HOT-MIX WORKSHEET INDEX

** NP for Not Presented or use a vertical line.

★ - Indicates the line has been modified since the last version of the worksheets, 2010-09-21.

REDUCING SAMPLES OF HOT-MIX ASPHALT TO TESTING SIZE (R47)

APPARATUS Date: _____

Equipment for **one** of the following methods:

Mechanical Splitter Method

1. Mechanical Splitter Type A:
   - (a) Designed so that the HMA field sample will flow smoothly and freely through the divider without restriction or loss of materials (See Figure 1)? ..... _____
   - (b) Splitter has four equal width chutes? ..... _____
   - (c) Four appropriate sized containers? ..... _____
   - (d) Hopper with release handle? ..... _____

2. Mechanical Splitter Type B:
   - (a) No less than 8 equal sized openings? ..... _____
   - (b) The openings minimum width must be at least 50% larger than largest particle to be split? ..... _____
   - (c) Hopper or straightedge pan? ..... _____

3. Approved Release Agent (such as non-stick cooking spray)? ..... _____
   - (a) Does not contain solvents? ..... _____
   - (b) Does not contain petroleum based products that affect binder properties? ..... _____

   Note to Assessors: *Products such as WD-40 contain solvents and petroleum products, and are not acceptable for this test method.*

Quartering Method:

1. One of the following:
   - (a) Quartering template? ..... _____
     - (1) Forms a cross forming 90 degree angles at juncture? ..... _____
     - (2) Sufficient length (1.1 times the diameter of the flattened cone of HMA to be quartered)? ..... _____

   or (b) Straightedges? ..... _____

2. Flat bottom scoop? ..... _____
3. A large spatula, trowel, or piece of metal to be used as a straightedge? ..... _____
4. Non-stick paper or heat resistant plastic? ..... _____
5. Approved Release Agent (such as non-stick cooking spray)? ..... _____
   - (a) Does not contain solvents? ..... _____
   - (b) Does not contain petroleum based products that affect binder properties? ..... _____

   Note to Assessors: *Products such as WD-40 contain solvents and petroleum products, and are not acceptable for this test method.*

Incremental Method

1. Flat bottom scoop? ..... _____
2. Non-stick heavy paper or heat-resistant plastic? ..... _____
3. Large spatulas, trowels, metal straightedges, or a 12-in drywall taping knife? ..... _____
4. Hot plate, gloves, buckets, and cans? ..... _____

COMMENTS (R47): (R47)

REDUCING SAMPLES OF HOT-MIX ASPHALT TO TESTING SIZE (R47)

PROCEDURE Date: _____

Mechanical Splitter Method: *for a large amount of material, Method A should be used whenever possible.*

1. **Optional:** Splitter and accessories heated, not to exceed 110°C as determined with a non-contact temperature device? ..... _____
2. **Optional:** All surfaces coming into contact with HMA coated with approved release agent? ..... _____
3. Mechanical Splitter Method (Type A)
   - (a) Field or laboratory sample placed in hopper avoiding sample segregation? ..... _____
   - (b) Sample containers positioned to receive HMA? ..... _____
   - (c) Release handle used dropping HMA through chutes? ..... _____
   - (d) Samples taken from opposing corners for reintroduction into hopper? ..... _____
   - (e) Split as many times as necessary for appropriate test? ..... _____
4. Mechanical Splitter Method (Type B)
   - (a) Sample placed in hopper or straightedge pan? ..... _____
   - (b) Uniformly spread edge to edge? ..... _____
   - (c) Rate at which sample introduced allows free flow into sample containers? ..... _____
   - (d) Steps repeated until sample size obtained? ..... _____

Note: *Unlike C702, the half of the split sample normally regarded as trash may be set aside for reduction in size for other tests.*

Quartering Method

1. Sample placed on a hard, non-stick, clean, level surface? ..... _____
2. Approved release agent, non-stick paper, or heat resistant plastic may be used to make surface non-stick? ..... _____
3. Sample mixed to uniformity by turning over four times? ..... _____
4. Mixed using flat bottom scoop or by alternately lifting each corner of the paper or plastic and pulling toward the opposite corner? ..... _____
5. During the last turning, entire sample formed into conical pile by depositing each scoopful on top of previous one or by lifting two opposite corners of the paper or plastic? ..... _____
6. Pile flattening into uniform thickness and diameter by pressing down on the apex? ..... _____
7. Diameter approximately four to eight times the thickness? ..... _____
8. A visual check is done to ensure that the material is homogenous? ..... _____
9. Flattened mass divided into four quarters using quartering template or straightedges? ..... _____
10. Quartering template pressed down until it has complete contact with surface? ..... _____
11. Two diagonally opposite quarters selected as "quartered" material? ..... _____
12. Steps repeated until sample size obtained? ..... _____

Incremental Method

1. Sample placed on a hard, non-stick, clean level surface covered with non-stick paper, heat resistant plastic, or another suitable material? ..... _____
2. Sample mixed to uniformity by turning over four times? ..... _____
3. Mixed using flat bottom scoop or by alternately lifting each corner of the paper or plastic and pulling toward the opposite corner? ..... _____
4. During the last turning, entire sample formed into conical pile by depositing each scoopful on top of previous one or by lifting two opposite corners of the paper or plastic? ..... _____
5. A visual check is done to ensure that the material is homogenous? ..... _____
6. Paper or plastic grasped and material is rolled into a cylindrical roll (loaf) and top of loaf flattened? ..... _____
7. Paper pulled so that at least ¼ of the length of the loaf is off of the edge of the counter and the portion overhanging the counter sliced off and placed in a container? ..... _____

   or A straightedge used to slice off approximately ¼ of the loaf and material placed in a container? ..... _____
8. Additional material removed as needed to obtain test size? ..... _____

COMMENTS (R47): (R47)

MECHANICAL ANALYSIS OF EXTRACTED AGGREGATE

(T30) _____
(D5444) _____

APPARATUS

Date: _____

1. Nest of sieves: Upper sieve: 2.00- or 1.18-mm (No. 10 or 16), lower sieve No. 200?..... _____

2. Mechanical Shaker, sieving accuracy met in a reasonable time period?..... _____
   Note: *A mechanical shaker is recommended for sample sizes greater than 20 kg (44 lb).*
   Time in excess of approx. 10 minutes may result in degradation of the sample.

3. Wetting agent used? ..... _____

4. Oven, capable of maintaining 110 ± 5°C (230 ± 9°F)? ..... _____

5. Balance, capable of weighing to 0.1 % of sample mass? ..... _____

6. Container, capable of holding sample covered with water and to permit agitation without without loss of sample? ..... _____

PROCEDURE

Sample Preparation: circle one **Extraction sample** **Ignition sample**

1. Sample consists of all aggregate after extraction or ignition oven sample? ..... _____
2. ***ASTM only: Gradation analysis only performed on aggregate extracted by ignition method in Test Method D6307 when the correction factor is 1.0 or less?*** ..... _____
3. Minimum mass of mix sample based on nominal maximum size? ..... _____
4. Sample dried to constant mass? ..... _____
5. Sample weighed to nearest 0.1g (enter mass below)? ..... _____
6. **Extraction samples only:** Total mass of aggregate for percent calculation includes mineral matter mass? ..... _____
7. *AASHTO only: If from T308, sample agrees with the mass after ignition from T308 (W_F) to within 0.1 % or else not used for acceptance purposes?* ..... _____

Wash

1. After mass is recorded, sample placed in container and covered with water? ..... _____
2. Small amount of wetting agent added? ..... _____
3. Contents of container agitated vigorously? ..... _____
4. Wash water poured through proper nest of two sieves? ..... _____
5. Decantation of coarse particles onto the sieves avoided as much as possible? ..... _____
6. Washing continued until wash water is clear? ..... _____
7. Material retained on nested sieves returned to container? ..... _____
8. Washed material coarser than 75-µm (No. 200) dried according to T255
   [ASTM only: Material can be dried to constant mass at a max temp. = compaction temperature + 9°F (5°C)]? _____
9. Mass Before Washing _____ Mass After Washing _____ Sample weighed to nearest 0.1g?. _____
10. Amount of - No. 200 material removed by washing calculated? ..... _____

COMMENTS (T30 / D5444): (T30 / D5444)

MECHANICAL ANALYSIS OF EXTRACTED AGGREGATE (T30) _____
(D5444) _____

PROCEDURE (Continued) Date: _____

Sieve Testing: circle which type(s) were used **8-in sieves** **12-in sieves** **Other** (such as square sieves)

1. Material sieved on specified sieves (including 75-µm)? ..... _____
2. Sieving continued until not more than 0.5 percent by mass of the total sample passes a given sieve in 1 min. (check by hand with 8 in. diameter sieve)? ..... _____

Sieve size: ____ Total sample: _____ Mass passing sieve: _____ Percent Passing: _____

(a) Mass retained on any sieve with openings smaller than No. 4 is less than 6 kg/m^2 (4 g/in.^{2}) (200 g for 8 in. diameter sieve, 438 g for 12 in. diameter sieve)? ..... _____

(b) Mass retained on any sieve with openings larger than No. 4 is less than 2.5 x (sieve opening in mm) x (πr^2) [see table below]? ..... _____

Note to assessors: *This is not identical to (T27/C136), they are calculated differently.*

Sieve	Opening (mm)	Mass (g) – 8 in. dia.	Mass (g) – 12 in. dia.
< #4	< 4.75	200	438
#4	4.75	385	867
1/4 in.	6.3	510	1149
3/8 in.	9.5	770	1734
1/2 in.	12.5	1013	2281
3/4 in.	19.0	1539	3468

3. Each fraction of aggregate weighed, including minus 75-µm (No. 200)? ..... _____
4. Does the final total mass after sieving agree with the mass after wash within 0.2 percent? ..... _____
   Mass before sieving _____ Mass after sieving _____ % difference _____

5. (a) **Extraction samples** (from T164/D2172): Total minus 75-µm (No. 200) = minus 75-µm by sieving + minus 75-µm by washing + mass of mineral matter (ash + increase in filter mass from extraction)? ... _____

or (b) **Ignition samples** (from T308/D6307): Total minus 75-µm (No. 200) = minus 75-µm by sieving + minus 75-µm by washing? ..... _____

Note: Optionally, the wash water can be evaporated or filtered through tared filter paper which is subsequently dried as check of wash over 75-µm (No. 200) sieve.

6. Sizes larger than 75-µm (No. 200) reported to nearest 1.0 percent (at least)? ..... _____
7. Minus 75-µm (No. 200) material reported to nearest 0.1 percent? ..... _____
8. *AASHTO only: If sample obtained from T308, aggregate correction factor determined in T308 applied to final total passing percentages?* ..... _____

COMMENTS (T30 / D5444): (T30 / D5444)

MOISTURE OR VOLATILE DISTILLATES IN PAVING MIXTURES (T110) _____
(D1461) _____

APPARATUS Date: _____

1. Still:
   (a) Height: 152.4 ± 6.4 mm (6.0 ± 0.25 in.) by 94.0 ± 5.1 mm (3.7 ± 0.2 in.) O.D.? ..... _____
   Note: *Stills with a 5 in. O.D. may be used to accommodate larger samples.*
   (b) Still head has one hole 25.4 mm (1 in.) in inside diameter? ..... _____
   (c) Clamp for still head satisfactory? ..... _____
   (d) Heavy paper gasket? ..... _____

2. Glass Tube Condenser:
   (a) Jacket length not less than 400 mm (15 3/4 in)? ..... _____
   (b) Inner tube O.D. 9.5 to 12.7 mm (3/8 to 1/2 in)? ..... _____
   Note: *It may be necessary to supplement one condenser with a second of the same dimensions.*

3. Receiver, made of well-annealed glass? **[*ASTM: conforming to Section 4.3?*]** ..... _____

4. Solvents:
   (a) Xylene? **or** 20% toluene and 80% xylene? ..... _____
   (b) Petroleum distillate? ..... _____
   (c) Sodium carbonate (Na_2CO_3) (For Volatile Distillates)? ..... _____

5. Heating device ..... _____

COMMENTS (T110 / D1461): (T110 / D1461)

MOISTURE OR VOLATILE DISTILLATES IN PAVING MIXTURES (T110) _____
(D1461) _____

PROCEDURE Date: _____

Sample Preparation:

1. Sample thoroughly mixed? _____
2. Weighed sample should be not less than 500 g for normal mixtures? _____
3. Weighed sample broken up to avoid large lumps and placed in the still? _____
4. Remainder of the sample kept in a tightly covered container? _____

Determination of Moisture

1. Sample placed in the still? _____
2. 200 mL of solvent added to the sample and stirred? _____
3. Gasket moistened with water? _____
4. Satisfactory assembly of components (all connections vapor or liquid tight, caution if the apparatus leaks)? _____
5. Loose cotton plug inserted in top of condenser? _____
6. Cold water circulated in jacket of condenser? _____
7. Heat applied and refluxing starts within 5 to 10 minutes? _____
8. Drip rate adjusted from 85 to 95 drops of distillate per minute? _____
9. Distillation time does not exceed 1.5 hours? _____
   or Distillation continued until three successive 15 minute intervals show no increase in water? _____
10. Contents of receiver allowed to reach room temperature and read to the nearest scale division? _____
11. Volume of water recorded and calculated in accordance with the method? _____

% Water = 100 (Volume of water in receiver / Mass of sample)

Determination of Volatile Distillates

1. Sample placed in the still? _____
2. 350 mL of water and approx. 3 g [AMRL: ± 1 g] of sodium carbonate added to the sample and stirred? _____
3. Gasket moistened with solvent? _____
4. Receiver used is the dilution trap specified in Section 4.3.2 and Figure 6? _____
5. Satisfactory assembly of components? _____
6. All connections vapor or liquid tight (caution if the apparatus leaks)? _____
7. Loose cotton (or similar) plug inserted in top of condenser? _____
8. Cold water circulated in jacket of condenser? _____
9. Heat applied and refluxing starts within 5 to 10 minutes? _____
10. Drip rate adjusted from 85 to 95 drops of distillate per minute? _____
    Note: *It may be necessary to add a second condenser or to reduce the rate of distillation somewhat to prevent escape of the solvent.*
11. Distillation continued until three successive 15 minute intervals show no increase in upper and lower levels of the diluent? _____
12. Heat removed and solvent allowed to stand for 0.5 hours? _____
13. Contents of receiver read to the nearest scale division? _____
14. Volume of dilute recorded and calculated in accordance with the method? _____

% Diluent = 100 [(Volume of dilute in receiver * Sp. G. of dilute at 25°C) / Mass of sample]

COMMENTS (T110 / D1461): (T110 / D1461)

QUANTITATIVE EXTRACTION OF BITUMEN FROM HMA (T164) _____
(D2172) _____

APPARATUS Date: _____

Apparatus Common to all Methods (A, B, D, and E)

1. Solvent:
   Note to Assessors: *Reclaimed / reused solvents should not be used for testing.*
   (a) Trichloroethylene?
      (1) Technical grade conforming to ASTM D4080? ..... _____
      (2) *AASHTO only: Reagent grade is required if running T170 using Trichloroethylene)?*..... _____
   (b) Methylene chloride, technical grade? ..... _____
   (c) normal-Propyl Bromide, conforming to ASTM D6368? ..... _____
   (d) *AASHTO only: Terpene extractant, AASHTO Method A or E?* ..... _____
   Note: *Terpene extractants that gel when exposed to water are not acceptable.*

2. Fume hood or effective surface exhaust system in a well-ventilated area? ..... _____
3. Oven, capable of maintaining 110 ± 5°C (230 ± 9°F) for warming sample? ..... _____
4. *AASHTO only: Oven, can maintain 149 to 163°C (300 to 325°F) for drying (if moisture not determined)?*..... _____
5. Pan of appropriate size **[*ASTM: 12 x 8 x 1 in.*]**? ..... _____
6. Spatula or trowel? ..... _____
7. *AASHTO only: Balance, readable to 0.1 % of sample mass, conforms to M231?* ..... _____
   ASTM only: Balance: accuracy of at least 0.01 percent of sample mass? ..... _____

Apparatus for Determining Mineral Matter

Ashing Method
(a) Graduated cylinder: capacity 1 or 2 L or 100 mL cylinder? ..... _____
(b) Ignition dish, minimum capacity of 125 mL? ..... _____
(c) Steam bath or hot plate?..... _____
(d) Desiccator, large enough to contain ignition dish? ..... _____
(e) Ammonium carbonate, reagent grade (as saturated solution or salt)?..... _____
(f) Class B (0.001 g) analytical balance available?..... _____
(g) AASHTO only: Ignition furnace or Bunsen burner? ..... _____

or *Centrifuge Method*
(a) Centrifuge capable of 3000 r/min or greater? ..... _____
(b) Continuous flow type?..... _____
(c) Class G1 (0.01 g) balance available **[*ASTM: Class GP1*]**? ..... _____

or *Volumetric Method*
(a) Flask large enough to hold extract? ..... _____
(b) Constant temperature bath?..... _____
(c) Thermometer readable to 0.2°F (0.1°C)? ..... _____

Additional Apparatus for Method A

1. Centrifuge Extractor:
   (a) Aluminum bowl with cover?..... _____
   (b) Can be rotated at variable speeds up to 3600 r/min?..... _____
   (c) Apparatus set up safely (not prone to explosions and installed in fume hood)? ..... _____
2. Filter rings, felt or paper, to fit rim of bowl?..... _____
   or Low-ash paper filter rings: ash content less than 0.2 percent? ..... _____

COMMENTS (T164 / D2172): (T164 / D2172)

QUANTITATIVE EXTRACTION OF BITUMEN FROM HMA (T164) _____
(D2172) _____

APPARATUS (Continued) Date: _____

Additional Apparatus for Method **B**

1. Reflux Extractor:
   - (a) Heat resistant glass jar free of scratches, cracks, or flaws? _____
   - (b) Cylindrical metal frames, one or two, each containing a conical filter cone support? _____
     - (1) Bottom of lower cone above level of solvent? _____
     - (2) If two frames, the upper frame can be supported on the lower? _____
2. Condenser, fits top of reflux extractor? _____
3. Filter paper: medium grade, fast filtering, completely lines cone? _____
   - (a) Electric hot plate, thermostatically controlled? _____
   - (b) *AASHTO only: Thermal-distributing protective pad of adequate thickness, approx. 3 mm thick?* _____
   - ***ASTM only: Thermal-distributing protective pad made of heat-resistant?*** _____

Additional Apparatus for Method **D**

1. Extraction Kettle:
   - (a) Metal or borosilicate glass? _____
   - (b) Perforated basket? _____
   - (c) Condenser top, fitted to basket? _____
2. Cloth filter sacks with elastic hem for lining basket? _____

Additional Apparatus for Method **E**

1. Vacuum Extractor (essentially as shown in Fig. 6a, b, and c): _____
   - (a) Vacuum pump (preferably vane type)? _____
   - (b) Filter support plate:
     - (1) Perforated with holes small enough to support the filter paper and numerous enough to ensure adequate suction? _____
     - (2) Overlaps or fits just inside "O" ring? _____
     - (3) Funnel ring? _____
2. Filter paper: medium grade, fast filtering, 330 mm diameter? _____
3. *AASHTO: Sample container, 3.8 L (4 qt.) capacity or greater?* _____
   - ***ASTM: Stainless steel beaker, 9 qt. capacity?*** _____
4. Two flasks, 4000 mL capacity each? _____
5. Glass graduate glass with a capacity of 500 mL? _____
6. Wash bottle filled with water? _____
7. Spatula and large mixing spoon? _____
8. Stiff-bristle brush, approximately 1 in. wide? _____
9. Dial thermometer, 50 to 180°F (10 to 82°C)? _____
10. **Optional:** Ultrasonic cleaner, 4 qt. minimum capacity with insert tray? _____
11. Ethyl alcohol, denatured [*AASHTO only: optional*]? _____
12. ***Optional*** *AASHTO only: 12 in. diameter No. 16 and No. 200 sieves?* _____
13. **Optional:** Additional Apparatus for Method **E-II** (Method for slow-filtering samples)
    - (a) Flask, 1000 mL capacity? _____
    - (b) Watch glass with a 4 in. diameter? _____
    - (c) Metal tongs for handling watch glass? _____
    - (d) Diatomaceous silica filtering aid, conforming to requirements of ASTM D604 - Type B? _____

COMMENTS (T164 / D2172): (T164 / D2172)

QUANTITATIVE EXTRACTION OF BITUMEN FROM HMA (T164) _____
(D2172) _____

PROCEDURE Date: _____

Sample Preparation:

1. If necessary, mixture warmed in pan at 230 ± 9°F (110 ± 5°C) until it can be handled? ..... _____
2. Particles of mixture separated with spatula or trowel? ..... _____
3. Sample obtained by splitting or quartering, conforms to minimum sample mass table below? ..... _____

Table of minimum sample masses for T164/D2172 conforms to minimum sample mass table below

No. 4	3/8 in.	1/2 in.	3/4 in.	1 in.	1.5 in.
1/2 kg	1 kg	1.5 kg	2 kg	3 kg	4 kg

4. Sample divided into equal portions for multiple extractions if necessary? ..... _____
5. If necessary, test specimen for moisture determination obtained? ..... _____

Water Determination

1. Mass of extraction test portion determined? (W_1) ..... _____
2. If recovery of bitumen is NOT required entire test specimen may be dried using a or b instead of c:
   (a) *AASHTO: Dried in an oven at 105 - 165°C (221 - 329°F) until constant mass prior to extraction?* .... _____
   ASTM: Dried to constant mass prior to extraction at 230 ± 9°F (110 ± 5°C)? ..... _____
   or (b) *AASHTO only: Moisture determined by T329? [min. 1000 g sample, oven at either JMF mixing range or at 163 ± 14°C (325 ± 25°F), dried for 90 ± 5 minutes, and then weighed at 90 ± 5 minute intervals]?* . _____
   or (c) Moisture determined by T110/D1461 (apparatus must be available, must be used for recovery)? ..... _____
3. Mass of water calculated by multiplying percent water of sample by mass of extraction test portion? (W_2) ..... _____

Note to Assessors: *If the sample is dried to constant mass, W_1 is the dry mass, and W_2 is 0 (the mass of the water).*

Extraction Procedure by Method **A (Centrifuge Method)**

1. Filter ring dried to constant mass in oven [*AASHTO only: at 230 ± 9°F (110 ± 5°C)*] and weighed? ..... _____
2. Sample covered with solvent and allowed to disintegrate for not more than 1 hr.? ..... _____
3. Bowl with solvent and sample placed in extraction apparatus? ..... _____
4. Weighed test portion placed into bowl? ..... _____
5. Dry filter ring fitted around edge of bowl and cover clamped tightly on bowl? ..... _____
6. Container placed under drain to collect extract? ..... _____
7. Centrifuge started revolving slowly and speed increased gradually? ..... _____
8. Maximum speed not greater than 3600 rpm? ..... _____
9. Centrifuge continued until solvent ceases to flow? ..... _____
10. Centrifuge stopped and 200 mL or more of solvent added? ..... _____
11. Steps (6) through (10) repeated, adding at least 3 increments of solvent? ..... _____
12. Last extract clear and not darker than light straw color? ..... _____
13. Contents dried in air under a hood until fumes dissipate? ..... _____
14. Sample can be dried by:
   (a) Filter ring and aggregate transferred to tared metal pan, then dried to constant mass in an oven at 110 ± 5°C (230 ± 9°F)? ..... _____
   or (b) Aggregate dried to constant mass in an oven or on a hot plate at 110 ± 5°C (230 ± 9°F), filter ring dried separately to constant mass in an oven at 110 ± 5°C (230 ± 9°F)? ..... _____
   or (c) Aggregate and filter ring dried in the bowl to constant mass in an oven at 110 ± 5°C (230 ± 9°F)? ..... _____

15. (Optional) If low ash filter paper is used, dried filter ring folded, stood on aggregate, and then burned in pan with aggregate to avoid loss? ..... _____
16. Initial dry mass of filter ring subtracted from mass of contents in pan to determine mass of extracted aggregate? (W_3) ..... _____
17. Mineral matter in the extract determined by one of the specified procedures? ..... _____

COMMENTS (T164 / D2172): (T164 / D2172)

QUANTITATIVE EXTRACTION OF BITUMEN FROM HMA (T164) _____
(D2172) _____

PROCEDURE (Continued) Date: _____

Extraction Procedure by Method **B (Reflux Method)**

1. Filter paper(s) dried to constant mass in oven [*AASHTO only: at 230 ± 9°F (110 ± 5°C)*] and weighed? _____
2. Mass of each frame with filter paper determined to the nearest 0.5 g and recorded? _____
3. Place test portion in frame(s)? _____
4. Mass of each loaded frame determined to the nearest 0.5 g and recorded? _____
5. Solvent poured into glass jar? _____
6. Frame with supporting legs placed in jar? _____
7. Solvent level below tip of cone in lower frame? _____
8. **Optional:** denatured alcohol used to wet filter paper? _____
9. If multiple frames, upper frame(s) stacked on bottom frame? _____
10. Insulating pad and cylinder placed on hot plate [*AASHTO only: optional*]? _____
11. Gentle steady flow of cold water circulated through covered condenser? _____
12. Heat adjusted so that solvent boils gently? _____
13. Steady flow drips into cone? _____
14. If necessary, adjust temperature of hot plate to maintain the solvent stream at a rate to keep test portions completely covered, but not overflowing the filter cones? _____
15. Extraction continued until running from tip of lower cone appears a light straw color when viewed against white background? _____
16. Heat shut off, but not condenser water? _____
17. Apparatus allowed to stand until cool enough to handle? _____
18. Condenser turned off and removed from cylinder? _____
19. Loaded frame(s) removed from jar and dried in air? _____
20. Dry frame(s) to constant mass in oven at 230 ± 9°F (110 ± 5°C)? _____
21. Mass of extracted aggregate determined? (W_3) _____
22. Mineral matter in solution determined by one of the procedures specified? _____

