

**Standard Practice for Preparing
Hot-Mix Asphalt (HMA) Specimens
by Means of the Rolling Wheel Compactor**

AASHTO Designation: PP3-94^{1,2} (Reapproved 1996)

1. Scope

1.1 This standard describes the mixing and compaction procedures to produce large slab specimens (approximately 102 mm thick by 762 mm wide by 762 mm long) of modified or unmodified hot mix asphalt (HMA) in the laboratory by means of a mechanical rolling wheel compactor.

1.2 This practice may involve hazardous materials, operations, and equipment. It does not purport to address all the safety problems associated with its use. It is the responsibility of whomever uses this practice to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to its use.

2. Referenced Documents

2.1 AASHTO Standards:

- PP2 Short and Long Term Aging of Hot Mix Asphalt
- TP39 Maximum Specific Gravity of Bituminous Paving Mixtures
- T2 Sampling Aggregates
- T11 Amount of Material Finer than 75- μ m Sieve in Aggregate
- T27 Sieve Analysis of Fine and Coarse Aggregates
- T40 Sampling Bituminous Materials
- T168 Sampling Bituminous Paving Mixtures
- T247 Preparation of Test Specimens of Bituminous Mixtures by Means of California Kneading Compactor

3. Summary of the Method

3.1 The rolling wheel compactor produces a 102 mm thick slab in a large square mold from a loose modified or unmodified HMA paving mix through

loading applied by a rolling wheel.

3.2 A loose HMA paving mix is prepared in the laboratory, aged in accordance with the short term aging procedure in PP2, heated to the proper compaction temperature, placed into a mold, leveled, and compacted with the rolling wheel device. Alternatively, a sample loose HMA plant mix is heated to the proper compaction temperature, placed into a mold, leveled, and compacted with the rolling wheel device.

3.3 Compacted slabs are cooled to room temperature, removed from the mold, and required specimens are cored or sawed from the slab using a suitable gas for the lubricating fluid.

4. **Significance and Use** - The slab is compacted to simulate the density, aggregate orientation, and structural characteristics obtained in the actual roadway when proper construction procedure is used in the placement of a paving mix. Test specimens obtained from the slab may be used to determine the characteristics of HMA by specified test methods.

5. Apparatus

5.1 **Rolling Wheel Compactor** - A mechanical, self-propelled rolling wheel compactor (Figure 1) equipped with forward/reverse control, capable of applying load of 1000 to 1500 kg through the rolling wheel to the HMA in a static (not vibratory) mode.

Note 1 - The roller shall be capable of compacting the specimen sizes given in Sections 1.1 and 5.2. It will have sufficient base width to cover the mold opening.

5.2 **Mold** - a 102 mm thick by 762 mm square mold to hold the HMA (Figure 2)

5.3 **Ovens** - Two forced-draft electric ovens capable

¹ This standard is based on SHRP Product 1015.

² Approved in October 1994, this provisional standard was first published in March 1995. Reconfirmed in January 2001.

of maintaining any selected temperature setting between 100 and 200°C within a tolerance of $\pm 3^\circ\text{C}$: one with a capacity between 0.028 and 0.042 m³ for heating asphalt binder, and one with a capacity between 0.700 and 0.850 m³ for heating aggregate

5.4 HMA Mixer - a mechanized aggregate and asphalt binder mixer with a capacity of 0.700 to 0.850 m³, capable of maintaining the HMA at the selected mixing temperature and homogeneously and completely coating the aggregate with asphalt binder during the mixing period (approximately 4 minutes)

Note 2 -- A conventional concrete mixer fitted with infrared propane heaters has been found suitable for preparing the HMA.

5.5 Coring Equipment - mechanized coring equipment capable of coring 102 to 204 mm diameter specimens from a compacted HMA slab, using a suitable gas (in lieu of liquid) as the coring lubricant

5.6 Saw Cutting Equipment - mechanized saw cutting equipment capable of sawing beams of different sizes from a compacted HMA slab, using a suitable gas (in lieu of liquid) as the sawing lubricant

5.7 Balances - a balance meeting the requirements of M231, Class G5 for determining the mass of asphalt binder and a balance with a capacity between 45 and 120 kg, readable to 0.5 kg, for determining the mass of aggregate or plant mix

5.8 Miscellaneous Apparatus - digital thermometers with thermocouple probe, spatulas, trowels, scoops, spades, rakes, heat resistant gloves, metal pans, socket wrench, sockets, screw drivers, crescent wrench, tape measure

6. Hazards - Use standard safety precautions and protective clothing when handling hot paving mix and preparing test specimens.

7. Sampling

7.1 Laboratory Mixed and Compacted Specimens - Sample asphalt binder in accordance with T40. Sample aggregate in accordance with T2.

