—in composite sieving*, the portion of material by mass in the subspecimen(s) passing a given sieve expressed in percent.

3.2.9.1 *Discussion*—When two subspecimens are used, there will be a 1st and 2nd fractional percent passing.

3.2.10 *fractional percent retained*, *n—in composite sieving*, the ratio of fractional material retained on a given sieve to the mass of the subspecimen, expressed in percent.

3.2.11 *gradation*, *n—in soil*, the proportion by mass of various particle sizes.

3.2.11.1 *Discussion*—This proportion is usually presented in tabular format (sieve size and percent passing) or graphical format (percent passing versus logarithm of the sieve size in mm). The graphical format is referred to as particle-size distribution or gradation curve.

3.2.12 *maximum particle size*, *n—in sieving*, the smallest sieve size from the standard sieve set on which less than one percent of the sample would be retained.

3.2.12.1 *Discussion*—For practical purposes, estimate the maximum particle size as equal to the smallest sieve size from the standard sieve set in which it appears that all the material being tested would pass through that sieve. The maximum particle size is needed to determine the required mass of the specimen and subspecimen.

3.2.13 *maximum sieve size*, *n—in sieving*, the smallest sieve size that is larger than any particle in the specimen or subspecimen.

3.2.14 *minimum sieve size*, *n—in sieving*, the smallest sieve size in a sieve set used in sieving the specimen or subspecimen.

3.2.14.1 *Discussion*—This size is either the size of the designated separating sieve (1st or 2nd) or the No. 200 (75-μm) sieve.

3.2.15 *percent passing*, *n—in sieving*, the portion of material by mass in the specimen passing a given sieve expressed in percent.

3.2.15.1 *Discussion*—This value is equal to the cumulative material retained in a given sieve set divided by the mass of the specimen, subtracting that ratio from one, and then multiplying by 100. For composite sieving, it would be the fractional percent passing multiplied by the composite sieving correction factor (*CSCF*).

3.2.16 *particle size distribution*, *n*—see *gradation*.

3.2.17 *percent retained*, *n—in sieving*, the ratio of the material retained on a given sieve to the mass of the specimen, expressed in percent.

3.2.18 *saturated surface-dry condition*, *n—in coarse-grained soils*, a state in which the soil particles are basically saturated with water, but there are not visible films of water.

3.2.19 *sieve set*, *n—in sieving*, a set of standard sized sieves. For single sieve-set sieving, the sieve set will range from the maximum sieve size to the No. 200 (75-µm) sieve. For composite sieving, there will be a coarser sieve set and a finer sieve set. Together, these sets will range from the maximum sieve size to the No. 200 (75-µm) sieve. The designated separating sieve will be used as the minimum size in the coarser set and the maximum size in the finer set.

3.2.20 *sieve size*, *n—in sieving*, the size of the opening in the wire cloth of a given sieve in mm or µm.

3.2.21 *single sieve-set sieving*, *v—in sieving*, the process in which only one set of sieves is required to determine the gradation of the specimen from the maximum particle size to the No. 200 (75-µm) sieve.

3.2.21.1 *Discussion*—Typically, this applies to specimens having a maximum particle size of 9.5 mm (3/8 in.) or less when using Method A or a maximum particle size of 4.75 mm (No. 4 sieve) or less when using Method B and the distribution of particles less than the No. 200 (75-µm) sieve is not needed.

3.2.22 *splitting*, *v—in sampling or subsampling*, the process of stockpile sampling, quartering material, or passing material through a splitter or riffle box to obtain a representative portion of that material for testing; i.e., a specimen or subspecimen.

3.2.22.1 *Discussion*—A description of stockpile sampling, and quartering and splitting material is given in Annex A2, A2.1.1 through A2.1.3.

3.2.23 *standard shaking period*, *n—in sieving*, a time period ranging from 10 to 20 minutes that a mechanical sieve shaker operates during the sieving process and which has been verified to satisfy the requirements for sieving thoroughness.

3.2.24 *standard sieve set*, *n—in sieving soils*, the group of fourteen specific sieve sizes required to determine the gradation of soils between and including the 3-in. (75-mm) and No. 200 (75-µm) sieves, as listed in Table 1.

3.2.24.1 *Discussion*—Most of these sieve sizes are different than those used in aggregate testing for concrete (Test Method C 136), especially for sieves finer than the No. 4 (4.75 mm).

3.2.25 *subspecimen*, *n—in composite sieving*, a representative portion of the material passing the designated separating sieve; i.e., the finer portion.

3.2.25.1 *Discussion*—When composite sieving requires multiple designated separating sieves, there will be more than one subspecimen. The 1^{st} subspecimen (i.e. the subspecimen from the finer portion) would be separated into a 2^{nd} coarser portion and a 2^{nd} finer portion that would be subsampled to obtain the 2^{nd} subspecimen.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *coarser portion*, *n—in composite sieving*, the portion of the specimen retained on the designated separating sieve.

3.3.1.1 *Discussion*—When two designated separating sieves are used, there will be a 1^{st} and 2^{nd} coarser portion.

3.3.2 *coarser sieve set*, *n—in composite sieving*, the sieve set that ranges from the maximum sieve size to the designated separating sieve size.

