



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

This standard is issued under the fixed designation C128; 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 relative density (specific gravity) and the absorption of fine aggregates. The relative density (specific gravity), a dimensionless quality, is expressed as oven-dry (OD), saturated-surface-dry (SSD), or as apparent relative density (specific gravity). The OD relative density is determined after drying the aggregate. The SSD relative density and absorption are determined after soaking the aggregate in water for a prescribed duration.

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

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 The text of this test method references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this test method.

1.5 *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”) and Voids in Aggregate
- C70 Test Method for Surface Moisture in Fine Aggregate
- C117 Test Method for Materials Finer than 75- μ m (No. 200)

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.

- Sieve in Mineral Aggregates by Washing
- C125 Terminology Relating to Concrete and Concrete Aggregates
- C127 Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
- C330 Specification for Lightweight Aggregates for Structural Concrete
- C332 Specification for Lightweight Aggregates for Insulating Concrete
- C188 Test Method for Density of Hydraulic Cement
- 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
- C1252 Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading) (Withdrawn 2015)³
- D75 Practice for Sampling Aggregates
- D854 Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
- 2.2 AASHTO Standard:
AASHTO T 84 Specific Gravity and Absorption of Fine Aggregates⁴

3. Terminology

3.1 *Definitions*—For definitions of terms used in this standard, refer to Terminology 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 is dried from the surface of the particles, and the mass determined. Subsequently, the sample (or a portion of it) is placed in a graduated container and the volume of the sample is determined by the gravimetric or volumetric method. Finally,

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ 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>.

the sample is oven-dried and the mass determined again. Using the mass values thus obtained and formulas in this test method, it is possible to calculate relative density (specific gravity) and absorption.

5. Significance and Use

5.1 Relative density (specific gravity) is the ratio of mass of an aggregate to the mass of a volume of water equal to the volume of the aggregate particles – also referred to as the absolute volume of the aggregate. It is also expressed as the ratio of the density of the aggregate particles to the density of water. Distinction is made between the density of aggregate particles and the bulk density of aggregates as determined by Test Method **C29/C29M**, which includes the volume of voids between the particles of aggregates.

5.2 Relative density is used to calculate the volume occupied by the aggregate in various mixtures containing aggregate including hydraulic 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 **C29/C29M** and in Test Method **C1252**. Relative density (specific gravity) (SSD) is used in the determination of surface moisture on fine aggregate by displacement of water in Test Method **C70**. Relative density (specific gravity) (SSD) is used if the aggregate is in a saturated surface-dry condition, that is, if its absorption has been satisfied. Alternatively, the relative density (specific gravity) (OD) is used for computations when the aggregate is dry or assumed to be dry.

5.3 Apparent relative density (specific gravity) pertain to the solid material making up the constituent particles not including the pore space within the particles that is accessible to water. This value is not widely used in construction aggregate technology.

5.4 Absorption values are used to calculate the change in the mass of an aggregate material due to water absorbed in the pore spaces within the constituent particles, compared to the dry condition, if 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 that 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 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** by drying.

5.5 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 24-h soak, as will the relative density (specific gravity) (SSD).

6. Apparatus

6.1 *Balance*—A balance or scale having a capacity of 1 kg or more, sensitive to 0.1 g or less, and accurate within 0.1 % of the test load at any point within the range of use for this test method. Within any 100-g range of test load, a difference between readings shall be accurate within 0.1 g.

6.2 *Pycnometer (for Use with Gravimetric Procedure)*—A flask or other suitable container into which the fine aggregate test sample can be readily introduced and in which the volume content can be reproduced within $\pm 0.1 \text{ cm}^3$. The volume of the container filled to mark shall be at least 50 % greater than the space required to accommodate the test sample. A volumetric flask of 500-cm^3 capacity or a fruit jar fitted with a pycnometer top is satisfactory for a 500-g test sample of most fine aggregates.

6.3 *Flask (for Use with Volumetric Procedure)*—A Le Chatelier flask as described in Test Method **C188** is satisfactory for an approximately 55-g test sample.

6.4 *Mold and Tamper for Surface Moisture Test*—The metal mold shall be in the form of a frustum of a cone with dimensions as follows: $40 \pm 3\text{-mm}$ inside diameter at the top, $90 \pm 3\text{-mm}$ inside diameter at the bottom, and $75 \pm 3 \text{ mm}$ in height, with the metal having a minimum thickness of 0.8 mm. The metal tamper shall have a mass of $340 \pm 15 \text{ g}$ and a flat circular tamping face $25 \pm 3 \text{ mm}$ in diameter.

6.5 *Oven*—An oven of sufficient size, capable of maintaining a uniform temperature of $110 \pm 5 \text{ }^\circ\text{C}$ ($230 \pm 9 \text{ }^\circ\text{F}$).

7. Sampling

7.1 Sample the aggregate in accordance with Practice **D75**. Thoroughly mix the sample and reduce it to obtain a test specimen of approximately 1 kg using the applicable procedures described in Practice **C702**.

8. Preparation of Test Specimen

8.1 Place the test specimen in a suitable pan or vessel and dry in the oven to constant mass at a temperature of $110 \pm 5 \text{ }^\circ\text{C}$ ($230 \pm 9 \text{ }^\circ\text{F}$). Allow it to cool to comfortable handling temperature (approximately $50 \text{ }^\circ\text{C}$), cover with water, either by immersion or by the addition of at least 6 % moisture to the fine aggregate, and permit to stand for $24 \pm 4 \text{ h}$. When Specification **C330** or Specification **C332** Group II lightweight aggregates are used, immerse the aggregate in water at room temperature for a period of $72 \pm 4 \text{ h}$, stirring for at least one minute every 24 h.

8.1.1 When the absorption and relative density (specific gravity) values are to be used in proportioning concrete mixtures in which the aggregates will be in their naturally moist condition, the requirement in **8.1** for initial drying is optional, and, if the surfaces of the particles in the sample have been kept continuously wet until tested, the requirement in **8.1** for $24 \pm 4 \text{ h}$ soaking or $72 \pm 4 \text{ h}$ is also optional.

NOTE 1—Values for absorption and for relative density (specific gravity) (SSD) may be significantly higher for aggregate not oven dried