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Standard Test Method for Density of Bituminous Paving Mixtures in Place by the Electromagnetic Surface Contact Methods[1]

This standard is issued under the fixed designation D 7113; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers the procedures for determining the in-place density and relative compaction of bituminous concrete pavement paving mixtures by an electromagnetic surface contact device by measuring changes in the electromagnetic field resulting from the compaction process.

1.2 The equipment referenced in this method is a surface contact device, which must accommodate surface moisture and temperature variation in the range typically encountered in paving applications. This can be accomplished by design parameters that reduce the device's sensitivity to surface moisture and temperature variation or by measurements and algorithms to account for surface moisture and temperature variance in the rolling pattern.

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 prior to use.*

1.4 The values stated in SI units are to be regarded as the standard.

2. Referenced Documents

2.1 ~~*ASTM Standards:*~~ *ASTM Standards:*[2]

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

D 1188 Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using ~~Paraffin-Coated Specimens~~Coated Samples

D 2726 Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures

D 3665 Practice for Random Sampling of Construction Materials

D 3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

D 5361 Practice for Sampling Compacted Bituminous Mixtures for Laboratory Testing

D 6752 Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method

3. Significance and Use

3.1 The test method described is useful as a rapid, nondestructive technique for determining the in-place density or relative compaction of compacted bituminous mixtures.

3.2 The test method can be used to establish the proper rolling effort and pattern to achieve the required density.

3.3 The non-destructive nature of the test allows repetitive measurements to be made at a single test location between roller passes or at multiple locations across the mat to monitor changes in density.

3.4 The density results obtained by this test method are relative. Device calibration (correlation with other test methods) is required to convert the results obtained using this method to actual density. Section 6 of this test method describes a method that has proven to be acceptable for correlation.

NOTE 1—The personnel and equipment used in performing this test can be evaluated in accordance with Specification D 3666.

NOTE 2—Research and evaluation of devices used in this test method has been conducted. Reference is made to "Evaluation of Non-Nuclear Gauges to Measure Density of Hot-Mixed Asphalt Pavements," a pooled fund study, Pedro Romero, Ph.D., P.E., July 2002.

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[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.

4. Interferences

4.1 Electromagnetic force fields such as high-tension power lines, or large metal objects in close proximity may interfere with the device reading.

4.2 The chemical composition of the material being tested may significantly affect the measurement and adjustments may be necessary. The device can be calibrated to the specific mix design being used in the field.

4.3 The test method exhibits spatial bias in that the device is most sensitive to the density of the material in closest proximity to the sensor.

4.4 The surface texture of the material being tested may cause lower than actual density determination.

4.5 Oversize aggregate particles in the sensor path may cause variations in density determination.

4.6 The actual sample volume varies with the apparatus and the density of the material. In general, the higher the density the smaller the volume (see Note 3).

NOTE 3—The volume of field compacted material represented by a test can effectively be increased by repeating the test at adjacent locations and averaging the results.

5. Apparatus

5.1 *Electronic Sensing Device*—An electronic counting device, capable of being seated on the surface of the material under test, and which meets the outline below:

5.1.1 The device shall be housed in an enclosure of heavy-duty construction and designed for taking in-situ density measurements of bituminous paving mixtures.

5.1.2 The device shall function in the mat temperature and moisture levels experienced during the placement of hot bituminous paving mixtures.

5.1.3 The device shall include the internal circuitry suitable for displaying individual measurements to allow operators to record the readings.

5.1.4 The device shall include a continuous reading mode of operation.

5.1.5 The device shall employ suitable electronic circuitry to provide power and signal conditioning to the sensor to provide the data acquisition and readout function, and allow calibration of the unit over the expected range of application conditions and materials.

NOTE 4—The device manufacturer may choose to supply a Reference Standard, a block of material used for checking device operation and to establish conditions before actual pavement measurements are made.

6. Calibration

6.1 Calibrate the device for each mixture prior to performing tests on that particular mixture.

6.2 Record the calibration method used and the specific values obtained for future use of the device on the same type of material.

6.3 The calibration must be conducted on the mat within the mat temperature range that will be encountered during subsequent testing.

6.4 The core calibration allows the device to be offset to a specific density measured using Test Method D 1188, Test Method D 2726, or Test Method D 6752.

6.4.1 Identify three to ten test locations within a 3-meter (10-ft) length in the direction of the paving train on the mat.

6.4.2 At each location take a minimum of four measurements following the device manufacturer's recommendation for seating the device on the pavement and the procedures of operation noted in 7.7.

6.4.3 Record each individual measurement and the average for each location.

6.4.4 Cut a 150-mm (6-in.) core from the pavement location in accordance with Practice D 5361 and proceed with the appropriate test method for determining the bulk specific gravity of the compacted specimen.

6.4.5 Average all device readings. Average all core measurements. Compare these values to determine a device offset.

6.4.6 Offset the device reading to reflect the value derived in step 6.4.5.

7. Procedure of Operation

7.1 The device should be turned on sufficiently in advance of taking any readings to allow the device to stabilize.

7.2 Standardize the device using the manufacturer's procedures as described in the device operation manual.

7.3 Select a test location in accordance with the project specifications, or, if not otherwise specified, in accordance with Practice D 3665.

7.4 Ensure that no sources of electromagnetic interference such as high-tension power lines or large metal objects are near the immediate vicinity of the device.

7.5 For best results, avoid surfaces with large temperature extremes.

7.6 The following procedure may be used to determine the required number of roller passes:

7.6.1 Measure and record readings on the un-compacted mixture exiting the screed.

7.6.2 After each roller pass, measure and record the compaction readings.

7.6.3 When the measurements no longer increase or fall back with additional roller passes, record this reading and the number of passes.