3.3.2.1 *Discussion*—When two designated separating sieves are used, the 1^{st} coarser sieve set ranges from the maximum sieve size to the 1^{st} designated separating sieve size. The 2^{nd} coarser sieve set would range from the 1^{st} designated separating sieve size to the 2^{nd} designated separating sieve size.

3.3.3 *composite sieving correction factor (CSCF)*, *n—in composite sieving*, a factor used to convert the fractional percent passing determined from sieving the subspecimen to the percent passing for the specimen. The *CSCF* is equal to the percent passing the designated separating sieve size in the coarser portion sieve set (i.e., the last sieve in the coarser portion set). This value shall be calculated to one more digit than required (0.1 %) to reduce rounding errors.

3.3.3.1 *Discussion*—When two designated separating sieves are used, there will be a 1^{st} and 2^{nd}*CSCF*.

3.3.4 *finer portion*, *n—in composite sieving*, the portion of the specimen passing the designated separating sieve.

3.3.4.1 *Discussion*—When two designated separating sieves are used, the 1^{st} subspecimen obtained from the 1^{st} finer portion will be separated into a 2^{nd} coarser portion and 2^{nd} finer portion, from which the 2^{nd} subspecimen is obtained.

3.3.5 *finer sieve set*, *n—in composite sieving*, the sieve set that ranges from the last designated separating sieve size to the No. 200 (75-µm) sieve.

3.3.5.1 *Discussion*—When composite sieving requires a 2^{nd} subspecimen, the finer sieve sets ranges from the 2^{nd} separating sieve size to the No. 200 (75-µm) sieve.

3.3.6 *insignificant sieve*, *n—in precision of test results*, any sieve which has 1 % or less cumulative material retained during the sieve analysis.

3.3.7 *separating*, *v—in composite sieving*, the process of dividing a specimen or subspecimen into two portions, the coarser (retained) and finer (passing) portions, using a designated separating sieve.

3.3.7.1 *Discussion*—When composite sieving requires two designated sieves, there will be a 1^{st} and 2^{nd} coarser portion, finer portion and subspecimen.

3.3.8 *significant sieve*, *n—in precision of test results*, any sieve which has more than 1 % of cumulative material retained during the sieve analysis.

4. Summary of Test Method

4.1 This test method is used to determine the particle-size distribution (gradation) of a soil sample. A representative specimen must be obtained from the sample by one of three procedures (moist, air-dried or oven-dried). For specimens containing relatively small particles, the specimen is sieved in its entirety, using single sieve-set sieving. However, the specimen may contain a wide range of particle sizes and may require separating the soil into two, or three size ranges for more efficient sieving, using one or two designated separating sieve(s). This process is termed composite sieving. For a single separation (two portions), the coarser portion is sieved in its entirety, while the finer portion is split into a smaller subspecimen for sieving. These results are mathematically combined. For specimens containing very large particles, the specimen may require two separations; i.e., three portions (1st and 2nd coarser portions and 2nd finer portion), see Fig. 1(a) and Fig. 1(b). Prior to sieving, as applicable, the material will be washed to remove fine particles and oven dried. The material to be sieved will be placed on the coarsest sieve size of each sieve set and mechanically shaken. The mass of particles retained on each sieve will be determined. The results will produce a tabulation of sieve sizes versus percent passing that can be graphically presented as a gradation curve (a plot of the percent passing versus the log of the particle size in mm.).

4.2 Flowcharts outlining the requirements of the various sieving processes covered above are presented below in four figures, Fig. 2 through Fig. 4(b).

5. Significance and Use

5.1 The gradation of the soil is used for classification in accordance with Practice D 2487.

5.2 The gradation (particle-size distribution) curve is used to calculate the coefficient of uniformity and the coefficient of curvature.

5.3 Selection and acceptance of fill materials are often based on gradation. For example, highway embankments, backfills, and earthen dams may have gradation requirements.

5.4 The gradation of the soil often controls the design and quality control of drainage filters, and ground-water drainage.

5.5 Selection of options for dynamic compaction and grouting is related to gradation of the soil.

5.6 The gradation of a soil is an indicator of engineering properties. Hydraulic conductivity, compressibility, and shear strength are related to the gradation of the soil. However, engineering behavior is dependent upon many factors (such as effective stress, stress history, mineral type, structure, plasticity, and geologic origins) and cannot be based solely upon gradation.

NOTE 1—The quality of the result produced by these test methods 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 testing/sampling/inspection/etc. Users of these test methods are cautioned that compliance with Practice D 3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D 3740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Sieves*—Each sieve shall conform to the requirements of Specification E 11. Generally, these sieve frames are circular and 200 mm or 8 in. in diameter, and either full (50 mm or 2 in.) or half height (25 mm or 1 in.). The sieve height generally depends upon the number of sieves typically required in the sieve set, the particle sizes being sieved, and the size and type of the sieve shaker. Particles having dimensions exceeding or relatively close to the sieve heights cannot be sieved in the sieve stack, but individually. Therefore, in a stack of sieves, the ratio of sieve height or spacing between rectangular sieves to sieve cloth opening shall exceed 2. Larger frames that conform to Specification E 11 are acceptable but require special considerations for reinforcement.