Extraction Procedure by Method **D (Kettle Method)**

1. Filter sack placed in extraction basket and mass determined with the tare pan and total tare mass determined? _____
2. Test portion placed in filter sack and total mass determined, then mass of test portion calculated? _____
3. Suspension rod attached to loaded basket and assembly set into the extraction kettle? _____
4. Approximately 600 mL [AMRL: ± 100 mL] of solvent poured over the test portion? _____
5. Condenser cover placed on kettle? _____
6. Cold water started through condenser cover? _____
7. Basket raised to immersion level, approx. 1/2 in. above bottom of kettle? _____
8. Extractor placed on hot plate and heated to a gentle boil? _____
9. Heating continued for 15 to 30 minutes in immersion position? _____
10. Basket raised [*AASHTO only: to refluxing level*]? _____
11. Heat increased to maintain active boiling until solvent dripping from the basket appears light straw color? _____
12. Extractor removed from plate and allowed to cool? _____
13. Basket removed from kettle and filter sack removed from basket and contents distributed into tared pan? _____
14. Filter sack placed on top of aggregate and dried on a steam bath and then in an oven at 230 ± 9°F (110 ± 5°C) to constant mass? _____
15. Extraction transferred to a 1000-mL graduate? _____
16. Extractor washed clean with solvent then washings added to the extract? _____
17. Mass of extracted aggregate determined? (W_3) _____
18. Mineral matter in the extract determined by one of the procedure specified? _____

COMMENTS (T164 / D2172): (T164 / D2172)

QUANTITATIVE EXTRACTION OF BITUMEN FROM HMA (T164) _____
(D2172) _____

PROCEDURE (Continued) Date: _____

Extraction Procedure by Method **E (Vacuum Method)**

1. *AASHTO: Filter paper (more than 1 may be used) dried to constant mass in oven at 230 ± 9°F (110 ± 5°C)?* .. _____
   ASTM: Filter paper dried to constant mass? ..... _____
2. Sample mass determined and recorded? ..... _____
3. Cooled below 130°F (54°C)? ..... _____
4. 200 mL alcohol added with care [*AASHTO only: optional, should not be need for if using terpene*]? ..... _____
5. Approx. 700 mL methylene chloride [*AASHTO only: or other approved solvent*] added? ..... _____
6. Stirred until bitumen visually in solution or ultrasonic cleaner used? ..... _____
7. Extractor assembled with dry filter paper (finger tight) centered? ..... _____
8. ***Optional*** *AASHTO only: No. 16 and No. 200 sieves used?* **[*ASTM only: sieves are not acceptable*]** ..... _____

9. **Optional:** Additional steps for Method **E-II** (for slow-filtering samples)
   Note: *A correction may be necessary to account for any diatomaceous silica that is washed through the filter. See note 23 in AASHTO T164.*
   (a) 50 to 200 g pre-dried filtering aid and 500 mL of solvent added to 1000-mL flask? ..... _____
   (b) Flask swirled until filtering aid is completely in suspension? ..... _____
   (c) Solvent and filtering aid mixture poured over filter? ..... _____
   Note, *AASHTO only, optional: Two pre-dried filters separated by an additional 50 to 100 g of filtering aid may be used to facilitate flow of liquid.*

10. Vacuum started and solution decanted onto filter or through sieves? ..... _____
11. Watch glass used if filtering aid needed [*AASHTO only: and sieves not used*]? (E-II) ..... _____
12. ***ASTM only: Vacuum stopped when all solvent is removed from filter paper?*** ..... _____
13. Sample remaining in the container covered with solvent and stirred? ..... _____
14. Steps 10 through 13 repeated until the solution is a light straw color and aggregate is visually clean? ..... _____
15. *AASHTO only: If terpene was used, aggregate rinsed with water, preferably above 43°C (110°F), in the same manner that the bitumen was rinsed off with solvent?* ..... _____
16. All aggregate carefully transferred onto the filter [*AASHTO only: if terpene used. If not, skip to (20)*]? ..... _____
17. Any aggregate clinging to the container washed onto the filter with the solvent? ..... _____
18. Aggregate dried using vacuum? ..... _____
19. Aggregate scraped towards center from funnel ring? ..... _____
20. Vacuum stopped and aggregate transferred to tared drying pan? ..... _____
21. Funnel ring and filter paper brushed? ..... _____
22. Aggregate and filter paper dried to constant mass in an oven at 230 ± 9°F (110 ± 5°C)? ..... _____
23. *AASHTO only: If low-ash filter paper is used, is it burned in the pan with aggregate to avoid loss?* ..... _____
24. Mass of aggregate and filter in the pan recorded? ..... _____
25. Mass of filter and pan subtracted to determine mass of extracted aggregate? (W_3) ..... _____
26. Mineral matter in solution determined by one of the procedures specified? ..... _____
    (Note to Assessor: The mineral matter determination is not required for laboratories performing Method E for plant control testing only. In all other cases, the mineral matter determination must be demonstrated during the assessment. Add standard Observation finding for Plant Control to final report.)

COMMENTS (T164 / D2172): (T164 / D2172)

QUANTITATIVE EXTRACTION OF BITUMEN FROM HMA (T164) _____
(D2172) _____

PROCEDURE (Continued) Date: _____

Total Mineral Matter Determination by **Ashing** Method

1. Volume [*AASHTO only: or mass*] of total extract and washings recorded? (W_1 or V_1) _____
   Note to Assessors: *Watch out, AASHTO labels both this volume and the original sample mass as W_1.*
2. *AASHTO only: Ignition dish conditioned in furnace or on Bunsen burner, then cooled in a desiccator?* _____
3. Ignition dish mass determined to 0.001 g? _____
4. Extract thoroughly agitated, approx. 100 mL [*AASHTO: or 100 g*] immediately measured into ignition dish? _____
5. ***ASTM only: Volume after removing ignition dish portion determined?*** (V_2) _____
6. Ignition dish evaporated to dryness on steam bath or hot plate? _____
7. Residue ashed at dull red heat [500 - 600°C (932 to 1112°F)] and cooled? _____
8. Mass of the ash determined? _____
9. 5 mL of saturated ammonium carbonate solution added per 1 g of ash? _____
10. Digested at room temperature for l hour? _____
11. Dried in oven to constant mass at 110 ± 5°C (230 ± 9°F) **[*ASTM: constant mass at 100°C*]**? _____
12. Cooled in desiccator and net mass of ash determined on analytical balance to the nearest 0.001 g? (G) _____
13. Mass of mineral matter calculated {*AASHTO: G* x (W_1 / 100)} {***ASTM:*** G x (V_1 / (V_1 - V_2))}? (W_4) _____

Total Mineral Matter Determination by **Centrifuge** Method

1. Empty centrifuge cup mass determined to 0.01 g? _____
2. Centrifuge cup placed in centrifuge? _____
3. Container positioned at appropriate spout to catch effluent? _____
4. Extract transferred to container suitably equipped with feed control (clamp or valve)? _____
5. Extract container rinsed several times with clean solvent, and washings added to feed container? _____
6. Centrifuge started and allowed to reach a constant speed? _____
7. Feed line opened and extract fed into centrifuge at a rate of 100 to 150 mL/min.? _____
8. Feed mechanism rinsed several times with clean solvent until effluent is essentially colorless? _____
9. Centrifuge allowed to stop and cup (or bowl) removed? _____
10. Outside of cup cleaned with solvent and allowed to evaporate in a funnel or steam hood? _____
11. Cup dried in oven at 230 ± 9°F (110 ± 5°C)? _____
12. Cup cooled and mass of the cup with residual material determined to nearest 0.01 g immediately? _____
13. Increase in mass of cup reported as the mass of the mineral matter? (W_4) _____

Total Mineral Matter Determination by **Volumetric** Method

1. Flask calibrated and tared mass recorded? _____
2. Extract placed in tared flask? _____
3. Flask brought to within ± 0.1°C (0.2°F) of calibration temperature in controlled-temperature bath? _____
4. Flask filled with solvent at same temperature? _____
5. Level of liquid in flask brought up to the neck of the flask? _____
6. Stopper inserted and flask dried? _____
7. Flask weighed to nearest 0.1 g? _____
8. Calculations made according to the book (AASTHO Section A1.3.2.2, ASTM Section 11.6.3.2) to determine mineral matter? (W_4) _____

Calculation of Asphalt Binder Content

1. Asphalt binder content percentage calculated? _____

$$\% \text{ Asphalt Binder Content} = \frac{(W_1 - W_2) - (W_3 + W_4)}{(W_1 - W_2)} \times 100$$

where:
W_1 = mass of test portion
W_2 = mass of water in test portion
W_3 = mass of extracted mineral aggregate
W_4 = mass of mineral matter in the extract

COMMENTS (T164 / D2172): (T164 / D2172)

BULK SPECIFIC GRAVITY OF COMPACTED HMA USING SATURATED SURFACE-DRY SPECIMENS (T166) _____ **(D2726)** _____

APPARATUS Date: _____

Common Apparatus for all methods

1. *AASHTO: Balance conforms to M231 for class required for principal sample mass of samples tested (G2 balance for specimens over 200 g)?* _____
   ASTM: Balance conforms to D4753, sensitive to 0.1 g for 100.1 - 999.9 g sample (GP2)? _____
   ASTM: Balance standardized according to interval in D3666 (12 months), see records? _____
2. Water bath:
   (a) Maintains 25 ± 1°C (77 ± 1.8°F)? _____
   (b) Equipped with overflow outlet to maintain constant water level? _____
3. *AASHTO: Drying oven at 52 ± 3°C (125 ± 5°F)?* _____
   ASTM: Drying oven at 110 ± 5°C °C (230 ± 9°F)? _____
   ASTM: Drying oven standardized according to interval in D3666 (12 months), see records? _____
4. *AASHTO only: Room temperature: 25 ± 5°C (77 ± 9°F)?* _____
5. Cloth towel, damp (considered damp when no water can be wrung from it)? _____

Additional Apparatus for AASHTO Method **A** and **ASTM**

1. Water bath suspension:
   (a) *AASHTO only: Suspension from center of balance pan?* _____
   (b) Holder and sample completely immersed? _____
   (c) *AASHTO only: No trapped air bubble exists under specimen?* _____
   (d) Can determine constant mass of specimen to 0.05 percent? _____
   (e) Water bath deep enough to completely immerse holder and sample? _____
   (f) Suspension wire of smallest practical size? _____
   Note to Assessors: *Ropes, strings, and sash cords are not acceptable. Wire or fishing line is suggested. Chain ok.*

*Additional Apparatus for AASHTO Method **B***

1. *Thermometer:*
   ASTM 17C (19 to 27 °C, graduated to 0.1°C)? _____
   or *ASTM 17 F (66 to 80°F, graduated to 0.2°F)?* _____
   ASTM only: temperature measuring device presented calibrated according to interval in D3666 (6 months), see records? _____
2. *Calibrated volumeter and tapered lid with capillary bore?* _____

COMMENTS (T166 / D2726): (T166 / D2726)

BULK SPECIFIC GRAVITY OF COMPACTED HMA USING SATURATED SURFACE-DRY SPECIMENS (T166) _____

AASHTO PROCEDURE Date: _____

*AASHTO Method **A** (sequence of steps is optional)*

1. *Dry sample used or sample dried at 52 ± 3 °C (125 ± 5 °F) to constant mass (0.05 percent)?* _____
   ***Note to Assessors:** Sample can either be checked for constant mass at successive 2 hr. intervals or dried overnight.*
2. *Sample cooled to room temperature, 25 ± 5 °C (77 ± 9 °F), and dry mass recorded? (A)* _____
3. *Sample immersed for 4 ± 1 min.?* _____
4. *Immersion water at 25 ± 1 °C (77 ± 1.8 °F) (check with AMRL thermometer)?* _____
5. *Each specimen immersed and weighed individually?* _____
6. *Immersed mass determined? (C)* _____
7. *Sample removed from bath and quickly blotted with damp towel (not to exceed 5 s)?* _____
8. *Saturated surface-dry mass determined? (B)* _____
9. *Bulk Specific Gravity calculated as { A / (B – C) }?* _____
10. *Percent Water Absorbed calculated { ((B – A) / (B – C)) x 100? }?* _____

*AASHTO Method **B** (sequence of steps is optional)*

***Note:** Method B is not acceptable for samples with air voids greater than 6 percent.*

1. *Dry sample used or sample dried at 52 ± 3 °C (125 ± 5 °F) to constant mass (0.05 percent)?* _____
   ***Note to Assessors:** Sample can either be checked for constant mass at successive 2 hr. intervals or dried overnight.*
2. *Sample cooled to room temperature, 25 ± 5 °C (77 ± 9 °F), and dry mass recorded? (A)* _____
3. *Sample immersed at least 10 min?* _____
4. *Immersion water at 25 ± 1 °C (77 ± 1.8 °F) (check with AMRL thermometer)?* _____
5. *Volumeter filled with distilled water at 25 ± 1 °C (77 ± 1.8 °F) and mass determined? (D)* _____
6. *Sample removed from bath and quickly blotted with damp towel (not to exceed 5 s)?* _____
7. *Saturated surface-dry mass determined? (B)* _____
8. *Sample placed in water-filled volumeter and allowed to stand for 60 s?* _____
9. *Volumeter water temperature brought to 25 ± 1 °C (77 ± 1.8 °F)?* _____
10. *Volumeter covered and some water allowed to escape through the capillary bore of the tapered lid?* _____
11. *Volumeter wiped dry and volumeter and contents weighed? (E)* _____
12. *Bulk Specific Gravity calculated {A / (B + D – E)}?* _____
13. *Percent Water Absorbed calculated { ((B – A) / (B + D – E)) x 100 }?* _____

*AASHTO Method **C***

Method C is for samples that are not required to be saved and contain a substantial amount of moisture.

1. *Procedure same as Method A or Method B except for determination of dry mass?* _____
2. *Dry mass determined as follows:*
   - *(a) Sample warmed in oven 110 ± 5 °C (230 ± 9 °F) until soft?* _____
   - *(b) Broken down to 1/4 in. particles?* _____
   - *(c) Dried in oven to constant mass (2 hr. change less than 0.05 percent)?* _____
   - *(d) Cooled to room temp. 25 ± 5 °C (77 ± 9 °F) and weighed? (A)* _____
3. *Calculations same as Method A or Method B?* _____

Final Calculations (all methods)

1. *Percent water absorbed determined to be less than 2.0 percent?* _____
2. *If the percent of water absorbed by the specimen exceeds 2.0 percent, T275 used to determine the bulk specific gravity instead?* _____
3. *Bulk Specific Gravity reported to nearest 0.001?* _____
4. *Absorption reported to nearest 0.01?* _____

COMMENTS (T166): (T166)

BULK SPECIFIC GRAVITY OF COMPACTED HMA USING SATURATED SURFACE-DRY SPECIMENS **(D2726) _____**

ASTM PROCEDURE Date: _____

Method For Laboratory-Prepared Thoroughly Dry Specimens

1. ***Specimen allowed to stand in room temperature air for at least 1 hr.?*** _____
2. ***Mass of dry specimen determined? (A)*** _____
3. ***Specimen immersed in bath for 3 to 5 min.?*** _____
   or ***If specimen temperature differs from the water temperature by more than 2°C (3.6°F), is specimen immersed 10 to 15 min.?*** _____
4. ***Immersion water at 25 ± 1°C (77 ± 1.8°F) (check with AMRL thermometer)?*** _____
5. ***Immersed mass determined? (C)*** _____
6. ***Sample quickly blotted with a damp towel?*** _____
7. ***Saturated surface-dry mass determined? (B)*** _____

Method For Specimens That Contain Moisture or Solvent, or Both

1. ***Specimen immersed in bath for 3 to 5 min.?*** _____
   or ***If specimen temperature differs from the water temperature by more than 2°C (3.6°F), is specimen immersed 10 to 15 min.?*** _____
2. ***Immersion water at 25 ± 1°C (77 ± 1.8°F) (check with AMRL thermometer)?*** _____
3. ***Immersed mass determined? (C)*** _____
4. ***Sample quickly blotted with a damp towel?*** _____
5. ***Saturated surface-dry mass determined? (B)*** _____
6. ***Specimen dried in an oven at 110 ± 5°C (230 ± 9°F) oven to constant mass?*** _____
   Note: *Other means of drying (such as microwave) ok as long as specimen is not over-heated and documentation exists showing results are equivalent to oven drying.*
7. ***Specimen cooled and weighed in air? (A)*** _____

Final Calculations (both methods)

1. ***Bulk Specific Gravity calculated { A / (B – C) }?*** _____
2. ***Percent Water Absorbed calculated { ((B – A) / (B – C)) x 100 }?*** _____
3. ***Density of specimen calculated { Bulk Sp. Gr. x density of water (997.0 (kg/m^3) or 62.24 (lb/ft^3)) }?*** _____
4. ***Percent water absorbed determined to be less than 2.0 percent?*** _____
5. ***If the percent of water absorbed by the specimen exceeds 2.0 percent, D1188 used to determine the bulk specific gravity instead?*** _____

COMMENTS (D2726): (D2726)

COMPRESSIVE STRENGTH OF BITUMINOUS MIXTURES (T167) _____
(D1074) _____

APPARATUS Date: _____

Testing Machine

1. Maker: _____ Capacity: _____
2. *AASHTO: capable of controlled speeds of 2.5 to 10.2 mm/min.?* _____
   ASTM: having a range of controlled speeds covering at least 0.1 in. (2.5 mm)/min for 2-in. (50.8-mm) specimens to 0.4 in. (10.2 mm)/min for 8-in. (203.2-mm) specimens? _____
3. Upper bearing block:
   (a) Spherically seated? _____
   (b) Center of sphere coincides with bearing face? _____
   (c) Block rotates freely and can be tilted in any direction? _____
   (d) Diameter of bearing face slightly greater than diameter of largest specimen tested? _____
   (e) Bearing face plane to 0.025 mm (0.001 in.)? _____
4. Lower bearing block:
   (a) Rests on platen and is seat for specimen? _____
   (b) Diameter of bearing face greater than diameter of largest specimen tested? _____
   (c) Bearing face plane to 0.025 mm (0.001 in.)? _____

Molds and Plungers

1. Standard molds

	Note: *record diameters*	1	2	3	4	5	6	7	8
(a)	Inside diameter of molds: 101.60 – 101.73 mm (4.000 – 4.005 in.)?								
(b)	Diameter of plungers < 101.6 mm (4.000 in.)?	**Top:**				**Bottom:**			
(c)	Max. difference between I.D. of molds and dia. of plungers is 1.27 mm (0.050 in.)?								

2. Other molds are acceptable provided the diameter is at least 4 times that of the largest particle size.
   (a) Top plunger may be of various design; face at least 12.7 mm (1/2 in.) thick? _____
   (b) Bottom plunger may be of various design; face at least 12.7 mm (1/2 in.) thick? _____
   (c) Plunger 50 ± 4 mm (2 ± 1/8 in.) in height? _____
3. Mold supports capable of supporting mold cylinder 25.4 mm above bottom of bottom plunger? _____
4. ***ASTM only: 2 steel bars 1 ± 1/8 in. (25.4 ± 3.1 mm) square and at least 3 in. (76.2 mm) long?*** _____

Other Apparatus

1. *AASHTO: Oven capable of control within ± 3 ℃ (± 5 ℉)?* _____
   ASTM: Oven controlled within ± 5°F (± 3°C) of any temperature above ambient up to 392° F (200°C)? _____
2. Hot plate, equipped with a rheostat, for mixing bowl available? _____
3. **Optional:** hot water bath
   (a) Large enough to hold 3 sets of 100 mm molds with plungers? _____
   (b) Capable of being maintained at just under boiling point? _____
   (c) Heater, if electric, provided with continuously variable control? _____
4. Air bath capable of being maintained at 25.0 ± 0.5°C (77 ± 1°F) **[*ASTM: 77 ± 1.8 ℉ (25 ± 0.5 ℃)*]**? _____
5. Mixing machine for sample preparation? _____
6. Spatulas, one limber and one stiff? _____
7. Ejection device, ejection head has smooth, uniform rate of travel? _____
8. Balance *AASHTO: Class G2 balance available?* _____
   ASTM: Balances or scales and weights meeting Specification D4753, GP2? _____
9. ***ASTM only, Thermometer:***
   (a) Calibrated liquid-in-glass thermometers of suitable range with a readability of 1°F (0.5°C) and conforming to the requirements of specification E 2251? _____
   or (b) Electronic thermometer (RTD, PRT, IPRT) of equal or better accuracy? _____

COMMENTS (T167 / D1074): (T167 / D1074)

COMPRESSIVE STRENGTH OF BITUMINOUS MIXTURES (T167) _____
(D1074) _____

PROCEDURE Date: _____

Preparation of Test Mixtures

1. Initial batch mixed to "butter" mixing bowl and stirrers? ..... _____
2. Trial specimen molded to determine proper mass of batch? ..... _____
3. Bowl emptied and batch used for trial specimen discarded? ..... _____
4. Bowl and stirrers cleaned by scraping with limber spatula? ..... _____
5. Wiping with cloth or washing with solvent avoided? ..... _____
6. *AASHTO: Mixing and compacting temperatures based upon the temperature-viscosity curve for the asphalt (170 ± 20 cSt, 280 ± 30 cSt)?* ..... _____
   ASTM: Mixing temperature does not exceed 347°F (175°C)? ..... _____
7. Aggregate and mixing bowl heated no more than 28°C (50°F) above the mixing temperature? ..... _____
8. Aggregate added to bowl and dry-mixed? ..... _____
9. Bituminous material quickly weighed into aggregate? ..... _____
10. Asphalt and aggregate mixed with minimal "fanning action"? ..... _____
11. Mixing completed within 90 to 120 seconds? ..... _____
12. Temperature of mixture after mixing about 3 to 5°C (5 to 9°F) above the compacting temperature? ..... _____
13. If necessary, mix reheated using a hot plate, oven, or similar device? ..... _____

Plant mixtures

1. Sample reduced according to T248/C136 to slightly more than amount needed to fabricate specimen? ..... _____
2. Mass of reduced sample adjusted to required mass by removing and discarding a small amount of the mixture? ..... _____
3. Both fine and coarse particles discarded to maintain proper gradation? ..... _____
4. Mixture placed in appropriate container and heated in an oven to the established mixing temperature? ..... _____
5. Sample removed from oven and thoroughly mixed until temperature is about 3 to 5°C (5 to 9°F) above the compacting temperature? ..... _____
6. Material may be placed into an oven for a short time if multiple samples tested (not more than 1 hour)? ..... _____

COMMENTS (T167 / D1074): (T167 / D1074)

COMPRESSIVE STRENGTH OF BITUMINOUS MIXTURES (T167) _____
(D1074) _____

PROCEDURE (Continued) Date: _____

Molding Test Specimens

1. Top plungers, bottom plungers, molds, and spatula preheated? _____
   (a) In a water bath just under the boiling point for at least 1 hr.? _____
   or (b) In an oven maintained between 200 - 275°F (93.3 - 135°C) for at least 2 hrs? _____
2. Mold and plungers removed and wiped with a clean cloth containing a few drops of oil? _____
3. With bottom plunger in place and molding cylinder supported on steel bars:
   (a) Approximately half of mixture placed in mold? _____
   (b) Fifteen blows with spatula struck around inside of mold? _____
   (c) Ten blows with spatula struck at random over mixture? _____
   (d) Penetration of spatula as deep as possible? _____
4. Remaining mixture quickly placed in molding cylinder? _____
5. Step 3, parts (a) through (d) repeated? _____
6. Top of mixture left slightly rounded or cone shaped? _____
7. Filled mold compressed between top and bottom plungers under about 1 MPa (150 psi) [*AMRL: ~1,886 lb*]? _____
8. Support bars removed from under mold? _____
9. Molding load increased to 20.7 MPa (3000 psi) for 2 min. [*AMRL: ~37,727 lb*]? _____
   Note: *When tested in accordance with T165/D1075, molding load of 20.7 MPa (3000 psi) may be increased or decreased to achieve a target air void percentage or density percentage*
10. *AASHTO only: Alternate methods of compaction may be used, provided approximately 7 percent air voids are achieved?* _____
11. Specimen removed from mold with ejection device? _____

Test Specimens

1. Specimens 102 mm in diameter? _____
2. Specimens 101.6 ± 2.5 mm in height? _____
3. After ejection, specimens placed in oven for 24 hrs. at 60°C (140°F)? _____
4. Specimens placed in air tight containers if NOT tested in compression within 24 hrs. after oven curing? _____

Procedure

1. Specimens cooled at room temp. for at least 2 hrs. after removal from curing oven? _____
2. Bulk Specific Gravity of specimens determined by Method A or B of (T166 / D2726)? _____
3. Specimens brought to 25 ± 1°C (77 ± 1.8°F) by storing in an air bath for at least 4 hrs? _____
4. Specimens tested in axial compression without lateral support? _____
5. Rate of vertical deformation uniform at 0.05 mm/min·mm (0.05 in./min·in.) of specimen height? _____
   Note: *For 101.6 mm (4 in.) specimens, use a rate of 5.08 mm/min (0.2 in./min).*

COMMENTS (T167 / D1074): (T167 / D1074)

RECOVERY OF ASPHALT FROM SOLUTION BY ABSON METHOD (T170) _____
(D1856) _____

APPARATUS Date: _____

1. Centrifuge apparatus (either of the following): _____
   (a) Batch unit capable of 770 times gravity? _____
      (1) Wide-mouth bottles [*AASHTO only: 250 to 500 mL capacity*]? _____
      or (2) Cylindrical tubes, 6 or 8 in. long, with conical ends; capacity 100 mL? _____
   or (b) Continuous unit capable of 3000 times gravity? _____
   Note to Assessors: *RCF (gravities) = 1.118 x 10^{-5} x r (in cm) x (RPM^2)*

2. Distillation flasks (2):
   (a) Wide-mouth, flat bottom, 250 mL extraction flasks? _____
   (b) Cork with holes for delivery tube, aeration tube, funnel and/or thermometer? _____

3. Suitable flask for the receiver? _____

4. Delivery tube: 10 mm I.D., goose-neck shaped glass tube connects flask to condenser? _____

5. Inlet aeration tube: at least 180 mm long having a 10 mm bulb with 6 staggered 1.5 mm holes? _____

6. Distillation flask heater:
   (a) Electric heating mantle with variable transformer? _____
   or (b) Oil bath with means of measuring temperature of bath? _____
   or (c) Fluidized sand bath with means of measuring temperature of bath? _____

7. Water jacketed condenser with 200 mm minimum jacket length? _____

8. Thermometer: ASTM 7C or 7F? _____

9. Gas flow meter capable of indicating flow up to 1000 mL/min. (CO_2)? _____

10. Separatory funnel: 125 mL capacity or larger (required only if Abson apparatus is used for primary distillation)? _____

11. Extraction solvent:
   (a) Trichloroethylene, reagent grade? _____
   or (b) Methylene Chloride, reagent grade [*AASHTO only: in case of dispute*]? _____
   or **(c)** ***ASTM only: Normal Propyl Bromides (nPB), conforming to Specification D6368?*** _____
   or (d) *AASHTO only: Technical grade: Methylene Chloride OR Trichlor., type I, Fed. Spec. O-T-634?* _____
      (1) If technical grade solvent used, has blank been run (recommended)? _____
      (2) If so, by technique of Note 1 (70 g asphalt with known properties dissolved into 800 mL solvent then recovered by T170)? _____

12. Supply of carbon dioxide gas? _____

COMMENTS (T170 / D1856): (T170 / D1856)

RECOVERY OF ASPHALT FROM SOLUTION BY ABSON METHOD (T170) _____
(D1856) _____

PROCEDURE Date: _____

Sample Preparation:

1. Is sample a solution from an extraction of sufficient mass to provide approximately 75 to 100 g of recovered asphalt? ..... _____
2. *AASHTO only: Asphalt mixture heated in covered container until workable at 110°C (230°F) for no longer than 30 minutes?* ..... _____
3. Extraction apparatus clean and free of petroleum distillates? ..... _____
4. Was all of the asphalt in the mixture extracted? ..... _____

   Time extraction started: _____
5. Extraction method A [*AASHTO only: or E*] used? ..... _____

Testing:

1. Centrifuging:
   - (a) Solution centrifuged at 770g for 30 or more minutes? ..... _____
   - **or** (b) Centrifuged continuously at not more than 150 mL/minute at not less than 3000g? ..... _____

2. Solution concentrated to approximately 200 to 300 mL by:
   - (a) Any primary distillation that meets the following criteria:
     - (1) Has a flask large enough to hold all the solution from the extraction? ..... _____
     - (2) Solution from primary distillation transferred to Figure 1 assembly using several washes of solvent? ..... _____

   - **or** (b) Distillation started in assembly shown in Figure 1:
     - (1) Separatory funnel in place through cork? ..... _____
     - (2) Distillation made continuous by adding solution through funnel keeping flask approximately 1/2 full? ..... _____
     - (3) Solution container and funnel washed into flask with clean solvent? ..... _____

3. Bulb of aeration tube lowered to make contact with the bottom of the flask? ..... _____
4. *AASHTO: Slow introduction of CO_2 begun at the beginning of the distillation (about 100 mL/min)?* ..... _____

   ASTM: Aeration tube lowered and CO_2 introduced at 135°C (275°F)? ..... _____
5. When temperature reaches 157 to 160°C (315 - 320°F), gas rate increased to 900 mL/minute?

