5. APPARATUS

5.1. Equipment for preparing and compacting specimens from 1 of the following: T 167, T 245, T 247, T 312 or ASTM D 3387.....

5.2. Equipment for determining the theoretical maximum specific gravity (G_{mm}) of the asphalt mixture from T 209.....

5.3. Balance and water bath from T 166.....

5.4. Water bath capable of maintaining a temperature of 60 ± 1°C.....

5.5. Freezer maintained at -18 ± 3°C.....

5.6. A supply of plastic film for wrapping specimens: heavy duty, leak proof plastic bags to enclose the saturated specimens and masking tape.....

5.7. 10 ml graduated cylinder.....

5.8. Pans having a surface area of 48 400 to 129 000 mm^2 in the bottom and a depth of approximately 25 mm.....

5.9. Forced draft oven, thermostatically controlled, capable of maintaining any desired temperature setting from room temperature to 176°C within ± 3°C.....

5.10. Loading jack and ring dynamometer from, T 245 or mechanical or hydraulic testing machine from T 167, to provide a range of accurately controllable rates of vertical deformation, including 50 mm/min.....

5.11. Steel loading strips with a concave surface having a radius of curvature equal to the nominal radius of the test specimen.....

For specimens 100 mm in diameter, the loading strips shall be 12.7 mm wide.....

For specimens 150 mm in diameter, the loading strips shall be 19.05 mm wide.....

The length of the loading strips shall exceed the thickness of the specimen.....

The edges of the loading strips shall be rounded to the appropriate radius of curvature by grinding

6. PREPARATION OF LABORATORY-MIXED, LABORATORY-COMPACTED SPECIMENS

6.1. Make at least 6 specimens for each test, half to be tested dry and the other half to be tested after partial saturation and moisture conditioning with a freeze-thaw cycle (Note 1).....

Note 1 – It is recommended that 2 additional specimens for the set be prepared. These specimens can then be used to establish compaction procedures as given in Section 6.5 or 7.4 and the vacuum saturation technique as given in Section 10.3.....

6.2. Specimens 100 mm in diameter by 63.5 ± 2.5 mm thick or 150 mm in diameter by 95 ± 5 mm thick are used.....

Specimens 150 mm in diameter by 95 ± 5 mm thick should be used if aggregate larger than 25 mm is present in the mixture.....

6.3. Prepare mixtures in batches large enough to make at least 3 specimens or alternatively prepare a batch large enough to just make 1 specimen at a time.....

If preparing a multispecimen batch, split the batch into single specimen quantities before placing in the oven.....

6.4. After mixing, the mixture shall be placed in a pan having a surface area of 48 400 to 129 000 mm^2 in the bottom and a depth of approximately 25 mm and cooled at room temperature for 2 ± 0.5 h...

Then the mixture shall be placed in a 60 ± 3°C oven for 16 ± 1 h for curing.....

The pans should be placed on spacers to allow air circulation under the pan if the shelves are not perforated.....

6.5. After curing, place the mixture in an oven for 2 h ± 10 min at the compaction temperature ± 3°C prior to compaction.....

Compact the specimens according to 1 of the following methods: T 167, T 245, T 247, T 312 or ASTM D 3387.....

The mixture shall be compacted to 7.0 ± 0.5 percent air voids.....

This level of voids can be obtained by adjusting the number of blows in T 245, adjusting foot pressure, number of tamps, levelling load or some combination in T 247 or adjusting the number of revolutions in T 312 or ASTM D 3387.....

The exact procedure must be determined experimentally for each mixture before compacting the specimens for each set (Note 2).....

Note 2 – Due to the elevated void content and potential instability of the specimens, ensure that each specimen is adequately cool and stable prior to removal from the mold.....

6.6. After removal from the molds, the specimens shall be stored for 24 ± 3 h at room temperature

7. PREPARATION OF FIELD-MIXED, LABORATORY-COMPACTED SPECIMENS

7.1. Make at least 6 specimens for each test, half to be tested dry and the other half to be tested after partial saturation and moisture conditioning with a freeze-thaw cycle (Note 1).....

7.2. Specimens 100 mm in diameter by 63.5 mm thick or 150 mm in diameter by 95 mm thick are used. Specimens 150 mm in diameter by 95 ± 5 mm thick should be used if aggregate larger than 25 mm is present in the mixture.....

