



Designation: ~~C 127-01~~ Designation: **C127 - 12**

Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate¹

This standard is issued under the fixed designation C127; 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 average density of a quantity of coarse aggregate particles (not including the volume of voids between the particles), the relative density (specific gravity), and the absorption of the coarse aggregate. Depending on the procedure used, the density (kg/m^3 (lb/ft^3)) is expressed as oven-dry (OD), saturated-surface-dry (SSD), or as apparent density. Likewise, relative density (specific gravity), a dimensionless quantity, is expressed as OD, SSD, or as apparent relative density (apparent specific gravity). The OD density and OD relative density are determined after drying the aggregate. The SSD density, SSD relative density, and absorption are determined after soaking the aggregate in water for a prescribed duration.

1.2 This test method is used to determine the density of the essentially solid portion of a large number of aggregate particles and provides an average value representing the sample. Distinction is made between the density of aggregate particles as determined by this test method, and the bulk density of aggregates as determined by Test Method ~~C 29/C 29M~~ C29/C29M, which includes the volume of voids between the particles of aggregates.

~~1.3 This test method is not intended to be used with lightweight aggregates.~~

1.3 This test method is not intended to be used with lightweight aggregates that comply with Specification C332 Group I aggregates.

1.4 The values stated in SI units are to be regarded as the standard for conducting the tests. The test results for density shall be reported in either SI units or inch-pound units, as appropriate for the use to be made of the results.

1.5 The text of this test method 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 this test method.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

C29/C29M [Test Method for Bulk Density \(“Unit Weight”\)\(Unit Weight\) and Voids in Aggregate](#)

C125 [Terminology Relating to Concrete and Concrete Aggregates](#)

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

~~C136 [Test Method for Sieve Analysis of Fine and Coarse Aggregates](#)~~² [Test Method for Sieve Analysis of Fine and Coarse Aggregates](#)

C330 [Specification for Lightweight Aggregates for Structural Concrete](#)

C332 [Specification for Lightweight Aggregates for Insulating Concrete](#)

C566 [Test Method for Total Evaporable Moisture Content of Aggregate by Drying](#)

C670 [Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials](#)

C702 [Practice for Reducing Samples of Aggregate to Testing Size](#)

D75 [Practice for Sampling Aggregates](#)

D448 [Classification for Sizes of Aggregate for Road and Bridge Construction](#)

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* Vol 04.02, volume information, refer to the standard’s Document Summary page on the ASTM website.

E11 ~~Specification for Wire Cloth and Sieves for Testing Purposes~~ Specification for Woven Wire Test Sieve Cloth and Test Sieves

2.2 *AASHTO Standard:*

AASHTO No. T 85 Specific Gravity and Absorption of Coarse Aggregate³

3. Terminology

3.1 Definitions:

3.1.1 *absorption, n*—the increase in mass of aggregate due to water penetration into the pores of the particles during a prescribed period of time, but not including water adhering to the outside surface of the particles, expressed as a percentage of the dry mass.

3.1.2 *oven-dry (OD), adj*—related to aggregate particles, the condition in which the aggregates have been dried by heating in an oven at 110 ± 5 °C for sufficient time to reach a constant mass.

3.1.3 *saturated-surface-dry (SSD), adj*—related to aggregate particles, the condition in which the permeable pores of aggregate particle are filled with water to the extent achieved by submerging in water for the prescribed period of time, but without free water on the surface of the particles.

3.1.4 *density, n*—the mass per unit volume of a material, expressed as kilograms per cubic metre (pounds per cubic foot).

3.1.4.1 *density (OD), n*—the mass of oven dry aggregate per unit volume of aggregate particles, including the volume of permeable and impermeable pores within the particles, but not including the voids between the particles.

3.1.4.2 *density (SSD), n*—the mass of saturated-surface-dry aggregate per unit volume of the aggregate particles, including the volume of impermeable pores and permeable, water-filled voidspores within the particles, but not including the poresvoids between the particles.

3.1.4.3 *apparent density, n*—the mass per unit volume of the impermeable portion of the aggregate particles.

3.1.5 *relative density (specific gravity), n*—the ratio of the density of a material to the density of distilled water at a stated temperature; the values are dimensionless.

3.1.5.1 *relative density (specific gravity) (OD), n*—the ratio of the density (OD) of the aggregate to the density of distilled water at a stated temperature.

3.1.5.2 *relative density (specific gravity) (SSD), n*—the ratio of the density (SSD) of the aggregate to the density of distilled water at a stated temperature.

3.1.5.3 *apparent relative density (apparent specific gravity), n*—the ratio of the apparent density of aggregate to the density of distilled water at a stated temperature.

3.1.6 For definitions of other terms related to aggregates, see Terminology ~~E-125~~:C125.

4. Summary of Test Method

4.1 A sample of aggregate is immersed in water for 24 ± 4 h to essentially fill the pores. It is then removed from the water, the water dried from the surface of the particles, and the mass determined. Subsequently, the volume of the sample is determined by the displacement of water method. Finally, the sample is oven-dried and the mass determined. Using the mass values thus obtained and formulas in this test method, it is possible to calculate density, relative density (specific gravity), and absorption.

5. Significance and Use

5.1 Relative density (specific gravity) is the characteristic generally used for calculation of the volume occupied by the aggregate in various mixtures containing aggregate, including portland cement concrete, bituminous concrete, and other mixtures that are proportioned or analyzed on an absolute volume basis. Relative density (specific gravity) is also used in the computation of voids in aggregate in Test Method ~~E-29~~:C 29MC29/C29M. Relative density (specific gravity) (SSD) is used if the aggregate is wet, that is, if its absorption has been satisfied. Conversely, the relative density (specific gravity) (OD) is used for computations when the aggregate is dry or assumed to be dry.

