



Designation: ~~D4469 – 11~~ D4469 – 17

Standard Practice for Calculating Percent Asphalt Absorption by the Aggregate in an Asphalt Pavement Mixture Mixtures¹

This standard is issued under the fixed designation D4469; 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 practice covers equations for calculating percent asphalt absorption by the aggregate in an asphalt paving mixture, expressed as percent of the oven-dry mass of the aggregate in the paving asphalt mixture. This calculation is based on measured values for components and properties of an oven-dry asphalt paving mixture.

1.2 *This practice 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.*

1.3 *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

[C127 Test Method for Relative Density \(Specific Gravity\) and Absorption of Coarse Aggregate](#)

[C128 Test Method for Relative Density \(Specific Gravity\) and Absorption of Fine Aggregate](#)

[C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates](#)

[D8 Terminology Relating to Materials for Roads and Pavements](#)

~~D1560~~ [D1561 Test Methods for Resistance to Deformation and Cohesion of Asphalt Mixtures Practice for Preparation of Bituminous Mixture Test Specimens by Means of Hveem Apparatus/California Kneading Compactor](#)

[D2041 Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures](#)

[D2172 Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures](#)

[D3289 Test Method for Density of Semi-Solid and Solid Asphalt Materials \(Nickel Crucible Method\)](#)

[D4125 Test Methods for Asphalt Content of Bituminous Mixtures by the Nuclear Method](#)

[D5444 Test Method for Mechanical Size Analysis of Extracted Aggregate](#)

[D6307 Test Method for Asphalt Content of Asphalt Mixture by Ignition Method](#)

[D6857 Test Method for Maximum Specific Gravity and Density of Bituminous Paving Mixtures Using Automatic Vacuum Sealing Method](#)

3. Terminology

3.1 For definitions of terms used in this standard, refer to Terminology [D8](#).

4. Summary of Test Method

4.1 The percent asphalt absorption for an oven-dry paving asphalt mixture (expressed as percent of the oven-dry mass of the total aggregate in the paving mixture) can be calculated by means of equations in which measured values for the theoretical maximum specific gravity of an oven-dry paving asphalt mixture, its asphalt content (expressed either as percent of the total mass of a sample of oven-dry paving asphalt mixture, or as percent of the mass of oven-dry aggregate in a sample of oven-dry paving asphalt

¹ This practice is under the jurisdiction of ASTM Committee [D04](#) on Road and Paving Materials and is the direct responsibility of Subcommittee [D04.51](#) on Aggregate Tests.

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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.

mixture), the apparent specific gravity of the asphalt, and the weighted average ASTM-bulk specific gravity of the oven-dry total aggregate in the paving asphalt mixture (Note 1).

NOTE 1—Whenever it is referred to in this practice, the phrase, “weighted average ASTM-oven-dry-bulk specific gravity of the aggregate,” refers to the weighted average of the ASTM-oven-dry bulk specific gravities of the coarse and fine aggregates as determined by Test Methods C127 and C128. The fine aggregate ordinarily includes the mineral dust portion of the fine aggregate that passes the No. 200 sieve. The weighted average ASTM-oven-dry bulk specific gravity of the total aggregate is to be calculated by means of the equation given in the calculation section of Test Method C127.

5. Significance and Use

5.1 The amount of asphalt absorbed by the aggregate contributes little or nothing to the durability of an asphalt pavement in service other than possibly providing greater resistance to stripping in the presence of water.

5.2 Percent asphalt absorption can be an indicator of changes that may occur in plant mix production during construction.

5.3 The calculated percent asphalt absorption can be used for calculating percent air voids during paving asphalt mixture design.

6. Procedure

6.1 Determine percent asphalt absorption by the aggregate in a paving mixture for a sample of oven-dried paving mixture that is prepared in a laboratory, taken from a pavement, or obtained for quality control during construction:

6.1.1 Establish For samples of oven-dried asphalt mixes, establish percent asphalt absorption by the aggregate in a sample of oven-dried paving mixture from values for the sample that have been obtained in accordance with the following ASTM-test methods:

6.1.1.1 Test Method D2041 or D6857, theoretical maximum specific gravity of the sample of oven-dry paving asphalt mixture.

6.1.1.2 Test Method D2172, D4125, or D6307, asphalt content. For samples of paving asphalt mixture obtained for quality control during construction, or taken from a pavement, determine the asphalt content of each sample by Test Methods Method D2172, D4125, or D6307. For samples of hot-mixed-asphalt paving mixture mixtures prepared in the laboratory with oven-dried aggregate according to Test Method Practice D1560/D1561, use the asphalt content that was added during the preparation of the paving asphalt mixture.

6.1.1.3 Test Method D3289, the apparent specific gravity of the asphalt in the sample of paving asphalt mixture.

6.1.1.4 Test Methods C127 and C128, the respective ASTM-dry-oven-dry bulk specific gravities of the coarse and fine aggregates in the sample of paving asphalt mixture.

6.1.1.5 Test Method C136 or D5444, to establish the percentages of coarse and fine aggregates employed for or recovered from the sample of paving mixture, mixture sample, and thereby enable the weighted average ASTM-oven-dry bulk specific gravity for the total aggregate in the sample of paving mixture mixture sample to be calculated (using the equation given in the calculation section of Test Method C127).

