Designation: D 2419 – 95

Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate[1]

This standard is issued under the fixed designation D 2419; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method is intended to serve as a rapid field-correlation test. The purpose of this test method is to indicate, under standard conditions, the relative proportions of clay-like or plastic fines and dust in granular soils and fine aggregates that pass the No. 4 (4.75-mm) sieve. The term "sand equivalent" expresses the concept that most granular soils and fine aggregates are mixtures of desirable coarse particles, sand, and generally undesirable clay or plastic fines and dust.

NOTE 1—Some agencies perform the test on material with a top size smaller than the No. 4 (4.75-mm) sieve. This is done to avoid trapping the clay-like or plastic fines and dust below flaky shaped No. 4 to 8 (4.75 to 2.36 mm) sized particles. Testing smaller top sized material may lower the numerical results of the test.

1.2 *Units of Measurement*:

1.2.1 With regard to sieve sizes and the size of aggregate as determined by the use of testing sieves, the values in inch-pound units are shown for the convenience of the user; however, the standard sieve designation shown in parentheses is the standard value as stated in Specification E 11.

1.2.2 With regard to mass, the values shown in SI units are to be regarded as the standard.

1.2.3 With regard to other units of measure, the values stated in inch-pound units are to be regarded as standard.

1.3 *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:*

C 125 Terminology Relating to Concrete and Concrete Aggregates[2]

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[2]

C 702 Practice for Reducing Samples of Aggregate to Testing Size[2]

D 75 Practice for Sampling Aggregates[3]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[4]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[5]

2.2 *AASHTO Standard:*

T 176 Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of Sand Equivalent Test[6]

3. Terminology

3.1 *Definitions:*

3.1.1 *fine aggregate*—aggregate passing the ⅜-in. (9.5-mm) sieve and almost entirely passing the No. 4 (4.75-mm) sieve and predominantly retained on the No. 200 (75-µm) sieve (see Terminology C 125).

3.1.2 *sand equivalent*—a measure of the amount of silt or clay contamination in the fine aggregate (or soil) as determined by test (see Terminology D 653). (For further explanation, see Summary of Test Method and Significance and Use.)

3.1.3 *soil*—sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks which may or may not contain organic matter (see Terminology D 653).

4. Summary of Test Method

4.1 A measured volume of soil or fine aggregate and a small quantity of flocculating solution are poured into a graduated plastic cylinder and are agitated to loosen the claylike coatings from the sand particles in the test specimen. The specimen is then "irrigated" using additional flocculating solution forcing the claylike material into suspension above the sand. After a prescribed sedimentation period, the height of flocculated clay is read and the height of sand in the cylinder is determined. The sand equivalent is the ratio of the height of sand to the height of clay times 100.

5. Significance and Use

5.1 This test method assigns an empirical value to the relative amount, fineness, and character of claylike material

[1] This test method is under the jurisdiction of ASTM Committee D-4 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.51 on Aggregate Tests.

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.03.

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

[5] *Annual Book of ASTM Standards*, Vol 14.02.

[6] Available from American Association of State Highway and Transportation Officials, 444 N. Capitol St. NW, Suite 225, Washington, DC 20001.

present in the test specimen.

5.2 A minimum sand equivalent value may be specified to limit the permissible quantity of claylike fines in an aggregate.

5.3 This test method provides a rapid field method for determining changes in the quality of aggregates during production or placement.

6. Interferences

6.1 Maintain the temperature of the working solution at 72 ± 5°F (22 ± 3°C) during the performance of this test.

NOTE 2—If field conditions preclude the maintenance of the temperature range, frequent referee samples should be submitted to a laboratory where proper temperature control is possible. It is also possible to establish temperature correction curves for each material being tested where proper temperature control is not possible. However, no general correction should be utilized for several materials even within a narrow range of sand equivalent values. Samples that meet the minimum sand equivalent requirement at a working solution temperature below the recommended range need not be subject to referee testing.

6.2 Perform the test at a location free from vibration. Excessive vibration may cause the suspended material to settle at a greater rate than normal.

