



Standard Test Method for Preparation and Determination of Bulk Specific Gravity of Dense-Graded Cold Mix Asphalt (CMA) Specimens by Means of Superpave Gyratory Compactor¹

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^{ε1} NOTE—Editorially corrected 9.1 in December 2013.

1. Scope

1.1 This test method concerns the preparation and compaction of cylindrical specimens of dense-graded cold mix asphalt (CMA) using the Superpave gyratory compactor (SGC).

1.2 This test method is applicable for road mixes or plant mixes prepared at ambient temperatures.

1.3 This test method also refers to the determination of the bulk specific gravity of the compacted CMA.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 A precision and bias statement for this test method has not been developed at this time. Therefore, this test method should not be used for acceptance or rejection of a material for purchasing purposes.

1.6 *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:²

- C566 Test Method for Total Evaporable Moisture Content of Aggregate by Drying
- D8 Terminology Relating to Materials for Roads and Pavements
- D977 Specification for Emulsified Asphalt

¹ This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.27 on Cold Mix Asphalts.

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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.

- D1188 Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
- D2041 Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
- D2397 Specification for Cationic Emulsified Asphalt
- D2489 Practice for Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
- D2726 Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
- D3203 Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
- D3628 Practice for Selection and Use of Emulsified Asphalts
- D4215 Specification for Cold-Mixed, Cold-Laid Bituminous Paving Mixtures
- D6752 Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
- D6925 Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
- D6934 Test Method for Residue by Evaporation of Emulsified Asphalt
- D6998 Practice for Evaluating Aggregate Coating using Emulsified Asphalts

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology D8.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *dense-graded aggregate emulsified asphalt cold mixtures*—mixtures of dense-graded aggregate and emulsified asphalt uniformly mixed at or near ambient temperature.

3.2.2 *dense-graded cold mix asphalt (CMA)*—emulsified asphalt that has been mixed with aggregate, dry, and compacted by a suitable compacting device.

3.2.3 *nominal maximum aggregate/sieve size*—one sieve size larger than the first sieve to retain more than 10 %.

4. Significance and Use

4.1 This test method is used to prepare specimens for determination of the bulk specific gravity of a cured compacted specimen. It covers modifications to Test Method **D6925** for preparation of CMA by means of the SGC.

4.2 This test method is useful for monitoring the density of the specimen during the compaction process. It is suitable for laboratory design and field control of CMA.

4.3 Local end-use specifications should be developed to establish conformance to the job and user requirements.

5. Apparatus

5.1 *Superpave Gyratory Compactor*—An electrohydraulic or electromechanical compactor with a ram and ram heads as described in Test Method **D6925**.

6. Materials

6.1 *Aggregates*³—Dense-graded aggregates meeting the requirements of Specification **D4215** are among those suitable for emulsified asphalt cold mixtures or further guidance should be obtained from the Cold Mix Manual.

6.2 *Emulsions*—Two types of emulsified asphalt are used for producing dense-graded emulsified asphalt cold mixtures and their selection are described in Practice **D3628**. These are designated as slow-setting and medium-setting emulsions. Medium-setting emulsions are used with aggregates that do not have excessive amounts passing the 0.075-mm sieve. Slow-setting emulsions are normally used with the more dense aggregates with larger amounts passing the 0.075-mm sieve. Specifications for these emulsions are given in Specifications **D977** and **D2397**.

7. Procedure

7.1 *Determination of Trial Emulsion Content*—If needed, a simple formula for base mixtures and one for surface mixtures is used. These formulas are based on the percentage of aggregate passing the 4.75-mm sieve and, in most cases, give a satisfactory starting point.

7.1.1 Determine the residue content of the emulsion to be used by Test Method **D6934** or another suitable acceptable procedure.

7.1.2 Estimate the initial emulsified asphalt content based on the dry weight of aggregate as follows:⁴

7.1.2.1 *Base Mixtures:*

$$E = \frac{(0.06B + 0.01C) \times 100}{A} \quad (1)$$

7.1.2.2 *Surface Mixtures:*

$$E = \frac{(0.07B + 0.03C) \times 100}{A} \quad (2)$$

where:

A = percent residue of the emulsion by distillation or other suitable procedure (see **7.1.1**),

B = percent of dry aggregate passing the 4.75-mm sieve,

C = 100 – B (dry aggregate retained on the 4.75-mm sieve and above), and

E = percent emulsified asphalt based on dry weight of aggregate.

7.2 *Coating Test*—Preliminary evaluation of the emulsified asphalt selected for mixture preparation is accomplished through a coating test. The trial emulsion content as determined in **7.1** is combined with the wet job aggregate corrected to dry weight. Coating is visually estimated by the user as satisfactory or unsatisfactory for the intended use of the mix (surface mixtures require a greater degree of coating than do base mixtures). Local end-use specifications or agreement between user and supplier should be developed to determine the degree of coating. If the degree of coating is considered satisfactory, proceed to making the mix. If the coating is considered unsatisfactory, select another grade of emulsion as described in Practice **D3628** and start over from **7.1**.

NOTE 1—As a general guideline, aggregates not exceeding 20 % passing the 0.075-mm sieve can be used for the slow-setting emulsions, and aggregates with less than 10 % passing the 0.075-mm sieve are used for the medium-setting emulsions. Local end-use specifications should be developed to finalize these requirements since aggregates vary from region to region.

NOTE 2—Coating may be quantitatively calculated by using the procedure described in Practice **D2489**.

NOTE 3—The emulsified asphalt/job aggregate coating test in Test Method **D6998** can be used for this screening process.

7.3 *Preparation of Test Specimens*—Prepare a specimen using the emulsion content determined in **7.1**. If the mixture in the coating tests (**7.2**) appears to be dry, start with the trial emulsion content (**7.1**). Conversely, if the mixture appears rich, reduce the emulsion content.

NOTE 4—A trial emulsion content of 8 % emulsion is a good starting point. Other trial blends can be 1 % higher or 1 % lower. Other trial blends would then be 9, 8, and 7 % of emulsion content, respectively. A normal difference between the emulsion content levels is 1 %, which is a residual difference of 0.65 % for an emulsion with a 65 % residue content.

7.4 *Preparation of Aggregates:*

7.4.1 Determine the moisture content of the aggregate following Test Method **C566**.

7.4.2 Weigh the appropriate amount of wet job aggregate, corrected to dry aggregate weight to obtain a compacted specimen height of 115 ± 5 mm, into suitable mixing bowls for each individual batch. Care must be taken so that the aggregate for each batch is representative of the project aggregate. If necessary, the aggregate maybe dried and separated into sizes then rebled into individual batch sizes. If this is done, water equivalent to stockpile moisture must be added to each batch and the mixture covered to prevent loss of moisture for about 24 h before mixing with emulsion.

NOTE 5—It may be necessary to produce a trial specimen to achieve this height requirement. Generally, 4500 to 4700 g of aggregate are required.

7.4.3 If premixing water is required, pour the predetermined amount (from section **7.2**) onto the aggregate and hand mix for 60 s or until uniform. As an option, mechanical mixing may be

³ *Asphalt Cold Mix Manual*, Asphalt Institute, Manual Series No. 14 (MS-14), 3rd Edition, 1997.

⁴ *A Basic Asphalt Emulsion Manual*, Asphalt Institute, Asphalt Emulsion Manufacturers Association, Manual Series No. 19 (MS- 9), 3rd Edition.