



Designation: D 4867/D4867M – 96

Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures¹

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1. Scope

1.1 This test method covers procedures for preparing and testing asphalt concrete specimens for the purpose of measuring the effect of water on the tensile strength of the paving mixture. This test method is applicable to dense mixtures such as those appearing in the Table for Composition of Bituminous Paving Mixtures in Specification D 3515. This test method can be used to evaluate the effect of moisture with or without antistripping additives including liquids and pulverulent solids such as hydrated lime or portland cement.

1.2 The values stated in either SI units or inch-pound units in parentheses shall be regarded separately as standard. The values in each system may not be exact equivalents; therefore, each system must be used independently of the other, without combining values in any way.

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.*

2. Referenced Documents

2.1 ASTM Standards:

- D 979 Practice for Sampling Bituminous Paving Mixtures²
- D 1074 Test Method for Compressive Strength of Bituminous Mixtures²
- D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus²
- D 1561 Practice for Preparation of Bituminous Mixture Test Specimens by Means of California Kneading Compactor²
- D 2041 Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures²
- D 2726 Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens²

¹ This test method is under the jurisdiction of ASTM Committee D-4 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.22 on Effect of Water and Other Elements on Bituminous Coated Aggregates.

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² *Annual Book of ASTM Standards*, Vol 04.03.

- D 3203 Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures²
- D 3387 Test Method for Compaction and Shear Properties of Bituminous Mixtures by Means of the U.S. Corps of Engineers Gyrotory Testing Machine (GTM)²
- D 3496 Method for Preparation of Bituminous Mixture Specimens for Dynamic Modulus Testing²
- D 3515 Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures²
- D 3549 Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens²
- D 3665 Practice for Random Sampling of Construction Materials²
- D 4013 Practice for Preparation of Test Specimens of Bituminous Mixtures by Means of Gyrotory Shear Compactor²
- D 4123 Test Method for Indirect Tension Test for Resilient Modulus of Bituminous Mixtures²

3. Summary of Test Method

3.1 *Potential for Moisture Damage*—The degree of susceptibility to moisture damage is determined by preparing a set of laboratory-compacted specimens conforming to the job-mix formula without an additive. The specimens are compacted to a void content corresponding to void levels expected in the field, usually in the 6 to 8 % range. The set is divided into two subsets of approximately equal void content. One subset is maintained dry while the other subset is partially saturated with water and moisture conditioned. The tensile strength of each subset is determined by the tensile splitting test. The potential for moisture damage is indicated by the ratio of the tensile strength of the wet subset to that of the dry subset.

3.2 *Additive Effect*—The effect of an antistripping additive is determined on a set of specimens containing an additive prepared and tested as described in 3.1. The effect of an additive dosage may be estimated by repeating the tests on sets with different additive dosages.

3.3 *Plant-Produced Mixtures*—The potential for moisture damage or the effectiveness of an additive in a plant-produced mixture is determined on specimens that are laboratory compacted to expected field-level void content, divided into wet and dry subsets, and evaluated as described in 3.2.

4. Significance and Use

4.1 This test method can be used to test asphalt concrete mixtures in conjunction with mixture design testing to determine the potential for moisture damage, to determine whether or not an antistripping additive is effective, and to determine what dosage of an additive is needed to maximize the effectiveness. This test method can also be used to test mixtures produced in plants to determine the effectiveness of additives under the conditions imposed in the field.

5. Apparatus

5.1 To prepare and compact the specimens use apparatus from any one of the following: Test Methods D 1074, D 1559, and D 3387, Method D 3496, or Practices D 1561 and D 4013.

5.2 *Vacuum Pump or Water Aspirator* in accordance with Test Method D 2041.

5.3 *Manometer or Vacuum Gage* in accordance with Test Method D 2041.

5.4 *Container*, preferably Type F, of Test Method D 2041.

5.5 *Balance* in accordance with Test Method D 2726.

5.6 *Water Baths* Three:

5.6.1 One waterbath in accordance with Test Method D 2726.

5.6.2 One bath capable of maintaining a temperature of $60 \pm 1.0^\circ\text{C}$ ($140 \pm 1.8^\circ\text{F}$) for 24 h, and

5.6.3 One bath capable of maintaining a temperature of $25 \pm 1.0^\circ\text{C}$ ($77 \pm 1.8^\circ\text{F}$).

5.7 *Loading Jack and Ring Dynamometer* in accordance with Test Method D 1559, or a *Mechanical or Hydraulic Testing Machine* capable of maintaining the required strain rate and measuring load with equal or better precision.

