Designation: D3203 – 22

Standard Test Method for Percent Air Voids in Compacted Asphalt Mixtures[1]

This standard is issued under the fixed designation D3203; 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 determination of the percent air voids in compacted asphalt mixtures.

1.2 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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]

D8 Terminology Relating to Materials for Roads and Pavements

D1188/D1188M Test Method for Bulk Specific Gravity and Density of Compacted Asphalt Mixtures Using Coated Samples

D2041/D2041M Test Method for Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures

D2726/D2726M Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures

D3549/D3549M Test Method for Thickness or Height of Compacted Asphalt Mixture Specimens

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

D4460 Practice for Calculating Precision Limits Where Values Are Calculated from Other Test Methods

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

D6857/D6857M Test Method for Maximum Specific Gravity and Density of Asphalt Mixtures Using Automatic Vacuum Sealing Method

3. Terminology

3.1 *Definitions:*

3.1.1 *dense asphalt mixtures*—asphalt mixtures in which the air voids are less than 10 % when compacted.

3.1.2 *open asphalt mixtures*—asphalt mixtures in which the air voids are 10 % or more when compacted.

3.1.2.1 *Discussion*—For borderline cases, an asphalt mixture shall be designated an open asphalt mixture if the calculated percent air voids, based on either 6.1 or 6.2, is 10 % or more.

3.2 For definitions of other terms used in this test method, refer to Terminology D8.

4. Significance and Use

4.1 The percent of air voids in an asphalt mixture is used as one of the criteria in the design methods and for evaluation of the compaction imparted in asphalt paving projects.

NOTE 1—The text of this test method references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the test method.

NOTE 2—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.

5. Sampling

5.1 Samples for testing shall consist of specimens from laboratory-molded mixtures or cores from field-compacted mixtures.

[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.

6. Procedure

6.1 For dense asphalt mixtures, determine the bulk specific gravity of the compacted mixture by Test Method D1188/D1188M, by Test Method D2726/D2726M, or by Test Method D6752/D6752M.

6.2 For open asphalt mixtures, determine the density of a regularly shaped specimen of compacted mixture from its dry mass (in grams) and its volume (in cubic centimetres).

6.2.1 Obtain the height of the specimens by Test Method D3549/D3549M.

6.2.2 Measure the diameter of the specimen at four locations and determine the average.

6.2.3 Calculate the volume of the specimen based on the average height and diameter measurement.

6.2.4 Convert the density to bulk specific gravity by dividing by 0.99707 g/cm^3 or 997 kg/m^3, the density of water at 25 °C.

NOTE 3—The density measurements should be converted to the appropriate SI units before performing the calculation in 6.2.4.

6.3 Determine the theoretical maximum specific gravity by Test Method D2041/D2041M or by Test Method D6857/D6857M on a comparable asphalt mixture to avoid the influence of differences in gradation, asphalt content, etc.

6.4 For referee purposes, determine both the bulk specific gravity and the theoretical maximum specific gravity on approximately equal portions of the same sample of compacted asphalt mixture.

7. Calculation

7.1 Calculate the percent air voids in a compacted asphalt mixture as follows:

$$\text{Percent air voids} = 100\,(1 - (\text{bulk sp gr}/\text{theoretical maximum sp gr})) \quad (1)$$

7.2 If the percent air voids of a specimen tested according to 6.1 equals or exceeds 10 %, the specimen shall be retested according to 6.2 as an open asphalt mixture.

8. Precision and Bias

8.1 The precision of this test method depends on the precision of test methods for bulk specific gravity and theoretical maximum specific gravity. It is computed by a procedure described in Practice D4460. Since the computation for percent air voids in 7.1 involves the quotient of bulk specific gravity divided by the theoretical maximum specific gravity, the quotient formula is used:

$$\sigma_{x/y} = \sqrt{\frac{\bar{y}^{\,2}\sigma_x^{\,2} + \bar{x}^{\,2}\sigma_y^{\,2}}{\bar{y}^{\,4}}} \quad (2)$$

where:

$\sigma_{x/y}$ = standard deviation for determining precision limits of test results based on the quotient of test results from Test Method D1188/D1188M, D2726/D2726M, or D6752/D6752M, and Test Method D2041/D2041M or D6857/D6857M,

$\bar{x}$ = mean (average) of x standard test results (bulk specific gravity, Test Method D1188/D1188M, D2726/D2726M, or D6752/D6752M),

$\bar{y}$ = mean (average) of y standard test results (theoretical maximum specific gravity, Test Method D2041/D2041M or D6857/D6857M),

σ_x = standard deviation from the precision statement of x standard test results (bulk specific gravity, Test Method D1188/D1188M, D2726/D2726M, or D6752/D6752M), and

σ_y = standard deviation from precision statement of y standard test results (maximum theoretical specific gravity, Test Method D2041/D2041M or D6857/D6857M).

8.2 Criteria for judging the acceptability of percent air voids test results would be presented in the form:

	Standard Deviation	Acceptable Range of Two Results
Operator Precision	$\sigma_{x/y}$	2.8 $\sigma_{x/y}$

APPENDIX

(Nonmandatory Information)

X1. EXAMPLE CALCULATION OF PRECISION

X1.1 Assume the following precision data:

Bulk specific gravity, x

Average	Standard Deviation
2.423	0.007

Theoretical maximum specific gravity, y

Average	Standard Deviation
2.523	0.004

Then using the equation in 8.1:

$$\sigma_{x/y} = \sqrt{\frac{(2.523)^2\,(0.007)^2 + (2.423)^2\,(0.004)^2}{(2.523)^4}} \quad (X1.1)$$

$$= 0.00316$$

This value is in terms of air voids; therefore it should be multiplied by 100 to convert it into a percentage. Therefore:

$$\sigma_{x/y} = 0.00316(100) = 0.32\,\% \quad (X1.2)$$