6.3 Do not expose the plastic cylinders to direct sunlight any more than is necessary.

6.4 Occasionally it may be necessary to remove a fungus growth from the working calcium chloride solution container and from the inside of the flexible tubing and irrigator tube. This fungus can easily be seen as a slimy substance in the solution, or as a mold growing on the inside of the container.

6.4.1 To remove this growth, prepare a cleaning solvent by diluting sodium hypochlorite solution (household chlorine bleach) with an equal quantity of water.

6.4.2 After discarding the contaminated solution, fill the solution container with the prepared cleaning solvent: allow about 1 L of the cleaning solvent to flow through the siphon assembly and irrigator tube, then place the pinch clamp on the end of the tubing to cut off the flow of solvent and to hold the solvent in the tube. Refill the container and allow to stand overnight.

6.4.3 After soaking, allow the cleaning solvent to flow out through the siphon assembly and irrigator tube.

6.4.4 Remove the siphon assembly from the solution container and rinse both with clear water. The irrigator tube and siphon assembly can be rinsed easily by attaching a hose between the tip of the irrigator tube and water faucet and backwashing fresh water through the tube.

6.5 Occasionally the holes in the tip of the irrigator tube may become clogged by a particle of sand. If the obstruction cannot be freed by any other method, use a pin or other sharp object to force it out using extreme care not to enlarge the size of the opening.

6.6 Working solution which is more than two weeks old shall be discarded.

6.7 Mixing and storage container(s) for solutions shall be thoroughly rinsed prior to mixing a fresh batch of solution.

6.8 Fresh solution shall not be added to old solution regardless of age.

7. Apparatus

7.1 A graduated transparent acrylic plastic cylinder, rubber stopper, irrigator tube, weighted foot assembly and siphon assembly all conforming to the respective specifications and dimensions shown in Fig. 1. See Annex A1 for alternative apparatus.

7.2 *Measuring Tin*— A cylindrical tin approximately 2¼-in. (57 mm) in diameter having a capacity of 85 ± 5 mL.

7.3 *No. 4 (4.75-mm) Sieve*, conforming to the requirements of Specification E 11.

7.4 *Funnel*, wide-mouth, for transferring test specimens into the graduated cylinder.

7.5 *Bottles*, two 1.0-gal (3.8-L) to store stock solution and working solution.

7.6 *Flat Pan*, for mixing.

7.7 *Clock or Watch*, reading in minutes and seconds.

7.8 *Mechanical Sand Equivalent Shaker*, designed to hold the required graduated plastic cylinder in a horizontal position while subjecting it to a reciprocating motion parallel to its length and having a throw of 8 ± 0.04 in. (203.2 ± 1.0 mm) and operating at 175 ± 2 cpm. A typical apparatus is shown in Fig. 2. The shaker shall be securely fastened to a firm and level mount.

NOTE 3—Moving parts of the mechanical shaker should be provided with a safety guard for protection of the operator.

7.9 *Manually Operated Sand Equivalent Shaker*—(optional), as shown in Fig. 3, or equivalent, capable of producing an oscillating motion at a rate of 100 complete cycles in 45 ± 5 s, with a hand-assisted half stroke length of 5 ± 0.2 in. (127 ± 5 mm). The device shall be designed to hold the required graduated cylinder in a horizontal position while subjecting it to a reciprocating motion parallel to its length. The shaker shall be fastened securely to a firm and level mount. If only a few tests are to be run the shaker may be held by hand on a firm level mount.

7.10 *Oven*, of sufficient size, and capable of maintaining a temperature of 230 ± 9°F (110± 5°C).

7.11 *Filter Paper*, Watman No. 2V or equivalent.

8. Reagents and Materials

8.1 *Stock Solution*— The materials listed in 8.1.1, 8.1.2 or 8.1.3 may be used to prepare the stock solution. If the use of formaldehyde as the biocide is of concern, the materials in 8.1.2 or 8.1.3 should be used. A fourth alternative is not to use any biocide provided the time of storage of stock solution is not sufficient to promote the growth of fungi.

