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Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures¹

This standard is issued under the fixed designation D2726/D2726M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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

1. Scope*

1.1 This test method covers the determination of bulk specific gravity and density of specimens of compacted asphalt mixtures.

1.2 This test method should not be used with samples that contain open or interconnecting voids or absorb more than ~~2%~~2.0% of water by volume, or both, as determined in **11.3**.

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 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.

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~~ safety, health, and health 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

~~D979~~D979/D979M Practice for Sampling Bituminous Paving Mixtures

~~D1188~~ Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples

~~D3203~~D3203/D3203M Test Method for Percent Air Voids in Compacted Asphalt Mixtures

~~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

~~D5364~~D5361/D5361M Practice for Sampling Compacted Asphalt Mixtures for Laboratory Testing

~~D6752~~D6752/D6752M Test Method for Bulk Specific Gravity and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method

~~D7227~~D7227/D7227M Practice for Rapid Drying of Compacted Asphalt Mixture Specimens Using Vacuum Drying Apparatus

E1 Specification for ASTM Liquid-in-Glass Thermometers

E77 Test Method for Inspection and Verification of Thermometers

E563 Practice for Preparation and Use of an Ice-Point Bath as a Reference Temperature

E644 Test Methods for Testing Industrial Resistance Thermometers

~~E1137~~E1137/E1137M Specification for Industrial Platinum Resistance Thermometers

E2251 Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *bulk density*—as determined by this test method, the mass of a metre cubed (or foot cubed) of the material at 25 °C [77 °F].

¹ This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.21 on Specific Gravity and Density of Asphalt Mixtures.

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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.

*A Summary of Changes section appears at the end of this standard

3.1.2 *bulk specific gravity*—as determined by this test method, the ratio of the mass of a given volume of material at 25 °C [77 °F] to the mass of an equal volume of water at the same temperature.

4. Summary of Test Method

4.1 The specimen is immersed in a water bath at 25 °C [77 °F]. The mass under water is recorded, and the specimen is taken out of the water, blotted quickly with a damp cloth towel, and weighed in air. The difference between the two masses is used to measure the mass of an equal volume of water at 25 °C [77 °F].

4.2 This test method provides guidance for determination of the oven dry or thoroughly dry mass of the specimen. The bulk specific gravity is calculated from these masses. Then the density is obtained by multiplying the specific gravity of the specimen by the density of the water.

5. Significance and Use

5.1 The results obtained from this test method can be used to determine the unit weight of compacted dense asphalt mixtures and in conjunction with Test Method ~~D3203~~D3203/D3203M, to obtain percent air voids. These values in turn may be used in determining the relative degree of compaction.

5.2 Since specific gravity has no units, it must be converted to density in order to do calculations that require units. This conversion is made by multiplying the specific gravity at a given temperature by the density of water at the same temperature.

NOTE 1—The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and 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 some similar acceptable guideline provides a means of evaluating and controlling some of those factors.

6. Apparatus

6.1 *Balance*, with ample capacity, and with sufficient sensitivity to enable bulk specific gravities of the specimens to be calculated to at least four significant figures, that is, to at least three decimal places. It shall be equipped with a suitable apparatus to permit weighing the specimen while suspended in water. To avoid erroneous readings by undue displacement of water, use wire or fish line of the smallest practical size to suspend the specimen and holder. Do not use chains, strings, or sash cords. The balance shall conform to Guide **D4753** as a Class GP2 balance.

NOTE 2—Since there are no more significant figures in the quotient (bulk specific gravity) than appear in either the dividend (the mass of the specimen in air) or in the divisor (the mass of the volume of water equal to the volume of the specimen, obtained from the difference in weight of the saturated surface-dry specimen in air and in water), this means that the balance must have a sensitivity capable of providing both mass values to at least four figures. For example, a sensitivity of 0.1 g [0.0002 lb] would provide four significant figures for mass in the range from 100.1 to 999.9 g [0.221 to 2.204 lb].

6.2 *Water Bath*, capable of maintaining a temperature of 25 ± 1 °C [77 ± 1.8 °F] for immersing the specimen in water while suspended, equipped with an overflow outlet for maintaining a constant water level. The use of an overflow outlet is mandatory.

NOTE 3—The water bath does not need to be a sophisticated device. Any method that maintains 25 ± 1 °C [77 ± 1.8 °F] can be used including tempering, aquarium heaters, stirrers, or other devices.

6.3 *Drying Oven*, capable of maintaining a temperature of 110 ± 5 °C [230 ± 9 °F].

6.4 *Thermometer*—The thermometer shall be one of the following:

6.4.1 A liquid-in-glass partial immersion thermometer of suitable range with subdivisions and maximum scale error of 0.5 °C [1.0 °F] which conforms to the requirements of Specification **E1**. Calibrate the thermometer in accordance with one of the methods in Test Method **E77** or verify its original calibration at the ice point (~~Note 4~~Notes 4 and 5 and ~~Note 5~~).

NOTE 4—Practice **E563** provides instructions on the preparation and use of an ice-point bath as a reference temperature.

NOTE 5—If the thermometer does not read 0.0 ± 0.5 °C [32.0 ± 1.0 °F] at the ice point, then the thermometer should be recalibrated.

6.4.2 A liquid-in-glass partial immersion thermometer of suitable range with subdivisions and maximum scale error of 0.5 °C [1.0 °F] which conforms to the requirements of Specification **E2251**. Calibrate the thermometer in accordance with one the methods in Test Method **E77** or verify its original calibration at the ice point (~~Note 4~~Notes 4 and 5 and ~~Note 5~~).