5.8 *Loading Strips* in accordance with Test Method D 4123.

6. Preparation of Laboratory Test Specimens

6.1 Make at least six specimens for each test, three to be tested dry and three to be tested after partial saturation and moisture conditioning.

6.2 Use specimens 100 mm (4 in.) in diameter and 62.5 mm (2.5 in.) high, in general, but specimens of other dimensions may be used if desired. When using aggregate larger than 25 mm (1 in.), use specimens at least 150 mm (6 in.) in diameter.

6.3 Prepare mixtures in batches large enough to make at least 3 specimens or, as an alternative, prepare a batch just large enough for 1 specimen. If theoretical maximum specific gravity is to be determined, use a batch large enough or prepare a separate batch to provide a specimen for this purpose.

6.4 When a liquid antistripping additive is used, heat a sufficient quantity of asphalt cement for one batch to $150 \pm 6^\circ\text{C}$ ($300 \pm 10^\circ\text{F}$) in a closed 1 L (1-qt) can in an oven. Add the required quantity of additive and immediately mix, for approximately 2 min, with a mechanical stirrer approximately 25 mm (1 in.) from the bottom of the container. Maintain the treated asphalt cement at $150 \pm 6^\circ\text{C}$ ($300 \pm 10^\circ\text{F}$) in the closed can until it is used. Discard the treated asphalt cement if not used the same day it is prepared, or if allowed to cool so that it requires reheating.

6.5 When using a pulverulent solid antistripping additive, use the addition procedure simulating the procedure expected in the field. Follow the procedure specified in either 6.5.1, 6.5.2, or 6.5.3.

6.5.1 When dry powder is added to dry aggregate, dry, batch, and heat the mineral aggregate to $150 \pm 6^\circ\text{C}$ ($300 \pm 10^\circ\text{F}$). Add the required quantity of additive to the aggregate, and thoroughly mix the entire mass until a uniform distribution of additive is achieved. Take care to minimize the loss of additive to the atmosphere in the form of dust. After mixing, maintain the treated aggregate at the required mixing temperature until it is used.

6.5.2 When dry powder is added to damp aggregate, batch the damp mineral aggregate, and adjust the moisture content of the combined aggregate to the expected field moisture level. Add the required quantity of additive to the damp aggregate, and thoroughly mix the entire mass until a uniform distribution of additive is achieved. Take care to minimize the loss of additive to the atmosphere in the form of dust. After mixing, dry the treated aggregate, heat to the required mixing temperature, and maintain at that temperature until it is used.

6.5.3 When powder slurry is used, add the required quantity of additive to water using the powder to water ratio expected in the field. Take care to minimize the loss of additive to the atmosphere in the form of dust. To prevent settling, continuously mix the resulting slurry until it is used. Batch the damp mineral aggregate, adjust the moisture content as required in 6.5.2, add the required quantity of slurry, and thoroughly mix the entire mass until a uniform distribution of slurry is achieved. After mixing, dry the treated aggregate, heat to the required mixing temperature, and maintain at that temperature until used.

6.6 Proportion, mix, and compact specimens in accordance with one of the following: Test Methods D 1074, D 1559, D 3387, Method D 3496, Practices D 1561 or D 4013, and 6.6.1 and 6.6.2. If Test Method D 1559 is used, either a manual or mechanical hammer may be used.

6.6.1 After mixing, stabilize the mixture temperature of each specimen at the required compaction temperature, in a closed container, in an oven for 1 to 2 h. If preparing a multi-specimen batch, split the batch into single-specimen quantities before placing into the oven.

6.6.2 Compact the specimens to $7 \pm 1\%$ air voids, or a void level expected in the field at the time of construction. This void level can be obtained by adjusting the following: the static load in double-plunger compaction; the number of blows in a marshall hammer compaction; the foot pressure, number of tamps, leveling load, or some combination in kneading compaction; or the number of revolutions in gyratory compaction. Determine the exact procedure by trial for each mixture.

6.6.3 Cool specimens in the mold to room temperature as rapidly as possible in a stream of moving air, extract from molds, then follow the procedure outlined in Section 8 within 24 h.

7. Preparation of Field Specimens

7.1 Select a truck to be sampled in accordance with Practice D 3665.