   Time temperature reaches 160°C (320°F): _____
6. Temperature at 160 to 166°C (320 - 330°F) and gas flow maintained at 900 mL/minute for 10 minutes (minimum) or until dripping stops? ..... _____

7. Gas flow minimum times:
   - (a) Gas flow and heat maintained for an additional 5 minutes after the last drop (CO_2 flow never less than 15 minutes)? ..... _____
   - (b) If residue in flask is highly viscous and the expected penetration is less than 30, maintain the gas flow and temperature for 20 - 22 min., including initial 15 minutes? ..... _____

8. CO_2 flow never less than 15 minutes? Time gas flow and heat cut off: _____ ..... _____
9. Ash content of recovered asphalt determined in accordance with (T111 / D2939)? ..... _____
10. Elapsed time between time extraction started and time gas flow and heat cut off 8 hrs. or less? ..... _____
11. Residue retained for further testing? ..... _____

COMMENTS (T170 / D1856): (T170 / D1856)

MAXIMUM SPECIFIC GRAVITY OF HMA (T209) _____
(RICE TEST) **(D2041)** _____

APPARATUS Date: _____

1. Container:
   (a) Vacuum bowl (used for weighing in air and water):
      (1) Either metal or plastic? ..... _____
      (2) Diameter approximately 180 to 260 mm (7 to 10.25 in.)? ..... _____
      (3) Height approximately 160 mm (6.3 in.)? ..... _____
      (4) Equipped with a transparent cover with a rubber gasket? ..... _____
      (5) Using a small sample in a large container avoided? ..... _____
      (6) *AASHTO only: Capacity between 2,000 and 10,000 mL?* ..... _____

   or (b) Vacuum flask (used for weighing in air only):
      (1) Thick-walled volumetric glass flask? ..... _____
      (2) Fitted with a rubber stopper with a connection for the vacuum line? ..... _____
      (3) Using a small in a large container avoided? ..... _____
      (4) *AASHTO: Capacity between 2,000 and 10,000 mL?* ..... _____
      ASTM: Approximately 4000 mL capacity? ..... _____

   or (c) *AASHTO only: Pycnometer (for weighing in air only):*
      (1) Glass, metal, or plastic pycnometer? ..... _____
      (2) Using a small in a large container avoided? ..... _____
      (3) Capacity between 2,000 and 10,000 mL? ..... _____

2. Hose opening covered with a small piece of wire mesh? ..... _____

3. Balance:
   (a) Class G2 / GP2 [***ASTM only: readable to nearest 0.1 g***]? ..... _____
   (b) For Weighing in Water: Balance equipped with a suitable suspension apparatus and holder to permit weighing the sample while suspended in water? ..... _____
   (c) *AASHTO only: Wire suspending the holder should be the smallest practical size?* ..... _____

4. Vacuum pump or water aspirator? ..... _____
   (a) Capable of evacuating air from the container to a residual pressure of 4.0 kPa (30 mm Hg) or less (preferably to zero)? ..... _____
   Note: *A pressure of 4.0 kPa (30 mm Hg) absolute approx. = 97 kPa (730 mm Hg) relative at sea level.*
   (b) When a vacuum pump is used, a suitable trap [*AASHTO only: one or more 1000 mL filter flasks, or equivalent*], is installed between the vacuum source and the vacuum vessel? ..... _____

5. Vacuum Measurement Device? (Reads in mm of Mercury) ..... _____
   (a) Connected at the end of the vacuum line using an appropriate tube and either a "T" connector on top of the vacuum vessel or by using a separate opening in the top of the vessel? ..... _____
   Note: *The manometer is not to be situated on top of the vessel but adjacent to it, to avoid damage.*
   (b) *AASHTO: Pressure gauge standardized every 12 months to be accurate to 0.1 kPa (1 mm Hg) (see R18)?* ..... _____
   ASTM: A calibrated absolute pressure gauge may be used instead of a manometer? ..... _____

   Note to assessor: *a mercury manometer does not need to be standardized. It is the standard.*

6. ***ASTM only: Manometer or vacuum gauge, connected either directly to the vacuum source or in vacuum line close to the source?*** ..... _____

COMMENTS (T209 / D2041): (T209 / D2041)

MAXIMUM SPECIFIC GRAVITY OF HMA (T209) _____
(RICE TEST) **(D2041)** _____

APPARATUS (Continued) Date: _____

7. Mechanical Agitation Device [*AASHTO only: Method A only*]
   (a) Capable of applying a gentle but consistent agitation of the sample? ..... _____
   (b) Equipped with means of anchoring the sample container so that it does not move on the surface of the device? ..... _____

8. Thermometric Device:
   (a) Calibrated liquid-glass thermometer, with subdivisions and maximum scale error 0.5°C (1°F)? ..... _____
   or (b) Any other thermometric device of equal accuracy, precision, and sensitivity? ..... _____

9. Water Bath, maintains a constant temperature between 20 and 30°C **[*ASTM only: 25 ± 1 °C (77 ± 1.8 °F)*]**? .... _____

10. Bleeder Valve, attached to the vacuum train? ..... _____

11. Drying Oven, *AASHTO only: maintaining 135 ± 5 °C (275 ± 9 °F) or 105 ± 5 °C (221 ± 9 °F)?* ..... _____
    ASTM only: capable of maintaining a temperature of 110 ± 5 °C (230 ± 9 °F)? ..... _____

12. Apparatus for Supplemental Procedure for Mixtures Containing Porous Aggregate Not Completely Coated
Note to Assessors: *Typically laboratories should not be demonstrating this supplemental procedure. It is included for reference.*
   (a) Electric fan? ..... _____
   (b) Towel **[*ASTM: 75µm (No. 200) sieve*]** for decanting water from aggregate? ..... _____

Standardization **[*ASTM: Calibration*]** of Container:
1. *AASHTO only: Water used to fill the container at a temperature between 20 and 30 °C?* ..... _____
2. *AASHTO only: If mass not determined at 25 ± 0.5 °C (77.0 ± 0.9 °F) then procedure repeated over range of water temperatures likely to be encountered and standardization curve plotted?* (*D*) ..... _____
3. *AASHTO only: Care taken to follow the same procedure in standardization as in conducting the test?* ..... _____
4. ***ASTM: Water used to fill or immerse the container at 25 ± 1 °C (77.0 ± 1.8 °F)?*** ..... _____

5. One of the following:

Weighing-in-water determination (bowl):
   (a) Bowl filled with water **[*ASTM: immersed in water*]** and mass-in-water determined? (*B*) ..... _____

Weighing-in-air determination (bowl):
   (a) Bowl filled with water **[*ASTM: immersed in water*]**? ..... _____
   (b) ***ASTM only: Lid placed on the bowl while submerged?*** ..... _____
   (c) Outside of bowl dried and mass-in-air determined? (*B*) ..... _____
   (d) ***ASTM only: Procedure repeated three times and results averaged?*** (*D*) ..... _____

Weighing-in-air determination (flask):
   (a) Flask filled with water? ..... _____
   (b) Glass cover plate or similar smooth, flat, transparent plate used to accurately fill the flask? ..... _____
   (c) Mass of flask in air determined? (*D*) ..... _____

COMMENTS (T209 / D2041): (T209 / D2041)

MAXIMUM SPECIFIC GRAVITY OF HMA (T209) _____
(RICE TEST) **(D2041)** _____

PROCEDURE Date: _____

Sample Preparation:

1. Sample obtained by splitting or quartering? ..... _____
2. Sample mass conforms to following tables (**Note to Assessors:** *Please mark which sample size was used.)*? ..... _____
   AASHTO: Mass of sample as follows (samples larger than the capacity of the container may be divided into suitable increments, tested, and the results averaged):
   ASTM: Mass of sample as follows (samples larger than about two thirds the capacity of the container shall be divided into portions that are not less than 1250 g and the results averaged):

Nominal Maximum Aggregate	*AASHTO: Min. Sample Size*	***ASTM: Min. Sample Size***
37.5 mm or greater (≥ 1.5 in.)	*4000 g* _____	***5000 g*** _____
19 mm – 25 mm (3/4 to 1 in.)	*2500 g* _____	***2500 g*** _____
12.5 mm or smaller (≤ 1/2 in.)	*1500 g* _____	***1500 g*** _____

3. *AASHTO only: Laboratory prepared samples conditioned and dried to constant mass (within 0.1%) in an oven at 135 ± 5°C for a minimum of 2 hours, or as appropriate to match the mix design?* ..... _____
   or *AASHTO only: Field samples dried to constant mass in oven at 105 ± 5°C (221 ± 9°F)?* ..... _____
   ASTM: Field samples dried to constant mass 105 ± 5°C (221 ± 9°F)? ..... _____
4. Particles of sample separated while warm by hand, using care not to fracture mineral fragments? ..... _____
5. After separation, fine aggregate particles not larger than 6.3 mm (1/4 in.) [***ASTM: 6 mm***]? ..... _____
6. Sample cooled to room temperature? ..... _____

Testing:

1. Placed in tared flask or bowl weighed and net mass of sample determined? (*A*) ..... _____
2. Water at approx. 25°C (77°F) added to cover sample? ..... _____
3. Vacuum increased until manometer reads 27.5 ± 2.5 mm Hg (3.7 ± 0.3 kPa)? ..... _____
4. ***ASTM only: Vacuum achieved within 2 minutes of turning the vacuum system on?*** ..... _____
5. Container and contents agitated continuously by mechanical device [*AASHTO: Method A*]? ..... _____
   or *AASHTO only, Method B: Container and contents agitated during the vacuum period by vigorously shaking at intervals of about 2 min.?* ..... _____
6. Vacuum and agitation continued for 15 ± 2 min after vacuum is achieved? ..... _____
7. Vacuum released slowly [*AASHTO only: at a rate not to exceed 8 kPa per second*]? ..... _____

COMMENTS (T209 / D2041): (T209 / D2041)

MAXIMUM SPECIFIC GRAVITY OF HMA (T209) _____
(RICE TEST) **(D2041)** _____

PROCEDURE (Continued) Date: _____

Note to Assessors: *The laboratory should demonstrate one of the following methods of determining maximum specific gravity.*

AASHTO/ASTM Weighing-in-water determination:

1. Bowl (without lid) and contents suspended in water? ..... _____
2. Net mass of contents in water determined after 10 ± 1 min immersion? (*C*) ..... _____
3. *AASHTO: If temperature is not 25 ±1°C (77.0 ± 1.8°F), mass corrected to 25°C (77°F)?* ..... _____
   ASTM: Temperature of the water in bath 25 ± 1°C (77.0 ± 1.8°F) (temperature recorded)? ..... _____
4. Theoretical maximum specific gravity calculated {*A* / (*A* – (*C* - *B*)}? ..... _____

AASHTO only: Weighing-in-air determination (any):

1. *Flask, pycnometer, or bowl filled with water?* ..... _____
2. *Contents adjusted to 25 ± 1°C (77.0 ± 1.8°F)?* ..... _____
3. *Mass of filled container determined 10 ± 1 min. after removal of entrapped air completed? (E)* ..... _____
4. *Theoretical maximum specific gravity calculated {A / (A + D – E)}?* ..... _____

ASTM only: Weighing-in-air determination (bowl):

1. ***Bowl and sample slowly submerged in the 25 ± 1°C (77.0 ± 1.8°F) bath for 10 ± 1 min?*** ..... _____
2. ***Lid also placed in water bath at the same time as the bowl?*** ..... _____
3. ***Lid placed on bowl without being removed from the water so as to avoid entrapping any air?*** ..... _____
4. ***Lid pressed firmly down on the bowl?*** ..... _____
5. ***Bowl with lid in place removed from the bath and the bowl and lid carefully dried off?*** ..... _____
6. ***Mass of the bowl, lid and sample determined? (E)*** ..... _____
7. ***Temperature of the water in bowl measured and recorded?*** ..... _____
8. ***Procedure repeated a second time (no need to wait 10 more minutes)?*** ..... _____
9. ***If mass varies by more than 1.0 g, procedure repeated until two masses are within 1.0 g?*** ..... _____
10. ***Theoretical maximum specific gravity calculated {A / (A + D – E)}?*** ..... _____

ASTM only: Weighing-in-air determination (flask):

1. ***Flask slowly filled with water taking care not to introduce air into the sample?*** ..... _____
2. ***Flask and contents placed in water bath for 10 ± 1 min?*** ..... _____
3. ***Top of flask should not be submerged?*** ..... _____
4. ***Temperature of the water in flask 25 ± 1°C (77.0 ± 1.8°F) (temperature recorded)?*** ..... _____
5. ***Flask completely filled with water using a cover plate?*** ..... _____
6. ***Care taken not to entrap air beneath cover plate?*** ..... _____
7. ***Moisture wiped from the exterior of the flask and cover plate?*** ..... _____
8. ***Mass of the flask, cover plate, and contents determined? (E)*** ..... _____
9. ***Theoretical maximum specific gravity calculated {A / (A + D – E)}?*** ..... _____

Supplemental Procedure for Mixtures Containing **Porous Aggregate**

Note: This procedure is only performed if the aggregates are not thoroughly sealed.

Note to Assessors: *Typically laboratories should not be demonstrating this supplemental procedure. It is included for reference.*

1. Water decanted from the container through towel **[*ASTM: through a 75µm (No. 200) sieve*]**? ..... _____
2. Several large pieces of aggregate broken to examine for wetness? ..... _____
3. If the aggregate has absorbed water, sample spread **[*ASTM only: on a flat tray*]** in front of a fan to remove surface moisture and stirred periodically? ..... _____
4. Sample weighed at 15 minute intervals until constant mass (less than 0.05%) is reached? ..... _____
5. Final surface dry mass substituted into the equation for the mass of the dry sample in air? ..... _____

COMMENTS (T209 / D2041): (T209 / D2041)

MARSHALL APPARATUS FOR HMA RESISTANCE TO PLASTIC FLOW (T245) _____
(D6926 / D6927) _____

APPARATUS Date: _____

1. Specimen Mold Assemblies:

	1	2	3	4	5	6	7	8	9
Inside diameter of mold: 3.995 – 4.005 in.?									
Collar and base plate fit mold?									

Does lab have at least three usable molds (recommended)? ..... _____

2. Specimen Extractor
   (a) Diameter of disk not less than 100 mm (3.95 in.)? ..... _____
   (b) Thickness at least 12.5 mm (1/2 in.)? ..... _____

3. Compaction Hammer
   (a) Maker: _____ Serial No. (or I.D. No.)_____

   (b) Manual hammers **[*ASTM: Manual hammer and mechanical hammer w/ non-rotating base pedestal*]:**
      (1) Tamping face: flat, not slanted, 3 7/8 in. (98.4 mm) **[*ASTM: 98.0 – 100.0 mm*]** in diameter?. _____
      (2) Sliding mass: 4527 to 4545 g (9.98 to 10.02 lb)? ..... _____
      Note to Assessors: *Check records for hammers that are difficult to assemble.*
      (3) Drop: 455.7 to 458.7 mm (17.94 to 18.06 in.)? ..... _____
      (4) AASHTO Mechanical compactor: calibrated to give results comparable with a manually-operated compactor (check records)? ..... _____

   (c) Mechanical hammer for use with rotating base pedestal [ASTM only]:
      (1) Sliding mass: 4.54 ± 0.01 kg (10.00 ± 0.02 lb)? ..... _____
      Note to Assessors: Check records for hammers that are difficult to assemble.
      (2) Drop: 457.2 ± 1.5 mm (18.00 ± 0.06 in.)? ..... _____
      (3) Hammer face: circular, slanted, & 99.36 ± 0.97 mm diameter? ..... _____
      (4) Face 14.44 ± 1.79 mm thick at thicker end? ..... _____
      (5) Face 12.7 ± 1.8 mm (0.5 ± 0.07 in.) thick at thinner end? ..... _____
      (6) Hammer blow rate: 64 ± 4 / minute? ..... _____

4. Compaction Pedestal:

   (a) Manual compaction pedestal **[*ASTM: non-rotating base*]**:
      (1) Wooden post: 203.3 x 203.2 x 457.2 mm (8 x 8 x 18 in.)? ..... _____
         1. Post plumb? ..... _____
         2. Attached to solid concrete slab by four angle brackets? ..... _____
         3. ***ASTM only: Average dry density of 670 – 770 kg/m^3 (42 to 48 lb/ft^2) [oak, yellow pine, etc.]?*** ..... _____
      (2) Steel cap, at least 304.8 x 304.8 x 25.4 cm (12 x 12 x 1 in.)? ..... _____
         1. Steel cap level? ..... _____
         2. Firmly attached to wooden post? ..... _____
      (3) Specimen holder mounted on pedestal and holds base plate, mold, and collar securely? ..... _____
         1. Centers specimen mold over center of post? ..... _____

COMMENTS (T245 / D6926 & D6927): (T245 / D6926 & D6927)

MARSHALL APPARATUS FOR HMA RESISTANCE TO PLASTIC FLOW (T245) _____
(D6926 / D6927) _____

APPARATUS (Continued) Date: _____

(a) Compaction pedestal (rotating base) [ASTM only]:
- ***(1) Wooden post plumb (vertical with respect to floor?)*** _____
  - ***1. Attached to solid concrete slab by four angle brackets*** _____
  - ***2. Average dry density of dry density of 670 – 770 kg/m^3 (42 to 48 lb/ft^2) [oak, yellow pine, etc.]?*** _____
- ***(2) Steel cap level and firmly attached to wooden post?*** _____
- ***(3) Mold holder mounted on pedestal and holds base plate, mold & collar securely?*** _____
- ***(4) Base rotation rate is 18 – 30 rpm?*** _____

5. Breaking Head
   - (a) Inside radius curvature in each segment is 2 in.? _____
   - (b) Ends of curvature lie in chordal plane 5/8 in. from center of curvature? _____
   - (c) 1/4 x 1/4 in. bevels on inside corners of each segment?
     Note to Assessors: *The clear plastic template should fit inside the breaking head. The ends of the breaking head should lie inside the two lines.*
   - (d) Two guide posts perpendicular to base with minimum diameter of 12.5 mm? _____
   - (e) Guide sleeves exhibit no appreciable play or friction? _____

6. Loading Device
   - (a) Maker: _____ Serial No. (or I.D. No.)_____
   - (b) Produces uniform movement of 50 ± 5 mm/min (2.00 ± 0.15 in./min)? _____
   - (c) Load measuring device:
     - (1) Capacity: 22.2 kN (5000 lbf) [***ASTM: 20 kN (5000 lb)***]*?* _____
     - (2) Sensitivity: 44.5 N up to 4.45 kN (10 lbf up to 1000 lbf) [***ASTM: minimum 50 N (10 lb)***]? _____
     - (3) If proving ring: micrometer dial graduated to 0.0025 mm (0.0001 in.) or finer? _____
     - (4) ***ASTM only: Calibrated?*** _____

7. Flow Measuring Devices:
   - (a) Guide sleeve and gauge (deformation indicator) graduated to 0.25 mm (0.01 in.) and operates with minimal friction? _____
   - *or* (b) Micrometer dial graduated in increments of 0.25 mm (0.01 in.) or finer? _____
   - *or* (c) Stress-strain recorder (LVDT) capable of indicating flow to 0.25 mm. (0.01 in.)? _____

8. Ovens and/or Hot Plates presented (for heating aggregate, asphalt, molds, hammers, etc.)? _____
   - (a) Thermostatically controlled to ± 2.8°C (±5°F) [*AASHTO only: recommended*]*?* _____
   - (b) If a hot plate, is it provided with a suitable shield, baffle, or sand bath to minimize local overheating? _____

9. Water Bath
   - (a) Depth at least 152.4 mm (6 in.)? _____
   - (b) Has perforated false bottom or a shelf at least 50.8 mm (2 in.) above bottom of bath? _____
   - (c) Bath thermostatically controlled to 60 ± 1°C (140 ± 2°F)? _____
     ASTM note, cutbacks: *Use an air bath that is thermostatically controlled to 25 ± 1°C (77± 2°F).*

10. Mixing Apparaturs
    - (a) Spoon, bowl, or pan for hand mixing or a mechanical mixer [*AASHTO: recommended*] which can be maintained at the required mixing temperature and produce a homogenous mixture? _____
    - (b) Hot plate, infrared lamp, or any other device for maintaining mixing temperature? _____

COMMENTS (T245 / D6926 & D6927): (T245 / D6926 & D6927)

MARSHALL APPARATUS FOR HMA RESISTANCE TO PLASTIC FLOW (T245) _____
(D6926 / D6927) _____

APPARATUS (Continued) Date: _____

11. Thermometers
(a) Thermometers for aggregates, bitumen, and mixes presented?..... _____
Note: Armored-glass, dial type, or digital thermometers with metal stems are recommended.
(1) Range: 9.9 to 204°C (50 to 400°F) [***ASTM: 50 to 400°F (10 to 200°C)***]?..... _____
(2) Sensitivity of 2.8°C (5°F) [***ASTM: 3°C (5°F)***]?..... _____
(3) ***ASTM only: Thermometers calibrated? SN:_____ ..... ★_____***
(b) Thermometer for water bath **[*ASTM only; standardized*]** (if not standardized also note under R18)? .. _____
(1) Readable to 0.2°C (0.4°F)?..... _____
(c) ASTM only: Temperature measuring device, readable to 2°F (1°C), for checking mixing and compaction temperatures?..... ★_____

12. Balances
(a) 2 kg capacity, sensitive to 0.1 g, for weighing molded specimens? ..... _____
(b) 5 kg capacity, sensitive to 1 g, for batching mixtures?..... _____

13. Temperature-Viscosity Curve
(a) Mixing and compaction temperatures based upon the temperature-viscosity curve for the asphalt used, AC or PG binder: 170 ± 20 cSt for mixing and 280 ± 30 cSt for compacting? ..... _____
Note, for cutbacks: 170 ± 20 cSt for mixing and 280 ± 30 cSt (tested with 50% solvent) for compacting.

