



Designation: D7063 – 05

Standard Test Method for Effective Porosity and Effective Air Voids of Compacted Bituminous Paving Mixture Samples¹

This standard is issued under the fixed designation D7063; 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 effective porosity or effective air voids of compacted mixtures by the use of a vacuum sealing method.

1.2 This method can be used for compacted field and laboratory bituminous paving samples, as well as other compacted samples with well defined geometrical shapes, such as concrete cylinders, cored rocks, and metal samples.

1.3 The results of this test method can be used to determine the degree of interconnectivity of air voids within a sample and can be correlated to permeability of compacted bituminous paving mixture samples.

1.4 A multi-laboratory precision and bias statement for this standard has not been developed at this time. Therefore, this standard should not be used for acceptance or rejection of a material for purchasing purposes.

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 requirements prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- D979 Practice for Sampling Bituminous Paving Mixtures
- 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
- D5361 Practice for Sampling Compacted Bituminous Mixtures for Laboratory Testing

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 Bituminous 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.

3. Significance and Use

3.1 In this test method a compacted sample is vacuum sealed inside a plastic bag. The density of the sample, SG1, is calculated using a water displacement method, with the sample sealed. With the sample still in water, the bag is cut open. Since the sample is under vacuum and the air voids are evacuated, water will rush in to fill all the water accessible air voids in the compacted sample. With the saturated weight of sample known, an apparent maximum density, SG2, can be calculated. The difference between SG2 and SG1 is the measure of the amount of water that has penetrated the compacted sample. This difference can be used to determine the fraction of total number of voids that are accessible to water, Effective Percent Porosity or Percent Effective Air Voids.

3.2 The results obtained from this method can be used to determine the percentage of total air voids in a compacted sample that can be filled with water through surface or interconnected paths within the sample. In general, Effective Percent Porosity should be less than total percent air voids.

3.3 This method can be used for 100 mm and 150 mm diameter cylindrical samples and cubical samples.

4. Definitions

4.1 *Porosity and Effective Air Voids*—Total amount of air voids within a compacted sample that can be saturated by water through paths starting from the surface of the sample (surface connected or interconnected voids).

5. Apparatus

5.1 *Balance*, with ample capacity, and with sufficient sensitivity to enable bulk 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 apparatus³ to permit weighing the specimen while it is suspended in water. The balance shall conform to Guide D4753 as a class GP2 balance.

³ The sole source of supply of the apparatus and the method known to the committee at this time is InstronTek, 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.

NOTE 1—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 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.

5.2 *Water Bath*, with minimum dimensions (Length × Width × Depth) of 610 × 460 × 460 mm (24 × 18 × 18 in.) or a large cylindrical container with a minimum diameter of 460 mm and depth of 460 mm (18 × 18 in.), for completely submerging the specimen in water while suspended, equipped with an overflow outlet for maintaining a constant water level and temperature controls to maintain the water temperature at $25 \pm 1^\circ \text{C}$ ($77 \pm 2^\circ \text{F}$).

NOTE 2—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 *Cushioned holder*, for water displacement of the sample, having no sharp edges.

NOTE 3—To avoid accidental puncture of the plastic bags in the water bath, plastic coated cushioned holders have been found to work well for this test method.

5.4 *Vacuum Chamber*, with a pump capable of evacuating a sealed and enclosed chamber to a pressure of 6 mm Hg, when at sea level. The chamber shall be large enough to test samples 150 mm wide by 350 mm long by 150 mm thick. 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 seconds, after the completion of the vacuum operation. The vacuum system shall be provided with a latch to control the chamber door opening.

5.5 *A Vacuum Measurement Gage*, 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 gage shall be capable of reading down to 3 mm Hg and readable to 1 mm Hg.

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 235 mm (9.25 in.) and maximum opening of 260 mm (10.25 in.) and the larger bags shall have a minimum opening of 375 mm (14.75 in.) and a maximum opening of 394 mm (15.5 in.). The bags shall be of plastic material that will not adhere to asphalt film, is puncture resistant, is capable of withstanding sample temperatures of up to 70°C , is impermeable and contains no air channels for evacuation of air from the bag. The bags shall have a minimum thickness of 0.127 mm (0.005 in.) and maximum thickness of 0.178 mm (0.007 in.). The apparent specific gravity for the bags shall be provided by the manufacturer for each bag shipment. The apparent specific gravities provided for each

size bag shall account for the different sample weights and bag weight used during testing.

5.7 *Specimen Sliding Plate*, used within the chamber for reduction of friction on the plastic bags.

5.8 *Bag Cutting Knife*, or scissors.

5.9 *Thermometer*, readable to 1°C (2°F).

6. Verification

6.1 System Verification:

6.1.1 The vacuum settings of the device shall be verified once every three months, after major repairs, and after each shipment or relocation.

6.1.2 Place the gage inside the chamber and record the setting. The gage shall indicate a pressure of 6 mm Hg (6 TORR) or less. The unit should not be used if the gage reading is above 6 mm Hg (6 TORR).

6.1.3 Vacuum gage used for verification shall be verified for accuracy once every three years.

NOTE 4—On line vacuum gages, while capable of indicating vacuum performance of the pump, are not suitable for use in enclosed vacuum chambers and can not accurately measure vacuum levels.

7. Sampling

7.1 Test specimens shall be molded from laboratory prepared samples or taken from the pavement in the field. Obtain field samples in accordance with Practice D979 and D5361.

8. Test Specimen

8.1 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. Pavement specimens are to be taken by such means as coring, sawing of blocks, and so forth.

8.2 Take care to avoid distortion, bending, or cracking of specimens during and after removal from pavement or mold. Store specimens in a safe, cool place.

8.3 Specimens shall be free of foreign materials, such as sealcoat, tack coat, foundation material, soil, paper, or foil. When any of these materials are visually evident, they shall be removed. Sealcoat or tackcoat, or both, may be removed by sawing the bottom or the top faces, or both, of the sample.

8.4 If desired, separate specimens from other pavement layers by sawing or other suitable means.

8.5 Use a brush or a soft sanding block to break sharp edges around the top and bottom corners of the sample.

9. Procedure

9.1 Set the vacuum chamber to operate at a pressure of 6 mm Hg for a minimum of 5 minutes

9.2 Mass of Unsealed Specimen:

9.2.1 *Laboratory Prepared Specimens*—Determine the mass of the specimen after it has cooled to room temperature. Designate this mass as A.

9.2.2 *Cores and Specimens Containing Moisture*—Dry the specimen to constant mass. Designate this mass as A. Constant mass is defined as less than 0.05 % change in mass between consecutive drying intervals.