6.1.1 *Standard Sieve Set*—This set consists of all the sieve sizes listed in Table 1. Additional sieves sizes may be added if requested or required to reduce sieve overloading. In addition, some larger sieve sizes may be omitted during the sieve analysis depending on the maximum particle size; however, at least one sieve in the sieving process shall have 100 percent passing.

6.1.2 *Washing Sieve, No. 200 (75-µm)*—A No. 200 (75-µm) sieve with a minimum height above the screen of 50 mm or 2 in. to prevent loss of retained material while washing. Stainless steel sieve cloth is preferred because it is more durable, and less prone to damage or wear. The sieve may be reinforced with a larger mesh underneath the 75-µm cloth. The reinforcement wire cloth (backing) should not have a mesh coarser than the No. 20 (850-µm) wire cloth. The reinforcement wire cloth should be bonded to the sieve frame along with the No. 200 (75-µm) wire cloth, not bonded to the sieve frame below where the No. 200 (75-µm) wire cloth was attached. In addition, it is good practice to use a flattened backing cloth (rolled or calendered backing cloth), so it is less abrasive to the No. 200 (75-µm) wire cloth.

6.1.3 *Designated Separating Sieve*—A sieve used to separate the specimen into two portions (coarser and finer portion) in composite sieving. The designated separating sieve shall conform to Specification E 11. It may be necessary to have various sizes of sieves to use as designated separating sieves. Normally, these are not the same sieves that are used in the stack of sieves (sieve set) placed in the sieve shaker. Typically, the 1st designated separating sieve is rectangular and quite large, while the 2nd designated separating sieve is either 200-mm or 8-in. in diameter.

6.2 *Washing Sink with Spray Nozzle*—A sink having a spray nozzle attached to a flexible line to facilitate the washing and material transferring processes without spillage. In addition, the spray nozzle shall be such that the rate of water flow can be easily controlled. The temperature of the water shall be relatively close to room temperature to prevent changing the dimensions of the sieve cloth and health and safety concerns.

6.3 *Mechanical Sieve Shaker*—A device that holds a stack of sieves while imparting sufficient motion to the sieves to meet the sieving thoroughness requirements covered in 8.2. The "Standard Shaking Period" must be from 10 to 20 minutes. The shaker shall have a timing device or a timing device shall be used in conjunction with the shaker.

NOTE 2—Shakers imparting a motion that causes the particles on the sieves to bounce and turn so that all particles have ample opportunity in various orientations to the sieve openings will typically meet this sieving thoroughness requirement. A sieve shaker that has a smooth horizontal and/or vertical gyratory/orbital motion will typically ***not*** meet this sieving thoroughness requirement, since the particles will not be bouncing and turning.

6.4 *Balances*—For single sieve-set sieving, one balance will be used. For composite sieving, more than one balance may be required. Balances must conform to the requirements of Specification D 4753; i.e., having a readability (with no estimation) to determine the mass of the specimen or subspecimen to a minimum of three significant digits for Method A or a minimum four significant digits for Method B. The mass of the specimen can be determined in parts (multiple mass determinations). The balance used to determine the cumulative material retained or the fractional cumulative material retained on any given sieve has to have a readability equal to or better than that used to determine the mass of the specimen/subspecimen.

NOTE 3—Preferably the balance should have a taring capability so that the mass of material can be directly determined without subtracting the mass of the container. This feature is extremely useful during the sieving process to determine the mass of the cumulative material retained or when making multiple mass determinations to determine specimen's mass.

6.5 *Drying Oven*—Thermostatically controlled oven, capable of maintaining a uniform temperature of 110 ± 5°C throughout the drying chamber. These requirements typically require the use of a forced-draft oven.

6.6 *Sieving Containers*—The containers used to: *(a)* contain the sieving specimen or material which will be sieved, such as coarser portion; *(b)* remove the retained material from the sieve(s); *(c)* collect and transfer that material; and, *(d)* contain the cumulative material retained.

6.6.1 *Specimen Containers*—Smooth walled containers, without tight corners to trap material, made of material resistant to corrosion and change in mass upon repeated heating, cooling, specimen soaking, and cleaning. The containers should be large enough to enable soaking of the specimen. The container should facilitate the transfer of the specimen from the container to the washing sieve (No. 200 (75 µm) or designated separating sieve) and back by a rinsing/washing operation, and allow for decanting the clear wash water from the container.

6.6.2 *Collection/Transfer Container*—This container is used to collect the material retained on a given sieve and to transfer it to the container holding the cumulative retained material during the sieving process. The container must be larger in diameter than the sieve. A smoothsurface 230-mm (9-in.) pie pan may be used along with a 25-mm (1-in.) paintbrush to assist in transferring all the material. The color of this container shall enhance the observation that all material has been transferred.

6.6.3 *Cumulative Mass Container*—This container shall be large enough to receive the retained material contained in the collection/transfer device without any loss. The mass should be less than the taring capacity of the balance so that the cumulative mass retained can be determined directly (see Note 3). In most cases, the specimen/subspecimen container can be used. This test method assumes that the mass of the cumulative retained material is determined directly. This approach is easier than determining the mass of retained material on each sieve.

