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Standard Test Method for Lightweight Particles in Aggregate[1]

This standard is issued under the fixed designation C123/C123M; 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 covers the determination of the percentage of lightweight particles in aggregate by means of sink-float separation in a heavy liquid of suitable specific gravity.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. Some values have only SI units because the inch-pound equivalents are not used in the practice.

NOTE 1—Sieve size is identified by its standard designation in Specification E11. The alternative designation given in parentheses is for information only and does not represent a different standard sieve size.

1.3 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

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 and health practices and determine the applicability of regulatory limitations prior to use.* For a specific hazard statement, see 6.1.4.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C33 Specification for Concrete Aggregates

C125 Terminology Relating to Concrete and Concrete Aggregates

C127 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

C128 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

C702 Practice for Reducing Samples of Aggregate to Testing Size

C1005 Specification for Reference Masses and Devices for Determining Mass and Volume for Use in the Physical Testing of Hydraulic Cements

D75 Practice for Sampling Aggregates

D3665 Practice for Random Sampling of Construction Materials

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

E100 Specification for ASTM Hydrometers

3. Terminology

3.1 For definitions of terms used in this test method, refer to Terminology C125.

4. Significance and Use

4.1 This test method is used to determine conformance with provisions of Specification C33 pertaining to the amount of lightweight material in fine and coarse aggregates. A heavy liquid with a specific gravity of 2.0 is used to separate particles which may be classified as coal or lignite. Heavier liquids are to be used to check the percentages of other lightweight particles such as chert and shale having a specific gravity less than 2.40.

4.2 The test method is useful in identifying porous aggregate particles in research activities or in petrographic analyses.

5. Apparatus

5.1 *Balances*—For determining the mass of fine aggregates, a balance having a capacity of not less than 500 g, sensitive to at least 0.1 g: for determining the mass of coarse aggregate, a balance having a capacity of not less than 5000 g, sensitive to at least 1 g. Both balances shall conform to the accuracy criterion of the applicable sections of Specification C1005.

5.2 *Containers* suitable for drying the aggregate sample, and containers suitable for holding the heavy liquid during the sink-float separation.

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.20 on Normal Weight Aggregates.

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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.

5.3 *Skimmer*—A piece of 300-µm (No. 50) sieve cloth, conforming to Specification E11, of suitable size and shape for separating the floating particles from the heavy liquid.

5.4 *Hot Plate or Oven*.

5.5 *Sieves*, 300-µm (No. 50) and 4.75-mm (No. 4) conforming to Specification E11.

5.6 *Specific Gravity Measurement*—A hydrometer conforming to the physical requirement sections for individual hydrometers of Specification E100, or a suitable combination of graduated glassware and balance capable of measuring the liquid specific gravity within ±0.01.

6. Heavy Liquid

6.1 The heavy liquid shall consist of one of the following (see 6.1.4):

6.1.1 A solution of zinc chloride in water (for a specific gravity up to about 2.0).

6.1.2 A mixture of kerosene with 1,1,2,2-tetrabromoethane, proportioned to produce desired specific gravities. (1,1,2,2-tetrabromoethane has a specific gravity of about 2.95) (see Note 2).

6.1.3 A solution of zinc bromide in water (for a specific gravity up to about 2.4).

6.1.4 **Warning**—The chemicals listed in 6.1.2 are toxic, both by absorption through the skin and by inhalation. They shall be used only in a hood (preferably of the down-draft type) or out-of-doors, and care shall be taken to avoid inhalation or contact with the eyes or skin. There is no particular hazard from the fumes of zinc-chloride solution (6.1.1) or zinc-bromide solution (6.1.3) but goggles and gloves shall be worn to prevent contact with the eyes or skin.

6.2 The specific gravity of the heavy liquid shall be maintained within ±0.01 of the specified value at all times during the test.

NOTE 2—1,1,2,2-tetrabromoethane is highly toxic and extremely dangerous to use and when heated emits highly toxic fumes of bromine, hydrogen bromide, and carbonyl bromide. It should be handled only by personnel trained and qualified in its use. Its storage should be in a secured location.

7. Sampling

7.1 Secure a field sample of the aggregate in accordance with Practices D75 and D3665. Reduce the sample to test portion size in accordance with Practice C702.

