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Standard Test Method for Maximum Specific Gravity and Density of Bituminous Paving Mixtures Using Automatic Vacuum Sealing Method[1]

This standard is issued under the fixed designation D6857; 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 maximum specific gravity of and density of uncompacted bituminous paving mixtures at 25°C (77°F).

1.2 The values stated in SI units are to be regarded as the standard. The other units given may be approximate and are given to help the user interpret units on available standard equipment used with this test method.

1.3 *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.*

~~1.4A multi-laboratory precision for this standard has not been developed at this time. This standard should not be used for acceptance or rejection of a material for purchasing purposes.~~

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

D979 Practice for Sampling Bituminous Paving Mixtures

D2041 Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

~~D4311Practice for Determining Asphalt Volume Correction to a Base Temperature~~

D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing ~~E1Specification for ASTM Liquid-in-Glass Thermometers~~

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

E1547 ~~Terminology Relating to Industrial and Specialty Chemicals~~ Terminology Relating to Industrial and Specialty Chemicals

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

3. Terminology

3.1 The terms specific gravity and density used in this test method are in accordance with the Terminology E1547.

3.2 *Definitions:*

3.2.1 *density, as determined by this test method*—the mass of a cubic meter of the material at 25°C in SI units, or the mass of a cubic foot of the material at ~~25°C~~77°F in inch-pound units.

3.2.2 *residual pressure, as employed by this test method*—the pressure in a vacuum chamber when vacuum is applied.

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

4. Summary of Test Method

4.1 A weighed sample of oven-dry paving mixture in the loose condition at room temperature is placed inside a specially designed channel bag. The bag containing the sample is placed inside another bag and placed inside a vacuum chamber. Air is evacuated from the sample to an absolute pressure of ~~5.6~~6.0 mm Hg (6 Torr) and is automatically sealed. The bags containing the sample are removed from the vacuum chamber and placed inside a large water tank equipped with scales for weighing the sample under water. While completely submerged, the bag is cut open by scissors to allow the water to enter the bag. Since the sample

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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.

is under complete vacuum, water will be forced around all the accessible areas of the sample. The difference in weight in air and suspended weight in water will provide the sample volume after correcting for the bag influence. The dry weight and the volume can be used to calculate the maximum specific gravity of the sample. This method is a rapid technique for determination of maximum specific gravity that minimizes the exposure of bituminous samples to water during testing and reduces the chance of water absorption.

NOTE 1—For porous aggregates, if water absorption correction is not performed on the maximum specific gravities obtained using this test method, the results may be higher than the results obtained by Test Method D2041. Without aggregate water absorption correction, air voids calculated based on these results may be higher.

5. Significance and Use

5.1 The maximum specific gravities and densities of bituminous paving mixtures are intrinsic properties whose values are influenced by the composition of the mixture in terms of types and amounts of aggregates and bituminous materials.

5.1.1 They are used to calculate values for percent air voids in compacted bituminous paving mixtures.

5.1.2 They provide target values for the compaction of paving mixtures.

5.1.3 They are essential when calculating the amount of bitumen absorbed by the internal porosity of the individual aggregate particles in a bituminous paving mixture.

NOTE 2—The personnel and equipment used in performing this test can be evaluated in accordance with Practice D3666.

6. Apparatus

6.1 *Balance*, with ample capacity, and with sufficient sensitivity to enable maximum specific gravity of 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 it is suspended in water. The suspension wire attached to the scales should break the surface of the water at a single point and should have a maximum diameter of 3 mm (0.125 in.). The balance shall conform to Specification D4753 as a class GP2 balance.

NOTE ~~2—Since~~ 3—Since there are no more significant figures in the quotient (maximum specific gravity) than appear in either the dividend (the mass of the specimen in air) or in the divisor (the volume of the specimen, obtained from the difference in mass of the specimen in air and in water), this means that the balance must have a sensitivity capable of providing both mass and volume values to at least four figures. For example, a sensitivity of 0.1 g would provide four significant figures for the determination of a mass in the range from 130.0 to 999.9 g when the specific gravity is 2.300.

6.2 *Water Bath*, with minimum dimensions (Length × Width × Depth) of 610 × 460 × 460 mm (24 × 18 × 18 in.) or a cylindrical container with a minimum diameter of 460 mm (18 in.) and minimum depth of 460 mm (18 in.), for completely submerging the specimen in water while suspended.

NOTE ~~3~~4—Setting the water tank at waist level will enable the user to conduct this test while standing and will significantly simplify the weighing operations.

6.3 *Vacuum Chamber*[3], with a 0.93 kW (1.25 hp) pump capable of evacuating a sealed and enclosed chamber to 5.6 mm Hg. The chamber shall be large enough to seal samples as large as ~~2000~~2200 g. 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 asphalt mixture. The air exhaust and vacuum operation time should be calibrated at the factory prior to initial use. The air exhaust system should be calibrated to bring the chamber to atmospheric pressure in 80 to 150 s, after the completion of the vacuum operation. The vacuum system should be provided with a latch to control the chamber door opening.

6.4 *Absolute Vacuum Measurement Gauge*, independent of the vacuum sealing device which may 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 pressure to 3 mm Hg (3 Torr).

