Preparation of Asphalt Mixture Specimens Using Marshall Apparatus ASTM D6926 – 16

4. Significance and Use

4.1 Compacted asphalt mixture specimens molded by this procedure are used for various physical tests such as stability, flow, indirect tensile strength, fatigue, creep, and modulus. Density and void analysis are also conducted on specimens for mixture design and evaluation of field compaction.
NOTE 1—Uncompacted mixtures are used for determination of theoretical maximum specific gravity.
NOTE 2—The quality of the results produced by this practice 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 practice 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. Apparatus

5.1 *Specimen Mold Assembly*—Mold cylinders, base plates, and extension collars shall conform to the details shown in Fig.1 of the ASTM (Compaction Mold) .....
5.2 *Specimen Extractor*—The specimen extractor shall have a steel disk that will enter the mold without binding and not be less than 3.95 in. (100.3 mm) in diameter and 0.5 in. (12.7 mm) thick.....
The steel disk is used for extracting compacted specimens from molds with the use of the mold collar. Any suitable extraction device such as a hydraulic jack apparatus or a lever arm device may be used, provided the specimens are not deformed during the extraction process.....
5.3 *Compaction Hammers:*
5.3.1 *Compaction Hammers with a Manually Held (Type 1) or Fixed (Type 2) Handle,* either mechanically or hand operated as generally shown in Figs. 2 and 3 of the ASTM, shall have a flat, circular compaction foot with spring-loaded swivel and a 10 ± 0.02 lb (4.545 ± 0.009 kg) sliding mass with a free fall of 18 ± 0.06 in. (457.2 ± 1.5 mm) (see Fig. 2 for hammer tolerances) .....
A typical manual compaction hammer is shown in Fig. 2. A typical mechanical hammer is showed in Fig. 3. NOTE 3—Manual compaction hammers should be equipped with a finger safety guard.
5.3.2 *Compaction Hammers with a Fixed Hammer Handle,* surcharge on top of handle, constantly rotating base, and mechanically operated (Type 3), shall have a slanted, circular tamping face and a 10 ± 0.02 lb (4.536 ± 0.009 kg) sliding weight with a free fall of 18 ± 0.06 in. (457.2 ± 1.5 mm) .....
See Fig. 4 of the ASTM (Hammer Bevel Detail) for hammer and tamping face bevel angle and tolerances, respectively.....
A rotating mechanism is incorporated in the base. The base rotation rate and hammer blow rate shall be 18 to 30 rpm and 64 ± 4 blows per minute, respectively.....
NOTE 4—Multiple hammer operation may affect the density of the samples.
5.4 *Compaction Pedestal*—The compaction pedestal shall consist of a 7.5 in. by 8.0 in. (191.0 mm by 203.2 mm) wooden post approximately 18 in. (457.2 mm) long, capped with a steel plate approximately 12 by 12 in. (304.8 by 304.8 mm) and 1 in. (25.4 mm) thick.....
The wooden post shall be oak, yellow pine, or other wood having an average dry density of 42 to 48 lb/ft^3 (674.2 to 770.5 kg/m^3) .....

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The wooden post shall be secured by bolts through four angle brackets to a solid concrete slab....
The steel cap shall be firmly fastened to the post.....
The pedestal assembly shall be installed so that the post is plumb and the cap is level.....
5.5 *Specimen Mold Holder*—With single-hammer compactors, the holder shall be mounted on the compaction pedestal so as to center the compaction mold over the center of the post.....
The holders shall hold the compaction mold, collar, and base plate securely in position during compaction of the specimen.....
5.6 *Ovens, Heating Pots or Hot Plates*—Circulating air ovens or thermostatically controlled heating pots and hot plates shall be provided for heating aggregates, asphalt material, specimen molds, compaction hammers, and other equipment to within 5 °F (3 °C) of the required mixing and compaction temperatures.....
Suitable shields, baffle plates, or sand baths shall be used on the surfaces of the hot plates to minimize localized overheating.....
5.7 *Mixing Apparatus*—Mechanical mixing is recommended, but also can be mixed manually.....
Any type of mechanical mixer may be used provided the mix can be maintained at the required temperature and mixing will produce a well-coated, homogeneous mixture of the required amount in the allowable time, and further provided that essentially all of the batch can be recovered.....
A metal pan or bowl of sufficient capacity for hand mixing may also be used.....
5.8 *Miscellaneous Equipment:*
5.8.1 *Containers for Heating Aggregates,* flat-bottom metal pans, or other suitable containers.....
5.8.2 *Covered Containers for Heating Asphalt Binder,* either gill-type tins, beakers, pouring pots, or saucepans may be used.....
5.8.3 *Mixing Tools,* shall consist of a steel trowel (mason's pointing trowel with point rounded), spoon or spatula, for spading and hand mixing.....
5.8.4 *Thermometer*—the thermometer shall be one of the following: .....
5.8.4.1 A liquid-in-glass thermometer of suitable range with subdivisions and maximum scale error of 1.0 °F (0.5 °C) which conforms to the requirements of Specification E1.....
Calibrate the thermometer in accordance with one of the methods in Test Method E77.....
5.8.4.2 A liquid-in-glass partial immersion thermometer of suitable range with subdivisions and maximum scale error of 1.0 °F (0.5 °C) which conforms to the requirements of Specification E2251
Calibrate the thermometer in accordance with one of the methods in Test Method E77.....
5.8.4.3 Electronic thermometers may be used, for example thermocouples, thermistors, or PRTs, with a readability of 1.0 °F (0.5 °C) that has been calibrated as a system (probe and meter) .....
5.8.5 *Sieves*—The sieve cloth and standard sieves, given in Specification E11, shall be mounted on substantial frames constructed in a manner that will prevent loss of material during sieving.....
NOTE 5—It is recommended that sieves mounted in frames larger than standard 8-in. (203.2-mm) diameter be used for testing coarse aggregates to reduce the possibility of overloading the sieves.
5.8.6 *Balance,* readable to at least 0.1 g for batching mixtures.....
5.8.7 *Gloves,* for handling hot equipment.....
5.8.8 *Markers,* for identifying specimens.....
5.8.9 *Scoop,* flat bottom, for batching aggregates.....
5.8.10 *Spoon,* large, for placing the mixture in the specimen molds.....