6.7 *Sieve Brushes*—Brushes to assist in the removal of the material retained on the smaller (≤ 200-mm or 8-in.) diameter and finer sieve sizes (≤ ¾-in. (19.0-mm)). The brushes shall have the following characteristics:

6.7.1 The bristles shall be firmly attached to the brush handle so that the bristles do not become part of the retained material.

6.7.2 The bristles shall be firm and small enough to readily remove the particles entangled in the sieve openings, but made of a material that will not damage the wire cloth or wear rapidly. Wire bristles, even brass, shall ***not*** be used on wire cloth size finer than No. 20 (850–µm).

6.7.3 The bristles shall be capable of contacting the boundary between the wire cloth and sieve's frame.

6.7.4 The brush's handle shall be such that one's hand can easily control the brushing motion and pressure. An example being, the handle is above the bristles (like a paintbrush) or inclined (30- to 45-degree angle) to the bristle's head (like a vegetable brush or bent toothbrush).

6.7.5 The bristles have to be small in diameter and soft when brushing wire cloth size equal to or less than the No. 100 (150-µm) mesh. Small diameter, soft bristles will remove the particles without any re-alignment of the wire cloth.

6.7.6 Brushes meeting these requirements are relatively small round or rectangular stiff paintbrushes with shortened bristles, soft to hard toothbrushes with bent handles, and vegetable brushes with shortened bristles.

6.8 *Miscellaneous Items*—Miscellaneous items such as wash bottle, spatula, and stirring rod may be useful.

6.9 *Splitter or Riffle Box (optional, but may be required during composite sieving)*—A device to obtain a representative smaller portion (specimen) from a larger portion (sample). This device has an even number of equal width chutes, but not less than eight, which discharge alternately to each side of the splitter. For dry material having particles coarser than the ⅜-in. (9.5-mm) sieve size, the minimum width of the chutes shall be approximately 1-½ times the largest particle in material being split, but not less than 12.5 mm or ½ in. For dry material finer than or equal to the ⅜-in. (9.5-mm) sieve size, the minimum chute width shall be approximately 1-½ times the largest particle in the material, but not less than approximately 3 mm or ⅛ in. The splitter shall be equipped with two or more receptacles to hold the two halves of the material following splitting. It shall also be equipped with a hopper/feed chute (preferably lever activated or having a cut-off gate) and a straight-edged pan or dustpan that has a width equal to or slightly less than the over-all width of the assembly of chutes, by which the dry material may be fed at a controlled rate to the chutes. The splitter and accessory equipment shall be so designed that the material will flow smoothly without restriction or loss of material.

NOTE 4—Some splitters are designed such that the width of the chutes can be adjusted.

6.10 *Quartering Accessories (optional)*—A hard, clean, level surface, or durable nonporous fabric or plastic sheet approximately 2 by 2.5 m or 6 by 8 ft; a straight-edged scoop, shovel, or trowel; and a broom or brush.

6.11 *Mortar and Rubber-Covered Pestle (optional)*—Apparatus for breaking up aggregations of air-dried or oven-dried soil particles without breaking up any individual particles.

6.12 *Low Temperature Drying Oven (optional)*—Thermostatically controlled oven, capable of maintaining a uniform temperature not to exceed 60°C throughout the drying chamber, for use in air-dried processing.

6.13 *Ultrasonic Water Bath (optional)*—The ultrasonic water bath must be large enough to hold a beaker or flask containing the material to be dispersed prior to washing. The water level in the bath should be equal or higher than the water level in the specimen container.

6.14 *Dispersion Shaker (optional)*—A platform, wrist action or similar type shaker having a gyratory, orbital, reciprocating, or similar motion to assist in the dispersion process by continuously agitating the soaking soil.

7. Reagents

7.1 *Dispersant*—Sodium hexametaphosphate (sometimes referred to as sodium metaphosphate) may be required to disperse some fine-grained soils after oven drying and prior to washing. Fine-grained soils requiring the use of a dispersant are those that do not readily slake in water, such as some fat clays and most tropical soils.

7.1.1 For materials requiring a chemical dispersant, the dispersant can be added either directly to the soaking material (dry addition) or by adding a dispersant solution to the material, plus water as required.

7.1.1.1 *Dry Addition*—Add about 4 grams of sodium hexametaphosphate for each 100 mL of water that has been added to the soaking material and stir to distribute the dispersant throughout the material.

7.1.1.2 *Solution*—Make a solution by using 40 g of sodium hexametaphosphate and 1,000 g distilled, deionized, or demineralized water. Add the solution to the material, plus water if required and stir to distribute the dispersant throughout the material. The solution must be less than one week old and thoroughly mixed or shaken prior to use. The date of preparation must be indicated on the bottle or in a log.

NOTE 5—Solutions of this salt, if acidic, slowly revert or hydrolyze back to the orthophosphate form with a resultant decrease in dispersive action.