6.5 *Plastic ~~Bags, (Internal Bags)~~Bags*, ~~shall have~~ consisting of inner plastic bag (internal bag) having random channels built into ~~at least~~ one side of the ~~bag to aid in evacuating all the air from the sample. The internal~~ bag, with minimum and maximum bag ~~shall have a minimum~~ opening sizes of 305 mm (12 in.) and ~~maximum opening of~~ 340 mm (13.5 in.), respectively, and ~~the outside~~ outer plastic bag (external bag) ~~shall have a minimum~~with minimum and maximum opening sizes of 375 mm (14.75 in.) and ~~a maximum opening of~~ 394 mm (15.5 in.), repectively. The bags shall be of plastic material that will not adhere to asphalt film, is puncture resistant, and is impermeable to air. ~~The bags~~Each bag shall have a minimum thickness of 0.100 mm (0.004 in.) and maximum thickness of 0.152 mm (0.006 in.). The combined apparent specific gravity of the two bags shall be provided by the manufacturer.

NOTE ~~4~~5—Protect the plastic bags during storage. Rough handling, storing in close proximity to sharp objects, near aggregates, or inside drawers will damage the plastic bags. Refer to manufacturers procedures for safe handling and storage of bags.

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

[3] The sole source of supply of the apparatus and the method known to the committee at this time is InstroTek, Inc., Raleigh, NC. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

6.7 *Filler Plates*, to position the sample and the bags in the same plane as the sealing bar.

6.8 *Bag Cutting Knife*, or scissors.

~~6.9Thermometers, calibrated liquid-in-glass thermometers of suitable range with subdivisions and maximum scale error of 0.5°C (0.9°F), or any other thermostatic device of equal accuracy, precision and sensitivity shall be used. Thermometers shall conform to the requirements of Specification E1.~~

6.9 *Thermometric Device*, a temperature measuring device readable to 0.5ºC (1ºF) and accurate to 0.3ºC (0.5ºF) for monitoring the temperature of the water bath.

6.10 Laboratory oven, capable of heating the asphalt sample to 110 ± 5ºC (230 ± 9ºF)

7. Sampling

7.1 Obtain the sample in accordance with Practice D979.

7.2 The size of the sample shall conform to the following requirements. Samples larger than ~~2000~~2200 g may be tested in ~~1500-2000~~1500–2000 g portions at a time.

Size of Largest Particle of Aggregate in Mixture, mm (in.)	Minimum Sample Size, g
50.0 (2)	6000
37.5 (1.5)	4000
25.0 (1)	2500
19.0 (0.75)	2000
12.5 (0.5)	1500
9.5 (0.375)	1500
4.75 (No. 4)	1500

8. Procedure

8.1 Separate the particles of the sample of paving mixture by hand, taking care to avoid fracturing the aggregate, so that the particles of the fine aggregate portion are not larger than 6.3 mm (¼ in.). If a sample of paving mixture is not sufficiently soft to be separated manually, place it in a flat pan, and warm it in an oven until it can be separated as described.

8.2 Unless the paving mixture has been prepared in a laboratory using oven dry aggregates, oven-dry the sample to a constant mass at a temperature of ~~105~~110 ± 5°C (~~221~~(230 ± 9°F). Other methods of drying can be used as long as the sample achieves a constant mass (mass repeats within 0.1 %). This drying and any required warming for particle separation as described in 8.1 should be combined as a single operation to minimize reheating effects.

8.3 Cool the sample to room temperature and record the weight. (Refer to column B of the data collection table. See ~~Table X1.2~~ Table X1.1 in the Appendix).

~~8.4Set the vacuum sealing machine according to the manufacture's recommendation to create at least a 5.6 mm Hg absolute pressure inside the chamber.~~

8.4 Set the vacuum sealing machine according to the manufacture's recommendation to create 99 % of absolute vacuum for a minimum of five minutes inside the chamber.

NOTE~~5—For asphalt mixture that contain polymers, the vacuum setting should be held at 99% of absolute vacuum for a minimum of five min. Follow manufacturers recommendations when performing tests on polymerized mixtures.~~ 6—For asphalt mixture that contain polymers, follow manufacturers recommendations.

8.5 If after examining the external bag there are no punctures or cuts, weigh one channel (internal) and one examined non channel (external) bag.

8.6 Record the combined weight of the bags in column A of the attached data collection table.

8.7 Place the sample in the internal bag. Ensure that no sample is lost during this transfer.

8.8 Place the empty external bag inside the vacuum chamber.

8.9 Place the internal bag containing the sample with the channel side (rough side) down into the external bag. The rough side is placed under the sample to protect against trapped air and to help in the evacuation of the air from the bag.

8.10 Spread the sample so that it is evenly distributed within the internal bag. Do not spread the sample by squeezing down on the sample from outside the bag.

8.11 Push in the opening of the internal bag away from the opening of the external bag to prevent the opening of the internal bag from being sealed. Make sure that the opening of the internal bag is flat and that the opening is not restricted by a fold in the bag.

8.12 Place the opening of the external bag over the seal bar making sure the internal bag is not over the seal bar.

8.13 Close the chamber door.

~~8.14Allow the vacuum chamber to remove the air from the chamber and the plastic bag. The vacuum chamber shall automatically seal the bag once the air is removed.~~

8.14 Allow the vacuum chamber to remove the air from the chamber and the plastic bag. Follow the manufacturers recommendations for proper machine settings and time required for the vacuum cycle. The vacuum chamber shall automatically seal the bag once the air is removed.

8.15 Exhaust air into the chamber until the chamber door opens indicating atmospheric pressure within the chamber. The chamber door latch can be used to avoid automatic opening of the door after completion of the test.