Designation: D 1074 – 02

Standard Test Method for Compressive Strength of Bituminous Mixtures[1]

This standard is issued under the fixed designation D 1074; 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 provides a method for measuring the compressive strength of compacted bituminous mixtures. It is for use with specimens weighed, batched, mixed, and fabricated in the laboratory, as well as for mixtures manufactured in a hot-mix plant.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are provided for information only.

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:*

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregate[2]

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[2]

C 702 Practice for Reducing Samples of Aggregate to Testing Size[2]

D 75 Practice for Sampling Aggregates[3]

D 140 Practice for Sampling Bituminous Materials[3]

D 979 Practice for Sampling Bituminous Paving Mixtures[3]

D 1075 Test Method for Effect of Water on Compressive Strength of Compacted Bituminous Mixtures[3]

D 2041 Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures[3]

D 2170 Test Method for Kinematic Viscosity of Asphalts (Bitumens)[3]

D 2493 Viscosity-Temperature Chart for Asphalts[3]

D 2726 Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures[3]

D 3203 Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures[3]

D 4402 Test Method for Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermoset Apparatus[4]

D 4753 Specification for Evaluating, Selecting and Specifying Balances and Scales for Use in Soil, Rock, and Construction Materials Testing[5]

E 4 Practices for Force Verification of Testing Machines[6]

2.2 *Federal Specification:*

Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects[7]

3. Significance and Use

3.1 The compressive strength of specimens prepared and tested by this test method along with density and voids properties are used for laboratory mix design of bituminous mixtures. One approach is described in ASTM STP 252.[8]

3.1.1 This test method also describes the methods for molding, curing, and testing of specimens being evaluated by Test Method D 1075.

3.1.2 When used in conjunction with other mixture physical properties, the compressive strength may contribute to the overall mixture characterization and is one factor determining its suitability for use under given loading conditions and environment as a highway paving material.

3.2 Typical values of minimum compressive strengths for design of bituminous mixtures by this test method for different traffic densities are given in Table 401-1 of the "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects."[7] Some state departments of transportation and federal agencies have specific requirements of their own based on their experience with this test method. The agencies should be consulted for their specific requirements if work is to meet their standards.

3.3 Reheated mixtures are permissible in this test method, but the resulting compressive strengths will be higher than for newly prepared mixtures due to the change in the binder viscosity, an element of the compressive strength as measured

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.03.

[4] *Annual Book of ASTM Standards*, Vol 04.04.

[5] *Annual Book of ASTM Standards*, Vol 04.08.

[6] *Annual Book of ASTM Standards*, Vol 03.01.

[7] "Asphaltic Concrete Mix Requirements," *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects*, 1996, Federal Highway Administration, Washington, DC 20590, p. 233.

[8] Goode, J. F., "Use of the Immersion-Compression Test in Evaluating and Designing Paving Mixtures." *ASTM STP 252*, 1959, pp. 113–129.

under these loading conditions and temperature.[9] See Note 1.

4. Apparatus

4.1 *Molds and Plungers*—The molds and plungers shall be in accordance with the following:

4.1.1 *Diameter Tolerances*—The mold shall have sufficient height to allow fabrication of a 101.6 by 101.6 mm (4 by 4 in.) specimen. It shall have an inside diameter of 101.60 to 101.73 mm (4.000 to 4.005 in.) and a nominal thickness of 6.4 mm. (¼ in.).

4.1.2 The plungers shall pass through the mold freely and shall have a diameter within 1.27 mm (0.050 in.) of the mold inside diameter. The plungers may be solid, hollow, or other structure so long as the ends are at least 12.7 mm (½ in.) thick and are at a right angle to the mold wall. The bottom plunger shall be 50± 4 mm (2 ± ⅛ in.) high but the top plunger may be any suitable height.

4.1.3 *Specimens Other than 101.6 by 101.6 mm (4 by 4 in.)*—Molds and plungers for fabricating these size specimens are allowed in accordance with Section 6.

4.2 *Supports*—Temporary supports for specimen molds shall consist of two steel bars, 25.4 ± 3.1 mm (1 ± ⅛ in.) square and a minimum length of 76.2 mm (3 in.).