8. Preparation of Apparatus

8.1 *Verification of Sieves*—Prior to ***initial use***, each sieve shall be examined for general condition of the wire cloth as specified in Test Method One of Specification E 11. That method provides the following examination instructions, "view the sieve cloth against a uniformly illuminated background. If obvious deviations, for example, weaving defects, creases, wrinkles, and foreign matter in the cloth, are found, the wire cloth (sieve) is unacceptable." This examination shall be documented. Unacceptable sieves shall be replaced and discarded or returned to the manufacturer for repair (wire cloth).

8.1.1 *Verification Interval*—The same examination shall be performed and documented at 6-month intervals on all sieves that are placed in continuous service. However, for sieves that have a limited usage of less than about 1,000 sieve analyses per 6-month interval, then this inspection interval may be increased to 12 months. Sieves that contain excessive soil particles (about 10 % of the sieve openings contain particles) shall be thoroughly cleaned. An ultrasonic water bath may be used to clean the finer sieve sizes, while a stiffer brush or pointed tool can be used to clean the coarser sieves.

8.1.2 During each sieving process, the sieves finer than and including the No. 100 (150-μm) sieve shall be inspected for damaged cloth, such as tearing at the frame contact. This inspection can be done while the retained material is being removed from the sieve during the sieving process. This inspection does not need to be documented.

8.2 *Verification of Mechanical Sieve Shaker and Standard Shaking Period*—Prior to initial use, the mechanical sieve shaker shall be checked for sieving thoroughness using applicable sieve sets (typically used coarser and finer) and representative material. In addition, the standard shaking period shall be determined for each applicable sieve set. For each size sieve set, follow the guidance given for single sieve-set sieving (see 11.4). Use enough material (specimen) of known mass (g or kg) such that each sieve in the set, except one or two, will have some retained material but no sieve will be overloaded. Shake the sieve set for ten minutes with the mechanical shaker. Upon completion of mechanical shaking, start with the largest sieve size and place the snug-fitting lid on top of the sieve and the pan underneath it. Shake each sieve by hand, for about one minute using the hand shaking procedure (see 8.2.3). For each sieve, determine the mass of material retained on the sieve and in the pan, to the nearest 0.01 g or one part in 1,000, whichever is largest. The ratio of the material mass in the pan to the specimen's mass multiplied by 100 for each sieve shall be less than 0.5 %. If all ratios are less than 0.5 %, the sieve shaker with a 10-minute shaking period is adequate and shall be used as the standard shaking period for that sieve set. If any ratio exceeds 0.5 %, repeat the process using a 15-minute shaking period. If this shaking period meets the above criterion, then it shall be used as the standard shaking period for that sieve set, unless a shorted shaking period, like 12 minutes is verified as adequate. If the 15-minute shaking period fails, then try the maximum allowable shaking period of 20 minutes. If the 20-minute shaking period fails, then the mechanical sieve shaker shall be considered inadequate for sieving. It shall either be repaired or discarded. After repair, repeat the instructions given above to determine the standard shaking period.

8.2.1 *Large Mechanical Sieve Shaker*—If a larger mechanical sieve shaker is used to shake large diameter (greater than 200 mm or 8 in.) or rectangular sieve sets and hand shaking is not practicable, then transfer the retained material in appropriate increments to a 200- mm or 8-in. diameter sieve of equal sieve designation, with lid and pan, and shake for one minute. Follow the instructions given above to determine the standard shaking period for each sieve set.

8.2.2 *Verification Interval*—The same verification shall be performed and documented at 12-month intervals for each sieve shaker placed in continuous service. However, for sieve shakers that have a limited usage of less than about 1,000 sieve analyses per 12-month interval, then this inspection interval may be increased to 24 months. Not all sieve set sizes (coarser and finer) have to be re-verified unless the standard shaking time changes for the sieve set being verified. The finer sieve set or the set having the longest standard shaking period shall be used for re-verification.

8.2.3 *Hand Sieve Shaking Procedure*—For 200-mm or 8-in. diameter sieves, hold the individual sieve, with lid and pan, in a slightly inclined (about 15°) position in one hand. Strike the side of the sieve sharply with the heel of the other hand using an upward motion and at a rate of about 150 times per minute, turn the sieve about one sixth of a revolution at intervals of about 25 strokes. Continue for about one minute.

8.2.3.1 For larger diameter or rectangular sieves, transfer the retained material to 200-mm or 8-in. diameter sieves, in appropriate portions to prevent overloading (see 11.3), and follow the above instructions for each portion.

9. Sampling

9.1 *General*—This test method does not cover, in any detail, procurement of the sample. It is assumed that the sample is obtained using appropriate methods and is representative. However, the testing agency shall preserve all samples in accordance with Practice D 4220, Group B; except if the as-received sample does not meet those requirements. In that case, the water content of the material does not have to be maintained. The mass of the sample shall meet or exceed the mass requirements for the specimen, as given in Table 2(see 10.2).

9.2 *Sample Sources*—The sample for a sieve analysis can be from a variety of sources and contain a wide range of particle sizes. Typically, samples for sieve analysis are obtained in the following forms: bulk samples (large bag or bucket samples), small bag or jar samples, tube samples, or specimens from other tests (such as strength, consolidation or hydraulic conductivity). In some cases, (e.g., compaction testing) prior testing may cause a reduction of particle sizes. For these cases, the sieve analysis may be required on the initial specimen, or the degraded specimen or both. An overview of how specimens may be selected for various sample types is given below; whereas details for obtaining specimens from samples are in Section 10.

