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

Designation: D4381 – 22

Standard Test Method for Sand Content by Volume of Construction Slurries[1]

This standard is issued under the fixed designation D4381; 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*

1.1 This test method covers the determination of the sand content of bentonitic slurries used in slurry construction techniques. This test method has been modified from API Recommended Practice 13B.

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

1.3 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard. Except, the sieve designation is identified using the "alternative" system in accordance with Practice E11 instead of the "standard system," such that the sieve used is referred to as a No. 200 sieve, instead of a 75 µm sieve.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D1796 Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory 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

D6026 Practice for Using Significant Digits and Data Records in Geotechnical Data

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

E542 Practice for Gravimetric Calibration of Laboratory Volumetric Instruments

2.2 *American Petroleum Institute (API) Standard:*

API RP 13B Recommended Practice Standard Procedure for Testing Drilling Fluids[3]

3. Terminology

3.1 *Definitions:*

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

4. Summary of Test Method

4.1 The measuring tube of the sand-content set (Fig. 1) is filled with construction slurry and water to the appropriate marks and is shaken. The mixture is poured through the sieve. The funnel is fitted over the top of the screen and the assembly inverted, inserting the tip of the funnel into the measuring tube. All material is washed from the screen and the amount of sand read in the measuring tube, as percent by volume.

5. Significance and Use

5.1 This test method is used to determine the percentage of sand by volume in construction slurry. The significance of this test method mainly relates to construction slurries used for concrete wall and drilled piers construction. The range of measurement is too limited for use in applications where the sand content is intended to be greater than 20 %, such as in the cases of cement bentonite or soil bentonite walls.

5.2 A high sand content in the construction slurry is abrasive for construction plant such as pumps, and is furthermore adverse to the formation of a filter cake in applications where bentonite fluid is used to stabilize an excavation.

NOTE 1—The quality of the result produced by this standard depends on the competence of the personnel performing it and the suitability of the equipment and facilities being used. Agencies that meet the criteria of

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.16 on Grouting.

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[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.

[3] Available from American Petroleum Institute (API), 200 Massachusetts Ave. NW, Suite 1100, Washington, DC 20001, http://www.api.org.

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

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NOTE 1—Photo courtesy of N. L. Baroid–N. L. Industries, Inc., Houston, TX.

FIG. 1 Sand-Content Set

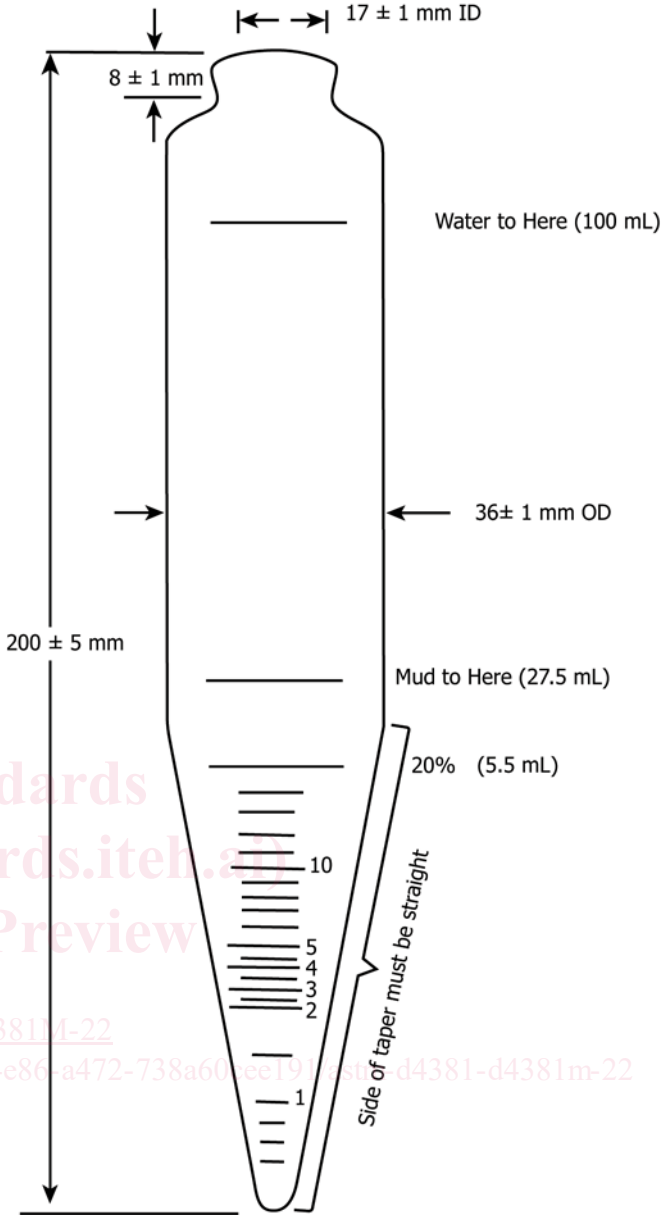

FIG. 2 Measuring Tube Dimensions

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Practice D3740 are generally considered capable of competent and objective testing, sampling, inspection, etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself ensure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Sand-Content Set* (see Fig. 1), consisting of the following:

6.1.1 *Sieve,* No. 200 mesh, shall be 50 mm in diameter.

6.1.2 *Funnel,* to fit screen and measuring tube.

6.1.3 *Measuring Tube, each:*

6.1.3.1 The measuring tube shall be a 200 mm long cone shaped centrifuge tube, conforming to the dimensions and tolerances given in Fig. 2 and made of thoroughly annealed glass. The taper shall be uniform, and the bottom shall be rounded. All graduations shall be clear and distinct. Scale error tolerances of the graduations apply to calibrations made with air-free water at 20°C, when reading the bottom of the shaded meniscus. Practice E542 references standards that address graduation marks and other glassware specifications in detail.