Mixing temperature range: _____ to _____ Compaction temperature range _____ to _____

COMMENTS (T245 / D6926 & D6927): (T245 / D6926 & D6927)

MARSHALL APPARATUS FOR HMA RESISTANCE TO PLASTIC FLOW (T245) _____
(D6926) _____

PROCEDURE Date: _____

Preparation of Mixture

1. *AASHTO only: Initial batch prepared for "buttering" the mixing bowl and stirrers and bowl and stirrers cleaned by scraping, not wiped with cloth or solvent?*..... _____
2. *AASHTO only: At least 3 specimens prepared for each combination of aggregates and bitumen content?*..... _____
3. Amount of each aggregate size fraction required for each specimen weighed into a pan and thoroughly mixed? _____
4. Pan containing aggregate placed on a hot plate or in an oven and heated to a temperature not exceeding the mixing temperature by more than approx. 28°C (50°F)? ..... _____
   Note, cutbacks: *no more than 14°C (25°F).*
5. *AASHTO only: Aggregate dried to constant mass?*..... _____
6. Hot aggregate placed in bowl, mixed with spoon for approx. 5 seconds & crater formed? ..... _____
7. Required amount of preheated bituminous material added to aggregate? ..... _____
   Note, cutbacks: *weigh the bowl, mixing blade, aggregate, and asphalt to be mixed.*
8. Temperature of the aggregate and bituminous material still within the established mixing temperature limits? .. _____
9. Aggregate and bituminous material rapidly mixed until thoroughly coated?..... _____
10. If hot plate used during mixing, wire mesh (or similar material) used to prevent direct contact between hot plate and mixing bowl (to avoid localized overheating)?..... _____
    Note, cutbacks: *cure the mix in a ventilated oven maintained at 11.1°C (20°F) above compaction temperature until the precalculated mass of 50% solvent loss is obtained. Weigh at 15-minute intervals at first, and then at intervals of less than 10 minutes when the desired mass is being approached.*

Conditioning of Mixture [ASTM only]

Single batched samples:

1. ***Samples transferred to covered metal containers and placed into an oven maintained at 8 to 11°C above the established compaction temperature for 1 – 2 hours?*****.....** _____

Multiple batched samples:

1. ***Entire batch placed on clean non-absorptive surface, mixed by hand to ensure uniformity and quartered into appropriate sample size to yield a height of 63.5 ± 2.5 mm (2.5 ± 0.1 in.)?*****.....** _____
2. ***Samples transferred to covered metal containers and placed into an oven maintained at 8 to 11°C above the established compaction temperature for 1 – 2 hours?*****.....** _____
   Note, cutbacks: *Cure in mixing bowl in a ventilated oven maintained at 11°C (20°F) above compaction temperature until the precalculated mass of 50% solvent loss is obtained. Masses should be obtained in 15-minute intervals at first, and then at intervals of less than 10 minutes when the desired mass is being approached.*

COMMENTS (T245 / D6926 & D6927): (T245 / D6926 & D6927)

MARSHALL APPARATUS FOR HMA RESISTANCE TO PLASTIC FLOW (T245) _____
(D6926) _____

PROCEDURE (Continued) Date: _____

Compaction of Specimens

1. Specimen mold assembly and face of the compaction hammer clean? ..... _____
2. Mold assembly and hammer heated in boiling water, on a hot plate, or in an oven at 93.3 to 148.9°C (200 to 300°F)? ..... _____
3. Filter paper or paper toweling placed in bottom of mold? ..... _____
4. Entire batch of mixture placed in mold? ..... _____
5. Mixture spaded vigorously with heated spatula or trowel? ..... _____
   (a) Spaded 15 times around perimeter? ..... _____
   (b) Spaded 10 times over the interior? ..... _____
6. *AASHTO only: Surface of mixture smoothed to slightly rounded shape?* ..... _____
7. Temp. of the mixture immediately prior to compaction within the limits of established compacting temp.? ..... _____
8. Filter paper placed on mixture and mold assembly placed in mold holder on compaction pedestal? ..... _____
9. 50 to 75 blows applied unless otherwise specified, with hammer held perpendicular to base of mold? ..... _____
10. ***ASTM only: No mechanical device used to restrict the handle of the manual hammer in vertical position?...*** _____
11. Mold and contents reversed? ..... _____
12. Same number of blows applied to reversed specimen? ..... _____

AASHTO only, Removal from Mold

1. *Sample extractor placed on end of specimen?* ..... _____
2. *Assembly, with collar up, placed in testing machine?* ..... _____
3. *Pressure applied to collar via load transfer bar?* ..... _____
4. *Specimen forced into collar or otherwise extruded up into collar (no free-fall of specimen)?* ..... _____
5. *Collar lifted from specimen and specimen transferred to smooth, flat surface?* ..... _____
6. *Allowed to stand overnight at room temperature?* ..... _____
7. *Specimen mass determined and recorded?* ..... _____
8. *Specimen measured, height is 63.5 ± 1.27 mm (2.5 ± 0.05 in.)?* ..... _____

ASTM only, Removal from Mold

1. ***Specimen allowed sufficient time to cool prior to extruding from mold?*** ..... _____
   Note to assessors: *Cooling specimens in mold may be facilitated by immersing in cold water. To facilitate extraction and reduce specimen distortion, specimens in mold may be briefly immersed in a hot water bath prior to extruding.*
2. ***Specimen extruded using any suitable device provided the specimen is not distorted during the process?*** ..... _____
3. ***Specimen transferred to smooth, flat surface and allowed to cool (preferably overnight)?*** ..... _____

COMMENTS (T245 / D6926 & D6927): (T245 / D6926 & D6927)

MARSHALL APPARATUS FOR HMA RESISTANCE TO PLASTIC FLOW (T245) _____
(D6927) _____

PROCEDURE (Continued) Date: _____

Testing of specimens:

1. ***ASTM only: Minimum of three replicate specimens tested?*** ..... _____
2. ***ASTM only: Bulk specific gravity of each specimen determined by D2726, D1188, or D6752?*** ..... _____
3. ***ASTM only: Specimen thickness measured according to D3549 (four measurements around perimeter)?*** ..... _____
4. Specimens brought to test temperature by immersing in water bath for 30 to 40 minutes or by placing in an oven for 2 hours? ..... _____
5. Bath or oven maintained at 60 ± 1°C (140.0 ± 1.8°F) for asphalt? ..... _____
   Note, cutbacks: *Specimens placed in air bath maintained at 25 ± 1°C (77.0 ± 2°F) for 2 hours.*
6. Guide rods and inside surfaces of breaking head cleaned? ..... _____
7. Guide rods lubricated? ..... _____
8. Temperature of breaking head maintained at 21.1 to 37.8°C (70 to 100°F)? ..... _____
9. Specimen removed from bath or oven and placed in lower segment of breaking head? ..... _____
10. ***ASTM only: Excess water removed with a towel?*** ..... _____
11. Breaking head and specimen positioned on testing machine? ..... _____
12. Flow meter (if used) placed over guide rod and adjusted to zero? ..... _____
13. Load applied to specimen until maximum load is reached? ..... _____
14. Maximum load applied within 30 seconds after removal of specimen from bath or oven? ..... _____
15. Maximum load and flow value recorded the instant the load begins to decrease? ..... _____
16. Load correction:
    (a) For core specimens: load corrected when thickness of specimen is not 63.5 mm (2 1/2 in.) by multiplying by factor from table 1? ..... _____
    (b) For lab-molded specimens: shall conform to thickness requirement of 63.5 mm (2 1/2 in.) by multiplying by factor from table 1? ..... _____

COMMENTS (T245 / D6926 & D6927): (T245 / D6926 & D6927)

HVEEM APPARATUS FOR RESISTANCE TO DEFORMATION AND COHESION OF BITUMINOUS MIXTURES (T246) _____ **(D1560)** _____

APPARATUS Date: _____

1. Specimen Preparation Apparatus
   (a) *AASHTO: California Kneading Compactor (from T247) available?* ..... _____
   ASTM: Any compaction device is acceptable. ..... _____
   or (b) Other kneading compactor that will show stabilometer values equivalent to those obtained from the California kneading compactor (the supplier is responsible for furnishing those substantiating data)? . _____
   Note: *other compactors that show a similar calibration curve to a California Kneading Compactor are acceptable.*

2. Resistance to Deformation Test Apparatus
   (a) Stabilometer in working condition? ..... _____
   (b) Rubber bulb for removing or adding air into stabilometer (during adjustment of stabilometer)? ..... _____
   (c) Compression testing machine: minimum capacity of 44.5 kN (10,000 lbf)? ..... _____
   Capable of speed of 1.3 mm/min (0.05 in/min)? ..... _____
   (d) Push-out device? ..... _____
   (e) Oven capable of being maintained at 60 ± 3°C (140 ± 5°F)? ..... _____
   (f) Calibration cylinder, hollow metal cylinder:
      (1) Height: 140 mm (5 1/2 in.) **[*ASTM: 140 ± 6.4 mm (5.5 ± 0.25 in.)*] [AMRL: 5 to 8 in.]**? ..... _____
      (2) Outside diameter: 101.47 to 101.73 mm (3.995 to 4.005 in.)? ..... _____
   (g) Solid-wall metal follower?
      (1) Height: 133.35 to 146.05 mm (5.25 to 5.75 in.) **[AMRL: 5 to 8 in.]**? ..... _____
      (2) Diameter: 101.092 to 101.346 mm (3.980 to 3.990 in.)? ..... _____

3. Cohesion Test Apparatus (*cohesion portion of the test not needed for "stability only" accreditation*)
   (a) Cohesiometer? ..... _____
   (b) 2000 g of steel shot passing 2.00-mm (No. 10) sieve and retained on 1.40-mm (No. 14) sieve? ..... _____
   (c) Steel shot flows 1800 ± 20 g/min.? ..... _____
   Note: *Other materials may be used provided rate of loading is equivalent to that obtained when using steel shot.*
   (d) Oven maintained at 60 ± 1°C (140 ± 2°F) **[*ASTM: 60 ± 3°C (140 ± 5°F)*]**? ..... _____
   (e) Balance: 5 kg capacity, sensitive to 1 g **[*ASTM: 10 kg capacity, sensitive to 1 g?*]**? ..... _____

COMMENTS (T246 / D1560): (T246 / D1560)

HVEEM APPARATUS FOR RESISTANCE TO DEFORMATION AND COHESION OF BITUMINOUS MIXTURES (T246) _____ **(D1560)** _____

PROCEDURE Date: _____

Adjustment of Stabilometer

1. Base adjusted so that distance from bottom of upper tapered ring to top of base is 89 mm (3.5 in.)? ..... _____
2. Calibration cylinder inserted into stabilometer? ..... _____
3. ***ASTM only: Cylinder preheated to 60°C (140°F)?*** ..... _____
4. A horizontal pressure of 34.5 kPa (5 psi) applied? ..... _____
5. ***ASTM only: Horizontal pressure of 34.5kPa (5 psi) applied while cylinder is held in place with either the hand or a vertical load of 0.45 kN (100 lbf) in the testing machine?*** ..... _____
6. Turns indicator dial adjusted to zero? ..... _____
7. Pump handle turned until the stabilometer dial reads 689 kPa (100 psi)? ..... _____
8. Pump handle turned at approx. two turns per second? ..... _____
9. Turns indicator dial reads 1.95 to 2.05 turns? ..... _____
10. If not, is the air in the cell adjusted and procedure repeated? ..... _____
11. Horizontal pressure released and calibration cylinder removed? ..... _____

Resistance to Deformation

1. Test specimens are 102 mm (4 in.) in diameter and 64±3 mm (2.5±0.1 in.) high? ..... _____
   Note: *If specimens are not correct height or diameter the stabilometer value shall be corrected.*
2. Test specimens mixed and compacted in accordance with (T247 / D1561)? ..... _____
3. Specimen brought to 60 ± 3°C (140 ± 5°F) **[*ASTM: in an oven for 3 to 4 hours*]**? ..... _____
   Note: *Bring specimen to room temperature when desired to test with whatever moisture is present.*
4. Specimen transferred from mold to stabilometer by means of the push-out device? ..... _____
5. Tamped end of specimen is up? ..... _____
6. Follower placed on top of specimen? ..... _____
7. Horizontal pressure of 34.5 kPa (5 psi) applied? ..... _____
8. Vertical movement of press begun? ..... _____
9. Speed of 1.3 mm/min (0.05 in./min)? ..... _____
10. If locking shims used on spherical head of loading device, shims removed prior to stabilometer test? ..... _____
11. Stabilometer gauge readings recorded at vertical loads of:
    AASHTO: 2.23, 4.45, 8.90, 13.4, 17.8, 22.3, and 26.7 kN (500, 1000, 2000, 3000, 4000, 5000, and 6000 lbf)?. _____
    ASTM: 13.4, 22.3, and 26.7 kN (3000, 5000, and 6000 lbf)? ..... _____
12. Vertical movement of press stopped at 26.7 kN (6000 lbf) load? ..... _____
13. Vertical load immediately reduced to 4.45 kN (1000 lbf) **[*ASTM: 4 to 4.9 kN (900 to 1100 lbf)*]**? ..... _____
14. Horizontal pressure adjusted to 34.5 kPa (5 psi)? ..... _____
    Note: *this will result in a further reduction of the vertical load and is normal.*
15. Pump handle turned until the stabilometer dial reads 689 kPa (100 psi)? ..... _____
16. Pump handle turned at approx. two turns per second? ..... _____
17. Number of turns recorded as the displacement reading? (D) ..... _____
18. Stabilometer value calculated correctly? ..... _____
19. If height of specimen is not 64 ± 3 mm (2.5 ±0.1 in.), is stabilometer value corrected according chart? ..... _____

$$S = \frac{22.2}{P_h * D / (P_v - P_h) + 0.222}$$

Where:
S = stabilometer value
P_h = horizontal pressure (kPa)
P_v = vertical pressure (kPa)
D = displacement

COMMENTS (T246 / D1560): (T246 / D1560)

HVEEM APPARATUS FOR RESISTANCE TO DEFORMATION AND COHESION OF BITUMINOUS MIXTURES (T246) _____ **(D1560)** _____

PROCEDURE (Continued) Date: _____

Cohesion (if demonstrated) [*AASHTO only: Cohesion testing is optional and not required to determine Stability*]

1. Specimen in oven at 60 ± 1°C (140 ± 2°F) for minimum of 2 hours? ..... _____
2. ***ASTM only: Specimen heated in oven at 60 ± 3°C (140 ± 5°F) for 3 to 4 hours?*** ..... _____
3. Cohesiometer preheated to 60 ± 1°C (140 ± 2°F) **[*ASTM: 60 ± 3°C (140 ± 5°F)*]**? ..... _____
4. Specimen clamped in cohesiometer **[*ASTM: with tamped end up*]**? ..... _____
5. Temperature allowed to recover before testing? ..... _____
6. Shot allowed to flow into receiver at 1800 ± 20 g/min? ..... _____
7. Flow stopped at break or at 13 mm (1/2 in.) deflection? ..... _____
8. Mass of shot used recorded? ..... _____
9. Cohesiometer value calculated from formula in (T246 / D1560)? ..... _____

$$C = \frac{L}{W * (0.20H + 0.044H^2)}$$

Where:
C = cohesiometer value
L = mass of shot
W = diameter, cm (or in.)
or width, cm (or in.)
D = height, cm (or in.)

COMMENTS (T246 / D1560): (T246 / D1560)

Note to Assessors: At all (except ~5) labs across the country you must write the "Cohesion not demonstrated" note. This is never a Nonconformity – it is always an ASTM only Observation.

CALIFORNIA KNEEDING COMPACTOR FOR PREPARATION AND TESTING OF HMA SPECIMENS (T247) _____ **(D1561)** _____

APPARATUS Date: _____

1. Kneading Compactor
   (a) California kneading compactor? ..... _____
   or (b) Other kneading compactor with calibration curve similar to California kneading compactor? ..... _____

   Maker: _____ Serial No. (or I.D. No.)? _____

2. Accessories
   (a) Feeder trough? ..... _____
   (b) Paddle to fit cross section of trough? ..... _____
   (c) Funnel? ..... _____
   (d) Mold holder? ..... _____
   (e) Steel shim approximately 6.4 x 19 x 64 mm [*ASTM: 6.4 x 19.1 x 63.5 mm*]
   [AMRL: piece of steel of any convenient shape, ¼ in. thick (6.4 mm thick)]? ..... _____
   (f) Round-nose steel rod, 9.5 mm (3/8 in.) in diameter by 406 mm (16 in.) long? ..... _____
   (g) Heavy paper disks, 102 mm **[*ASTM: 101.6 mm*]** diameter? ..... _____

3. Molds

	1	2	3	4	5	6	7	8	9
Inside dia.: 101.47 – 101.73 mm (3.995 – 4.005 in.)?									
Height approx. 127 mm (5 in.)?									

   Does the laboratory have three usable molds (recommended)? ..... _____

4. Apparatus for Application of Static "Leveling Off" Load
   (a) Compression testing machine: minimum capacity 222 kN (50,000 lbf)? ..... _____
   (b) Two metal followers:
      (1) Height: 140 mm (5 1/2 in.) **[*ASTM: 139.7 mm*]** [AMRL: min. 5 in., no max.] high? ..... _____
      Outside diameter: 101.09 to 101.31 mm (3.980 to 3.990 in.) **[*ASTM: 101.2 mm*]**? ..... _____
      (2) Height: 38.1 mm (1 1/2 in.)? ..... _____
      Outside diameter: 101.09 to 101.31 mm (3.980 to 3.990 in.) **[*ASTM: 101.2 mm*]**? ..... _____

5. Miscellaneous
   (a) Thermometers (preferably armored or dial type)? ..... _____
   (b) Trowels, spatulas, and scoops? ..... _____
   (c) Metal pans? ..... _____
   (d) Balance, 5 kg capacity, sensitive to 1 g? ..... _____
   (e) *AASHTO: Ovens, capable of maintaining 60 ± 3°C (140 ± 5°F) and 110 ± 3°C (230 ± 5°F)?* ..... _____
   ASTM: Ovens, capable of maintaining temperatures up to 163°C (325°F)? ..... _____
   (f) Measuring device for measuring the height of the specimen to the nearest 0.3 mm (0.01 in.)? ..... _____
   (g) Suitable equipment for mixing the aggregate and bituminous material? ..... _____
   (h) Sample splitter, riffle-type or equivalent? ..... _____

COMMENTS (T247 / D1561): (T247 / D1561)

CALIFORNIA KNEEDING COMPACTOR FOR PREPARATION AND TESTING OF HMA SPECIMENS (T247) _____ **(D1561)** _____

PROCEDURE Date: _____

Sample Preparation:

1. Estimated optimum bitumen content determined? ..... _____
2. *AASHTO only: Tests conducted on 3 samples of different asphalt content: one at estimated optimum, one above, and one below?* ..... _____
3. Aggregate separated into fractions and dried? ..... _____
4. Aggregate recombined to 1200 g of specified grading? ..... _____
5. Asphalt and aggregate at correct temperature when mixing begins (see table below)? ..... _____

Mixing Temperature Table — Temperature Range, °C (°F)

Asphalt Grade	*AASHTO min.*	***ASTM min.***	maximum
AC-2.5, AR 1000, or 200-300 Pen	*107 (225)*	***99 (210)***	121 (250)
AC-5, AR 2000, or 120-150 Pen	*121 (250)*	***110 (230)***	135 (275)
AC-10, AR 4000, or 85-100 Pen	*135 (275)*	***121 (250)***	149 (300)
AC-20, AR 8000, or 60-70 Pen	*149 (300)*	***132 (270)***	163 (325)
AC-40, AR 16000, or 40-50 Pen	*149 (300)*	***132 (270)***	163 (325)

6. Asphalt and aggregate rapidly and thoroughly mixed? ..... _____
7. ***ASTM only: Mix transferred to flat pan and cured for 2 to 3 h at 146 ± 3°C (295 ± 5°F) or for 15 to 18 h at 60 ± 3°C (140 ± 5°F) in an oven equipped with air circulation?*** ..... _____
8. Mixture and molds brought to correct temperature [110°C (230°F) for paving grade asphalt]? ..... _____

Compaction

1. Mold placed on mold holder and paper disk placed in bottom of mold? ..... _____
2. Shim placed under mold? ..... _____
3. Mass of mixture for one specimen placed in preheated trough? ..... _____
4. Mixture spread uniformly in trough? ..... _____
5. One half of mixture pushed into mold with paddle? ..... _____
6. Mixture rodded 20 times in center and 20 times around periphery with preheated rod? ..... _____
7. Rest of mixture placed in mold and rodding repeated? ..... _____
8. Compactor foot heated? ..... _____
9. Mold holder and mold placed in compactor? ..... _____
10. Approx. 20 tamping blows at 1.7 MPa (250 psi) applied? ..... _____
    [AMRL: Number of tamping blows depends on the mixture.]
11. Shim removed and mold tightening screw released? ..... _____
12. 150 tamping blows at 3.4 MPa (500 psi) applied? ..... _____
13. Mold and mixture placed in oven at 60°C (140°F):
    (a) *AASHTO: For 1.5 hour at 60°C (140°F)?* ..... _____
    (b) ***ASTM: For 1 hour if compacted at 60°C (140°F) [liquid grade asphalt]?*** ..... _____
    (c) ***ASTM: For 1.5 hours if compacted at 110°C (230°F) [paving grade asphalt]?*** ..... _____
14. Followers inserted into mold? ..... _____
15. Leveling-off load of 6.9 MPa (1000 psi) [*ASTM: 56 kN (12600 lbf)*] applied to specimen using followers as plungers? ..... _____
16. ***ASTM only: Testing machine head or platen speed 6 mm/min. (0.25 in./min)?*** ..... _____
17. Height measured to nearest 0.25 mm (0.01 in.) in mold? ..... _____
18. Specimen returned to oven at 60°C (140°F)? ..... _____
19. *AASHTO only: If specimens to be tested according to (T246 / D1560), testing completed within 3 hours of returning specimens to the oven?* ..... _____

COMMENTS (T247 / D1561): (T247 / D1561)

PERCENT AIR VOIDS IN COMPACTED BITUMINOUS PAVING MIXTURES (T269) _____
(D3203) _____

APPARATUS Date: _____

1. Equipment for one of the following:
   (a) Method T166 / D2726 (Bulk Specific Gravity)? ..... _____
   or (b) Method T275 / D1188 (Bulk Sp. G by Paraffin Coating)? ..... _____
   or (c) Method T331 / D6752 (Bulk Sp. G by Vacuum Sealing)? ..... _____

2. Equipment for one of the following:
   (a) Method T209 / D2041 (Maximum Specific Gravity by Rice Method)? ..... _____
   or (b) ***ASTM only: Method D6857 (Max Sp. G by Vacuum Sealing)?*** ..... _____
   Note to Assessors: *AMRL currently does not assess for D6857.*

PROCEDURE

For Dense Bituminous Paving Mixtures
1. Bulk specific gravity determined by (T166 / D2726), (T275 / D1188), or (T331 / D6752)? ..... _____
2. Theoretical maximum specific gravity determined by (T209 / D2041) **[*ASTM only: or D6857*]**? ..... _____

For Open Bituminous Paving Mixtures (**10% air voids or higher**)
1. Density of bituminous mixture determined from its dry mass and its volume? ..... _____
2. Height of specimen determined? ..... _____
3. Volume of specimen determined based on average height and diameter measurement? ..... _____
4. Density converted to bulk specific gravity? ..... _____
5. Theoretical maximum specific gravity determined by (T209 / D2041)? ..... _____

Calculations
1. Percent air voids calculated in accordance with method? ..... _____

Percent Air Voids = 100 * [1 - (bulk sp gr / theoretical max sp gr)]

Note to Assessors, alternative terminology:

Gmm = maximum specific gravity (Rice Test, T209/D2041)
Gmb = bulk specific gravity (Bulk Sp G Test, T166/D2726)
Percent Air Voids = 100 * [1 - (Gmb / Gmm)]
Percent Air Voids = 100 * (Max – Bulk) / Max

COMMENTS (T269 / D3203): (T269 / D3203)

BULK SPECIFIC GRAVITY OF HMA USING PARAFFIN-COATED OR PARAFILM-COATED SPECIMENS (T275) _____ **(D1188)** _____

APPARATUS Date: _____

AASHTO METHOD A

1. *Balance (M231), can determine constant mass of specimen to 0.1 percent?* _____
2. *Bath for immersed weighing with overflow outlet, thermostatically controlled to 25.0 ± 0.5 °C (77.0 ± 0.9 °F)?* _____
3. *Suitable suspension and holder for immersed weighing:*
   - *(a) Suspended from center of pan?* _____
   - *(b) Holder and specimen completely immersed?* _____
   - *(c) Wire suspending holder of smallest practical size?* _____
4. *Paraffin (Specific Gravity known)?* _____
5. *Room temperature: 25 ± 5 °C (77 ± 9 °F)?* _____

AASHTO METHOD B

1. *Balance (M231), can determine constant mass of specimen to 0.1 percent?* _____
2. *Constant temperature water bath:*
   - *(a) Thermostatically controlled to 25.0 ± 0.5 °C (77.0 ± 0.9 °F)?* _____
   - *(b) ASTM 17C or 17F thermometer?* _____
3. *Calibrated volumeter with a tapered lid and capillary bore?* _____
4. *Drying oven at 52 ± 3 °C (125 ± 5 °F)?* _____
5. *Paraffin (Specific Gravity known)?* _____
6. *Room temperature: 25 ± 5 °C (77 ± 9 °F)?* _____

ASTM METHOD

1. ***Balance (D4753) with ample capacity and with sufficient sensitivity to determine bulk specific gravity to four significant figures? (i.e. 0.1 g for 100.1 to 999.9 g) such as a GP2?*** _____
2. ***Bath for immersed weighing:***
   - ***(a) Constant level overflow?*** _____
   - *or* ***(b) Electronic tare feature on balance?*** _____
3. ***Suspension and holder for completely immersed weighing?*** _____
4. ***Parafilm (Specific Gravity known)?*** _____
5. ***Polyurethane foam:***
   - ***(a) Mat with a minimum 50 x 50 cm (20 x 20 in) for working surface by 12.5 mm (0.5 in.) thick?*** _____
   - ***(b) At least one mat with a size approx. equal to the top surface dimensions of specimen on hand?*** _____
6. ***Calibration cylinder:***
   - ***(a) Smooth, sided aluminum cylinder?*** _____
   - ***(b) Approximately 100-mm (4-in) diameter by 60-mm (2.5 in)?*** _____
7. ***Sharp knife to cut parafilm?*** _____

COMMENTS (T275 / D1188): (T275 / D1188)

BULK SPECIFIC GRAVITY OF HMA USING PARAFFIN-COATED SPECIMENS (T275) _____

AASHTO PROCEDURE Date: _____

Specimens

1. *Recommended size:*
   - (a) *Diameter (or side of sawed specimens) at least 4 times maximum size of aggregate?* ..... _____
   - (b) *Thickness at least 1 1/2 times maximum size of the aggregate?* ..... _____
2. *Drying to constant mass:*
   - (a) *Distortion, bending, or cracking avoided and free of foreign material?* ..... _____
   - (b) *Overnight at 52 ± 3 °C (125 ± 5 °F)?* ..... _____
   - (c) *Additional 2 hr. drying intervals?* ..... _____
   - (d) *Constant mass (change less than 0.05 percent)?* ..... _____

*METHOD **A***

1. *Mass in air determined (dry; see 1 (b) above)? (A)* ..... _____
2. *Allowed to cool in air at room temperature at 25 ± 5 °C (77 ± 9 °F) for 30 minutes?* ..... _____
3. *Coated with paraffin, filling all voids?* ..... _____
   Note: *The specimen may optionally be coated with powdered talc before coating with paraffin to facilitate removal.*
   Note: *The specimen may optionally be cooled to 40 °F before coating.*
4. *Cooled 30 min., then weighed in air? (D)* ..... _____
5. *Immersed in water at 25 ± 1 °C (77 ± 2 °F) and weighed? (E)* ..... _____
6. *Sp. Gr. of paraffin determined (if unknown)? (F)* ..... _____
7. *Bulk Specific Gravity calculated as follows?* ..... _____

$$\text{Bulk Specific Gravity} = \frac{A}{D - E - ((D-A)/F)}$$

*METHOD **B***

1. *Mass of dry sample in air determined? (A)* ..... _____
2. *Room temperature 25 ± 5 °C (77 ± 9 °F)?* ..... _____
3. *Coated with paraffin, filling all voids, and then cooled 30 min.?* ..... _____
4. *Mass of specimen + paraffin determined?* ..... _____
5. *Outside of volumeter wiped dry?* ..... _____
6. *Mass of volumeter + water at 25 ± 1 °C (77 ± 2 °F) determined?* ..... _____
7. *Mass of volumeter + water + specimen at 25 ± 1 °C (77 ± 2 °F) determined?* ..... _____
8. *Determine specific gravity of Paraffin (if unknown)?* ..... _____
9. *Bulk Specific Gravity calculated as follows?* ..... _____

$$\text{Bulk Specific Gravity} = \frac{A}{D - [\, E - C + ((C-A)/F) \,]}$$

COMMENTS (T275): (T275)