7.2 Dry the test portion to constant mass at a temperature of 110 ± 5 °C [230 ± 10 °F] before testing and sieve to remove the undersize material as specified in 8.1 and 8.2. The minimum size of the test specimen shall be as follows:

Nominal Maximum Size of Aggregate (square-opening sieves)		Minimum Mass of Sample, g [lb]
4.75 mm or smaller	(No. 4 or smaller)	200 [0.5]
9.5 mm	(⅜ in.)	1 500 [3]
12.5 to 19.0 mm	(½ to ¾ in.)	3 000 [7]
25 to 37.5 mm	(1 to 1½ in.)	5 000 [11]
50 mm or larger	(2 in. or larger)	10 000 [22]

8. Procedure

8.1 *Fine Aggregate*—Allow the dried test specimen of fine aggregate to cool to room temperature and then sieve over a 300-µm (No. 50) sieve until less than 1 % of the retained material passes the sieve in 1 min of continuous sieving. Determine the mass of the material coarser than the 300-µm (No. 50) sieve to the nearest 0.1 g, and bring this material to a saturated-surface-dry condition by means of the procedure specified in Test Method C128 (see 8.1.1), then introduce it into the heavy liquid (see 6.1.4) in a suitable container. The volume of liquid shall be at least three times the absolute volume of the aggregate. Pour the liquid, including the floating particles, into a second container, passing it through the skimmer, taking care that only the floating particles are poured off with the liquid and that none of the fine aggregate that sinks is decanted onto the skimmer. Return to the first container the liquid that has been collected in the second container and, after further agitation of the sample by stirring, repeat the decanting process just described until the specimen is free of floating particles. Wash the decanted particles contained on the skimmer in an appropriate solvent to remove the heavy liquid. Alcohol is appropriate for 1,1,2,2-tetrabromoethane and water for the zinc-chloride and zinc-bromide solutions. After the decanted particles have been washed, allow them to dry (see 8.1.2). Brush the dry decanted particles from the skimmer onto the balance pan and determine the mass to the nearest 0.1 g. If more precise determination is required, the decanted particles shall be dried to constant mass at 110 ± 5 °C [230 ± 10 °F] to determine the value of W_1 used for the calculation in 9.1 (see 8.1.3).

8.1.1 If the absorption as determined in accordance with Test Method C128 is known, the fine aggregate is permitted to be prepared for test by adding to a known mass of dry sand the amount of water it will absorb, mixing thoroughly, and permitting the sand to stand in a covered pan for 30 min before use.

8.1.2 Drying shall take place in the hood or out-of-doors if other than zinc chloride or zinc bromide is used. An oven or hot plate is permitted to be used to accelerate the drying providing that it is done in the hood or that the oven is forced-air ventilated to the outside of the building and that a temperature of 115 °C [240 °F] is not exceeded.

8.1.3 Normally the discrepancy between oven-dry mass and saturated-surface-dry mass of the decanted particles will not significantly affect the calculated percentage of light-weight particles.

8.2 *Coarse Aggregate*—Allow the dried test specimen of coarse aggregate to cool to room temperature and sieve over a 4.75-mm (No. 4) sieve. Determine the mass of the material coarser than the 4.75-m (No. 4) sieve to the nearest 1 g, and bring to a saturated-surface-dry condition by means of the procedure specified in Test Method C127; then introduce it into the heavy liquid in a suitable container. The volume of liquid shall be at least three times the absolute volume of the aggregate. Using the skimmer, remove the particles that float to the surface, and save them. Repeatedly agitate the remaining particles, and remove the floating particles until no additional particles rise to the surface. Wash the particles which are skimmed off in an appropriate solvent to remove the heavy liquid (see 8.1). After the heavy liquid has been removed, allow the particles to dry (see 8.1.2). Determine the mass of the decanted particles to the nearest 1 g. If a more precise

determination is required, dry the particles to constant mass at 110 ± 5 °C [230 ± 10 °F] to determine the value of W_1 used for the calculation in 9.1 (see 8.1.3).

9. Calculation

9.1 Calculate the percentage by mass of lightweight particles (particles floating on the heavy liquid) as follows:
For fine aggregate:

$$L=(W_1/W_2)\times 100 \quad (1)$$

For coarse aggregate:

$$L=(W_1/W_3)\times 100 \quad (2)$$

where:
L = percentage by mass of lightweight particles,
W_1 = dry mass of particles that float,
W_2 = dry mass of portion of specimen coarser than 300-μm (No. 50) sieve, and
W_3 = dry mass of portion of specimen coarser than the 4.75-mm (No. 4) sieve.

10. Report

10.1 Report the following information:

10.1.1 Identification of the aggregate as to source, type and nominal maximum size,

10.1.2 The mass of the test sample used,

10.1.3 Type and specific gravity of heavy liquid used for the test, and

10.1.4 Percentage by mass of lightweight particles rounded to nearest 0.1 %.

11. Precision and Bias

11.1 *Precision*—No interlaboratory or intralaboratory studies have been conducted using this test method to determine precision indices. The committee is seeking pertinent data from users of the test method.

11.2 *Bias*—Bias of the test method may be estimated by running separate specific gravity and absorption determinations on individual particles of the separate sink, or float fractions, or both.

12. Keywords

12.1 aggregate; heavy liquid; lightweight particles