6. Test Specimens

6.1 *Preparation of Aggregates*—Dry aggregates to constant weight in an oven. Drying should be done at 230 ± 9 °F (110 ± 5 °C) .....
After cooling, separate the aggregates by dry-sieving into the desired size fractions. .....
The following minimum size fractions are recommended:

1 to 3⁄4 in. (25 to 19 mm)
3⁄4 to 1⁄2 in. (19 to 12.5 mm)
1⁄2 to 3⁄8 in. (12.5 to 9.5 mm)
3⁄8 to No. 4 (9.5 to 4.75 mm)
No. 4 to No. 8 (4.75 to 2.36 mm)
Passing No. 8 (2.36 mm)

6.2 *Determination of Mixing and Compacting Temperatures:*

6.2.1 The asphalt binder used in preparing the samples must be heated to the range of mixing temperatures recommended for manufacturer/supplier or must be heated to the range of mixing and compaction temperatures to produce a viscosity of 170 ± 20 cP (0.17 ± 0.02 Pa.s) and 280 ± 30 cP (0.28 ± 0.03 Pa.s), respectively, for a binder density measured in accordance with Test Method D4402.....

NOTE 6—Selection of mixing and compaction temperatures at viscosities of 170 ± 20 cP (0.17 ± 0.02 Pa·s) and 280 ± 30 cP (0.28 ± 0.03 Pa·s), respectively, may not apply to modified binders. Modified asphalt binders, such as those produced with polymer additives or crumb rubber, generally use mixing and compaction temperatures different than indicated in 6.2.1. The user should contact the manufacturer to establish appropriate mixing and compaction temperature ranges.

6.2.2 *Cutback Asphalt Mixture*—The temperature to which a cutback asphalt must be heated to produce a viscosity of 170 ± 20 cP (0.17 ± 0.02 Pa·s) shall be the mixing temperature. The compaction temperature for a cutback asphalt mixture is selected using a compositional chart of viscosity versus percent solvent for that cutback asphalt. From the compositional chart, determine the cutback asphalt's percentage of solvent by weight from its viscosity at 140 °F (60 °C) after it has lost 50 % of its solvent (for rapid-cure and medium-cure cutbacks) or 20 % of its solvent (for slow cure cutbacks). The compaction temperature is determined from the viscosity temperature chart as that to which the cutback asphalt must be heated to produce a viscosity of 280 ± 30 cP (0.28 ± 0.03 Pa·s) after losing the specified amount of original solvent.

6.2.3 *Recompacted Paving Mixtures*—Materials obtained from an existing pavement shall be warmed in covered containers in an oven to within ±5 °F (±3 °C) of the desired compaction temperature.....
Heating should only be long enough to achieve desired compaction temperature.....
If the compaction temperature for a specific mixture is not known, experience has shown that these mixes should be compacted at a temperature between 250 ± 5 °F (120 ± 3 °C) and 275 ± 5 °F (135 ± 3 °C) .....
In preparation for heating to compaction temperature, the material should be warmed and worked until a loose mixture condition is obtained. Any cut aggregate can be removed.....
Stability of reheated and recompacted mixtures from existing pavements is likely to be higher than the original mixture due to in-service hardening of the binder. The reheating process will have only minor influence on binder hardening.