BULK SPECIFIC GRAVITY OF HMA USING PARAFILM-COATED SPECIMENS (D1188) _____

ASTM PROCEDURE Date: _____

Specimens

1. ***Diameter (or side of sawed specimens) at least 4 times maximum size of aggregate?*** _____
2. ***Thickness at least 1 1/2 times maximum size of the aggregate?*** _____
3. ***Drying to constant mass:***
   - ***(a) Distortion, bending, or cracking of specimen avoided?*** _____
   - ***(b) Specimen free of foreign materials?*** _____
   - ***(c) Dried under fan until constant mass achieved?*** _____

Procedure

1. ***Mass in air determined (dried under a fan until constant mass has been achieved)? (A)*** _____
2. ***On a hard surface, sharp blade used to cut two 100 x 100 mm and one 100 x 200 mm pieces of parafilm?*** _____
3. ***Backing taken off one of the 100 x 100 mm pieces?*** _____
4. ***Opposite sides of film grasped and stretched?*** _____
   - ***(a) Repeated on other two sides?*** _____
   - ***(b) Stretched to an approximately 150 x 150-mm square?*** _____
   - ***(c) Care taken to avoid holes in film?*** _____
5. ***Stretched film placed over one end of specimen and sides of film pressed around sample?*** _____
6. ***Specimen turned over, placed on foam mat, and Steps 4 - 6 repeated?*** _____
7. ***Another piece of foam placed on top of wrapped specimen?*** _____
8. ***Wrapped specimen pressed with another specimen of same size to eliminate air pockets from surfaces?*** _____
9. ***Sharp knife used to trim excess film from sides of sample?*** _____
   - ***(a) Care taken to avoid damage of sample?*** _____
   - ***(b) Minimum of 15 mm (approximately 1/2 in) of film remaining on each side of specimen?*** _____
10. ***Backing peeled off remaining piece of film and ends stretched to 400 mm (16 in.)?*** _____
11. ***One end of stretched film placed on side of specimen and rolled over so film stretched tightly over surface?.*** _____
12. ***Edges folded and pressed over edges of specimen?*** _____
13. ***Mass of covered specimen in air determined? (D)*** _____
14. ***Mass of covered specimen in water bath at 25 ± 1°C (77 ± 1.8°F)? (E)*** _____
    - ***(a) Is correction made if temperature of water differs from 25 ± 1°C (77 ± 1.8°F)?*** _____
    - ***(b) If water differs by more than 2°C (3.6°F), specimen immersed 10 to 15 minutes?*** _____

Calculations

1. ***Specific gravity of film determined by procedure in Sec. 8.3? (F)*** _____
2. ***If specimen contains moisture, correction made using Sec. 9?*** _____
3. ***Bulk Specific Gravity calculated as follows?*** _____

$$\text{Bulk Specific Gravity} = \frac{A}{D - E - ((D-A) / F)}$$

COMMENTS (D1188): (D1188)

RESISTANCE OF COMPACTED BITUMINOUS MIXTURES (T283) _____
TO MOISTURE INDUCED DAMAGE (TSR / Lottman) **(D4867)** _____

APPARATUS Date: _____

1. Equipment for one of the following:
   (a) Method T245/D6926 (Marshall), T247/D1561 (CA kneading compactor), T312/D4013 (Superpave Gyratory), or D3387 (US Corp of Engineers Gyratory Testing Machine)? ..... _____
   or (b) ***ASTM only: D1074 (Compressive strength) or D3496 (Dynamic Modulus)? .....*** _____

2. Vacuum Apparatus
   (a) Vacuum container **[*ASTM only: preferably vacuum bowl from Rice test D2041*]**? ..... _____
   (b) Vacuum pump or water aspirator, conforms to (T209 / D2041)? ..... _____
   (c) Includes a manometer or vacuum gauge? ..... _____

3. Balance, conforming to (T166 / D2726), reads to 0.1% of sample mass, G2/GP2? ..... _____

4. Water bath(s):
   (a) Conforming to (T166 / D2726), has balance suspension apparatus, etc? ..... _____
   (b) Capable of maintaining a temperature of 140.0 ± 1.8°F (60 ± 1°C) **[*ASTM: for 24 h*]**? ..... _____
   (c) Capable of maintaining a temperature of 77.0 ± 1°F (25.0 ± 0.5°C) **[*ASTM: ± 1.8 °F (1 °C)*]**? ..... _____

5. Freezer, maintained at 0 ± 5°F (-18 ± 3°C) **[*ASTM only: optional*]**? ..... _____

6. *AASHTO only: Oven, forced air draft, capable of maintaining any desired temperature setting from room temperature to 176 °C (350 °F) within ± 3 °C (± 5 °F)?* ..... _____

7. Testing Apparatus
   (a) Loading jack and ring dynamometer, conforms to (T245 / D6926)? ..... _____
   or (b) *AASHTO: Mechanical or hydraulic testing machine (conforms to AASHTO T167) that provides a range of rates including 2 in. (50 mm) per minute?* ..... _____
   ASTM: Mechanical or hydraulic testing machine capable of maintaining the required strain rate and measuring load with equal or better precision?**.....** _____

8. Loading Strips **[*ASTM only: conforming to D4123 - Indirect Tension Test for Resilient Modulus*]**
   (a) Concave surface with a radius of curvature equal to the nominal radius of the test specimen? ..... _____
   (b) The width is:
      (1) 0.5 in. for a 4 in. diameter specimen? ..... _____
      (2) 0.75 in. for a 6 in. diameter specimen? ..... _____
   (c) The length exceeds the thickness of the specimens? ..... _____
   (d) The edges are rounded by grinding? ..... _____

9. Miscellaneous:
   (a) Plastic film or heavy-duty plastic bags, masking tape, 10 mL graduated cylinder? ..... _____
   (b) *AASHTO only: Pan, bottom surface area of 75 - 200 sq. in. and depth of approximately 1 in.?* ..... _____

Note to Assessors – some helpful facts

1 atmosphere (sea level) = 14.7 psi = 760 mm Hg (or torr) = 30 in Hg = 101.3 kPa

An absolute pressure gauge reads the pressure difference between a complete vacuum (0 pressure) and the sample. Examples include mercury manometers and some electronic gauges. Absolute gauges read atmosphere pressure (see above) when the vacuum system is off.

A relative pressure gauge reads the pressure difference between the normal atmosphere and the sample. Examples include most "vacuum gauges close to the source." Relative gauges read 0 when the vacuum system is off.

COMMENTS (T283 / D4867): (T283 / D4867)

RESISTANCE OF COMPACTED BITUMINOUS MIXTURES TO MOISTURE INDUCED DAMAGE (TSR / Lottman) (T283)

AASHTO PROCEDURE Date: _____

*Sample Preparation (**laboratory mixed** and compacted)*

1. Specimen size:
   - (a) 4 in. diameter and 2.5 in. thick specimens used? ..... _____
   - **or** (b) 6 in. diameter and 3.55 – 3.95 in. (90 – 100 mm) thick? ..... _____
   - **Note:** 6 in. specimens should be used if aggregate larger than 1 in. is presented.
2. After mixing:
   - (a) Mixture placed in a pan and cooled at room temperature for 2.0 ± 0.5 hours? ..... _____
   - (b) Mixture placed in a 140°F (60°C) oven for 16 ± 1 hour for curing? ..... _____
   - (c) Placed on spacers if shelf is not perforated? ..... _____
3. After curing:
   - (a) Mixture placed in an oven at compaction temperature, ± 3°C (± 5°F), for 2 hours ± 10 min. prior to compaction? ..... _____
   - (b) Mixture compacted to 7.0 ± 0.5 percent air voids, or a void level expected in the field? ..... _____
4. After extraction from molds, test specimens are stored for 24 ± 3 hour at room temperature? ..... _____

*Sample Preparation (**field mixed** and laboratory compacted)*

1. Specimen size:
   - (a) 4 in. diameter and 2.5 in. thick specimens used? ..... _____
   - **or** (b) 6 in. diameter and 3.55 – 3.95 in. (90 – 100 mm) thick? ..... _____
   - **Note:** 6 in. specimens should be used if aggregate larger than 1 in. is presented.
2. Field-mixed asphalt mixtures sampled in accordance with ASTM D979? ..... _____
3. No loose mix curing shall be performed? ..... _____
4. After sampling, mixture placed in oven until it reaches compaction temperature to within ± 3°C (± 5°F)? ..... _____
5. After extraction from molds, test specimens are stored for 24 ± 3 hour at room temperature? ..... _____

*Sample preparation (**core** test specimens)*

1. At least 6 cores for each set of mix conditions? ..... _____
2. Separate core layers as necessary by sawing or other suitable means, and layers to be stored at room temperature? ..... _____

Evaluation of test specimens and grouping

1. Theoretical maximum specific gravity of mixture determined by AASHTO T209? ..... _____
2. Specimen thickness determined by ASTM D3549 (average four thickness measurements at quarter points)? ..... _____
3. Bulk specific gravity determined by AASHTO T166? ..... _____
4. Volume of specimens expressed in cubic centimeters? ..... _____
5. Air voids calculated by AASHTO T269? ..... _____
6. Specimens sorted into two equal subsets of at least three specimens each so that average air voids of the two subsets are approximately equal? ..... _____

***Dry** subset - Preconditioning of test specimens*

1. Specimens stored at room temperature for 24 ± 3 hours? ..... _____
2. Specimens wrapped with plastic or placed in a heavy duty leak proof plastic bag? ..... _____
3. Specimens placed in a 77 ± 1°F (25 ± 0.5°C) water bath for at least 2 hours ± 10 min. and then tested? ..... _____
4. At least 1 in. of water above surface? ..... _____

COMMENTS (T283): (T283)

RESISTANCE OF COMPACTED BITUMINOUS MIXTURES TO MOISTURE INDUCED DAMAGE (TSR / Lottman) (T283)

AASHTO PROCEDURE (Continued) Date: _____

Conditioned *subset – Vacuum saturation procedure*

1. Specimens placed in the vacuum container supported above bottom by a spacer at least 1 in. from bottom? ..... _____
2. Container filled with potable water at room temperature to at least one inch above specimen surface? ..... _____
3. A partial vacuum 10-26 inches Hg partial pressure (250-660 mm Hg partial or 13-67 kPa absolute) applied? .... _____

Note to Assessors: *This is **not** the same amount of vacuum applied to Rice samples (T209 / D2041), which is 27.5 mm Hg. A typical manometer that reads in mm Hg will not even move under the correct vacuum for T283.*

Correct TSR Pressure	TSR pressure in.	TSR pressure mm Hg
Absolute gauge (if vacuum is off reads 1 atm)	10 – 26 in.	254 – 660 mm Hg
Relative gauge (if vacuum is off reads 0)	~ 20 – 4 in.	~ 500 – 100 mm Hg

4. Vacuum applied for a short time, approximately 5-10 min as needed to achieve correct saturation? ..... _____

Note to Assessors: *The vacuum pressure and time is much less important than achieving 70-80% saturation.*

5. Vacuum removed and specimens left submerged for a short time (5-10 min)? ..... _____
6. Mass of the SSD specimen after partial vacuum saturation determined by T166? ..... _____
7. SSD mass of conditioned samples compared with air dry mass and volume of absorbed water calculated? ..... _____
8. Degree of saturation determined by comparing volume of air voids with volume of water absorption? ..... _____
   (a) If the volume of water is less than 70 percent, is the procedure repeated using more vacuum and/or more time? ..... _____
   (b) If the volume of water is more than 80 percent, is the specimen discarded? ..... _____
   (c) If the volume of water is between 70 and 80 percent, is the test continued? ..... _____

Conditioned *subset – Temperature conditioning procedure*

1. Vacuum saturated specimens covered tightly with a plastic film and each specimen placed in a plastic bag containing 10 ± 0.5 mL of water and placed in a freezer at 0 ± 5°F (-18 ± 3°C) for a minimum of 16 hours? ..... _____
2. Specimens placed into a 140 ± 2°F (60 ± 1°C) water bath for 24 ± 1 hours with a minimum of 1 in. of water above specimen? ..... _____
3. Plastic bag and film removed from the specimens as soon as possible after placement in the water bath? ..... _____
4. After 24 hours in the water bath, the specimens removed and placed in a water bath, already at 77 ± 1°F (25.0 ± 0.5°C), for 2 hours ± 10 min.? ..... _____
   (a) If necessary, ice used to prevent water temperature from rising above 77°F (25°C)? ..... _____
   (b) The water bath should not require more than 15 minutes to reach 77°F (25°C)? ..... _____

Testing

1. The indirect tensile strength of dry and conditioned specimens determined at 77°F (25°C)? ..... _____
2. The specimens in the 77°F water bath removed and placed in the steel loading strips? ..... _____
3. Loading strips placed between the bearing plates in the testing machine? ..... _____
4. Care taken that the load applied is along the diameter of the specimen as illustrated in Table 1? ..... _____
5. Load applied to the specimen by means of the constant rate of movement of the testing machine head of 2 in. (50 mm) per minute? ..... _____
6. Is maximum compressive strength on the testing machine recorded? (P) ..... _____
7. Is load continued until crack appears, specimen removed from the machine, pulled apart at the crack, inspected for stripping, and observations recorded? ..... _____
8. Calculations determined as follows (see Section 12 for standard units calculation, also in IDT test)? ..... _____

$$\text{Tensile Strength (kPa)} = \frac{2000 * P}{\pi * t * D}$$

P = maximum load (N)
t = specimen thickness (mm)
D = specimen diameter (mm)

TSR = (average tensile strength of conditioned subset) / (average tensile strength of dry subset)

COMMENTS (T283): (T283)

EFFECT OF MOISTURE ON ASPHALT-CONCRETE PAVING MIXTURES (D4867)
ON TENSILE STRENGTH RATIO (TSR / Lottman)

ASTM PROCEDURE Date: _____

Sample Preparation *(laboratory* ***test specimens)***

1. Sample size:
   (a) 4 in. diameter and 2.5 in. thick specimens used? ..... _____
   or (b) Specimens of other dimensions used if aggregate larger than 1 in. is presented? ..... _____
2. Six specimens made for each test: three to be tested dry and three to be tested after partial saturation and moisture conditioning? ..... _____
3. Mixtures prepared in batches large enough to make at least 3 specimens or a batch large enough for just 1 specimen? ..... _____
4. Mixing temperatures and procedures followed for the method used? ..... _____
5. If an anti-stripping additive is used, are procedures in 6.4 and 6.5 used? ..... _____
6. After mixing:
   (a) Mixture placed in a closed container and placed in an oven for 1 to 2 hours to stabilize the specimen at the required compaction temperature? ..... _____
   (b) If preparing multi-specimen batch, split into single specimens before placing into oven? ..... _____
7. After curing, mixture compacted to 7 ± 1 percent air voids, or a void level expected in the field? ..... _____
8. After compaction, test specimens are cooled as rapid as possible in a stream of moving air, extracted from molds, then procedure followed in Section 8 within 24 hours? ..... _____

Sample Preparation *(field* ***specimens)***

1. Truck to be sampled selected in accordance with D3665 (Random Sampling of Construction Materials)? ..... _____
2. Sample taken from truck at plant in accordance with D979 (Sampling Bituminous Paving Mixtures)? ..... _____
3. Mixture temperature stabilized to approximately the temperature found in the field when rolling begins and temperature maintained in a closed container, in an oven for approximately the time lapse between mixing and the start of actual rolling? ..... _____
4. After curing, mixture compacted to 7 ± 1 percent air voids, or a void level expected in the field? ..... _____
5. After compaction, test specimens are cooled as rapid as possible in a stream of moving air, extracted from molds, then rest of procedure followed within 24 hours (saturation, testing, etc)? ..... _____
6. If specimens are not to be compacted in the field laboratory, place the samples in a sealed container, transported to the laboratory, and reheated to required temperature? ..... _____

Evaluation of test specimens and grouping

1. Theoretical maximum specific gravity of mixture determined by D2041? ..... _____
2. Specimen height determined by taking the average of four height measurements, ASTM D3549? ..... _____
3. Bulk specific gravity determined by ASTM D2726? ..... _____
4. Volume of specimens determined from Bulk specific gravity test (B - C expressed in cubic centimeters)? ..... _____
5. Air voids calculated D3203? ..... _____
6. Specimens sorted into two subsets of three specimens each so that average air voids of the two subsets are approximately equal? ..... _____

COMMENTS (D4867): (D4867)

EFFECT OF MOISTURE ON ASPHALT-CONCRETE PAVING MIXTURES (D4867) _____
ON TENSILE STRENGTH RATIO (TSR / Lottman)

ASTM PROCEDURE (Continued) Date: _____

Dry *subset - Preconditioning of test specimens*

1. Specimens stored at room temperature until test? ..... _____

Conditioned *subset – Preconditioning of test specimens*

1. Specimens placed in the vacuum chamber? ..... _____
2. Container filled with distilled water at room temperature? ..... _____
   Note: *The water used to saturate the specimens may be heated up to 140°F (60°C).*
3. A partial vacuum such as 20 in Hg applied for a short time (such as 5 minutes)? ..... _____
   Note to Assessors: *This is not the same amount of vacuum applied to Rice samples (T209 / D2041), which is 27.5 mm Hg.*
4. Volume of the partially saturated specimen determined in accordance D2726? ..... _____
5. Volume of the absorbed water determined by subtracting air dry mass of the specimen from the saturated surface-dry mass of the partially saturated specimen (Sec.8.6.2)? ..... _____
6. Degree of saturation determined by dividing the volume of the absorbed water by the volume of air voids and expressed as a percentage (Sec. 8.6.3)? ..... _____
   (a) If the volume of water is less than 55 percent, is the procedure repeated using more vacuum? ..... _____
   (b) If the volume of water is more than 80 percent, is the specimen discarded? ..... _____
   (c) If the volume of water is between 55 and 80 percent, is the procedure continued? ..... _____
7. Specimens placed into a 140.0 ± 1.8°F (60 ± 1°C) water bath filled with distilled water for 24 hours? ..... _____
8. If a freeze-thaw cycle is desired, procedure in Note 6 used? ..... _____
9. After 24 hours in the water or air bath, specimens are removed and placed in a water bath already at 77.0 ± 1.8°F (25 ± 1°C) for 1 hour? ..... _____
10. Height of the conditioned specimens determined by taking 4 measurements at quarter points (D3549)? ..... _____
11. Volume of conditioned subset specimens determined by D2726? ..... _____
12. Water absorption and degree of saturation determined in accordance with 8.6.2 and 8.6.3 (a degree of saturation exceeding 80% is acceptable after water bath soaking)? ..... _____
13. Swell calculated for partially saturated specimens (just after vacuuming procedure) and moisture-conditioned specimens (after additional water bath soaking time) (see Section 8.9.2)? ..... _____
14. Temperature of the dry subset adjusted by soaking in a water bath for 20 min. at 77.0 ± 1.8°F? ..... _____

Testing

1. Height of dry specimens determined just before tensile testing by taking 4 measurements at quarter points? .... _____
2. The tensile strength of dry and conditioned specimens determined at 77 ± 1.8°F (25 ± 1°C)? ..... _____
3. Specimens in the 77°F water bath removed and height measured? ..... _____
4. Specimens placed into the loading apparatus and the loading strips positioned so that they are parallel and centered on the vertical diametral plane? ..... _____
5. Load applied to the specimen by means of the constant rate of movement of the testing machine head of 2 in. per minute? ..... _____
6. Maximum compressive strength on the testing machine recorded? (P) ..... _____
7. Load continued until crack appears, specimen removed from the machine, pulled apart at the crack and inspected for degree of moisture damage? ..... _____
8. Calculations determined by as follows (see Section 9 for standard units calculation, also in IDT test)? ..... _____

$$\text{Tensile Strength (kPa)} = \frac{2000 * P}{\pi * t * D}$$

P = maximum load (N)
t = specimen thickness (mm)
D = specimen diameter (mm)

TSR = (average tensile strength of conditioned subset) / (average tensile strength of dry subset)

COMMENTS (D4867): (D4867)

ASPHALT CONTENT OF BITUMINOUS MIXTURES BY THE NUCLEAR METHOD (T287) _____ **(D4125)** _____

APPARATUS Date: _____

1. Nuclear gauge
   (a) Neutron source - an encapsulated and sealed radioactive source (such as americium/beryllium)? _____
   (b) Thermal neutron detector (such as helium-3 or boron tri-fluoride)? _____
   (c) Read-out instrument displaying the percent asphalt binder to the nearest 0.1 percent? _____
   (d) Daily standard log count? _____
   (e) Factory or laboratory calibration data sheet? _____
   (f) Leak test certificate? _____
   (g) Shippers declaration for dangerous goods? _____
   (h) Procedure memo for storing, transporting, and handling nuclear testing equipment? _____

2. Sample Pans, 3 or more made of stainless steel? _____

3. Balance, readable to 0.1 g with at least 20 kg capacity **[*ASTM: balance readable to 1 g*]**? _____

4. Heating Device
   (a) Oven, capable of heating to 350 ± 5°F (177 ± 3°C)? _____
   or (b) *AASHTO only: Microwave Oven, capable of maintaining a temp. of 177 ± 3°C (350 ± 5°F) and determined to not be detrimental to aggregate?* _____

5. ASTM only: straightedge, made of steel and approx. 18 inches long? _____

6. Leveling Plate, flat and rigid plate, made of:
   (a) metal with a minimum thickness of 12.5 mm (0.5 in)? _____
   or (b) wood, with a minimum thickness of 19 mm (0.75 in) **[*ASTM: 20 mm*]**? _____
   or (c) *AASHTO only: plexiglas, with a minimum thickness of 12.5 mm?* _____

7. Thermometer, range of 50 to 500°F (10 to 260°C) **[*ASTM: range of 10 to 250°C (50 to 482°F)*]**? _____

8. Mechanical Mixer, with a 10 kg capacity? _____

9. Spoons and mixing bowls? _____

10. Splitting or quartering equipment? _____

11. *AASHTO only: Sample containers, such as paint cans or unwaxed, non-absorbent cardboard boxes that can be closed to prevent contamination of the sample?* _____

ASTM only: Additional apparatus for Test Method B (for compacted bituminous mixtures)

1. Apparatus necessary to prepare compacted specimens as specified in Test Methods D6926, D1561, D3387, or Practice D4013? _____

2. Molded laboratory specimen container provided by manufacturer (ref. Figure 1):
   (a) For 4 in. diameter specimens: container has 2 holes that can hold specimens (dia. 10.312 cm)? _____
   (b) For 6 in. diameter specimens: container has 1 hole that can hold a specimen (dia. 15.392 cm)? _____
   (c) Container fits inside nuclear gauge device (dimension are 24.689 x 18.161 x 6.985 cm)? _____
   (d) Height from container bottom to specimen level is 5.715 cm? _____

COMMENTS (T287 / D4125): (T287 / D4125)

ASPHALT CONTENT OF BITUMINOUS MIXTURES BY THE NUCLEAR METHOD (T287)

AASHTO CALIBRATION (page 1 of 4) Date: _____

Calibration and Verification (Assessor: Check Records)

A. Sampling

1. Approximately 50 kg (110 lbs) of aggregate obtained? ..... _____

2. Approximately 4 L (1 gal) of asphalt obtained? ..... _____

B. Aggregate Preparation

1. If used, appropriate amount of lime hydrated onto aggregate? ..... _____

2. Aggregate dried to constant mass according to T255? ..... _____

3. Aggregate dry sieved? ..... _____

a) Sieve set includes 75-µm (No. 200) sieve? ..... _____

b) Cumulative mass required for each sieve size calculated as follows: ..... _____

$X = T (100-P)/100$ *where:*

X = the required, cumulative batch mass for each specified sieve (g)
T = the initial, total aggregate mass (g)
*P = the percent passing for each specified sieve according to the JMF**

4. Aggregate dust correction performed? ..... _____

a) Prepare a washed-gradation sample from the masses calculated above? ..... _____

b) Perform a wash gradation according to T27 and T11? ..... _____

c) Calculate the corrected batch mass for each specified sieve for the calibration points as follows: ..... _____

$Z_n = X^2/Y$ *where:*

Z_n *= the adjusted, cumulative batch mass for any sieve size, n (g)*
X = the pre-wash, cumulative batch mass for each specified sieve (g)
Y = the post-wash, cumulative batch mass for each specified sieve (g)

d) Blend the aggregate together at the proper proportion to match the JMF using the masses calculated in 4c? ..... _____

*(**Note to Assessors:** JMF = Job Mix Formula. The job mix formula is the mix design specified for performing the calibrations.)*

COMMENTS (T287): (T287)

ASPHALT CONTENT OF BITUMINOUS MIXTURES BY THE NUCLEAR METHOD (T287)

AASHTO CALIBRATION (page 2 of 4) Date: _____

Calibration and Verification (Continued)

C. Asphalt Binder Preparation

1. *Heat a minimum of 2 L (0.5 gal) of asphalt binder to the mid-point of the mixing temperature range in a covered container?* ..... _____
2. *When used, appropriate amount of liquid anti-stripping additive added to asphalt binder?* ..... _____
3. *Asphalt binder used as soon as it reaches the mid-point of the mixing temperature range (if this is not possible, maintain the temperature for not more than 4 hours)?* ..... _____
4. *Asphalt not cooled and reheated?* ..... _____
5. *Amount of asphalt binder and aggregate required calculated by one of the following methods:*

Method A – Asphalt binder percent by mass of the asphalt mixture

1. *Calculate the mass of asphalt binder for each calibration point as follows:* ..... _____