8.1.1 Stock solution with formaldehyde.

8.1.1.1 *Anhydrous Calcium Chloride*, 454 g (1.0 lb) of technical grade.

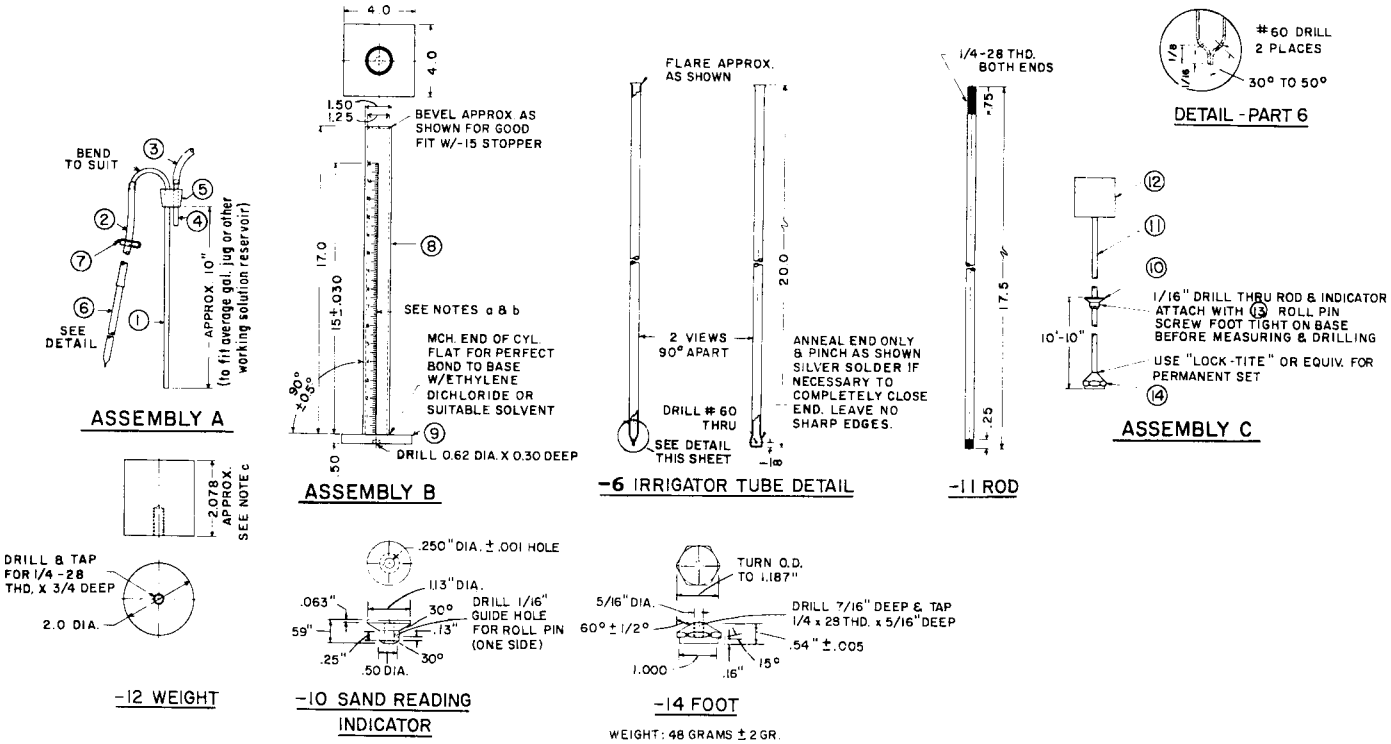
8.1.1.2 *USP Glycerin*, 2050 g (1640 mL).

8.1.1.3 *Formaldehyde*, (40 volume % solution) 47 g (45 mL).

8.1.1.4 Dissolve the 454 g (1.0 lb) of calcium chloride in 1.89 L (½ gal) of distilled water. Cool and filter through ready pleated rapid filtering paper. Add the 2050 g of glycerin and the 47 g of formaldehyde to the filtered solution, mix well, and dilute to 3.78 L (1 gal).

