

METHOD OF SAMPLING AND TESTING
MT 323-04
METHOD OF TEST FOR FABRICATING SPECIMENS
FOR COMPRESSIVE STRENGTH OF BITUMINOUS MIXTURES
(Modified AASHTO T 167)

1 Scope:

- 1.1** This method of fabrication for compacted bituminous mixtures of the hot mixes, holt-laid type, for use in pavement surfaces and base courses, is intended to provide test specimens for measuring the loss of cohesion resulting from the action of water (MT-324) and the compressive strength of these paving mixtures.

2 Referenced Documents:

2.1 AASHTO:

T 167 Standard Test Method for Compressive Strength of Bituminous Mixtures

MT Manual:

MT-308 Temperature/Viscosity Charts

MT-311 Marshall Method for Field Control of Hot Mix Asphalt Paving

MT-324 Effect of Water on Cohesion of Compacted Bituminous Mixtures

3 Apparatus:

- 3.1** *Mold* – The molds used for specimen fabrication consist of three principal parts: a heavy steel walled molding cylinder, a steel top plunger and a bottom plunger. The molding cylinder is machined and hardened with an inside diameter of 4 inches (100 mm) with a tolerance of +.005 inch (+.125/-.000mm) and approximately 7 inches (175 mm) in length. The top and bottom molding plungers will fit inside the molding cylinders tightly enough to uniformly compress the asphalt mixture. The plungers are designed not to jam within the molding cylinder. Vertical alignment is maintained by steel webbing connecting the top and bottom of each plunger. The top plunger is approximately 6.5 inches (162 mm) in length with a diameter of 3.996 inches and a tolerance of +.000/-.005 inches, and the bottom plunger will be approximately 2.0 inches (50 mm) in length with a diameter of 3.996 inches with a tolerance of +.000/-.005 inches.

Note 1 - The lengths of the molding cylinder and plungers are not critical. When the molding cylinder is over the lower plunger and is resting on the temporary supports, the molding chamber created must be at least 6 inches (150 mm) in depth to accommodate an un-compacted sample and have room to start the top piston. The cylinder must not be more than two inches longer than the combined length of the upper and lower plunger to ensure unrestricted compression of the asphalt specimen.

- 3.2** *Supports* – Temporary supports will be provided to raise the molding cylinder enough to initiate double plunger action.

Note 2 - The mold, plungers and supports are used as accessories to a compressive press with a minimum capacity of 38,000 lbs.

- 3.3** *Oven* – The convection oven for the preparation of hot mixtures shall be capable of being set to maintain any desired temperature from room temperature to 325 °F (163 °C).
- 3.4** *Heating Device* - A small hot plate with a continuously variable heating rate, a sand bath, an infrared lamp or an oven shall be provided for supplying sufficient heat under the mixing bowl to maintain the aggregate and bituminous material at the desired temperature during mixing.
- 3.5** *Air Bath* – The air bath shall be capable of either manual or automatic control for storing the specimens at 77 ± 1 °F (25 ± 0.5 °C) immediately prior to making the compression test.

3 Apparatus: (continued)

- 3.6** *Mixing Machine* – The mixture should preferably be prepared in a mechanical mixer. 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 2 min. 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. Hand mixing may be used, 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.
- 3.7** *Spatulas* - Limber for scraping the mixing bowl, and stiff, for spading the specimen in the mold, shall be provided.
- 3.8** *Balance* – A balance having a capacity of 5 kilograms or more and be sensitive to 0.1 gram or less.