$B = (E)(P_{bm})$ *where:*
B = the mass of the asphalt binder to the nearest 0.1 g
E = the mass of asphalt mixture (g)
P_{bm} *= the percent of asphalt binder by total mass of the asphalt mixture, expressed as a decimal*

2. *A minimum of four samples mixed, containing the following binder contents: 0.8% below optimum, at optimum, 0.8% above optimum, and 1.6% above optimum?* ..... _____
3. *Calculate the mass of aggregate required for each calibration point (asphalt content) as follows?*..... _____

$A = E - B$ *where:*
A = the mass of the aggregate to the nearest 0.1 g
E = the mass of the asphalt mixture (g)
B = the mass of asphalt (from above)

OR

Method B – Asphalt binder percent by mass of the aggregate

1. *Calculate the mass of aggregate for each calibration point as follows:* ..... _____

$A = E/(1+P_{ba})$ *where:*
P_{ba} *= the percent of asphalt binder by mass of the aggregate, expressed as a decimal*
E = the mass of the asphalt mixture (g)

2. *A minimum of four samples mixed, containing the following binder contents: 0.8% below optimum, at optimum, 0.8% above optimum, and 1.6% above optimum?* ..... _____
3. *Calculate the mass of asphalt binder required for each calibration point as follows:* ..... _____

$B = (A)(P_{ba})$ *where:*
P_{ba} *= the percent of asphalt binder by mass of the aggregate, expressed as a decimal*
A = Mass of aggregate (from above)

COMMENTS (T287): (T287)

ASPHALT CONTENT OF BITUMINOUS MIXTURES BY THE NUCLEAR METHOD (T287)

AASHTO CALIBRATION (page 3 of 4) Date: _____

Calibration and Verification (Continued)

D. Target Mass Determination

1. *Butter batch prepared to determine the mass to be used for the calibration samples?* _____
2. *Mix the preheated aggregate and asphalt according to preparation of specimens section?* _____
3. *Mass of a clean gage-sample pan determined and scale tared?* _____
4. *Asphalt mixture placed into pan until pan is half full?* _____
5. *Asphalt sample lightly tamped with preheated spoon or spatula?* _____
6. *Remaining asphalt mixture placed in pan until it is mounded about 13 mm (0.5 in.) above the top of the pan?* _____
7. *Leveling plate placed on top of mixture immediately after filling the pan?* _____
8. *Sample compacted into the pan until it is level with the top of the pan by pressing down on the plate?* _____
9. *Sight across the top of the pan to ensure that the asphalt mixture is not above the pan?* _____
10. *Determine and record the mass (i.e. target mass) of the filled pan?* _____
11. *Calibration and sample specimens within ± 5 g of the target mass?* _____

E. Preparation of Calibration Specimens (Mixing)

1. *Mass of the aggregate and asphalt binder determined for each sample according to Aggregate Preparation and Asphalt Binder Preparation Sections of the method?* _____
2. *A minimum of four aggregate samples prepared, containing the following binder contents: 0.8% below optimum, at optimum, 0.8% above optimum, and 1.6% above optimum?* _____
3. *Target mass used for each aggregate sample?* _____
4. *Aggregate and asphalt binder materials heated to the mid-point of the mixing temperature range and allowed to stabilize at that temperature?* _____
5. *Mass of heated mixing bowl determined to the nearest 0.1 g?* _____
6. *Heated aggregate specimen placed in the mixing bowl?* _____
7. *Crater formed in aggregate large enough to hold the required amount of asphalt binder?* _____
8. *Mixing bowl placed on scale and required asphalt binder added into the crater to the nearest 0.1 g?* _____
9. *Aggregate and asphalt mechanically mixed for a minimum of two minutes?* _____
   Note: *hand mixing is acceptable using large bowl and mixed for a minimum of five minutes.*
10. *All material thoroughly coated after mixing procedure?* _____
11. *If necessary, remix the sample by hand until it is thoroughly mixed?* _____
12. *Mixture removed from mixing bowl, and the bowl weighed to ensure that all material is removed?* _____
13. *Mass of bowl within ± 5 g of its original mass?* _____
14. *If not, bowl scraped with spatula and added to sample until sample mass is within tolerance?* _____

F. Calibration (Testing Calibration Specimens)

1. *Mass of a clean gage-sample pan determined and the pan tared on the scale?* _____
2. *Asphalt mixture place in the pan until it is half full?* _____
3. *Asphalt sample lightly tamped with preheated spoon or spatula?* _____
4. *Remaining asphalt mixture placed in pan so that the mixture is mounded about 13 mm (0.5 in.) above the top of the pan?* _____
5. *Leveling plate placed on top of the asphalt mixture immediately after filling the pan?* _____
6. *Sample compacted into the pan until it is level with the top of the pan by pressing down on the leveling plate?* _____
7. *Sight across the top of the pan to ensure that the asphalt mixture does not protrude above the top of the pan?* _____
8. *Mass of the compacted asphalt mixture in the pan determined and recorded?* _____
9. *Mass within ± 5 g of the target mass?* _____
10. *Pan placed into the gage, and manufacturer's instructions for operating the equipment and sequence of operations followed?* _____
11. *Repeat steps 1 through 11 for all calibration samples?* _____

COMMENTS (T287): (T287)

ASPHALT CONTENT OF BITUMINOUS MIXTURES BY THE NUCLEAR METHOD (T287)

AASHTO CALIBRATION (page 4 of 4) Date: _____

Calibration and Verification (Continued)

G. Calibration Curve

1. Calibration curve prepared for each asphalt mixture type, aggregate blend, asphalt binder source, or addition of liquid anti-strip or hydrated lime? ..... _____

2. Calibration curve covers the range of expected values found in field samples? ..... _____

3. Do the limits for the calibration curve consider the allowable range of asphalt binder content plus the allowable aggregate moisture (which reads as asphalt binder in the gage)? ..... _____

4. At least four calibration-curve pans prepared at 0.8 below, optimum, 0.8 above, and 1.6 above the optimum asphalt binder content? ..... _____

I. Presentation of Calibration Data

For Gages that generate the calibration internally to the gage:

1. Formula coefficients, coefficient of fit, and the calculated percent difference for each calibration point printed or recorded? ..... _____

2. Calibration not acceptable if the coefficient of fit is less than 0.998 for a dense-graded asphalt mixture or 0.995 for an open-graded asphalt mixture, or any calibration point has a calculated difference greater than 0.09 percent? ..... _____

3. If calibrations are not acceptable are they performed again? ..... _____

4. Acceptable calibrations stored in the gages memory, using the JMF and an easily recognizable calibration number, according to the manufacturer's instructions? ..... _____

For gages that do not generate the calibration internally to the gage:

1. Calibration curve prepared by plotting the gage readings for calibration samples versus asphalt binder content on linear graph paper, choosing convenient scale factors for the gage readings and asphalt binder content? ... _____

J. Cross-Calibration (When Applicable)

This process creates a relationship between the field gage and the gage used in the JMF calibration (see Section A10 of the annex for details).

COMMENTS (T287): (T287)

ASPHALT CONTENT OF BITUMINOUS MIXTURES BY THE NUCLEAR METHOD (T287)

AASHTO PROCEDURE Date: _____

Standardization

1. *A background count performed in accordance with manufacturer's procedure each day prior to testing?* _____
2. *Measurement times of the background count the same as testing time?* _____
3. *Background count does not change by more than 1 percent; if it does are more background counts performed?* _____

Procedure

1. *Obtain a representative sample according to T168?* _____
2. *If required, sample reduced to appropriate size by splitting and quartering according to T248, Method B?* _____
3. *Test performed while mixture is hot, if sample cools it may be reheated to the mid-point of the compaction temperature range for the asphalt binder used?* _____
4. *Determine the mass of a clean gage-sample pan and tare the pan on the balance?* _____
5. *Pan filled half full with the asphalt mixture?* _____
6. *Asphalt mixture lightly tamped with a preheated spatula or spoon?* _____
7. *Additional asphalt added to the pan until the required mass, as found in the Target Mass Determination, is reached within ± 5 g?* _____
8. *Leveling plate placed on top of the asphalt mixture immediately after filling the pan?* _____
9. *Sample compacted into the pan until it is level with the top of the pan by pressing down on the leveling plate?* _____
10. *Sight across the top of the pan to ensure that the asphalt mixture does not protrude above the top of the pan?* _____
11. *Mass of asphalt mixture compacted in the pan determined and recorded?* _____
12. *Mass within ± 5 g of the target mass?* _____
13. *If the gage has the ability to store multiple calibrations, activate the calibration for the mixture?* _____
14. *Pan containing mixture placed into the gage and a 4 minute count performed?* _____
15. *Uncorrected asphalt binder content determined by the direct read out on the gage, calibration graph, or the formula supplied by the manufacturer, and recorded to the nearest 0.1 percent?* _____
16. *If the sample is not dried in an oven at 110 ± 5°C (230 ± 9°F), prior to testing:*
    - (a) *Moisture correction determined by performing T110, T329, or by microwave oven at temp. of 177 ± 3°C (350 ± 5°F), using a representative portion of the sample?* _____
    - (b) *Moisture content recorded to the nearest 0.1 percent?* _____
    - (c) *Moisture content subtracted from the uncorrected asphalt binder content and reported to the nearest 0.1 percent?* _____

COMMENTS (T287): (T287)

ASPHALT CONTENT OF BITUMINOUS MIXTURES BY THE NUCLEAR METHOD **(D4125)**

ASTM CALIBRATION (page 1 of 2) Date: _____

Calibration (general)

1. Calibration curve developed according for each mix-type and aggregate blend? ..... _____
2. New calibration curve developed whenever there is a change is asphalt/aggregate source, significant change in aggregate gradation, or new or repaired apparatus? ..... _____

Calibration – Method A

A. Blank Sample

1. Blank sample (with no asphalt) prepared to determine mass used for calibration and plant mix samples? ..... _____
2. Blank prepared by filling a sample pan with aggregate in 3 layers, avoiding segregation? ..... _____
3. Each layer settled by raising pan 1 to 2 in. and tapping to work surface 2 or 3 times? ..... _____
4. Third layer filled to a point slightly above top edge of pan? ..... _____
5. Straightedge used to make sample flush with top of pan with no compaction to sample? ..... _____
6. Mass of blank sample determined and recorded to nearest 1 g? ..... _____
7. This mass used for all calibration and plant mix samples? ..... _____
8. Sample pan placed in gauge and sample count recorded? ..... _____

B. Calibration Curve Samples

1. Enough aggregate obtained for a minimum of 3 samples [approx. 30 kg (65 lb)]? ..... _____
2. Approx. 2.5 kg (5.5 lb) of asphalt obtained? ..... _____
3. Minimum of 3 samples prepared to establish calibration curve? ..... _____
4. Range of asphalt contents vary by at least 2% from lowest to highest? ..... _____
5. Range encompasses the design asphalt content? ..... _____
6. Masses of the samples agree within 10 g of each other? ..... _____
7. Calibration samples prepared and tested as close as possible to temperature of test samples of completed mixes? ..... _____
8. Calibration samples tested within ±5°C (9°F) of each other? ..... _____
9. Aggregates and asphalt for the three samples heated to approx. 150°C (300°F)? ..... _____
10. All bowls, sample pans, and tools also heated to approx. 150°C (300°F)? ..... _____
11. Prior to mixing first sample, mixture of asphalt and aggregate fines used to butter the bowl? ..... _____
12. Aggregate placed in bowl and asphalt added to within 1 g of desired percent by mass? ..... _____
13. Mixed thoroughly? ..... _____
14 Mixed sample placed in sample pan in 3 layers? ..... _____
15. Each layer distributed evenly using scoop or spatula? ..... _____
16. Each layer settled by raising pan 1 to 2 in. and tapping to work surface 2 or 3 times? ..... _____
17. Third layer filled to a point slightly above top edge of pan? ..... _____
18. Material added or removed from sample until mass is within 10 g of blank sample? ..... _____
19. Mass recorded? ..... _____
20. Sample compacted with flat metal or wood plate until level with top of pan? ..... _____
21. Sample pan placed in gauge and sample count recorded? ..... _____
22. Steps 1 through 21 repeated for each of the remaining mixes? ..... _____
23. Bowl not completely cleaned between remaining mixes? ..... _____

COMMENTS (D4125): (D4125)

ASPHALT CONTENT OF BITUMINOUS MIXTURES BY THE NUCLEAR METHOD **(D4125)**

ASTM CALIBRATION (page 2 of 2) Date: _____

Calibration – Method B

1. Aggregates sampled and prepared for blending according to method of compaction selected? ..... _____
2. Enough asphalt sampled for test? ..... _____
3. Four known asphalt contents selected? ..... _____
4. Range of asphalt contents vary by at least 2% from lowest to highest? ..... _____
5. Three specimens prepared for each of the selected asphalt contents? ..... _____
6. Specimens compacted by one of the following methods: D1561, D3387, D6926 or Practice D4013? ..... _____
7. Masses of each set of replicate specimens within 10 g (0.02 lb) of each other? ..... _____
8. Mass of each specimen determined to nearest 1 g (0.002 lb)? ..... _____
9. For 4-in. specimens: Two specimens whose masses are closest to each other selected for each of the asphalt contents? ..... _____
10. For 6-in. specimens: One specimen selected from each asphalt content such that masses of four specimens selected are as close as possible? ..... _____
11. Specimens not used retained for further testing? ..... _____
12. Specimens placed in molded specimen container and container placed in gauge? ..... _____
13. Sample count recorded? ..... _____
14. Process repeated for each set of calibration samples? ..... _____
15. For samples containing RAP: RAP material is of uniform gradation, asphalt content, and asphalt type? ..... _____
16. RAP calibration samples contain same percentage of RAP as samples to be tested? ..... _____
17. Method not used for job control testing if RAP material is not uniform? ..... _____
18. Final calibration response is in form of curve, data table, or equation for computer processing? ..... _____

Note to Assessors: ***Some gauges will do this on their own.***

Calibration Factor – Methods A and B

1. For each calibration, correlation factor calculated according to Equation (1) of test method? ..... _____
2. Correlation factor greater than or equal to 0.995? ..... _____

Background and Stability Check

1. Background radiation count obtained each day before taking measurements? ..... _____
2. Measurement period of background count ≥ normal measurement period? ..... _____
3. New background count taken if gauge has been moved (even within same room)? ..... _____
4. New background count taken if environment around gauge has been changed significantly? ..... _____
5. For gauges that <u>have not</u> been moved, background count within 1% of previous count for gauge to be considered stable? ..... _____
6. For gauges that <u>have</u> been moved, background count within 2 - 3% of previous count for gauge to be considered stable? ..... _____
7. If background counts are not within limits or if gauge stability is suspect, statistical stability test performed according to manufacturer's instructions? ..... _____
8. Statistical stability test also performed when gauge is new or repaired? ..... _____
9. Statistical stability test performed at least once a month otherwise? ..... _____
10. Failure of statistical stability test prompts a check for hydrogen bodies in or around gauge? ..... _____
11. Stability test repeated for longer measurement period? ..... _____
12. Further failure prompts adjustment or repair of the gauge according to manufacturer's instructions? ..... _____

COMMENTS (D4125): (D4125)

ASPHALT CONTENT OF BITUMINOUS MIXTURES BY THE NUCLEAR METHOD **(D4125)**

ASTM PROCEDURE Date: _____

Sampling

1. Test sample obtained according to D979 (Standard Practice for Sampling HMA)? ..... _____
2. Moisture content of the test sample determined:
   (a) By ASTM D1461 (Moisture or Volatile Distillates Content of HMA)? ..... _____
   or (b) By drying test sample to constant mass in an oven at 110 ± 5°C (230 ± 9°F)? ..... _____

Method A

1. Sample pan filled in three layers? ..... _____
2. Each layer distributed evenly with scoop or spatula? ..... _____
3. After each layer, pan lifted approx. 20 to 50 mm (1 to 2 in.) and tapped on working surface two or three times to settle contents? ..... _____
4. Last layer fills pan slightly above top edge? ..... _____
5. Material added or removed until mass of mix in pan is within 10 g (0.02 lb) of the calibration sample? ..... _____
6. Mass of mix in pan recorded? ..... _____
7. Sample compressed with flat plate until level with top edge of pan? ..... _____
8. Temperature of sample recorded? ..... _____
9. Temperature within 5°C (9°F) of calibration temperature unless the apparatus makes provision for temperature correction? ..... _____
10. Sample placed in chamber? ..... _____
11. Manufacturer's instructions followed to obtain sample counts? ..... _____
12. Asphalt content of mixture determined? ..... _____
13. Corrected for moisture content, if necessary? ..... _____

Method B

1. Specimens prepared using Test Method, D1561, D3387, D6926, or Practice D4013? ..... _____
2. Two specimens used for 10-cm (4 in.) diameter specimens? ..... _____
3. One specimen used for 15-cm (6 in.) diameter specimens? ..... _____
4. One of the following:
   (a) For 10-cm specimens: the mass of the two test specimens are within 10 g (0.02 lb) of each other and the average of the two test specimens are within 10 g (0.02 lb) of the average of the calib. samples? ..... _____
   or (b) For 15-cm specimens: the mass of the test specimen is within 10 g (0.02 lb) of the calibration sample? _____
5. Sample(s) placed in the molded specimen container and then placed in the testing chamber? ..... _____
6. Manufacturer's instructions followed to obtain sample counts? ..... _____
7. Asphalt content of mixture determined? ..... _____
8. Corrected for moisture content, if necessary? ..... _____

COMMENTS (D4125): (D4125)

DETERMINING THE ASPHALT CONTENT OF HMA BY THE IGNITION METHOD

(T308) _____
(D6307) _____

APPARATUS Date: _____

1. Ignition Furnace
   - (a) One of the following:
     - (1) Convection-type furnace that maintains 578°C (1072°F) **[*ASTM: 580°C*]**? ..... _____
     - (2) Direct Irradiation-type furnace with an internal balance? ..... _____
   - (b) Dimensions adequate to accommodate a 3500 g sample **[*ASTM: 2500 g sample*]**? ..... _____
   - (c) Door cannot be opened during test (do not attempt to open it during the test!)? ..... _____
   - (d) Method for reducing furnace emissions? ..... _____
   - (e) Vented into a hood or to the outside? ..... _____
   - (f) A fan to pull air through the furnace? ..... _____
   - (g) Sample Baskets:
     - (1) Allows sample to be thinly spread? ..... _____
     - (2) Allows air to flow through and around sample? ..... _____
     - (3) Sets of two or more baskets nested? ..... _____
     - (4) Sample completely enclosed with a mesh screen or perforated stainless steel plate? ..... _____
   - (h) Catch pan of sufficient size to hold baskets? ..... _____

2. Internal balance (Method A only)
   - *(a) AASHTO only: Thermally isolated from furnace chamber?* ..... _____
   - (b) Accurate to 0.1 g? ..... _____
   - (c) Capable of weighing a 3500 g **[*ASTM: 2500 g*]** sample in addition to the baskets? ..... _____

3. Data collection system (Method A only)
   - (a) Mass can be determined and displayed during the test? ..... _____
   - (b) Built-in computer program? ..... _____
   - (c) Calculates the change in mass? ..... _____
   - *(d) AASHTO only: Provides for the input of a correction factor?* ..... _____
   - *(e) AASHTO only: Audible alarm and indicator light?* ..... _____
   - (f) Capable of changing the ending mass loss percentage to 0.02 percent **[*ASTM: 0.01%*]**? ..... _____

4. Printed ticket (Method A only)
   - (a) Records initial specimen mass? ..... _____
   - (b) Records specimen mass loss? ..... _____
   - (c) Records temperature compensation? ..... _____
   - (d) Records correction factor? ..... _____
   - (e) Records corrected asphalt content (%)? ..... _____
   - (f) Records test time? ..... _____
   - (g) Records test temperature? ..... _____

   Note to assessors: *NCATs should be set to print the long ticket.*

5. Miscellaneous
   - (a) Oven capable of maintaining a temperature of 110 ± 5°C (230 ± 9°F)? ..... _____
   - (b) Balance readable to 0.1 g, conforming to M231, Class G2 **[*ASTM: D4753, class GP2*]**? ..... _____
   - *(c) AASHTO only: Protective cage capable of surrounding baskets?* ..... _____

COMMENTS (T308 / D6307): (T308 / D6307)

DETERMINING THE ASPHALT CONTENT OF HMA BY THE IGNITION METHOD (T308)

AASHTO PROCEDURE Date: _____

1. *Correction Factor (AASHTO only)*
   - (a) Determined for each job mix formula (JMF)? ..... _____
   - (b) Determined before any acceptance testing is completed and if any change in ingredients or design occurs? ..... _____
   - (c) A new correction factor is determined if any changes greater than 5% in stockpiled aggregate proportions occur? ..... _____
   - (d) "Butter mix" prepared and discarded to condition bowl? ..... _____
   - (e) "Blank" aggregate specimen batched and tested for aggregate gradation? ..... _____
   - (f) Two correction factor samples mixed at the design asphalt content? ..... _____
   - (g) Freshly mixed samples placed directly into basket assembly or if allowed to cool, dried to constant mass at 110 ± 5°C? ..... _____
   - (h) Baskets are not preheated? ..... _____
   - (i) Specimens tested according to method? ..... _____
   - (j) Gradation analysis performed on residual aggregate and compared to blank [1(c) above]? ..... _____
   - (k) Asphalt contents determined? ..... _____
   - (l) If the asphalt contents differ by more than 0.15 percent:
     - (1) Test repeated with two more samples? ..... _____
     - (2) Highest and lowest result discarded from the four tests? ..... _____
     - (3) Correction factor determined from the two remaining results? ..... _____
   - (m) Convection-type furnace - if correction factor exceeds 1.0 percent, test repeated at 482 ± 5°C (900 ± 8°F), and the resulting correction factor used for further testing? ..... _____
   - (n) One of the following
     - (1) Test temperature is the same as that of correction factor? ..... _____
     - (2) Direct irradiation-type furnace - DEFAULT burn profile used for most materials? ..... _____

     Note: Burn profile OPTION 1 or OPTION 2 may be selected to optimize burn cycle?
     OPTION 1 is designed for samples with correction factor greater than 1.0 percent.
     OPTION 2 is designed for samples that may not burn completely using DEFAULT burn profile.

Note. AASHTO only: Historical data or scientific studies may be used to determine the correction factor(s) in lieu of using this testing procedure if the testing agency provides reference to the studies/data.

2. *Aggregate Correction Factor (AASHTO Only)*
   - (a) Aggregate correction factor determined for aggregates known for excessive breakdown or from an unknown source? ..... _____
   - (b) Gradation analysis performed on residual aggregate for each correction factor sample? ..... _____
     Note: residual aggregate is the aggregate removed from the ignition oven when determining the asphalt content correction factor.
   - (c) Difference between percent passing a given sieve in the correction factor samples and in the blank sample determined and the average difference calculated?
   - (d) If the average difference is greater than allowable, correction factor average for any sieve (equal to resultant average difference) for all sieves applied to all test results? ..... _____
     - (1) Sieves larger than or equal to 2.36-mm (No. 8) allowed 5% difference? ..... _____
     - (2) Sieves larger than or equal to 75-µm (No. 200) allowed 3% difference? ..... _____
     - (3) Sieves smaller than 75- µm (No. 200) (or bottom pan) allowed 0.5% difference? ..... _____

COMMENTS (T308): (T308)

DETERMINING THE ASPHALT CONTENT OF HMA BY THE IGNITION METHOD (T308) _____ **(D6307)** _____

PROCEDURE Date: _____

3. Calibration Factor (ASTM only)

(a) Calibration performed for each change in mix design or ingredients? _____
(b) Sample approximately the same mass and gradation as that to be used for the HMA test sample? _____
(c) Aggregate oven dried to constant mass (no temperature specified)? _____
(d) Aggregate, asphalt cement, and all mixing bowls and tools heated to approx. 150°C? _____
(e) Butter mix prepared to condition bowl? _____
(f) Three calibration samples mixed at the design asphalt content? _____
(g) Freshly mixed specimens placed directly into baskets? _____
(h) Specimens tested according to method? _____
(i) Asphalt contents determined:

Convection-type furnace

(1) Test temperature is the same as that of calibration (540 ± 5°C)? _____
(2) If the calibration factor exceeds 1.0 percent, lower the temperature to 482 ± 5°C and repeat. Factor obtained at 482°C used even if it exceeds 1.0 percent? _____

or

Direct irradiation –type furnace

(3) Burn profile set to DEFAULT for most materials? _____
(4) Burn profile OPTION 1 or OPTION 2 may be selected to optimize burn cycle? _____
Note: OPTION 1 is designed for aggregates with correction factor greater than 1.0 percent.
OPTION 2 is designed for samples that may not burn completely using DEFAULT burn profile.