9.2.1 *Bulk Samples*—Generally, bulk samples are obtained because multiple tests are required or large particles are present, or both. In addition, the bulk sample will usually become the specimen and composite sieving will be required. If other testing is required, these tests should be coordinated with the sieve analysis so that all specimens are obtained efficiently and representatively using moist (preferred) or air-dried procedure. For example, Test Method D 698 or D 1557 is frequently requested on bulk samples in addition to the sieve analysis. For this test, it is probably most efficient to process the as-received sample, now a specimen, over the designated separating sieve having either the ¾-in. (19.0-mm), ⅜-in. (9.5-mm) or No. 4 (4.75- mm) sieve and obtain the sieve specimens (coarser and finer portions) during this processing. Although oversize particles (coarser portion) are not used in testing with D 698 or D 1557, the composite sieve analysis should be calculated to represent both the bulk sample and the compaction material (two gradations). Flowcharts presenting an overview of this procedure are presented in Fig. 2 through Fig. 4(b).

9.2.2 *Jar and Small Bag Samples*—Depending on the sample's gradation, it may be necessary to use the entire sample for the specimen. Observe and estimate the maximum particle size. If the amount of material in the sample is less than the minimum mass required (as given in Table 2), note that the specimen is undersized. If the amount (by mass) of sample is much more (by about 50 %) than needed, the sample can be reduced using moist (preferred) or oven-dried procedure. If there is other testing to be obtained from the sample, it may be best to perform the other testing, such as water content and specific gravity and then sieve the used material. Note on the data sheet if prior testing has been performed on the specimen. This approach cannot be used for tests that might alter the gradation of the soil, such as Atterberg Limits.

9.2.3 *Undisturbed Tube Samples*—To obtain a sieve analysis specimen from an undisturbed tube sample, extrude either the entire sample, or a portion. Observe and estimate the maximum particle size. Use moist procedure (see 10.4.1) to obtain the required specimen.

9.2.4 *Samples from Prior Testing*—Frequently, after strength, hydraulic conductivity, consolidation or other testing has been completed, that specimen or a portion of it (from water content) is used for a sieve analysis specimen. The entire specimen can be used or split using the most appropriate procedure for specimen selection (moist or oven dried). If the specimen mass is less than required according to Table 2, note that the specimen is undersized on the data sheet. There may be conditions when it is undesirable to test the entire specimen due to the nonhomogeneity of the specimen. If there are layers in the specimen, it may be necessary and more useful to determine the gradation of individual layers.

10. Specimen

10.1 *General*—This section is separated into four parts. The mass requirement for the specimen is given in the first part (*Minimum Mass Requirement*). In the second part on *Selection of Sieving Procedure*, the determination of which sieving procedure applies, single sieve-set or composite sieving, is explained. In the third part on *Specimen Procurement*, an overview of the three applicable procedures (moist, air dried and oven dried) for use in obtaining a specimen from the sample and processing it for sieving is given. Following this overview is a discussion about special considerations relating to soils that readily segregate. In the fourth part on *Specimen Procurement and Processing Requirements*, details are given on how the above moist, air-dried and oven-dried procedures are to be applied to obtain a specimen(s) and prepare it for single sieve-set or composite sieving.

10.2 *Minimum Mass Requirement*—The minimum dry mass needed for a sieve analysis specimen is based on the maximum particle size in the sample and the test method (Method A or B) used to record the data. Based on the estimated maximum particle size, use Table 2 to determine the minimum mass of the specimen in g or kg.

10.3 *Selection of Sieving Procedure*—As shown in Fig. 2, the first decision step in this test method is to estimate the maximum particle size contained in the sample and then determine, based on the assigned Method (A or B), if single sieve-set sieving or composite sieving procedure is required.

10.3.1 *Single Sieve-Set Sieving*—For Method A, this procedure applies to samples having a maximum particle size equal to or less than 9.5 mm (⅜-in. sieve). For Method B, this procedure applies to samples having a maximum particle size equal to or less than 4.75 mm (No. 4 sieve). However, if the material is ***not*** relatively well graded, then these acceptable maximum particle sizes may be smaller. If Method B is assigned and the sample has a maximum particle size larger than 4.75 mm, then this non-conformance should be noted on the data sheet and if necessary, inform the requesting authority. In addition, switch to Method A and if necessary, composite sieving.

10.3.1.1 Single sieve-set sieving ***could*** apply to samples having a maximum particle size up to 19.0 mm (¾-in. sieve) or possibly the 25.4 mm (1-in. sieve); providing Method A applies and the mass of the specimen meets the requirements presented in Table 2. In addition, it depends on the gradation of the sample, the size (diameter) of sieves being used, and if the tester wants to sieve the specimen in portions.

10.3.2 *Composite Sieving*—This procedure applies to samples having a maximum particle size equal to or greater than 19.0 mm (¾-in. sieve), unless 10.3.1.1 applies.