7.2 Plant Mixed, Laboratory Compacted Specimens - Obtain hot mix asphalt samples in accordance with T168.

8. Preparation of Apparatus

8.1 Preheat the mixer for at least 1 hour prior to mixing.

8.2 Assemble the mold as shown in the schematic illustrated in Figure 2.

8.3 Preheat the mold with a "tent" equipped with infrared heat lamps as shown in Figure 3.

8.4 Check the oil and fuel levels in the rolling wheel compactor and refill if necessary. Start the compactor and allow it to warm up. Spray a mild soapy solution on the rollers.

8.5 Apply sparingly a light oil (e.g. PAM cooking oil) to the base and sides of the mold.

8.6 Preheat the ovens to the required temperature.

9. Determining the Quantity of Material Required

9.1 Measure and record the height (H), length (L) and width (W) of the compaction mold to the nearest millimeter.

9.2 Calculate the volume (V) of the mold and record it to the nearest 0.001 m³.

9.3 Determine the maximum specific gravity of the HMA (G_{mm}) at the desired asphalt content in accordance with TP39.

9.4 Determine the target bulk specific gravity for the compacted slab as follows:

$$G_{mb} = G_{mm} \left[1 - \frac{A_v}{100} \right] \quad (1)$$

where:

G_{mb} = target bulk specific gravity of the compacted slab

A_v = target air voids of the compacted slab in percent

9.5 Determine the unit mass (density) of the compacted slab as follows:

$$\rho = G_{mb} \rho_w \quad (2)$$

where:

ρ = unit mass of the compacted slab, kg/m³

ρ_w = 997 kg/m³, the unit mass of water

9.6 Determine the mass (M) of the compacted slab in kilograms as follows:

$$M = \rho V \quad (3)$$

9.7 Determine the mass of the aggregate required for compaction as shown below in Equations 4 and 5. Equation 4 uses the asphalt content based on the dry mass of the aggregate, whereas Equation 5 uses the asphalt content based on total mass of the mixture.

$$M_{agg} = \left[\frac{M}{\left(1 + \frac{A_c}{100} \right)} \right] \quad (4)$$

$$M_{agg} = M \left[1 - \frac{A_c}{100} \right] \quad (5)$$

where:

M_{agg} = total mass of the aggregate, kg

A_c = asphalt content

9.8 Determine the mass of asphalt binder required for compaction as shown in Equations 6 and 7 below. Equation 6 uses the asphalt content based on the dry mass of the aggregate, whereas Equation 7 uses the asphalt content based on total mass of the mixture.

$$M_{AC} = M_{agg} \left[\frac{A_c}{100} \right] \quad (6)$$

$$M_{AC} = M \left[\frac{A_c}{100} \right] \quad (7)$$

where:

M_{AC} = mass of the asphalt binder, kg

10. Preparing Laboratory Mixtures

10.1 Wash the aggregate to be used for specimen preparation in accordance with T11. After the aggregate has dried to a constant weight, remove the aggregate from the oven, and cool it to room temperature. Sieve the aggregate according to T27

and separate it into size fractions necessary for accurately recombining into test mixtures conforming to specified grading requirements.

10.2 If the asphalt binder is supplied in 20 L (5 gal) or larger containers, subdivide the asphalt binder sample into smaller containers for subsequent use.

10.2.1 Cover the container loosely with a metal lid and heat the asphalt binder to 135°C (275°F) in a forced draft oven. Typically, a 20 L (5 gal) sample will require approximately 5 h for the entire heating cycle.

10.2.2 After approximately 1.5 h, remove the sample from the oven, and stir it with a large spatula or metal rod. Stir the sample approximately every half hour to ensure uniform heating.

10.2.3 Watch for signs of blue smoke which indicates overheating. If a noticeable quantity of smoke is observed, reduce the oven temperature by 5 to 8°C (10 to 15°F).

10.2.4 After heating for 5 hours, remove the container from the oven, stir the asphalt binder for approximately 1 minute, and pour the asphalt binder into 1 L containers. (Different sized containers may be used.)

10.2.5 After filling, close all containers tightly, and allow to cool to room temperature. Store the asphalt binder at a temperature of 10 ± 2°C (50 ± 4°F) until the scheduled time for preheating prior to mixing. Closing the containers prior to cooling produces a vacuum seal.

11. Procedure

11.1 Use the Bitumen Test Data Chart shown in Figure 4 to determine the mixing temperature for the asphalt binder. The temperature to which the asphalt binder must be heated to produce a viscosity of 170 ± 20 mm²/s (based on the original asphalt binder properties) shall be the mixing temperature. The procedure utilizing the Bitumen Test Data Chart is the preferred procedure. Alternatively, when mixes employing unmodified asphalt binders are prepared, the aggregate and the asphalt may be heated to the temperature specified in T247 for mixing.

11.2 Laboratory Mixtures