4.3 *Testing Machine*—The testing machine must be of any type of sufficient capacity that will provide a range of accurately controllable rates of vertical deformation. Since the rate of vertical deformation for the compression test is specified as 0.05 mm/min·mm (0.05 in./min·in.) of specimen height, and it may be necessary to test specimens ranging in size from 50.8 by 50.8 mm (2 by 2 in.) to perhaps 203.2 by 203.2 mm (8 by 8 in.) in order to maintain the specified minimum ratio of specimen diameter to particle size, the testing machine should have a range of controlled speeds covering at least 2.5 mm (0.1 in.)/min for 50.8-mm (2-in.) specimens to 10.2 mm (0.4 in.)/min for 203.2-mm (8-in.) specimens. The testing machine shall conform to the requirements of Practices E 4. The testing machine shall be equipped with two steel bearing blocks with hardened faces, one of which is spherically seated and the other plain. The spherically seated block shall be mounted to bear on the upper surface of the test specimen and the plain block shall rest on the platen of the testing machine to form a seat for the specimen. The bearing faces of the plates shall have a diameter slightly greater than that of the largest specimens to be tested. The bearing faces, when new, shall not depart from a true plane by more than 0.0127 mm (0.0005 in.) at any point and shall be maintained within a permissible variation limit of 0.025 mm (0.001 in.). In the spherically seated block, the center of the sphere shall coincide with the center of the bearing face. The movable portion of this block shall be held closely in the spherical seat, but the design shall be such that the bearing face can be rotated freely and tilted through small angles in any direction.

4.4 *Oven*—The oven used in the preparation of materials or reheating of mixtures shall be controllable within ±3°C (±5°F) of any specified temperature above ambient up to 200°C (392°F).

4.5 *Hot Plate*—A small hot plate equipped with a rheostat shall be provided for supplying sufficient heat under the mixing bowl to maintain the aggregate and bituminous material at the desired temperature during mixing.

4.6 *Hot Water Bath or Oven*—A water bath or oven sufficiently large to hold three sets of 101.6-mm (4-in.) molds and plungers. If the water bath does not have an internal temperature control, a hot plate of sufficient capacity with a control to maintain the water bath at a temperature just under the boiling point will be required. The oven shall be capable of maintaining a temperature of between 93.3 to 135°C (200 to 275°F).

4.7 *Air Bath*—The air bath shall be capable of either manual or automatic control for storing the specimens at 25 ± 0.5°C (77 ± 1.0°F) immediately prior to making the compression test.

4.8 *Balance*—Balances or scales and weights meeting the requirements of Specification D 4753 shall be provided as appropriate for the sample or ingredient mass.

4.9 *Mixing Machine*—Mechanical mixing is preferable over handmixing. Any type of mixer may be used, provided it can be maintained at the required mixing temperature and will produce a well-coated, homogeneous mixture of the required size in two minutes or less, and further provided that it is of such design that fouling of the blades will be minimized and each individual batch can be retrieved in essentially its entirety including asphalt and fines. Handmixing is allowable, if necessary, but for hot mixtures the time required to obtain satisfactory coating is often excessive and generally the test results are less uniform than when machine mixing is employed.

4.10 *Spatulas*—A flexible spatula for scraping the mixing bowl and a stiff spatula for spading the specimen in the mold.

5. Preparation of Test Mixtures

5.1 Limit the size of the individual batches to the amount required for one test specimen.

5.2 Mix an initial batch for the purpose of "buttering" the mixing bowl and stirrers. Empty this batch after mixing and clean the sides of the bowl and stirrers of mixture residue by scraping with a small limber spatula. Do not wipe with cloth or wash clean with solvent, except when a change is to be made in the binder or at the end of a run.

5.3 Mold a trial specimen in order to determine the correct weight of materials to produce a specimen of the desired height. Use the initial or "buttering" batch for this purpose, if desired.

5.4 Aggregate ingredient samples shall be obtained in accordance with Practice D 75 and reduced to the appropriate size by Practice C 702. When preparing aggregates for batching, each reduced ingredient sample shall be separated into the desired size fractions in accordance with Test Method C 136. Agency practice will specify which of the following sieves should be used to derive the desired fractions: 50.0 mm, 37.5 mm, 25.0 mm, 19.0 mm, 12.5 mm, 9.5 mm, 4.75 mm, 2.36 mm, and 2.00 mm (2 in., 1½ in., 1 in., ¾ in., ½ in., ⅜ in., No. 4, No. 8, and No. 10). The mixture design, job mix formula, or other control shall be used to combine the appropriate mass of

[9] Welborn, J. Y., Halstead, W. J., and Olsen, R. E., "Relation of Absolute Viscosity of Asphalt Binders to Stability of Asphalt Mixtures," *Public Roads*, Vol. 32, No. 6, February 1963, FHWA, Washington, DC. (Also "Symposium on Fundamental Viscosity of Bituminous Materials" *ASTM STP No. 328*.