10.4 *Specimen Procurement*—This test method presents three procedures to obtain a representative specimen from the sample (moist, air-dried and oven-dried). In these procedures, the terms moist, air-dried or oven-dried refer to the condition of the material or sample as it is being processed to obtain the specimen. Additional guidance for splitting material to obtain a representative portion (specimen) using a splitter, quartering or moist stockpile sampling (Practice C 702, Methods A, B and C, respectively) is given in Annex A2.

10.4.1 *Moist Procedure*—The sample is processed and split using moist stockpile sampling or quartering, if required, in a moist, as-received state to obtain a representative specimen, unless the material is excessively wet or dry. This procedure is the preferred method for soils that readily segregate in a dry state such as coarse-grained soils with or without fines, or fine-grained soils containing coarse-grained particles, see 10.4.4. In addition, it is the preferred method for any sample containing soil whose properties are altered due to drying, and testing to determine those properties is required. These soil types may include most organic soils; many highly plastic fine-grained soils; tropical soils; and soils containing halloysite. Examples of such testing may include compaction, Atterberg Limits, specific gravity, and gradation by sedimentation. For samples requiring composite sieving, the sample typically becomes the specimen and requires additional processing as covered in 10.5.2.

10.4.2 *Air-Dried Procedure*—The sample is air dried, and then processed and split, if required, using only a splitter to obtain the required specimen. The specimen is oven dried, washed, re-dried and then sieved. For samples requiring composite sieving, the sample typically becomes the specimen and requires additional processing as covered in 10.5.5.

10.4.3 *Oven-Dried Procedure*—The sample is oven dried, and then processed and split using only a splitter, if required, to obtain the required specimen. The specimen is washed, re-dried, and then sieved. For samples, especially large ones requiring composite sieving and other testing, this procedure is typically not practical and shall not be used for soil types mentioned in 10.4.1.

10.4.4 *Discussion on Segregating Soils*—There are some special considerations relating to soils that readily segregate (such as gravels and sands, with or without fines). Experience gained from the ASTM Reference Soils and Testing Program and obtained at AASHTO Materials Reference Laboratory (AMRL) has clearly demonstrated the following conclusions. When dealing with soils that readily segregate and are in an air-dried or oven-dried state, the splitting processes (Practice C 702, Method A) cannot be used more than a few times to obtain a representative specimen. The resulting specimen will have less fine sand and finer particles than the sample. This standard specifies when using a splitter, there cannot be more than two splitting operations (splits) to obtain the specimen. This number is based on judgment. There will be cases when more or less splits would be appropriate; however, use extreme caution in selecting more than two splits. For referee testing two splits cannot be exceeded. The method to obtain representative specimens from these soils requires that the soils be in a moist state. The water content should optimize bulking or be slightly wetter than the saturated surface-dry condition. This water content is to the point that the surface of the soil should look slightly wet but there are no signs of free water exiting the soil. This will minimize particle segregation and loss. The sample can be mixed and readily scooped/shoveled to obtain representative portions of the material (Practice C 702, Method C, see A2.1.3). This procedure is especially useful if the maximum particle size is less than about 19.0 mm (¾-in. sieve).

10.5 *Specimen Procurement and Processing Requirements*:

10.5.1 *Moist Procedure, Single Sieve Set Sieving*—If single sieve-set sieving applies, as determined in 10.3, then either select the whole sample or split the sample after it is mixed in the as-received condition, unless it is too dry or wet for processing to obtain a representative specimen, see 10.5.1.2.

10.5.1.1 If the sample contains standing water or is very wet; then it may be dried back to a moist state, as defined in 10.4.1, 10.4.4, or A2.1.3, by air-drying or oven-drying (60°C). If oven drying is used, the sample is placed in a low temperature, drying oven (not to exceed 60°C) and mixed frequently to avoid excessive drying of any portion of the sample. If the sample is too dry; then water can be added (preferably by spraying) while the sample is being mixed to a moist state.

10.5.1.2 After mixing, obtain a representative specimen having the required mass (Table 2) by taking one or more scoops from the sample. The number of scoops shall increase as the mass of the specimen increases and come from various locations, and each scoop shall have about an equal mass, see A2.1.3. Place all the material in the scoop into the specimen container of known mass (g or kg). In this process, do not attempt to obtain an exact mass or increase the specimen size by adding very small amounts of material. For relatively well-graded coarse-grained soils, especially relatively clean ones containing gravel and coarse sand; do not add material by shaking it off the edge of the scoop. All of these processes could result in altering the gradation of the specimen. Oven dry the specimen (110 ± 5°C), see Notes 6 and 7. Record the identification of the specimen container and the mass (g or kg) of the container on the data sheet. Proceed to Section 11 on *Procedure (Sieving)*.

NOTE 6—For non-referee testing, it is acceptable practice to determine the oven-dried mass of a specimen or subspecimen, based on its moist mass and water content determined to the nearest 1 % for Method A or 0.1 % for Method B.

NOTE 7—This procedure for selecting material from a sample is basically the same as that presented in Practice C 702, Method C—Miniature Stockpile Sampling (Damp Fine Aggregate Only) and summarized in A2.1.3.

