Designation: D7370/D7370M – 25

Standard Test Method for Determination of Relative Density and Absorption of Fine, Coarse, and Blended Aggregate Using Combined Vacuum Saturation and Rapid Submersion[1]

This standard is issued under the fixed designation D7370/D7370M; 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 and absorption of fine aggregates by Method A and coarse and blended aggregates by Method B.

1.2 A multi-laboratory precision and bias statement for coarse and combined aggregate tests in this standard has not been developed at this time. Therefore, this standard should not be used for acceptance or rejection of coarse and combined aggregate materials for purchasing purposes.

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

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]

C29/C29M Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

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

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

C136/C136M Test Method for Sieve Analysis of Fine and Coarse Aggregates

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

C702/C702M Practice for Reducing Samples of Aggregate to Testing Size

D75/D75M Practice for Sampling Aggregates

D3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Summary of Test Method

3.1 Sufficient aggregate sample is dried to constant mass. For each test, two representative dry aggregate samples of the same material are selected for testing. One sample is evacuated in a vacuum chamber inside a plastic bag and opened under water for rapid saturation of the aggregate. The dry mass and submerged mass of the sample are used for calculation of apparent relative density. The second sample of the same aggregate is tested in a known volume metal pycnometer. The known mass of the pycnometer with water, mass of the dry aggregate, and mass of the aggregate and pycnometer filled with water are used for calculation of unsaturated density. The results from the two samples tested are then used to calculate absorption and relative density (OD).

3.2 This test can be completed in less than 30 min and can be used for rapid determination of aggregate properties in construction testing laboratories.

3.3 This test can be performed on fine, coarse, and blended (combined) aggregates by using appropriate plastic bag and pycnometer sizes.

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

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

4. Significance and Use

4.1 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 C29/C29M. Relative density (specific gravity) saturated surface dry (SSD) is used if the aggregate is at SSD, that is, if its absorption has been satisfied. Conversely, the relative density (specific gravity) oven dry (OD) is used for computations when the aggregate is dry or assumed to be dry.

4.2 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.

4.3 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, when it is deemed that the aggregate has been in contact with water long enough to satisfy the absorption potential. The laboratory standard for absorption is that obtained after submerging dry aggregate for a prescribed period of time.

NOTE 1—There are other test methods that have been used and continue to be used to determine these aggregate properties: Test Methods C127 and C128. This test method may result in values for these properties that are close to or divergent from values from other test methods.

NOTE 2—The quality of the results produced by this standard are dependent upon the competence of the personnel performing the procedure and the capability, calibration, and the maintenance of the equipment used. Agencies that meet the criteria of Specification D3666 are generally considered capable of competent and objective testing, sampling, inspection, etc. Users of this standard are cautioned that compliance with Specification D3666 alone does not completely ensure reliable results. Reliable results depend on many factors; following the suggestions of Specification D3666 or similar acceptable guideline provides a means of evaluating and controlling some of those factors.

5. Apparatus

5.1 *Balance,* a balance that conforms to Guide D4753. The balance shall be sensitive, readable, and accurate to 0.1 g. The balance shall be equipped with suitable apparatus for suspending the sample in water.

5.2 *Water Bath,* with minimum dimensions (length by width by depth) of 610 by 460 by 460 mm [24 by 18 by 18 in.] or a large cylindrical container with a minimum diameter of 460 mm and depth of 460 mm [18 by 18 in.], for completely submerging the sample in water while suspended, equipped with an overflow outlet for maintaining a constant water level and means to maintain the water temperature at 25 ± 1 °C [77 ± 2 °F].

NOTE 3—It is preferable to keep the water temperature constant by using a temperature-controlled heater. Also, to reduce the chance for the bag to touch the sides of the water tank, it is preferable to elevate the water tank to a level at which the sample can be placed on the weighing mechanism while the operator is standing up (waist height), and the placement of the sample and the bag in the water tank can easily be inspected.

5.3 *Sample Holder,* for water displacement of the sample, having no sharp edges.

5.4 *Vacuum Chamber,* with a pump capable of evacuating a sealed and enclosed chamber to a pressure of 6 mm Hg [6 Torr], when at sea level. The device shall automatically seal the plastic bag and exhaust air back into the chamber in a controlled manner to ensure proper conformance of the plastic to the specimen. The air exhaust and vacuum operation time shall be set at the factory so that the chamber is brought to atmospheric pressure in 80 to 125 s, after the completion of the vacuum operations.

5.5 *Vacuum Measurement Gauge,* independent of the vacuum sealing device that could be placed directly inside the chamber to verify vacuum performance and the chamber door sealing condition of the unit. The gauge shall be capable of reading down to 3 mm Hg [3 Torr] and readable to ±1 mm Hg [±1 Torr].

5.6 *Plastic Bags,* used with the vacuum device shall be one of the two following sizes. The smaller bags shall have a minimum opening of 241 mm [9.50 in.] and maximum opening of 267 mm [10.5 in.] and the larger bags shall have a minimum opening of 368 mm [14.5 in.] and a maximum opening of 394 mm [15.5 in.]. The bags shall be of plastic material, shall be puncture resistant, and shall be impermeable to water. The bags shall have a minimum thickness of 0.127 mm [0.005 in.] and a maximum thickness of 0.178 mm [0.007 in.]. The apparent specific gravity for the bags shall be provided by the manufacturer.

5.7 *Small Metal Pycnometer,* with 137 ± 0.2 mm [5.375 ± 0.01 in.] ID and 89 ± 0.40 mm [3.5 ± 0.02 in.] height, for testing fine aggregates. The pycnometer shall be machined to be smooth on all surfaces. The inside of the lid shall be machined at a 5° angle to create an inverted conical surface. The pycnometer shall be equipped with a graduated temperature strip to allow the user to visually monitor temperature during testing.

5.8 *Large Metal Pycnometer,* with 198 ± 0.2 mm [7.776 ± 0.01 in.] ID and 114 ± 0.8 mm [4.5 ± 0.03 in.] height, for testing coarse and blended aggregate. The pycnometer shall be machined to be smooth on all surfaces. The inside of the lid shall be machined at a 5° angle to create an inverted conical surface. The pycnometer shall be equipped with a graduated temperature strip to allow the user to visually monitor temperature during testing.

5.9 *Fine Aggregate Fixture,* for holding and securing the lid on the small metal pycnometer from lifting during fine aggregate tests. The fixture shall be provided with a level indicator.

5.10 *Accessories*—Bag cutting knife or scissors, spray bottle filled with isopropyl alcohol, a bucket large enough to allow the pycnometer to be fully submerged in water, water containers to dispense water into pycnometer during testing, syringe with a needle no larger in diameter than 3 mm [0.125 in.], small paint brush, and 25 ± 5 mm [1 ± 0.2 in.] wide metal spatula.

5.11 *Rubber Sheets,* for protecting the plastic bags against punctures caused by sharp edges on coarse and blended