6.4.3 A platinum resistance thermometer (PRT) with a probe which conforms to the requirements of Specification **EH37E1137/E1137M**. The PRT shall have a 3-~~three-~~ or 4-~~wire~~four-wire connection configuration and the overall sheath length shall be at least 50 mm (2 in.)-50 mm [2 in.] greater than the immersion depth. Calibrate the PRT system (probe and readout) in accordance with Test Methods **E644** or verify its original calibration at the ice point (~~Note 4~~Notes 4 and 5 and ~~Note 5~~). Corrections shall be applied to ensure accurate measurements within 0.5 °C [1.0 °F].

6.4.4 A metal-sheathed thermistor with a sensor substantially similar in construction to the PRT probe described in 6.4.3. Calibrate the thermistor system (sensor and readout) in accordance with Test Methods **E644** or verify its original calibration at the ice point (~~Note 4~~Notes 4 and 5 and ~~Note 5~~). Corrections shall be applied to ensure accurate measurements within 0.5 °C [1.0 °F].

7. Standardization

- 7.1 *Balance*—Standardize at least once each twelve months.
- 7.2 *Temperature-Measuring Devices*—Standardize at least once every twelve months.
- 7.3 *Drying Oven*—Standardize thermometric devices at least once every twelve months.

NOTE 6—The terms of standardization, verification, calibration, and check are defined in Specification D3666 Section 3.

8. Sampling

- 8.1 Specimens may be either laboratory-molded asphalt mixtures or from asphalt pavements.
- 8.2 Obtain field samples in accordance with Practice ~~D979~~D979/D979M.
- 8.3 Pavement specimens shall be taken from pavements with a core drill, diamond or carborundum saw, or by other suitable means, in accordance with Practice ~~D536~~D5361/D5361M.

9. Test Specimens

- 9.1 *Size of Specimens*—It is recommended (1) that the diameter of cylindrically molded or cored specimens, or the length of the sides of sawed specimens, be at least equal to four times the maximum size of the aggregate; and (2) that the thickness of specimens be at least one and one-half times the maximum size of the aggregate.
- 9.2 Care shall be taken to avoid distortion, bending, or cracking of specimens during and after removal from pavements or mold. Specimens shall be stored in a safe, cool place.
- 9.3 Specimens shall be free of foreign materials such as seal coat, tack coat, foundation material, soil, paper, or foil. When any of these materials is visually evident, it shall be removed by sawing. Wire brushing to remove paper, soil, and foil is acceptable if all traces of the materials are eliminated.
- 9.4 If desired, specimens may be separated from other pavement layers by sawing or other satisfactory means.

10. Procedure

10.1 *For Cores and for Other Specimens that That May Contain Moisture or Solvent*—Only specimens that are known to be thoroughly dry (that is, laboratory-prepared dried specimens; specimens) are to be tested in accordance with 10.2. All others are assumed to contain moisture or solvent and are to be tested in accordance with 10.1. The sequence of testing for 10.1 is: in water, saturated surface-dry, dry.

NOTE 7—Laboratory-prepared dried specimens include dry plant-produced, laboratory-compacted samples.

10.1.1 *Mass of Specimen in Water*—Completely submerge the specimen in the water bath at $25 \pm 1^\circ\text{C}$ [$77 \pm 1.8^\circ\text{F}$] for 3 to 5 min, then determine the mass by weighing in water. Designate this mass as *C*. If the temperature of the specimen differs from the temperature of the water bath by more than 2°C [3.6°F], the specimen shall be immersed in the water bath for 10 to 15 min, instead of 3 to 5 min.

10.1.2 *Mass of Saturated Surface-Dry Specimen in Air*—Within 15 s of removing the sample from the water bath, surface dry the specimen by blotting quickly with a damp cloth towel and then determine the mass by weighing in air. Designate this mass as *B*.

10.1.3 After determining the mass in water and in a saturated surface-dry condition, thoroughly dry the specimen to a constant mass at $110 \pm 5^\circ\text{C}$ [$230 \pm 9^\circ\text{F}$]. Allow the specimen to cool and weigh in air. Designate this mass as *A*. Other methods may be used to dry the specimen as long as a constant mass is achieved (mass repeats within 0.1 %). *Mass of Dry Specimens:*

NOTE 7—Drying the specimen at the required temperature of 110°C [230°F] will change the characteristics and shape of the specimen. This will make the specimen unsuitable for further testing. Drying the specimen at a reduced temperature such as 52°C [125°F], in order to keep it intact, will not meet the requirements of this test method.

10.1.3.1 Practice For ~~D727~~D727, microwave drying, or other approved methods may be used to dry the specimen if the specimen is not overheated and documentation exists showing that the results are equivalent to oven drying. The interval of time between readings to determine constant mass must be sufficient to ensure that all moisture and solvent has cores and other specimens that are not used for further resting and evaluations, after determining the mass in water and in a saturated surface-dry condition, thoroughly dry the specimen to a constant mass at $110 \pm 5^\circ\text{C}$ [$230 \pm 9^\circ\text{F}$]. Allow the specimen to cool and weigh in air. Designate this mass as *beenA*. removed. This interval is dependent on Other methods such as Practice ~~D727~~D727M the size of the specimen and can be determined by experimentation and confirmed with the oven-dried comparisons. Documentation must exist to validate the intervals. may be used to dry the specimen as long as a constant mass is achieved (mass repeats within 0.1 %).

NOTE 8—Drying the specimen at the required temperature of 110°C [230°F] will change the characteristics and shape of the specimen. This will make the specimen unsuitable for further testing. Drying the specimen at a reduced temperature such as 52°C [125°F], in order to keep it intact, will not meet the requirements of this test method.