7.3. Field mixed asphalt mixtures shall be sampled in accordance with ASTM D 979/D 979M.....

7.4. No loose mix curing as described in Section 6.4 shall be performed on the field mixed samples

After sampling, divide the sample to obtain the desired size in accordance with R 47.....

Next, place the mixture in an oven until it reaches the compaction temperature ± 3°C.....

Then compact the specimen according to 1 of the following methods: T 167, T 245, T 247, T 312 OR ASTM D3387.....

The mixture shall be compacted to 7.0 ± 0.5 percent air voids.....

This level of voids can be obtained by adjusting the number of blows in T 245, adjusting foot pressure, number of tamps, levelling load or some combination in T 247 or adjusting the number of revolutions in T 312 or ASTM D 3387.....

The exact procedure must be determined experimentally for each mixture before compacting the specimen for each set (Note 2).....

7.5. After removal from the molds, the specimens shall be stored for 24 ± 3 h at room temperature.....

8. PREPARATION OF FIELD-MIXED, FIELD-COMPACTED SPECIMENS (CORES)

8.1. Select locations on the completed pavement to be sampled and obtain cores.....

When testing pavement layers with a thickness less than or equal to 63.5 mm use 100 mm diameter cores.....

Otherwise, use either 100 mm or 150 mm diameter cores.....

The number of cores shall be at least 6 for each set of mix conditions.....

8.2. Separate the core layers as necessary by sawing them or by other suitable means and store the layers to be tested at room temperature until they are dry.....

8.3. No loose mix curing (Section 6.4) or compacted mix curing (Section 6.6) shall be performed on the field mixed, field compacted specimens (cores).....

9. EVALUATION AND GROUPING OF SPECIMENS

9.1. After curing, heating, or drying mixture samples or cores for the theoretical maximum specific gravity (G_{mm}) test as described in Sections 6.4 and 6.5, Section 7.4, or Section 8.2 as appropriate, determine the G_{mm} of those samples by T 209.....

9.2. Determine each specimen thickness (t) in accordance with ASTM D 3549/D 3549M.....

9.3. Record each specimen diameter (D) as defined in Section 6.2, 7.2 or 8.1, as appropriate.....

9.4. Determine each bulk specific gravity (G_{mb}) by Method A of T 166. Express the volume (E) of the specimens or the saturated, surface-dry mass minus the mass in water, in cubic centimetres.....

9.5. Calculate the percentage of air voids (P_a) in accordance with T 269.....

9.6. Separate the specimens into 2 subsets, of at least 3 specimens each, so that the average air voids of the 2 subsets are approximately equal.....

9.7. For those specimens to be subjected to vacuum saturation, a freeze cycle and a warm water soaking cycle, calculate the volume of air voids (V_a) in cubic centimetres using the following equation: .....

$$V_a = \frac{P_a E}{100}$$

Where:

V_a = volume of air voids, cm^3

P_a = air voids, percent

E = volume of specimen, cm^3

Note 3 – A data sheet that is convenient for use with this test method is shown as Table 1, see T 283.....

10. PRECONDITIONING OF TEST SPECIMENS

10.1. – 1 subset will be tested dry and the other will be partially vacuum saturated, subjected to freezing and soaked in warm water before testing.....

10.2. The dry subset will be stored at room temperature as described in Section 6.6 or Section 7.5, as appropriate.....

At the end of the curing period from Section 6.6 or 7.5, as appropriate, the specimens shall be wrapped with plastic or placed in a heavy duty, leak proof plastic bag.....

The specimens shall then be placed in a 25 ± 0.5°C water bath for 2 h ± 10 min with a minimum 25 mm of water above their surface.....

Then test the specimens as described in Section 11.....

10.3. The other subset shall be conditioned as follows: .....

10.3.1. Place the specimen in the vacuum container supported a minimum of 25 mm above the container bottom by a perforated spacer.....

Fill the container with potable water at room temperature so that the specimens have at least 25 mm of water above their surface.....

Apply a vacuum of 13 to 67 kPa absolute pressure (10 to 26 in. Hg partial pressure) for a short time (approximately 5 to 10 min).....

Remove the vacuum and leave the specimen submerged in water for a short time (approximately 5 to 10 min).....