6.3 *Lab Mix Lab Compacted (LMLC) Mixture Preparation*—Specimens may be prepared from single batches or multiple batches containing sufficient material for three or four specimens.....
6.3.1 Weigh into separate containers the amount of each aggregate size fraction required to produce a batch that will result in one, two, three, or four compacted specimens 2.5 ± 0.1 in. (63.5 ± 2.5 mm) in height (about 1200, 2400, 3600, or 4800 g, respectively) .....
Place aggregate batches in containers on a hot plate or in an oven and heat to a temperature above but not exceeding the mixing temperature established in 6.2 by more than 50 °F (28 °C) for asphalt cement and tar mixes and 25 °F (14 °C) for cutback asphalt mixes.....
Charge the mixing container with the heated aggregate and dry mix thoroughly (approximately 5 s) with scoop or spoon.....
Form a crater in the dry-blended aggregate and weigh the required amount of asphalt material at mixing temperature into the mixture.....
For mixes prepared with cutback asphalt, introduce the mixing blade in the mixing bowl and determine the total weight of the mix components plus bowl and blade before proceeding with mixing.
Care must be exercised to prevent loss of the mix during mixing and subsequent handling.....
At this point, the mixture temperature shall be within the limits of the mixing temperature established in 6.2.....
Mix the aggregate and asphalt binder rapidly until thoroughly coated for approximately 60 s for single-specimen batches and approximately 120 s for multiple-specimen batches.....
6.3.2 After completing the mixing process, subject the loose mix of the single batches to short-term conditioning for 2h ± 5 min in pans or in metal containers with covers at the compaction temperature ±5 °F (±3 °C) .....
Stir the mix after 60 ± 5 min to maintain uniform conditioning.....
6.3.3 For multiple-batched samples, place the entire batch or sample on a clean nonabsorptive surface.....
Hand mix to ensure uniformity and quarter into appropriate sample size to conform to specimen height requirements.....
For asphalt cements and tar mixtures, put the samples into metal containers and cover.....
After completing the mixing process, subject the loose mix to short-term conditioning for 2h ± 5 min in pans or in metal containers with covers at the compaction temperature ±5 °F (±3 °C) .....
Stir the mix after 60 ± 5 min to maintain uniform conditioning.....
Cure cutback asphalt mixture in the mixing bowl in a ventilated oven maintained at approximately 20 °F (11 °C) above the compaction temperature. Curing is to be continued in the mixing bowl until precalculated weight of 50 % solvent loss or more has been obtained. The mix may be stirred in the mixing bowl during curing to accelerate the solvent loss. However, care should be exercised to prevent mix loss. Weigh the mix during curing in successive intervals of 15 min initially and less than 10-min intervals as the weight of the mix at 50 % solvent loss is approached.
6.3.4 Plant mix laboratory compacted (PMLC) or reheated plant mix lab compacted (RPMLC) asphalt mixtures may require special curing techniques.....
NOTE 7—Heating mixtures for a period of time prior to compaction may result in specimens having properties that are different from those that are compacted immediately after mixing (original Marshall criteria are based on a no-cure procedure). Asphalt mixture conditioning, reheat temperature, and reheat time should be defined in the applicable specification.

6.4 *Compaction of Specimens:*
6.4.1 Thoroughly clean the specimen mold assembly and the face of the compaction hammer and heat them either in boiling water, in an oven, or on a hot plate to a temperature between 200 °F and 300 °F (90 °C and 150 °C) .....
Place a piece of nonabsorbent paper, cut to size, in the bottom of the mold before the mixture is introduced.....
Place the mixture in the mold, spade the mixture vigorously with a heated spatula or trowel 15 times around the perimeter and 10 times over the interior.....
Place another piece of nonabsorbent paper cut to fit on top of the mix.....
Temperature of the mixture immediately prior to compaction shall be within the limits of the compaction temperature established in 6.2.....
6.4.2 Place the mold assembly on the compaction pedestal in the mold holder and apply the required number of blows with the specified compaction hammer.....
Remove the base plate and collar and reverse and reassemble the mold.....
Apply the same number of compaction blows to the face of the reversed specimen. .....
After compaction, remove the collar and base plate. Allow the specimen to cool sufficiently to prevent damage and extract the specimen from the mold.....
Cooling specimens in the mold can be facilitated by using a fan.
Carefully transfer specimens to a smooth, flat surface and allow to cool at room temperature (this may be overnight) .....
6.4.2.1 When compaction is accomplished with a manually held and operated hammer, hold the axis of the compaction hammer by hand, as nearly perpendicular as possible to the base of the mold assembly during compaction.....
No device of any kind shall be used to restrict the handle of the hammer in the vertical position during compaction.....
NOTE 8—Hammer shaft should be clean and lightly oiled.

7. Report

7.1 The report shall include at least the following information:
7.1.1 Sample identification (number, lab mix lab compacted (LMLC), plant mix laboratory compacted (PMLC), or reheated plant mix lab compacted (RPMLC)) .....
7.1.2 Type of asphalt binder, source, and content.....
7.1.3 Type(s) of aggregate, source, and grading.....
7.1.4 Type and time of curing prior to compaction.....
7.1.5 Type of hammer (that is, manually held or fixed and mechanically or manually operated hammer and flat or slanted foot) .....
7.1.6 Number of blows/side.....
7.1.7 Mixing temperature.....
7.1.8 Compaction temperature.....
7.1.9 Type and time of cooling.....

Comments