4 Preparation of Test Mixtures:

- 4.1** The size of the individual batches shall be limited to the amount required for one test specimen. The percentage of asphalt cement can also be the optimum asphalt content as determined by Marshall Method for Field Control of Hot Mix Asphalt Paving (MT-311).
- 4.2** An initial batch shall be mixed for the purpose of “buttering” the mixture bowl and stirrers. This batch shall be emptied after mixing and the sides of the bowl and stirrers shall be cleaned of mixture residue by scraping with a small limber spatula but shall not be wiped with cloth or washed clean with solvent, except when a change is to be made in the binder or at the end of a run.
- 4.3** In preparing aggregates for making mixtures, a sieve analysis shall be made on each aggregate involved. All coarse and fine aggregates shall be separated individually and recombined in the necessary quantities to meet the formula under study. The weighed aggregate fractions for each batch shall be thoroughly mixed dry and then heated to the planned mix temperature in a convection oven before the bituminous material is added. A sufficient quantity of bituminous material for each batch shall be heated in a convection oven to the same temperature as the dry aggregates. Any residual bituminous material that is left over at the end of the day must be discarded.
- 4.4** When the bituminous material and dry aggregates have been brought to the mix temperature, the mixing bowl, which shall have been preheated to approximately the temperature of the aggregate, shall be charged with the preheated and dry mixed aggregate, the preheated bituminous material shall be weighed into the aggregate, and wet mixing shall be started and continued for not less than 90 s nor more than 120 s. Excessive loss of heat during mixing may be offset by the use of a small hot plate, sand bath, or infrared lamp under the mixing bowl, or a heating mantle may be used. The mixing bowl shall not be in direct contact with a hot plate, if used.

5 Molding and Curing Test Specimens:

- 5.1** Generally, the test specimens shall be cylinders with the same diameter tolerance as the molding cylinder and 4.0 ± 0.1 inches (100 mm = 2.5 mm) in height. It is recognized that the size of the test specimens has an influence on the results of the compressive strength tests.
- 5.2** Laboratory prepared mixtures shall be fabricated as quickly as possible after mixing as follows:
- 5.3** Mixtures from a field project shall be brought to molding temperature by careful, uniform heating immediately prior to molding. The approximate mixing temperature for a particular asphalt will produce a viscosity of 170 ± 20 C_{st} obtained by using the temperature-viscosity charts in MT 308. The approximate compaction temperature for a particular asphalt will produce a viscosity of 280 ± 30 C_{st} obtained by using the temperature-viscosity charts in MT 308.

5 Molding and Curing Test Specimens: (continued)

- 5.4 Mix the measured weights of asphalt cement and dry aggregate (90-120S) at the determined mix temperature.
- 5.5 While mixing is taking place, take the preheated mold and plungers (heated to the same temperature as the dry aggregate) and wipe them lightly with an oiled cloth to prevent sticking. Place the bottom plunger on the table of the press. Position the temporary supports on each side of the plunger and place the mold cylinder on them.
- 5.6 Pour the bituminous mixture from the mixing bowl into a large scoop. Scrape the mixing bowl with a spatula, do not clean with solvent.
- 5.7 Pour one half of the mixture from the scoop into the molding cylinder, using a spatula to obtain an even discharge. Spade vigorously twenty-five (25) times with a heated spatula. Fifteen of the blows will be delivered around the inside of the mold, to reduce honeycombing, and the remaining ten at random over the mixture. The remaining half of the mixture shall then be quickly transferred to the molding cylinder and a similar spading action repeated. The spatula should penetrate the mixture as deeply as possible. A spatula having a slightly curved cross-section has been used to advantage by some laboratories.
- 5.8 Round or cone-shape the top of the mixture to aid in firm seating of the upper plunger. Then place the upper plunger on the spaded mixture and slide the whole assembly under the press plates.
- 5.9 The mixture, with the temporary supports in place, shall be compressed between the top and bottom plungers to an initial load of about 150 psi to set the mixture against the sides of the mold. The load shall then be released and the support bars removed to permit full double-plunger action.
- 5.10 Smoothly and rapidly apply a load of approximately 3000 psi, maintain for 120S and release.
- 5.11 The specimen shall then be removed from the mold with an ejection device that provides a smooth, uniform rate of travel.
- 5.12 After removal from the mold, specimens shall be oven cured 15-24 hours at $140 \pm 1^{\circ}\text{F}$ ($60 \pm 0.5^{\circ}\text{C}$). In case specimens are to be stored dry for more than 24 h from completion of oven curing to compression testing, they shall be protected from exposure to the air by sealing them in closely fitting, airtight containers.