NOTE 4 – The time required for some specimens to achieve the correct degree of saturation (between 70 and 80 percent) may be less than 5 min. In addition, some specimens may require the use of an absolute pressure of greater than 67 kPa (26 in. Hg partial pressure) or less than 13 kPa (10 in. Hg partial pressure).....

10.3.2. Determine the mass of the saturated, surface-dry specimen after partial vacuum saturation (B') by Method A of T 166.....

10.3.3. Calculate the volume of absorbed water (J') in cubic centimetres by use of the following equation: .....

$J' = B' - A$

Where:

J' = volume of absorbed water, cm^3

B' = mass of saturated, surface-dry specimen after partial vacuum saturation, g

A = mass of the dry specimen in air, g (Section 9.4)

10.3.4. Determine the degree of saturation (S') by comparing the volume of absorbed water (J') with the volume of air voids (V_a) from Section 9.6 using the following equation: .....

$$S' = \frac{100J'}{V_a}$$

Where:

S' = degree of saturation, percent

10.3.5. If the degree of saturation is between 70 and 80 percent, proceed to Section 10.3.7.....

10.3.6. If the degree of saturation is less than 70 percent, repeat the procedure beginning with Section 10.3.1 using more vacuum and/or time.....

If the degree of saturation is more than 80 percent, the specimen has been damaged and must be discarded. In this case, repeat the procedure on the next specimen beginning with Section 10.3.1 using less vacuum and/or time.....

10.3.7. Cover each of the vacuum saturated specimens tightly with a plastic film (Saran Wrap© brand or equivalent).....

Place each wrapped specimen in a plastic bag containing 10 ± 0.5 ml of water and seal the bag.....

Place the plastic bags containing the specimens in a freezer at a temperature of -18 ± 3°C for a minimum of 16 h.....

Remove the specimens from the freezer.....

10.3.8. Place the specimens in a bath containing potable water at 60 ± 1°C for 24 ± 1 h.....

The specimens should have a minimum of 25 mm of water above their surface.....

As soon as possible after placement in the water bath, remove the plastic bag and film from each specimen.....

10.3.9. After 24 ± 1 h in the 60 ± 1°C water bath, remove the specimens and place them in a water bath at 25 ± 0.5°C for 2 h ± 10 min.....

The specimens should have a minimum of 25 mm of water above their surface.....

It may be necessary to add ice to the water bath to prevent the water temperature from rising above 25°C. Not more than 15 min should be required for the water bath to reach 25 ± 0.5°C.....

Remove the specimens from the water bath and test them as described in Section 11.....

11. Testing

11.1. Determine the indirect-tensile strength of dry and conditioned specimens at 25 ± 0.5°C.....

11.1.1. Remove the specimen from 25 ± 0.5°C water bath and determine the thickness (t') by ASTM D 3549.....

Place it between the steel loading strips and then place the specimen and loading strips between the 2 bearing plates in the testing machine.....

Care must be taken so that the load will be applied along the diameter of the specimen.....

Apply the load to the specimen, by means of the constant rate of movement of the testing machine head, at 50 mm/min.....

11.1.2. Record the maximum compressive strength noted on the testing machine and continue loading until a vertical crack appears.....

Remove the specimen from the machine and pull it apart at the crack.....

Inspect the interior surface for evidence of cracked or broken aggregate, visually estimate the approximate degree of moisture damage on a scale of "0" to "5" (with "5" being the most stripped) and record the observations in Table 1, see AASHTO T 283.....

12. Calculations

12.1. Calculate the tensile strength as follows: .....

SI Units:

$$S_t = \frac{2000P}{\pi t D}$$

Where:

S_t = tensile strength, kPa

P = maximum load, N

t = specimen thickness, mm

D = specimen diameter, mm

U.S. Customary units: .....

$$S_t = \frac{2P}{\pi t D}$$

Where:

S_t = tensile strength, psi

P = maximum load, lbf

t = specimen thickness, in.

D = specimen diameter, in.

12.2. Express the numerical index of resistance of asphalt mixtures to the detrimental effect of water as the ratio of the original strength that is retained after the moisture and freeze-thaw conditioning.

Calculate the tensile strength ratio to 2 decimal places as follows: .....

$$\text{tensile strength ratio (TSR)} = \frac{S_2}{S_1}$$

Where:

S_1 = average tensile strength of the dry subset, kPa (psi)

S_2 = average tensile strength of the conditioned subset, kPa (psi)

COMMENTS