(j) Calibration factor determined by calculation below? _____

$$C_F = \frac{(B - A) * 100}{B} - P$$

Where: ***B =*** *total mass Before ignition*; ***A =*** *total mass After ignition*; ***P =*** *% of asphalt cement by mass of the total mix*

(k) Average of the three taken and used as the calibration factor? _____

4. Sample Preparation

(a) Mixture warmed in an oven at 110 ± 5°C (230 ± 9°F) until it can be handled if necessary? _____
(b) Sample not warmed in oven for extended period of time? _____
(c) Particles of mixture separated with spatula or trowel? _____
(d) Sample obtained by reducing a larger sample **[*ASTM: by splitting or quartering*]**? _____
(e) Sample mass at least as much as indicated on table below? _____
1200 g for No. 4 **[*ASTM: 500 g for No. 4*]**? _____
1200 g for 3/8 in. **[*ASTM: 1000 g for 3/8 in.*]**? _____
1500 g for 1/2 in.? _____
2000 g for 3/4 in.? _____
3000 g for 1 in.? _____
4000 g for 1 1/2 in.? _____
(f) *AASHTO only: Specimen mass not more than 500 g greater than the minimum recommended mass?* _____
(g) Sample divided into suitable increments and tested if necessary? _____

COMMENTS (T308 / D6307): (T308 / D6307)

DETERMINING THE ASPHALT CONTENT OF HMA BY THE IGNITION METHOD (T308) _____ **(D6307)** _____

PROCEDURE (Continued) Date: _____

5. Ignition Procedure by Method A

(a) Convection-type furnace preheated to 538°C (1000°F) or the correction factor temperature **[*ASTM: 540* ± *5°C*]**? ..... _____

or Direct Irradiation-type furnace use the same burn profile as used to determine the correction factor? .. _____

(b) *AASHTO only: Convection-type furnace, temperature recorded prior to test (can be automatic)?* ..... _____

(c) Sample dried to constant mass at 105 ± 5°C (221 ± 9°F) **[*ASTM: 110* ± *5°C*]**?..... _____

or Test specimen for moisture determination obtained if necessary and moisture content determined according to (T110 / D1461)? ..... _____

(d) *AASHTO only: Correction factor entered for the mix or manually recorded?* ..... _____

(e) Basket(s) placed in catch pan and weighed with guards in place?..... _____

(f) *AASHTO only: Sample evenly distributed in the basket, material kept away from edges and leveled?* _____

(g) Total mass of the sample, basket, catch pan and basket guards recorded? ..... _____

(h) Initial mass of the specimen calculated?..... _____

(i) *AASHTO only: Initial mass entered into the furnace controller and verified?*..... _____

(j) Baskets placed in the furnace and chamber door closed? ..... _____

(k) *AASHTO only: Furnace scale agrees within 5 g of the total mass?* ..... _____

(l) Pressing the start button locks the door and starts the blower?..... _____

(m) Test continued until change in mass does not exceed 0.01 percent for three consecutive minutes?..... _____

***Note,** AASHTO only: Ending mass loss percentage of 0.02 percent may be used for excessive aggregate loss.)*

6. *AASHTO Only, Method A (continued)*

(a) *Pressing the stop button unlocks the door and prints the test results?* ..... _____

(b) *Corrected asphalt content (%) from the printed ticket reported?*..... _____

or *If asphalt content on ticket is not corrected, the asphalt binder correction factor subtracted?*..... _____

or *Percent moisture subtracted from the printed ticket and the resultant value reported?*..... _____

(c) *Baskets removed and allowed to cool to room temperature for approximately 30 minutes?*..... _____

7. ***ASTM Only, Method A (continued)***

(a) ***Final mass obtained by subtracting the mass loss by the furnace from the initial mass of the mix?..*** _____

(b) ***Corrected asphalt content calculated by the formula below?*** ..... _____

Note: The furnace may measure and record this information.

$$\%AC = \frac{(B - A) * 100}{B} - C_F$$

Where: ***B =*** ***total mass Before ignition***

A = ***total mass After ignition***

C_F = ***calibration factor***

COMMENTS (T308 / D6307): (T308 / D6307)

DETERMINING THE ASPHALT CONTENT OF HMA BY THE IGNITION METHOD (T308) _____ **(D6307)** _____

PROCEDURE (Continued) Date: _____

8. Ignition Procedure, Method B

(a) Furnace preheated to 538°C (1000°F) or the correction factor temperature **[*ASTM: 540 ± 5°C*]**? ..... _____

(b) Sample dried to constant mass at 105 ± 5°C (221 ± 9°F) **[*ASTM: 110 ± 5°C*]**?..... _____

or *AASHTO only: Test specimen for moisture determination obtained if necessary and moisture content determined according to (T110 / D1461) or by other suitable method?* ..... _____

(c) *AASHTO only: Correction factor recorded for the mix?* ..... _____

(d) Basket(s) placed in catch pan and weighed with guards in place?..... _____

(e) *AASHTO only: Sample evenly distributed in the basket, material kept away from edges and leveled?* _____

(f) Total mass of the sample, basket, catch pan and basket guards recorded? ..... _____

(g) Initial mass of the specimen calculated?..... _____

(h) Sample burned in the furnace for at least 45 minutes?..... _____

(i) Sample removed and allowed to cool to room temperature at least 30 minutes **[*ASTM: 10 minutes*]**? _____

(j) Sample weighed after ignition to the nearest 0.1 g? ..... _____

(k) Sample placed back in the furnace?..... _____

(l) Sample burned for at least 15 minutes after reaching set temperature? ..... _____

(m) Steps (i) through (l) repeated until change in mass does not exceed 0.01 percent of the initial sample mass? ..... _____

***Note,** AASHTO only: Ending mass loss percentage of 0.02 percent may be used for excessive aggregate loss.)*

(n) Corrected asphalt content (%) determined by calculation listed as ASTM above?..... _____

or *AASHTO only: If a moisture content has been determined, subtract the percent moisture from the AC percent, and report the resultant value as the corrected asphalt binder content?*..... _____

9. Gradation (AASHTO only)

(a) Contents emptied into a flat pan, including any residual fines? ..... _____

(b) Gradation analysis performed according to T30?..... _____

(c) Sample allowed to cool to room temperature in sample baskets? ..... _____

10. Report (ASTM only)

***(a) Mass of HMA sample before and after ignition (to nearest 0.1 g) included on report?*..... _____**

***(b) Measured asphalt content (to nearest 0.01%) included on report?*..... _____**

COMMENTS (T308 / D6307): (T308 / D6307)

PREPARING HMA SPECIMENS BY MEANS OF THE SUPERPAVE GYRATORY COMPACTOR (T312) _____ **(D6925)** _____

APPARATUS Date: _____

1. Gyratory Compactor
   (a) Manufacturer: _____
   (b) *AASHTO: Capable of applying a pressure of 600 ± 18 kPa?* ..... _____
   ASTM: Capable of applying a constant vertical pressure of 600 ± 60 kPa during the first five gyrations, and 600 ± 18 kPa during the remainder of the compaction process? ..... _____
   (c) ***ASTM only: Axis of the loading ram perpendicular to the platen of the compactor?*** ..... _____
   (d) Gyrates specimen molds at 30.0 ± 0.5 r/min? ..... _____
   (e) Records height of specimen to 0.1 mm during compaction once per gyration [*AASHTO: if density is monitored during compaction*]? ..... _____
   (f) Applies:
      (1) An average internal angle of 20.2 ± 0.35 mrad (1.16 ± 0.02 degrees)? ..... _____
      or (2) ***ASTM only: An external angle of 21.8 ± 0.4 (1.25 ± 0.02 degrees)?*** ..... _____

2. 150-mm (6-in.) diameter gyratory molds and base plates: as specified in T312/D6925? ..... _____
   Note to Assessors: *150-mm diameter molds are required for determination of volumetric properties of the specimen. The laboratory may use 100-mm diameter molds if volumetric properties are not determined. Indicate below and on the preliminary report if the laboratory is determining volumetric properties and 150-mm diameter molds are not available.*

3. Balance, *AASHTO: G5 balance (readable to 1 g)?* ..... _____
   ASTM: Minimum capacity of 10,000 grams with a sensitivity of 0.1 grams? ..... _____

4. Ovens – forced draft oven capable of being thermostatically controlled to ± 3°C? ..... _____
   ASTM: Two ovens recommended:
   One forced draft oven capable of maintaining the temperature required, nominally 135°C? ..... _____
   One oven shall have a range to a minimum of 204°C for heating aggregates, binder, and equipment? ..... _____

5. Thermometers - armored, glass or dial-type with metal stems, range of at least 10 - 232°C? ..... _____
   ASTM only: minimum sensitivity of 3°C? ..... _____

6. Standardization: *AASTHO: in accordance with AASHTO TP 71 (at least every 12 months)?* ..... _____
   ASTM: in accordance with manufacturer's instructions (usually 12 months)? ..... _____
   Have the following been verified? Check records.
   (a) Ram pressure? ..... _____
   (b) Angle of gyration? ..... _____
   (c) Gyration frequency? ..... _____
   (d) LVDT (or other device to continuously record height)? ..... _____
   (e) Mold dimensions? ..... _____
   (f) Plate faces? ..... _____
   (g) Oven temperature? ..... _____
   Note, ASTM only: *If manufacturer's instructions are not available these pieces of equipment should be checked at the following intervals: angle of gyration, vertical pressure, and height measurement system (monthly); frequency of gyration (quarterly); mold and platen dimensions (annually).*

COMMENTS (T312 / D6925): (T312 / D6925)

PREPARING HMA SPECIMENS BY MEANS OF THE SUPERPAVE GYRATORY COMPACTOR (T312) _____ **(D6925)** _____

PROCEDURE Date: _____

Preparation of Apparatus

1. Main power for compactor turned on for manufacturer's required warm-up period? ..... _____
2. Angle, pressure and number of gyrations set? ..... _____
3. Bearing surfaces lubricated as needed per manufacturer's instructions? ..... _____

Preparation of Mixtures (**Laboratory** mixed)

1. Aggregate fractions weighed into separate pan and combined to desired batch weight? ..... _____
2. If specimens are used for determination of volumetric properties, are the batch weights adjusted to result in a compacted specimen 150 mm in diameter and 115 mm in height? ..... _____
3. Aggregate and binder placed in oven and heated to required mixing temperature? ..... _____
4. ***ASTM only: Mixing implements heated to mixing temperature?*** ..... _____
5. Mixing and compacting temps. determined from a temperature-viscosity chart (T316/D4402)? ..... _____
6. Mixing temperature based on viscosity of 0.17 ± 0.02 Pa·s and compaction temperature based on viscosity of 0.28 ± 0.03 Pa·s **[*ASTM: temperatures based on viscosity of 0.17 ± 0.02 Pa·s*]**? ..... _____
7. Mixing bowl charged with heated aggregate and thoroughly dry-mixed? ..... _____
8. Crater formed in aggregate and binder added? ..... _____
9. Aggregate and binder mixed quickly and thoroughly? ..... _____
10. Mix placed in pan and aged [*AASHTO only: in accordance with R30*]? ..... _____
11. Mix kept in oven 2 hours ± 5 minutes at compaction temperature ± 3°C (Volumetric Design)? ..... _____
12. Mixture stirred every 60 ± 5 minutes to maintain uniform aging? ..... _____
13. *AASHTO only: Mold and base plate preheated to compaction temperature for at least 30 minutes?* ..... _____
    ASTM only: Compaction mold assembly preheated to compaction temp. ± 5°C for at least 45 minutes? ..... _____
14. Mix removed from oven and immediately compacted? ..... _____
15. *AASHTO only: If the compaction temperature differs from the conditioning temperature used in accordance with R30, mix placed in oven at compaction temperature, maximum 30 min., to achieve the required temp.?* .... _____

Preparation of Mixtures (**Plant** sample)

1. *AASHTO: Loose mix brought to compaction temp. by uniform heating in an oven prior to molding?* ..... _____
   ASTM: For samples of as-produced mixture, follow one of the following short-term aging procedures:
   (a) No conditioning- compacted immediately as produced? ..... _____
   or (b) Condition for 2 h ± 5 min. at the compaction temperature ± 3°C, stirring after 60 ± 5 min? ..... _____
   or (c) Any conditioning method which has been demonstrated to replicate design conditioning? ..... _____

COMMENTS (T312 / D6925): (T312 / D6925)

PREPARING HMA SPECIMENS BY MEANS OF THE SUPERPAVE GYRATORY COMPACTOR (T312) _____ **(D6925)** _____

PROCEDURE (Continued) Date: _____

Compaction Procedure

1. Mold, base plate, and upper plate (if required) removed from oven and paper disk placed on bottom of mold?.. _____
2. Mixture placed into mold in one lift, mix leveled, and paper disk and upper plate (if required) placed on top of material **[*ASTM only: Quickly place mix into mold using a transfer bowl or other suitable device*]**? ..... _____
3. Mold loaded into compactor and a pressure of 600 ± 18 kPa applied? ..... _____
4. Internal angle of 20.2 ± 0.35 mrad (1.16 ± 0.02 degrees) applied to the mold and compaction started? ..... _____
   or ***ASTM only: External angle of 1.25 ± 0.02° (22 ± 0.35 mrad) applied to the mold and compaction started?..*** _____

5. *AASHTO: Compactor shuts off when desired number of gyrations are reached?* ..... _____
   N_{design}: 50, 75, 100, 125 ***or*** *N_{max}: 75, 115, 160, 205*

   ASTM: Compaction shall proceed until the desired endpoint – either a required number of gyrations (volumetric properties), or a specified height (physical property testing)? ..... _____

6. *AASHTO only: No leveling off load applied (dwell gyrations, reverse gyrations, or square load), unless specified in another standard referencing T312?* ..... _____
   Note to Assessors: *The following is guidance for certain models of gyratory compactors. If a delay is being applied a counter will often be displayed counting down [Reference: LAP technical bulletin 1-08].*

   Pine Model AFGB Compactor - requires a dwell setting of "2" for no delay. This does not mean a 2-second delay.
   Pine Models AFG1 & AFGC125X – may indicate "Compaction Complete, Squaring specimen, please wait" but this is ok. The ram will retract immediately after the angle is removed, which is correct.

7. Mold removed and specimen extruded (may require cooling time before extruding)? ..... _____
8. Paper disks removed? ..... _____
9. If specimens are used for determination of volumetric properties, is the compacted specimen 150 mm in diameter and 115 ± 5 mm in height at the desired number of gyrations? ..... _____

Density Procedure

1. Maximum specific gravity (T209/D2041) determined on companion sample aged to same extent? ..... _____
2. Bulk specific gravity (T166/D2726 or T275/D1188) of specimen determined? ..... _____
3. Height recorded to nearest 0.1 mm after each revolution (when monitored)? ..... _____

Note to assessors: the relative density at any given gyration of interest can be determined as follows

$G_{mbx} = G_{mbfinal} (h_{final} / h_x)$ (1)

$\% G_{mm} = (G_{mbx} / G_{mm}) * 100$ (2)

Where:

G_{mbx} = bulk specific gravity of the extruded specimen, at any gyration, x
G_{mm} = maximum theoretical specific gravity of the mixture (companion sample)
h_{final} = height of the specimen recorded at the final gyration, mm
h_x = height of the specimen recorded at any gyration, x, during the compaction process, mm
$G_{mbfinal}$ = bulk specific gravity of the extruded specimen at the final gyration
$\% G_{mm}$ = relative density at any gyration, x, expressed as a percentage of the maximum theoretical specific gravity, to the nearest 0.1 % at selected number of gyrations.

COMMENTS (T312 / D6925): (T312 / D6925)

HAMBURG WHEEL-TRACK TESTING OF COMPACTED HMA (T324)

APPARATUS Date: _____

1. Hamburg Wheel-Tracking Machine
   - (a) Electrically powered machine capable of moving a 203.2-mm (8-in.) diameter, 47-mm (1.85-in.) wide steel wheel over a test specimen? _____
   - (b) The load on the wheel is 705 ± 4.5 N (158 lb ± 1.0 lb) while traveling back and forth across the specimen? _____
   - (c) Wheel makes approximately 50 passes across the specimen per minute? _____
   - (d) The speed of the wheel is approximately 0.305 m/s (1 ft/sec) and is reached at the midpoint of the specimen? _____

2. Temperature Control System
   - (a) Water bath controlled to within ± 1.0°C (1.8°F) over a range of 25 to 70°C (77 to 158°F)? _____
   - (b) Water bath has a mechanical circulating system to stabilize the temperature in the specimen tank? _____

3. Impression Measurement System
   - (a) An LVDT device capable of measuring the depth of the impression of the wheel within 0.01 mm (0.0004 in.), over a minimum range of 0 to 20 mm (0.8 in.)? _____
   - (b) System mounted to measure the depth of the impression at the midpoint of the wheel's path on the slab specimen? _____
   - (c) Impression measured at least every 400 passes of the wheel? _____
   - (d) System capable of measuring rut depth without stopping the wheel? _____

4. Wheel Pass Counter
   - (a) Non-contacting solenoid that counts each wheel pass over the specimen? _____
   - (b) Data from signal of counter coupled to wheel impression measurement, allowing for rut depth to be expressed as a function of wheel passes? _____

5. Specimen Mounting System
   - (a) Stainless steel tray that can be mounted rigidly to the machine? _____
   - (b) Mounting restricts shifting of the specimen to within 0.5 mm (0.02 in.) during testing? _____
   - (c) System suspends the specimen, allowing for free circulation of the water bath on all sides? _____
   - (d) Minimum of 20 mm (0.8 in.) of free circulating water on all sides of the specimen? _____

6. Balance, capacity of 12,000 g, accurate to 0.1 g? _____

7. Oven - for heating aggregate and asphalt binders? _____

8. Superpave Gyratory Compactor and molds, conforming to AASHTO Test Method T312? _____
   Note to Assessors: *this is only needed if the laboratory is testing gyratory specimens in the wheel tester.*

9. Plaster of Paris - mixed at approximately a 1:1 ratio of plaster to water? _____
   or Plastic mounting sheets? _____

COMMENTS (T324): (T324)

HAMBURG WHEEL-TRACK TESTING OF COMPACTED HMA (T324)

PROCEDURE Date: _____

Calibration / Equipment Verification (Optional)

1. Water bath temperature is verified within ± 1.0°C (1.8°F) of the temperature readout every 6 months? ..... _____
2. LVDT height verified to within ± 0.05 mm (0.002 in.) between the three (10. 20, and 30 mm) (0.4, 0.8, and 1.2 in.) calibration blocks? ..... _____
3. Wheel force verified, mid-stroke, at the correct level elevation, to be 705 ± 4.5 N (158 ± 1.0 lb)? ..... _____
   Note to Assessors: *A calibrated load cell, accurate to 0.4 N (0.1 lb) is sufficient to perform this check.*
4. Steel wheel reciprocating back and forth on the test sample at 50 ± 5 passes per minute verified?..... _____

Specimen Preparation

1. At least two specimens prepared for each test?..... _____
2. Slab specimens or cylinders? ..... _____

Circle One: Slab Specimen Core or Gyratory Specimen

3. Either laboratory-produced HMA or field-produced HMA?..... _____

Laboratory-Produced HMA:

mixing temp. range: _____ to _____ compaction temp. range: _____ to _____

1. Mixture proportions batched in accordance with the desired job-mix formula? ..... _____
2. Mixing temp. is the temperature the asphalt binder must be heated to achieve a viscosity of 170 ± 20cSt?..... _____
3. Mixing temperature recommended by the manufacturer used for modified binders? ..... _____
4. Aggregates and mineral admixture (if used) dry-mixed? ..... _____
5. Correct percent of asphalt binder added and mixed until all aggregates are thoroughly coated?..... _____
   Note to Assessors: *The aggregates can be wet-mixed if a lime slurry or other wet materials are used.*
6. Test sample conditioned at the appropriate compaction temperature in accordance with the short-term conditioning procedure in R 30? ..... _____
7. Compaction temp. is the temperature the asphalt binder must be heated to achieve a viscosity of 280 ± 30cSt? . _____
8. If using modified binders, is the compaction temperature recommended by the manufacturer used? ..... _____

Laboratory Compaction of Specimens – **Slab** Specimens

1. Compacted into slabs using a Linear Kneading Compactor (or equivalent)?..... _____
2. Specimens are 320 mm (12.5 in.) long and 260 mm (10.25 in.) wide? ..... _____
3. Slab thickness is between 38 mm (1.5 in.) and 100 mm (4 in.)? ..... _____
4. Slab thickness is at least twice the nominal maximum aggregate size? ..... _____
5. Compacted specimen cooled at normal room temperature on a clean, flat surface until the specimen is cool to the touch? ..... _____

Laboratory Compaction of Specimens – **Gyratory** Specimens

1. Material compacted into specimens using a Gyratory compacter according to AASHTO T312? ..... _____
2. Specimen thickness is between 38 mm (1.5 in.) and 100 mm (4 in.)? ..... _____
3. Specimen thickness is at least twice the nominal maximum aggregate size?..... _____
4. Two specimens prepared? ..... _____
5. Compacted specimen cooled at normal room temperature on a clean, flat surface until the specimen is cool to the touch? ..... _____

COMMENTS (T324): (T324)

HAMBURG WHEEL-TRACK TESTING OF COMPACTED HMA (T324)

PROCEDURE (Continued) Date: _____

Core / Slab Specimens

1. Specimens are wet saw-cut compacted specimens taken from HMA pavements? _____
2. Specimen size:
   (a) Field core is 250 mm (10 in.) in diameter and may be 38 mm (1.5 in.) high? _____
   or (b) Cut slab specimen is approximately 260 mm (10.25 in.) wide and 320 mm (12.5 in.) long and 38 mm (1.5 in. high)? _____

Determining air void content

1. Bulk specific gravity determined in accordance with AASHTO T166? _____
2. Maximum specific gravity of the mixture determined in accordance with AASHTO T209? _____
3. Air void of the specimens determined in accordance with AASHTO T269? _____
4. Air voids:
   (a) Air void of laboratory-compacted specimens is 7.0 ± 2.0 percent? _____
   or (b) Field specimens (cores / cut slabs) tested at the air void content at which they were obtained? _____

Procedure

1. Plaster of Paris used to mount the specimens in the mounting trays? _____
2. Plaster poured to a height equal to that of the specimen so that the air space between the specimen and the tray is filled? _____
3. Plaster layer underneath the specimen does not exceed 2 mm (0.08 in.)? _____
4. Plaster set for at least 1 hour? _____
   Note: *If other mounting material is used, it should be able to withstand 890 N (200 lb) of load without cracking.*
5. Test temperature selected based upon the applicable specifications? _____
6. Drain valves closed and wheel-tracking device filled with hot water until the float device floats to a horizontal position? _____
7. After the water has reached the test temperature for 30 minutes, wheels lowered onto the specimens? _____
8. Micro-control unit's LVDT reads between 10 mm (0.4 in.) and 18 mm (0.7 in.) and test started? _____
9. Wheel-tracking device shut off when (a) 20,000 passes have occurred or (b) if the average LVDT displacement is 40.90 mm (1.6 in.) or greater for a specimen? _____
10. Screen readout subtracts the initial LVDT reading from the total displacement? _____
11. Machine and the main power supply turned off? _____
12. Valves opened to drain the bath, and the wheels raised and the rutted specimens and spacers removed? _____
13. Water baths, heating coils, wheels, and temperature probe cleaned with water and scouring pads? _____
14. Wet-dry vacuum used to remove particles that have settled to the bottom of the baths? _____
15. Filter element and spacers cleaned after every test? _____
16. Calculations performed according to the test method? _____

Report

1. HMA production (field or lab) and compaction method used? _____
2. Number of passes at the maximum impression and maximum impression? _____
3. Test temperature? _____
4. Specimen air voids? _____
5. Type and amount of anti-stripping additive? _____
6. Creep slope, strip slope, and stripping inflection point? _____

COMMENTS (T324): (T324)

MOISTURE CONTENT OF HOT-MIX ASPHALT (HMA) BY OVEN METHOD (T329)

APPARATUS

Date: _____

1. Oven, maintains 163 ± 14°C (325 ± 25°F)? ..... _____
2. Sample container, of sufficient size to contain the sample without danger of spilling? ..... _____
3. Balance, 2-kg (4.4-lb) capacity, readable to at least 0.1 g? ..... _____

PROCEDURE

1. Test sample obtained by AASHTO T248, Method B (quartering)? ..... _____
2. Minimum sample mass is 1000 g? ..... _____
3. Mass of the sample container determined to the nearest 0.1 g? ..... _____
4. Sample placed into the container, distributed evenly, and the temperature of the test sample determined? ..... _____
5. Mass of the sample container and moist test sample determined to the nearest 0.1 g? ..... _____
6. Mass of the moist test sample determined by subtracting the mass of the sample container from the total mass of the sample container and moist test sample? (M_i) ..... _____
7. Sample dried to constant mass within the mixing temperature for the Job Mix Formula (JMF)? ..... _____
8. If a mixing temperature range is not supplied, dried at 163 ± 14°C (325 ± 25°F)? ..... _____
9. Sample initially dried for 90 ± 5 minutes and mass determined? ..... _____
10. Sample then dried at 30 ± 5 minute intervals until a constant mass is reached? ..... _____
11. Test sample removed from oven and cooled to approximately the same temperature determined in Step 4? ..... _____
12. Mass of the sample container and dry test sample determined to the nearest 0.1 g? ..... _____
13. Mass of the final dry test sample determined by subtracting the mass of the sample container from the total mass of the sample container and dry test sample? (M_f) ..... _____
14. Moisture content calculated according to Section 7.1.1 or 7.1.2 (see below)? ..... _____

For AC content reported as % of HMA:

$$\% \text{ moisture} = \frac{M_i - M_f}{M_f} \times 100$$

Where: M_i = Before drying (moist mass)
M_f = After drying (dry mass)

COMMENTS (T329): (T329)

BULK SPECIFIC GRAVITY OF COMPACTED HMA USING AUTOMATIC VACUUM-SEALING METHOD (T331) _____ **(D6752)** _____

APPARATUS Date: _____

1. Balance
   (a) *AASHTO: Readable to 0.1 percent of the sample mass or better, conforming to M231?* _____
   ASTM: Has sufficient readability to determine bulk specific gravity to four significant figures (0.1 g for 130.0 to 999.9 g) (meets D4753, GP2)? _____
   (b) Equipped with an apparatus for weighing specimen while suspended in water? _____

2. Water Bath
   (a) Minimum dimensions of 610 x 460 x 460 mm (24 x 18 x 18 in.) or a large cylindrical container capable of completely submerging the specimen while suspended? _____
   (b) Equipped with an overflow outlet to maintain constant water level? _____
   (c) *AASHTO: Suspension wire of smallest practical size?* _____
   ASTM: Has a cushioned specimen holder, without sharp edges, for submerging samples? _____

3. Vacuum Chamber
   (a) Equipped with a pump capable of evacuating a sealed and enclosed chamber to a minimum pressure of 5 mm Hg absolute **[*ASTM: 10 mm Hg*]** in less than 60 seconds at sea level? _____
   (b) Chamber large enough to seal samples with dimensions of 150 x 350 x 150mm (6 x 14 x 6 in.)? _____
   (c) Automatically seals bag? _____
   (d) Exhausts air back into chamber in a controlled manner to ensure plastic conforms to specimen? _____
   (e) Air exhaust and vacuum operation time calibrated at factory prior to initial use? _____
   (f) Air exhaust system calibrated to bring chamber to atmospheric pressure in 80 to 120 seconds, after the completion of the vacuum operation? _____
   (g) Vacuum system provided with a latch to control the chamber door opening? _____

4. Vacuum Measurement Gauge
   (a) Independent from the vacuum sealing device? _____
   (b) *AASHTO: Calibrated gage capable of reading 1 mm Hg (1 torr) pressure with a minimum range of 10 to 0 mm Hg (10 to 0 torr)?* _____
   ASTM: Gauge capable of reading 3 mm Hg (3 torr) pressure? _____