5.2 Apparent density and apparent relative density (apparent specific gravity) pertain to the solid material making up the constituent particles not including the pore space within the particles which is accessible to water.

5.3 Absorption values are used to calculate the change in the mass of an aggregate due to water absorbed in the pore spaces within the constituent particles, compared to the dry condition, when it is deemed that the aggregate has been in contact with water long enough to satisfy most of the absorption potential. The laboratory standard for absorption is that obtained after submerging dry aggregate for a prescribed period of time. Aggregates mined from below the water table commonly have a moisture content greater than the absorption determined by this test method, if used without opportunity to dry prior to use. Conversely, some aggregates which have not been continuously maintained in a moist condition until used are likely to contain an amount of absorbed moisture less than the 24-h soaked condition. For an aggregate that has been in contact with water and that has free

³ Annual Book of ASTM Standards, Vol 04.03.

³ Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, <http://www.transportation.org>.

moisture on the particle surfaces, the percentage of free moisture is determined by deducting the absorption from the total moisture content determined by Test Method C566.

5.4 The general procedures described in this test method are suitable for determining the absorption of aggregates that have had conditioning other than the 24-h soak, such as boiling water or vacuum saturation. The values obtained for absorption by other test methods will be different than the values obtained by the prescribed soaking, as will the relative density (specific gravity) (SSD).

~~5.5 The pores in lightweight aggregates are not necessarily filled with water after immersion for 24 h. In fact, the absorption potential for many such aggregates is not satisfied after several days' immersion in water. Therefore, this test method is not intended for use with lightweight aggregate.~~

6. Apparatus

6.1 *Balance*—A device for determining mass that is sensitive, readable, and accurate to 0.05 % of the sample mass at any point within the range used for this test, or 0.5 g, whichever is greater. The balance shall be equipped with suitable apparatus for suspending the sample container in water from the center of the platform or pan of the balance.

6.2 *Sample Container*—A wire basket of 3.35 mm (No. 6) or finer mesh, or a bucket of approximately equal breadth and height, with a capacity of 4 to 7 L for 37.5-mm (1½-in.) nominal maximum size aggregate or smaller, and a larger container as needed for testing larger maximum size aggregate. The container shall be constructed so as to prevent trapping air when the container is submerged.

6.3 *Water Tank*—A watertight tank into which the sample container is placed while suspended below the balance.

6.4 *Sieves*—A 4.75-mm (No. 4) sieve or other sizes as needed (see 7.2-7.4), ~~conforming to Specification E11E11~~, conforming to Specification E11.

6.5 *Oven*—An oven of sufficient size, capable of maintaining a uniform temperature of 110 ± 5 °C (230 ± 9 °F).

7. Sampling

7.1 Sample the aggregate in accordance with Practice D75.

7.2 Thoroughly mix the sample of aggregate and reduce it to the approximate quantity needed using the applicable procedures in Practice C702. Reject all material passing a 4.75-mm (No. 4) sieve by dry sieving and thoroughly washing to remove dust or other coatings from the surface. If the coarse aggregate contains a substantial quantity of material finer than the 4.75-mm sieve (such as for Size No. 8 and 9 aggregates in Classification D448), use the 2.36-mm (No. 8) sieve in place of the 4.75-mm sieve. Alternatively, separate the material finer than the 4.75-mm sieve and test the finer material according to Test Method C128.

NOTE 1—If aggregates smaller than 4.75 mm (No. 4) are used in the sample, check to ensure that the size of the openings in the sample container is smaller than the minimum size aggregate.

7.3 The minimum mass of test sample to be used is given as follows. Testing the coarse aggregate in several size fractions is permitted. If the sample contains more than 15 % retained on the 37.5-mm (1½-in.) sieve, test the material larger than 37.5 mm in one or more size fractions separately from the smaller size fractions. When an aggregate is tested in separate size fractions, the minimum mass of test sample for each fraction shall be the difference between the masses prescribed for the maximum and minimum sizes of the fraction.

Nominal Maximum Size, mm (in.)	Minimum Mass of Test Sample, kg (lb)
12.5 (½) or less	2 (4.4)
19.0 (¾)	3 (6.6)
25.0 (1)	4 (8.8)
37.5 (1½)	5 (11)
50 (2)	8 (18)
63 (2½)	12 (26)
75 (3)	18 (40)
90 (3½)	25 (55)
100 (4)	40 (88)
125 (5)	75 (165)

7.4 If the sample is tested in two or more size fractions, determine the grading of the sample in accordance with Test Method C136, including the sieves used for separating the size fractions for the determinations in this method. In calculating the percentage of material in each size fraction, ignore the quantity of material finer than the 4.75-mm (No. 4) sieve (or 2.36-mm (No. 8) sieve when that sieve is used in accordance with 7.2).

NOTE 2—When testing coarse aggregate of large nominal maximum size requiring large test samples, it may be more convenient to perform the test on two or more subsamples, and the values obtained combined for the computations described in Section 9.

8. Procedure

8.1 Dry the test sample to constant mass at a temperature of 110 ± 5°C, cool in air at room temperature for 1 to 3 h for test samples of 37.5-mm (1½-in.) nominal maximum size, or longer for larger sizes until the aggregate has cooled to a temperature that is comfortable to handle (approximately 50°C). Subsequently immerse the aggregate in water at room temperature for a period