7. Calculation

7.1 *Paving Asphalt Mixtures for Which Asphalt Content is Expressed as Percent by Mass of the Total Mix in a Sample of Oven-Dry Paving Asphalt Mixture:*

7.1.1 When the values for the various items in 5.26.1 become available, calculate the asphalt absorption as percent of the oven-dry mass of the total aggregate in the sample of oven-dry paving asphalt mixture, by substituting the relevant values in the following equation:

$$A_{ac} = 100 \left[\frac{P_{tac}}{100 - P_{tac}} + \frac{G_{ac}}{G_{ag}} - \frac{100G_{ac}}{(100 - P_{tac})G_{tm}} \right] \quad (1)$$

where:

A_{ac} = absorbed asphalt as percent by mass of the oven-dry aggregate.

P_{tac} = asphalt content as percent by mass of the total mix in the sample of oven-dry paving mixture.

G_{ac} = apparent specific gravity of the asphalt in the paving mixture sample.

G_{ag} = weighted average ASTM-oven-dry bulk specific gravity of the total aggregate in the sample of paving mixture.

G_{tm} = theoretical maximum specific gravity of the sample of oven-dry paving mixture.

A_{ac} = absorbed asphalt as percent by mass of the oven-dry aggregate,

P_{tac} = asphalt content as percent by mass of the total mix in the sample of oven-dry asphalt mixture,

G_{ac} = apparent specific gravity of the asphalt in the mixture sample,

G_{ag} = weighted average oven-dry bulk specific gravity of the total aggregate in the mixture sample, and

G_{tm} = theoretical maximum specific gravity of the sample of the oven-dry mixture sample.

7.2 *Paving Asphalt Mixtures for Which Asphalt Content is Expressed as Percent of the Mass of the Oven-Dry Total Aggregate in a Sample of Oven-Dry Paving Mixture: Asphalt Mixture:*

7.2.1 When the values for the various items in [5.26.1](#) become available, calculate the asphalt absorption as percent of the oven-dry mass of the aggregate in the sample of oven-dry paving asphalt mixture by substituting the relevant values in the following equation:

$$A_{ac} = 100 \left[\frac{P_{aac}}{100} + \frac{G_{ac}}{G_{ag}} - \frac{(100 + P_{aac})(G_{ac})}{100 G_{im}} \right] \quad (2)$$

where:

P_{aac} = ~~asphalt content as percent of the mass of the oven-dry total aggregate in a sample of oven-dry paving mixture.~~

and = ~~the other symbols have the significance designated for them in [6.1.1](#).~~

P_{aac} = asphalt content as percent of the mass of the oven-dry total aggregate in a sample of oven-dry asphalt mixture.

The other symbols have the significance designated for them in [7.1.1](#).

NOTE 2—The calculated percent asphalt absorption increases with an increase in theoretical maximum specific gravity of a ~~paving asphalt~~ asphalt mixture, increases with an increase in its asphalt content, decreases with an increase in the apparent specific gravity of the asphalt, and decreases with an increase in the total aggregate's weighted average ~~ASTM~~ oven-dry bulk specific gravity.

8. Report

8.1 Report asphalt absorption as percent of the oven-dry mass of the total aggregate in the sample of oven-dry paving asphalt mixture to the nearest 0.1 %. The precision of the reported value for percent asphalt absorption depends on the accuracy of the value measured for each of the four variables that are included in either [Eq 1](#) or [Eq 2](#). Errors in these measured values can have a major influence on the value for percent asphalt absorption. The influence of these errors on the calculated value for percent asphalt absorption is illustrated by the data in [X1.2.1](#) in [Appendix X1](#).

8.2 Report the value for each of the four variables that are included either in [Eq 1](#) or [Eq 2](#) as follows:

8.2.1 Theoretical maximum specific gravity of the oven-dry ~~sample of paving mixture~~ asphalt mixture sample.

8.2.2 Asphalt content as percent of the mass of the oven-dry ~~sample of paving mixture~~ asphalt mixture sample, [Eq 1](#), or asphalt content as percent of the mass of the oven-dry total aggregate in a sample of oven-dry paving mixture, the asphalt mixture sample, [Eq 2](#).

8.2.3 Apparent specific gravity of the asphalt in the ~~sample of paving mixture~~ asphalt mixture sample.

8.2.4 Weighted average ~~ASTM~~ oven-dry bulk specific gravity for the total aggregate in the ~~sample of paving mixture~~ asphalt mixture sample.

9. Keywords

9.1 aggregate-asphalt absorption; asphalt absorption; asphalt mixture

APPENDIX

(Nonmandatory Information)

X1. SAMPLE CALCULATIONS

X1.1 Sample Calculations for Percent Asphalt Absorption

X1.1.1 The usefulness and bias of [Eq 1](#) and [Eq 2](#) for determining the percent asphalt absorption by the aggregate in a sample of asphalt ~~paving~~ mixture is illustrated by the following sample calculations:

X1.1.2 *Numerical Calculation*—Assume the following:

X1.1.2.1 Theoretical maximum specific gravity of an oven-dry sample of paving mixture = 2.501.

X1.1.2.2 Asphalt content of oven-dry paving asphalt mixture sample expressed as percent by mass of total mix = [6.27.2](#) (for use with [Eq 1](#)).