8.1.2 Stock solution with glutaraldehyde.

8.1.2.1 *Calcium Chloride Dihydrate*, 577 g (1.27 lb) of A. C. S. grade.



List of Material

Assembly	Part No.	Description	Stock Size, In.	Material
A		*Siphon Assembly:*		
	1	siphon tube	¼diameter by 16	copper tube (may be plated)
	2	siphon hose	3/16ID by 48	rubber tube, pure gum or equivalent
	3	blow hose	3/16ID by 2	rubber tube, pure gum or equivalent
	4	blow tube	¼diameter by 2	copper tube (may be plated)
	5	2-hole stopper	No. 6	rubber
	6	irrigator tube	¼OD 0.035 wall by 20 SS tube, Type 316	
	7	clamp	Pinchcock, Day, BKH No. 21730 or equivalent	
B [A,B]		*Graduate Assembly:*		
	8	tube	1.50 OD by 17	transparent acrylic plastic
	9	base	¼ by 4 by 4	transparent acrylic plastic
C [C]		*Weighted Foot Assembly:*		
	10	sand reading indicator	1¼diameter by 0.59	nylon 101 type 66 annealed
	11	rod	¼ diameter by 17½	brass (may be plated)
	12	weight	2 diameter by 2.078	C. R. steel (may be plated)
	13	roll pin	1/16 diameter by½	corrosion-resistant metal
	14	foot	11/16 hex by 0.54	brass (may be plated)
	15	solid stopper	No. 7	rubber

[A] *Assembly B*—Accuracy of scale should be± 0.010 in. per tenth of an inch. Error at any point on scale should be± 0.030 in. of true distance to zero.
[B] *Assembly B*—Graduations on graduate should be in tenths of an inch. Inch marks should be numerically designated as shown. The inch and half-inch division lines should be approximately ¼ in. long. All division lines should be 0.015 in. deep with width across top 0.030 in.
[C] *Assembly C*—Weighted foot assembly should weigh 1000 ± 5 g.

Metric Equivalents

in.	mm	in.	mm	in.	mm	in.	mm
0.001	0.025	0.13	3.30	0.62	15.75	2	50.80
0.005	0.127	3/16	4.76	0.63	16.00	2.078	52.78
0.010	0.254	0.25	6.35	0.75	19.05	4	101.60
0.015	0.381	¼	6.35	¾	19.05	10.10	256.54
0.020	0.508	0.30	7.62	1	25.4	15	381.00
0.030	0.762	5/16	7.94	1 1/16	26.99	16	406.40
0.035	0.889	⅜	9.51	1.24	31.50	17	431.80
1/16	1.59	0.50	12.70	1¼	31.75	17.5	444.50
0.100	2.54	0.54	13.72	1.50	38.10	20	508.00
⅛	3.17	0.59	14.99	1½	38.10	48	1219.2

NOTE 1—The sand reading indicator and foot specified by ASTM Method D 2419 – 69. Fig. 1, may be used where this equipment is previously available.

FIG. 1 Sand Equivalent Test Apparatus

FIG. 2 Mechanized Shaker

NOTE 4—ACS grade calcium chloride dihydrate is specified for the stock solution prepared with glutaraldehyde because tests indicate that impurities in the technical grade anhydrous calcium chloride may react with the glutaraldehyde resulting in an unknown precipitate.

8.1.2.2 *USP Glycerin*, 2050 g (1640 mL).

8.1.2.3 *1,5-Pentanedial (Glutaraldehyde)*, 50 % solution in water 59 g (53 mL).

8.1.2.4 Dissolve the 577 g (1.27 lb) of calcium chloride dihydrate in 1.89 L (½ gal) of distilled water. Cool and add the 2050 g of glycerin and the 59 g of glutaraldehyde to the solution, mix well, and dilute to 3.78 L (1 gal).

NOTE 5—1,5-pentanedial, also known as glutaraldehyde, glutaric dialdehyde, and trade name UCARCIDE 250, may be obtained as "Glutaraldehyde Solution 50 %."[7]

8.1.3 Stock solution with Kathon CG/ICP.

8.1.3.1 *Calcium Chloride Dihydrate*, 577 g (1.27 lb) of A. C. S. grade.