10.5.2 *Moist Procedure, Composite Sieving*—For composite sieving, typically the whole sample becomes the specimen. If splitting is required, obtain a representative portion by either the moist stockpile sampling procedure, as described in 10.5.1.2 or quartering (see A2.1.2). For an overview of the composite sieving method, refer to Fig. 2 through Fig. 4(b). In composite sieving, the following information must be obtained:

(a) The oven-dried mass of the coarser portion retained on designated separating sieve, CP,M_d in g or kg,

(b) The moist mass of the finer portion passing the designated separating sieve, FP,M_m in g or kg,

(c) The water content of a subspecimen obtained from the finer portion, w_{fp} in %,

(d) The calculated oven-dry mass of the finer portion, FP,M_d in g or kg, and

(e) The oven-dry mass of the subspecimen obtained from the finer portion for sieving over the finer sieve set, $SubS,M_d$ in g or kg.

10.5.2.1 If required, adjust the moisture condition of the material by drying or adding water as described in 10.5.1.1.

10.5.2.2 Select a designated separating sieve following the guidance given in 9.2.1 on *Bulk Samples* and Note 8. Process the specimen over this sieve. Manually or mechanically shake, or wiggle the finer portion through the sieve and collect both the coarser and finer portions. Remove any large conglomerations from the designated separating sieve and break them into individual particles or into conglomerations that are smaller than the openings in the designated separating sieve. Return the soil to the designated separating sieve and continue processing. Do not apply pressure that could damage the sieve. If fines are adhering to the coarser particles, scrape or brush these larger particles and dislodge the fines. If the fines are adhering into large clumps, use knives or spatulas to cut the clumps into chucks that will pass the designated separating sieve.

NOTE 8—Smaller cloth size of the designated separating sieve increases the difficulty in processing the material and having a limited amount of the fines adhering to the retained particles. In addition, selection of the designated separating sieve size may be based on ease of separating the specimen, additional testing to be performed, or convenience. For very plastic, clayey materials, it is easier to select a larger designated separating sieve. For materials that require compaction testing using either D 698 or D 1557, it is easiest to use the sieve (either No. 4 (4.75 µm), ⅜ in. (9.5 mm) or ¾ in. (19.0 mm)) required for the compaction method. Some laboratories are equipped with two sets of mechanical sieve shakers depending on size range, and, hence, the selection would be based on the equipment. There can be more than one designated separating sieve used in composite sieving, because the first subspecimen can be split again to obtain a second subspecimen.

10.5.2.3 *Coarse Portion Acceptable Loss (CP_L)*—It is usually not possible to remove all the fines (particles that would pass the designated separating sieve) adhering to the retained coarser particles. For the finer portion to be representative, the amount adhering to the retained coarser particles has to be less than 0.5 % of the dry mass of the specimen (S,M_d), see Note 8. If it appears that the material adhering to the retained portion will exceed the 0.5 % criterion, then the retained portion must be washed using a minimum amount of water and the washings added to the portion passing the designated separating sieve. The actual value will be determined at the end of the test.

10.5.2.4 Place the coarser portion in a suitable container of known mass (g or kg) and oven dry it (110 ± 5°C). Record the container identification and mass on the data sheet. If the water content of the coarser portion is required (for example to report the as received condition), determine it in accordance with Test Method D 2216. Record the oven dry mass of the coarser portion, CP,M_d in g or kg.

10.5.2.5 Determine and record the moist mass (g or kg) of finer portion, using a balance meeting the requirements given in 6.4 and 11.2. Depending on the size of this portion, this mass determination can be done in increments as the material is being processed or after it has been processed. Record this moist mass as FP,M_m in g or kg.

10.5.2.6 Mix the moist finer fraction and obtain a representative subspecimen for both a water content determination and sieving using the moist stockpile sampling procedure, see 10.5.1.2. The finer portion subspecimen shall have a mass meeting the requirements given in Table 2. Record the container identification, mass of the container, and mass of the container plus moist material representing the finer portion subspecimen. The balance used shall meet or exceed the requirements of Test Method D 2216 for water contents determined to the nearest 1 % or better.

10.5.2.7 Oven-dry the subspecimen in the oven at 110 ± 5°C. Calculate and record the water content, w_{fp}. Determine and record the dry mass of the subspecimen as $SubS,M_d$ in g or kg. If this subspecimen requires a second separation, (see Fig. 4(a) and Fig. 4(b)—composite sieving with double separation) processing the second subspecimen will be performed later (see 11.6).

10.5.2.8 Determine the dry mass of the specimen (coarser portion plus finer portion) in g or kg, see 12.4, and proceed to Section 11 on *Procedure (Sieving)*.

10.5.3 *Air Dried Procedure, General*—This method requires the use of a splitter to obtain a specimen from a sample that has been air-dried, unless the whole sample is tested. Therefore, this procedure can only be used for smaller samples in which no more than two splitting processes will be required, see 10.4.4. Typically, this procedure would only be used for soils coming from an arid region in which the soil will become air-dried and when other testing requires an air-dried condition.

10.5.3.1 Depending on the size of the sample, place the material either on a tray(s)/pan(s), smooth tarp/plastic sheet/etc. or sealed-smooth floor (prevent loss of fines) and air-dry. Alternatively, an oven not exceeding 60°C may be used. Upon the completion of air-drying; place the material into either a