6.1.3.2 The mud line graduation shall correspond to a volume of 27.5 mL, and the water line graduation shall correspond to a volume of 100.0 mL, as shown in Fig. 2. The limit of error in determining these graduations shall not exceed 1.0%.

6.1.3.3 Sand content graduations shall be marked volumes as percentages from 0 to 20 % and as shown in Fig. 2. The limit of error in determining these graduations are given in Table 1.

NOTE 2—Volume of sand, including void spaces between grains, is measured and expressed as percent by volume of construction slurry.

6.1.3.4 The accuracy of the graduation marks shall be gravimetrically certified, in accordance with Practice E542 using equipment traceable through the National Institute for

TABLE 1 Measuring Tube Graduation Tolerances

Marking	Scale Division, %	Limit of Error, %
0.00 % – 1.00 %	0.25 %	0.10 %
1.00 % – 5.00 %	0.50 %	0.20 %
5.00 % – 10.00 %	1.00 %	0.50 %
10.00 % – 20.00 %	2.00 %	1.00 %

Standards and Technology (NIST). The verification and certification shall include verification for each mark through the 1 % mark, of the 5 %, 10 %, and 20 % marks; and of the mud line and water line marks. The tube shall not be used if the scale error exceeds the applicable tolerances specified in 6.1.3.2 and 6.1.3.3.

6.1.3.5 A tube may be marked with graduations identifying volumes in lieu of the marking scheme described in 6.1.3.2 and 6.1.3.3, with tubes used in widely practiced test methods such as Test Method D1796, provided that the tube calibration demonstrates that volumetric graduations correspond to the graduations described in this standard and meets the requirements of this standard.

7. Calibration

7.1 The tube and funnel shall be checked on each test occasion that they are clean and free of foreign material. Rinse and mechanically remove any mud or foreign material prior to conducting a test.

7.2 Borosilicate volumetric glassware will hold its calibration indefinitely provided the test procedures are followed faithfully and are used for the specified test purpose only. Practice E542 describes some of the conditions that can limit the calibration interval of similar glassware. As a precaution, it is recommended that the glassware be recalibrated after ten years of service regardless of its appearance.

7.3 The wire cloth on the sieve shall be clean and unperforated. The wire mesh shall be inspected for damaged cloth, such as tearing at the frame contact. Specification E11 covers such checks in detail. This inspection shall be documented. An ultrasonic bath may be used to clean the sieve.

7.4 The sieve evaluation shall be performed and documented at a six month interval. However, for sieves that have limited usage of less than about 1,000 sieve analyses per 6-month interval, than this interval may be increased to 12 months.

8. Sampling and Test Specimen

8.1 Obtain a representative sample of the slurry to be tested to the beaker capacity using dippers, buckets, mud or slurry samplers, or equivalent equipment from a laboratory slurry mix or field construction operation.

8.2 The sample size shall not be less than 1L and shall be in an appropriate container or beaker with a spout.

8.3 The specimen shall be sampled from thoroughly-mixed slurry immediately prior to testing.

NOTE 3—When allowed to sit undisturbed, slurries containing clay and/or other viscosity modifiers may form a gel, which may affect the flow into the beaker and produce an unrepresentative specimen. Particles in slurries may also settle if allowed to sit, which may result in variable density in the sample and an unrepresentative specimen.

9. Procedure

9.1 Fill the measuring tube to the designated mark with construction slurry.

9.2 Add water to the next designated mark.

9.3 Close the mouth of the tube and shake vigorously.

9.4 Pour the mixture into the clean, No. 200 mesh sieve.

9.5 Discard the liquid that passes through the sieve.

9.6 Add more water to the tube, shake, and pour into the sieve. Repeat until the water which passes through the sieve is clear.

9.7 Wash the sand retained on the sieve to clean any remaining slurry.

9.8 Attach the funnel upside down over the top of the sieve.

9.9 Carefully invert the assembly and insert the tip of the funnel into the mouth of the measuring tube.

9.10 With a fine spray of water, wash the sand retained on the sieve back into the measuring tube.

9.11 Allow the sand to settle.

9.12 For tubes with markings in units of percentage of the volume of construction slurry originally added in 9.1, record the percentage of sand as marked on the tube to the nearest scale division. For tubes with markings in units of volume, read the volume of sand from the graduations on the measuring tube to the nearest scale division, and report the volume as a percent of the volume of construction slurry originally added in 9.1.

9.13 Wash and dry all equipment thoroughly after each test.

10. Report: Test Data Sheet(s)/Form(s)

10.1 The methodology used to specify how data are recorded on the test data sheet(s)/form(s), as given below, is covered in 1.2 and Practice D6026.

10.2 Record as a minimum the following general information (data):

10.2.1 Sample/specimen identifying information, such as location, project, date and time, the source of the slurry tested, such as its station and depth, person who conducted the test, and general testing conditions.

10.3 Record as a minimum the following sand content data:

10.3.1 The sand content of the slurry to the nearest scale division.

10.3.2 Notable foreign material if any.

11. Precision and Bias

11.1 *Precision*—Test data on precision is not presented due to the nature of this test method and the construction slurry. Having ten or more agencies participate in an in situ testing program at a given site is either not feasible or too costly at this time.

11.1.1 Subcommittee D18.16 is seeking any data from the users of this test method that might be used to make a limited statement on precision.

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