8.1.3.2 *USP Glycerin*, 2050 g (1640 mL).

8.1.3.3 *Kathon CG/ICP*[8], 63 g (53 mL).

8.1.3.4 Dissolve the 577 g (1.27 lb) of calcium chloride dihydrate in 1.89 L (½ gal) of distilled water. Cool and add the 2050 g of glycerin and the 63 g of Kathon CG/ICP to the solution, mix well, and dilute to 3.78 L (1 gal).

8.2 *Working Calcium Chloride Solution*—Prepare the working calcium chloride solution by diluting one measuring tin (85 ± 5 mL) full of the stock calcium chloride solution to 1.0 gal (3.8 L) with water. Use distilled or demineralized water for the normal preparation of the working solution. However, if it is determined that the local tap water is of such purity that it does not affect the test results, it is permissible to use it instead of distilled or demineralized water except in the event of dispute.

NOTE 6—The effect of local tap water on sand equivalent test results may be determined by comparing the results of three sand equivalent tests using distilled water with the results of three sand equivalent tests using the local tap water. The six test specimens required for this comparison shall be prepared from the sample of material and oven-dried as prescribed in this test method.

9. Sample Preparation

9.1 Sample the material to be tested in accordance with Practice D 75.

9.2 Thoroughly mix the sample and reduce it as necessary using the applicable procedures in Practice C 702.

9.3 Obtain at least 1500 g of material passing the No. 4 (4.75-mm) sieve in the following manner:

9.3.1 Separate the sample on the No. 4 (4.75-mm) sieve by means of a lateral and vertical motion of the sieve, accompanied by a jarring action so as to keep the sample moving continuously over the surface of the sieve. Continue the sieving until not more than 1 weight % of the residue passes the sieve during 1 min. The sieving operation may be performed either by hand or by a mechanical apparatus. When thoroughness of mechanical sieving is being determined, test by the hand method described above using a single layer of material on the sieve.

9.3.2 Break down any lumps of material in the coarse fraction to pass the No. 4 (4.75-mm) sieve. A mortar and rubber-covered pestle or any other means that will not cause appreciable degradation of the aggregate may be used.

9.3.3 Remove any coatings of fines adhering to the coarse aggregate. These fines may be removed by surface-drying the coarse aggregate, then rubbing between the hands over a flat pan.

9.3.4 Add the material passing the sieve obtained in 9.3.2 and 9.3.3 to the separated fine portion of the sample.

9.4 Prepare test specimens from the material passing the No. 4 (4.75-mm) sieve portion of the sample by either the procedure described in 9.4.1 or 9.4.2.

NOTE 7—Experiments show that as the amount of material being reduced by splitting or quartering is decreased, the accuracy of providing representative portions is decreased. For this reason, it is imperative that extreme care be exercised when preparing the test specimens.

9.4.1 *Test Specimen Preparation, Procedure A*:

9.4.1.1 If it appears necessary, dampen the material to avoid segregation or loss of fines during the splitting or quartering operations. Use care in adding moisture to the sample to retain a free-flowing condition of the material.

9.4.1.2 Using the measuring tin, dip out four of these measures from the sample. Each time a measure full of the material is dipped from the sample, tap the bottom edge of the measure on a work table or other hard surface at least four times and jog it slightly to produce a measure of consolidated material level-full or slightly rounded above the brim.

9.4.1.3 Determine and record the amount of material contained in these four measures either by weight or by volume in a dry plastic cylinder.

9.4.1.4 Return this material back to the sample and proceed to split or quarter the sample, using the applicable procedures

[7] Available from Aldrich Chemical Company, P. O. Box 2060, Milwaukee, WI 53201 or Fisher Scientific, 711 Forbes Ave., Pittsburg, PA 15219.

[8] Kathon CG/ICP may be obtained from Rohm and Hass Chemical Company, Independence Mall West, Philadelphia, PA 19105.