5. Plastic Bags
   (a) One of the two following sizes:
      (1) Smaller bags: Openings from 235 to 260 mm (9.25 to 10.25 in.) **[*ASTM only: 241 mm to 260 mm (9.5 to 10.25 in.)*]**? _____
      (2) Larger bags: Openings from 375 to 394 mm (14.75 to 15.5 in.)? _____
   (b) Does not adhere to asphalt film? _____
   (c) Capable of withstanding temperatures of up to 70ºC (158ºF)? _____
   (d) Impermeable to water and is puncture resistant? _____
   (e) Contains no air channels for evacuation of air from bag? _____
   (f) Thickness of bags 0.100 to 0.152 mm (0.004 to 0.006 in.)? _____
   Note to assessors: measure the thickness with calipers.
   (g) Specific gravity known [*AASHTO: provided by manufacturer*]? _____

6. Additional Apparatus
   (a) Specimen sliding plate with a smooth, flat surface? _____
   (b) Bag cutting knife, scissors, or other type of clipping device? _____
   (c) ***ASTM only: For bag density verification, sufficient aggregate and AC to prepare a lab-compacted sample of 4.75 mm design mixture with min. dimensions of 100 mm diameter by 60 mm thick?*** _____
   (d) *AASHTO only: Drying oven?* _____
   (e) *AASHTO only: Thermometer, ASTM 17C (range 19 to 27 ºC, subdivisions of 0.1 ºC)?* _____
   or *AASHTO only: Thermometer, ASTM 17F (range 66 to 80 ºF, subdivisions of 0.2 ºF)?* _____
   or *AASHTO only: An electronic temperature measuring device?* _____

COMMENTS (T331 / D6752): (T331 / D6752)

BULK SPECIFIC GRAVITY OF COMPACTED HMA USING AUTOMATIC VACUUM-SEALING METHOD (T331) _____ **(D6752)** _____

PROCEDURE Date: _____

Sampling and Test Specimens

1. Type of specimens:
   - (a) Laboratory prepared specimens? ..... _____
   - **or** (b) Field samples **[*ASTM only: obtained in accordance with Practice D5361 (pavement cores)*]**?..... _____
2. Diameter of cylindrically molded or cored specimens, or the length of the sides of sawed specimens at least four times the maximum aggregate size?..... _____
3. Thickness of specimens at least 1 ½ times the maximum aggregate size?..... _____
4. Care taken to avoid distortion, bending, or cracking of specimen and stored in a cool, dry place?..... _____
5. *AASHTO: Sample conforms to the requirements of T166?* ..... _____

Verification

1. System Verification
   - (a) Vacuum settings of the device verified every three months, after repairs, and after each shipment or relocation? ..... _____
   - (b) Verification performed with an absolute vacuum gage capable of being set inside the chamber and reading the vacuum setting of the sealing device?..... _____
   - (c) Vacuum gage indicates a reading of 10 mm Hg (10 torr) or less? ..... _____
   - (d) ***ASTM only: Vacuum gage used for verification calibrated every 12 months?*****.....** _____
2. Plastic Bag Verification
   - (a) Plastic bag apparent specific gravity provided by manufacturer verified periodically?..... _____
   - (b) Laboratory compacted sample used to verify bags? ..... _____
     - (1) 4.75 mm mixture compacted by Marshall compactor or Gyratory compactor?..... _____
     - (2) Minimum sample diameter of 100 mm by 60 mm thick? ..... _____
     - (3) *AASHTO: Sample compacted to produce air voids in the range of 4.0 ± 1.0 percent?* ..... _____
       ASTM: Sample compacted to air voids in the range of 4% to 8% at 6% AC content?**.....** _____
   - (c) Average of results from three bags (per size) used to measure the bulk spec. gravity of the sample?.... _____
   - (d) Bulk specific gravity of the same sample determined using (T166 / D2726)?..... _____
   - ***(e)*** *AASHTO: Average bulk spec. gravity calculated for the lab-compacted specimen within 20 kg/m^3 (± 0.020 g/cm^3) of the bulk spec. gravity determined by T166 for the same asphalt sample?* .....
     ASTM: Average bulk spec. gravity calculated for the lab-compacted specimen within 10 kg/m^3 (± 0.010 g/cm^3) of the bulk spec. gravity determined by D2726 for the same asphalt sample?**.....** _____
   - (f) *AASHTO only: If difference between T166 and T331 bulk spec. gravity is outside of the tolerance, sample dried and verification repeated?* ..... _____
   - (g) *AASHTO only: Manufacturer contacted if second test fails?*..... _____

COMMENTS (T331 / D6752): (T331 / D6752)

BULK SPECIFIC GRAVITY OF COMPACTED HMA USING AUTOMATIC VACUUM-SEALING METHOD (T331) _____ **(D6752)** _____

PROCEDURE (Continued) Date: _____

Testing

1. Mass in air determination:
   - (a) Laboratory-prepared, dry specimens mass determined at room temperature? (*A*) _____
   - **or** (b) Cores and specimens containing moisture mass determined after drying to constant mass, [*AASHTO: at 52 ± 3°C (125 ± 5°F)*] or dried by D7227 (vacuum drying) less than 0.05% change between consecutive 15 minute drying intervals? (*A*) _____

2. ASTM only: Anything that would prevent the bag from complying with the sample removed by sawing? _____

3. Appropriate size bag selected and mass determined [*AASHTO only: and inspected for holes or damage?*]? _____
   - (a) Small bag used for all specimens with diameters of 100 mm (4 in.)? _____
   - (b) Small bag used for 150 mm (6 in.) diameter specimens with a thickness less than 50 mm (2 in.) **[*ASTM only: thickness less than 75 mm (3 in.)*]**? _____
   - (c) Large bag used for 150 mm (6 in.) diameter specimens with a thickness greater than 50 mm (2 in.) **[*ASTM only: thickness greater than 75 mm (3 in.)*]**? _____

   Note: *Use manufacturer's recommendation for specimens weighing more than 5500 g or abnormally shaped.*

4. AASHTO only: If needed, filler plates added or removed before inserting specimen? _____

5. Bag placed on top of specimen sliding plate inside vacuum chamber? _____

6. *AASHTO: Specimen placed in bag, smoothest side down?* _____
   ASTM: Specimen placed in bag without puncturing, dropping, or impacting the bag? _____

7. AASHTO only: End of bag pulled over the sample, centered over the sealing bar with at least 1 in. overlap? _____

8. Any wrinkles in the bag straightened just prior to closing the lid and latching the bar? _____

9. Chamber door latched to avoid automatic opening of door after the completion of the test? _____

10. Vacuum chamber allowed to remove air from chamber and bag and automatically seal bag? _____

11. Exhaust air into chamber until chamber door opens indicating atmospheric pressure within the chamber? _____

12. Sealed sample removed from the vacuum chamber without puncturing bag? _____

13. *AASHTO: Mass of sealed specimen in air determined? (B)* _____
    ASTM: Sample immediately placed in water bath at 25 ± 1ºC (77 ± 1.8ºF) and mass determined? _____

14. AASHTO only: Specimen fully submerged in bath and no air bubbles entrapped under specimen? _____

15. AASHTO only: Mass of sealed specimen in a water bath at 25 ± 1ºC (77 ± 1.8ºF) determined? (E) _____

Note: *The time between the lid opening and putting the specimen in the water bath should not exceed 1 min.*

16. ASTM only: If temperature differs from specified range, is a correction to the bulk specific gravity to 25ºC made in accordance with Section 8.3? _____

17. Sample removed from bag and mass determined? (*C*) _____

18. Specimen's new mass in air (*C*) checked against the initial mass (*A*) and if the check fails is test restarted? _____
    - (a) *AASHTO: check passes if less than 0.08 % is lost or no more than 0.04 % is gained?* _____
    - ***(b) ASTM: check passes if dry mass after test < (the initial dry mass + 5 g)?*** _____

19. AASHTO only: Specimen oven or vacuum dried to constant mass prior to recording specimen dry mass? _____

20. AASHTO only: Specimen must be vacuum dried for referee testing? _____

21. ASTM only: Specimen dry mass after procedure recorded? _____

22. Bulk specific gravity calculated according to the method to four significant figures (see formula below)? _____

Note to Assessors: *The formula given below is the ASTM version. The AASHTO version is slightly different and uses different letters to designate the values.*

$$G_{mb} = \frac{A}{[C+(B-A)] - E - [(B-A)/F]}$$

A = initial dry mass of specimen, g
B = mass of sealed specimen in air, g
C = dry mass in air at end of test without bag, g
E = mass of sealed specimen in water at 25ºC, g
F = spec. gravity of bag to nearest 0.001
G_{mb} = specimen bulk specific gravity

23. Density of the specimen calculated and reported to nearest 0.001 (see formula below)? _____

$$\tilde{n} = G_{mb} * \tilde{a}$$

G_{mb} = specimen bulk specific gravity
$\tilde{a}$ = density of water at 25ºC (77ºF), 0.999 g/cm^3
$\tilde{n}$ = density of specimen kg/m^3 (lb/ft^3)

COMMENTS (T331 / D6752): (T331 / D6752)

EFFECT OF WATER ON COHESION OF COMPACTED HMA (D1075) _____

APPARATUS Date: _____

1. Water Bath at 25°C (77°F)
   - (a) Sufficient size to permit total immersion of 3 specimens? _____
   - (b) Temperature: 25 ± 1°C (77.0 ± 1.8°F)? _____

2. Water Bath at 49 or 60°C (120 or 140°F)
   - (a) Automatic temperature control, capable of controlling temperature to ± 1°C (± 1.8°F)? _____
   - (b) Lined with copper, stainless steel, or other non-reactive material? _____
   - (c) Sufficient size to permit total immersion of 3 specimens? _____
   - (d) Is bath emptied, cleaned, and refilled for each series of tests? _____
   - (e) Water in bath: distilled or treated to eliminate electrolytes? _____

3. Air Bath, capable of being maintained at 25 ± 1°C (77.0 ± 1.8°F) for 4 hours? _____

4. Transfer Plates
   - (a) Flat; glass, metal, or other non-reactive material; at least 3 available? _____
   - **or** (b) One large transfer plate sufficient to hold all three specimens? _____

5. Compressive Strength Testing Machine available [required for test method T167 (***D1074***)]? _____

6. Apparatus for T166, Method A / D2726, Method A? _____

COMMENTS (D1075): (D1075)

EFFECT OF WATER ON COHESION OF COMPACTED HMA (D1075) _____

PROCEDURE Date: _____

Test Specimens

1. At least six 102 x 102 mm diameter specimens prepared in accordance with (T167/D1074)? _____

Determination of Bulk Specific Gravity (sequence of steps optional)

1. Specimens allowed to cool at least 2 hrs. after removal from curing oven? _____
2. Oven-dry mass of each specimen determined? _____
3. Each specimen immersed for 3 to 5 minutes in water at 25 ± 1°C? _____
4. Immersed mass of specimen recorded? _____
5. Blotted quickly with damp towel? _____
6. Surface-dry mass of each specimen determined? _____
7. Bulk specific gravity of each specimen calculated? _____

Procedure

1. Each set of six specimens separated into groups of three specimens each so that the average bulk specific gravity of Group 1 is essentially the same as that of Group 2? _____
2. Transfer plates kept under each specimen during immersion period and handling except when weighing and testing? _____
3. Test specimens in each group tested as follows:

   Group 1

   (a) Specimens stored in air bath at 77.0 ± 1.8°F (25 ± 1°C) for at least 4 hours? _____
   (b) Compressive strength of each Group 1 specimen by (T167 / D1074)? _____

   Group 2

   (a) Specimens on transfer plates immersed in water at 140.0 ± 1.8°F (60 ± 1°C) for 24 hrs? _____
   (b) Specimens transferred to water bath at 77.0 ± 1.8°F (25 ± 1°C) for 2 hrs? _____
   (c) Compressive strength of each Group 2 specimen by (T167 / D1074)? _____

   Group 2, Alternate Procedure

   (a) Specimens on transfer plates immersed in water at 120.0 ± 1.8°F (49 ± 1°C) for 4 days? _____
   (b) Specimens transferred to water bath at 77.0 ± 1.8°F (25 ± 1°C) for 2 hrs? _____
   (c) Compressive strength of each Group 2 specimen by (T167 / D1074)? _____

Calculations

Numerical index of resistance to water calculated according to equation below? _____

$$\text{Index of retained strength, \%} = (S_2 / S_1) \times 100$$

Where: S_1 = Compressive strength of dry specimens (Group 1)
S_2 = Compressive strength of immersed specimens (Group 2)

COMMENTS (D1075): (D1075)

DENSITY OF BITUMINOUS CONCRETE IN PLACE BY NUCLEAR METHODS (D2950) _____

APPARATUS Date: _____

Nuclear Device:

1. An electronic counting instrument capable of being seated on the surface of the material to test? _____
2. A sealed high energy gamma source such as cesium or radium? _____
3. Equipped with a gamma detector such as a Geiger-Mueller tube? _____

Reference Standard Block: A block of dense material able to produce reference count rates? _____

Site Preparation Device:

1. A metal plate, straightedge, or suitable leveling tool capable of conditioning the test surface to the required smoothness? _____
2. Drive Pin:
   (a) A steel rod of slightly larger diameter than the rod in the direct transmission instrument? _____
   or (b) A drill capable of creating a perpendicular hole? _____

CALIBRATION

When to calibrate:

1. New gages initially calibrated? _____
2. Existing gages calibrated to re-establish calibration curves, tables, or equivalent coefficients at least once each year and after all major repairs? _____

Calibration Requirements:

1. Calibrations completed in accordance with manufacturer's recommended procedures? _____
2. Calibration produces calibration response within ± 16 kg/m^3 (± 1.0 lb/ft^3) on standard blocks or material of established and constant densities (can be done by manufacturer, user, or independent vendor)? _____
   Note: *one-point calibration is not acceptable.*
3. The densities of the materials used to establish or verify the calibration extend through a range wide enough to include the types and densities on the in-place materials to be tested? _____
4. Blocks used to establish calibration identified on the calibration data sheets? _____

STANDARDIZATION

Records:

1. Standardization performed at the start of each day's work? _____
2. Permanent records of this data retained? _____

Location:

1. Standardization performed with apparatus located at least 8 m (25 ft) away from other radioactive sources? _____
2. Area clear of large mass or other items that could affect the reference count? _____

Reference Count:

1. Device turned on prior to standardization and allowed to stabilize? _____
   Note: *Follow manufacturer's instructions in order to provide the most stable and consistent results.*
2. Placed on reference standard block? _____
3. At least four repetitive reading at normal measurement period obtained to determine the mean? _____
   Note to Assessors: *One measurement of four or more times the normal period is acceptable.*

COMMENTS (D2950): (D2950)

DENSITY OF BITUMINOUS CONCRETE IN PLACE BY NUCLEAR METHODS (D2950) _____

STANDARDIZATION (Continued) Date: _____

4. Are current day count ratios determined using the following equation? ..... _____

$$\left|N_s - N_o\right| \le 2.0\sqrt{N_o F}$$

N_s = value of current standard count
N_o = average of past four values of N_s taken previously
F = value of any pre-scale (a divisor supplied by the manufacturer)

5. If the value is outside of limits, is the device allowed additional stabilization time before repeating procedure? _____
6. If the device fails a second time, is the device adjusted or repaired as recommended by the manufacturer?..... _____
7. If measured densities become suspect, is another standardization count performed? ..... _____

PROCEDURE

Nuclear Device:
1. Instrument turned on prior to use and allowed to stabilize?..... _____
2. Power left on during the entire day's testing? ..... _____

Site Preparation:
1. If the instrument will be closer than 250 mm (10 in.) to any vertical mass, manufacturer's correction procedure followed?..... _____
2. Test site leveled with the guide / scraper plate? ..... _____
3. Native fines or fine sand used to fill voids on the site surface? ..... _____
4. Maximum void does note exceed 6 mm (1/4 in.)? ..... _____

Backscatter Method:
1. Device placed on prepared test site? ..... _____
2. Count taken for normal measurement period? ..... _____
3. If the Air Gap Technique is used, an additional measurement taken in the air-gap position as recommended by manufacturer (rare)?..... _____
4. Ratio of the reading compared to the standard count or the air gap count?..... _____

Direct Transmission Method:
1. Guide / scraper plate placed on test site? ..... _____
2. Steel rod driven to a depth of at least 25 mm (1 in.) deeper than the desired measurement depth? ..... _____
3. Guide plate removed and device placed on prepared test site? ..... _____
4. Source rod lowered to proper position? ..... _____
5. Instrument moved so that the rod is firmly against the side of the hole in the gamma measurement path? ..... _____
6. Ratio of the reading compared to the standard count? ..... _____

Calculations:
1. In-place density (bulk or wet density) determined from the ratio and the calibration and adjustment data?..... _____
   Note: *Some instruments may have built-in provisions to compute the ratio and density. Otherwise, calibration charts, tables, equations, or coefficients may be used.*
2. Adjustment bias may be calculated by comparing the results from instrument measurements to results D2726 (Bulk Specific Gravity of Bituminous Mixtures)? ..... _____
3. Compared to laboratory test to determine acceptability? ..... _____

COMMENTS (D2950): (D2950)

PREPARATION OF TEST SPECIMENS OF BITUMINOUS MIXTURES BY MEANS OF GYRATORY SHEAR COMPACTOR (D4013)

APPARATUS Date: _____

1. Gyratory Shear Compactor
   - (a) Platen and ram face ground flat? _____
   - (b) Low pressure gauge with resolution of ±0.3 psi (±2.0 kPa) capable of displaying:
     - (1) Pregyration stress of 31.8 psi (219 kPa) (400 lbf total on 4-in. specimen)? _____
     - (2) End point stress of 95.3 psi (657 kPa) (1200 lbf total on 4-in. specimen)? _____
   - (c) High pressure gauge with resolution of ±16.0 psi (±110 kPa) capable of displaying:
     - (1) Consolidation stress of 1590 psi (11.0 MPa) (20000 lbf total on 4-in. specimen)? _____
   - (d) Tilt mechanism capable of cocking the mechanism 6 degrees while under pre-gyration stress? _____
   - (e) Gyration mechanism driving at a rate of 1 revolution per second? _____
   - (f) Metered hydraulic pump (applies 0.020-in. (0.508-mm) of ram movement per application)? _____

2. Check the following items at room temperature:

Molds, Ram Faces, and Base Plates			1	2	3	4	5	6
Face diameter of ram:	3.995 - 4.000 in. (101.47 - 101.60 mm.)	A						
Face diameter of base plate:	3.995 - 4.000 in. (101.47 - 101.60 mm.)	A						
Thickness of base plate rim:	0.052 – 0.072 in. (1.32 – 1.82 mm)	C						
Thickness of base plate:	0.55 – 0.58 in. (13.89 – 14.65 mm)	E						
Inside diameter of mold:	3.96 - 4.06 in. (100.58 – 103.12 mm)	F						
Height of mold:	3.87 – 4.00 in. (98.30 mm - 101.60 mm)	G						

Note to Assessors: *There is a typographical error in Table 1 measurement C. The mm measurement is listed first. Therefore it appears that the tolerance is larger than the measurement. This information provided for reference.*

3. Balance: Minimum capacity of 4500g with a sensitivity of 0.1g? _____
4. Sieve or screen: A 1-in. (25-mm) screen (round openings) or a 7/8 in. (22.4-mm) sieve (square openings)? _____
5. Spatula: Blade about 4 in. (100 mm) long and 3/4 in. (20 mm) wide? _____
6. Spoon: Bent to a right angle between bowl and handle? _____
7. Measuring device: Caliper or micrometer for measuring the height of the sample? _____
8. Specimen Extrusion Device: (Any means which does not distort or damage the specimen is acceptable)? _____
9. Oven: Range of 100 to 300°F (37.8 to 148.9°C) thermostatically controlled to ± 5°F (± 3°C)? _____
10. Miscellaneous: Gloves, trowels, mixing pans, and thermometers? _____
11. Kerosene? _____
12. Paper Disks, appropriate in diameter to the mold being used? _____

COMMENTS (D4013): (D4013)

PREPARATION OF TEST SPECIMENS OF BITUMINOUS MIXTURES BY MEANS OF GYRATORY SHEAR COMPACTOR (D4013)

PROCEDURE Date: _____

Calibration and Verification:

1. Low- and high-pressure gauges calibrated to indicate distinct points for:
   (a) Pre-gyration stress? (low pressure gauge)..... _____
   (b) End point stress? (low pressure gauge)..... _____
   (c) Consolidation stress? (high pressure gauge)..... _____
   Note to Assessors: *These gauges may measure in total force, pressure applied to the specimen, or pressure applied to the ram. In any of these cases, verify that the appropriate pressure is applied to the specimen at each of the calibration points.*
2. Low- and high-pressure gauges verified on the gyratory shear molding press at each of the calibrated points? .. _____

Sample and Apparatus Preparation:

1. Sample mass required to produce a specimen conforming to requirements calculated by Section 7? ..... _____
2. If mixing, HMA samples mixed at 250 ± 5°F (121 ± 3°C)?..... _____
3. Samples cured to constant mass in an oven at 140 ± 10°F (60 ± 6°C)? ..... _____
4. Samples stirred throughout curing?..... _____
5. If the sample contains material larger than 7/8 in., material separated over a 7/8-in. (22.4-mm) sieve, or through a 1-in. (25.0-mm) round opening screen, scraping material to ensure recovery of fines clinging to the surface of larger particles? ..... _____
6. Molds and base plates preheated to approximately 100°F (38°C)?..... _____
7. Gyratory apparatus in loading position? ..... _____
8. Apparatus run through at least one gyration prior to testing? ..... _____
9. Platen, lower bearing, and top of the mold ring lubricated?..... _____
10. Mold and base plate removed from oven and insides wiped down with either kerosene or light lubricating oil? _____
11. Paper disk placed in the bottom of the mold? ..... _____

Compaction:

1. Sample heated to 250 ± 5°F (121 ± 3°C) prior to compaction? ..... _____
2. Mixtures funneled into the mold in two layers?..... _____
3. After each lift, top leveled by pressing down with the spoon?..... _____
4. Any large aggregates moved away from the walls? ..... _____
5. Paper disk placed on top of the material?..... _____
6. Mold placed onto the lower platen and centered beneath the press?..... _____
7. Ram pumped down until pre-gyration stress is reached? ..... _____
8. Mold immediately tilted to the specified angle of gyration?..... _____
9. Handle of the pump lifted up to fill the metering pump? ..... _____
10. Gyration mechanism switched on and mold gyrated three times? ..... _____
11. Mold immediately squared (angle removed) and one full stroke of the metering pump performed?..... _____
    Note: *One stroke of the pump should take approximately one second.*
12. Low pressure gauge reaches the end-point stress, otherwise pressure reduced below pre-gyration stress and steps 7 to 11 repeated until end-point stress is reached on one application of the metering pump?..... _____
13. Pump slowly applied until the low-pressure gauge is cut out of the system, then pressure pumped up to consolidation stress (on the high-pressure gauge)? ..... _____
14. Pumping stopped once consolidation stress is reached? ..... _____
15. Pressure released slowly so as to prevent damage to the gauge? ..... _____
16. Ram retracted and mold removed from the press? ..... _____
17. Any method of removal that does not damage the specimen used to extract the sample from the mold?..... _____
18. Sample measured for height to confirm conformance to specification?..... _____
19. Mold cleaned with a kerosene rag if more specimens are to be molded?..... _____

COMMENTS (D4013): (D4013)

RECOVERY OF ASPHALT FROM SOLUTION USING THE ROTAVAPOR (D5404)

APPARATUS Date: _____

1. Rotavapor apparatus
   - (a) Distillation flask, depth of approximately 40 mm (1.5 in) when fully immersed? _____
     Note: A flask having a 2000 mL capacity is recommended.
   - (b) Variable speed motor, capable of rotating the distillation flask at least 50 rpm? _____
   - (c) Condenser? _____
   - (d) Solvent recovery flask? _____
   - (e) Heated oil bath? _____
   - (f) Angle of distillation flask from horizontal to bath is approx. 15 degrees? _____

2. Centrifuge apparatus (either of the following):
   - (a) Batch unit capable of 770g? _____
   - (b) Centrifuge tubes (either of the following types): _____
     - (1) Wide-mouth bottles, 250 to 500 mL capacity? _____
     - (2) Cylindrical tubes, 6 or 8 in. long, with conical ends; capacity 100 mL? _____

   or (c) Continuous unit capable of 3000 gravity? _____

3. Manometer or vacuum gage, suitable for measuring the specified vacuum? _____

4. Gas flow meter, capable of indicating a gas flow of up to 1000 mL/min.? _____

5. Sample container, having an adequate volume to hold the sample and added solvent? _____

6. Vacuum system, capable of maintaining a vacuum to within ± 0.7 kPa (± 5 mm Hg) of the desired level up to and including 80 kPa (600 mm Hg)? _____

7. Nitrogen gas or carbon dioxide gas? _____

8. Bath liquid:
   - (a) USP White Oil? _____

   or (b) Silicone Fluid SWS-101, with flash point above 215°C (420°F)? _____

   or (c) Other? _____ _____

9. Solvent
   - (a) Reagent grade trichloroethylene or methylene chloride? _____
     Note: Trichloroethylene, Technical Grade, Type I may be used, but it is recommended that for each new supply of the solvent, a blank should be run.

   or (b) Normal Propyl Bromide (nPB)? _____
     Note: Because there may be some differences in nPB products, it is recommended that for each new supply of the solvent, a blank should be run.

10. Solvents listed used only under a hood or with an effective exhaust system in a well ventilated area? _____

COMMENTS (D5404): (D5404)

RECOVERY OF ASPHALT FROM SOLUTION USING THE ROTAVAPOR (D5404)

PROCEDURE Date: _____

Sample Preparation:

1. Solution obtained by D2172, extraction method A? ..... _____
2. Solution from D2172 centrifuged by one of the following methods? ..... _____
   (a) At least 30 min at 770 times gravity in either wide-mouth bottles or centrifuge tubes in batch apparatus? ..... _____
   (b) At least 3000x gravity in a continuous centrifuge charged at a rate not to exceed 150 mL/min? ..... _____

Procedure

1. Oil bath heated to 140 ± 3°C (285 ± 5°F)? ..... _____
2. Cold water circulated through condenser? ..... _____
3. Vacuum of 40 mm below atmospheric pressure applied? ..... _____
4. Approx. 600 mL of AC solution drawn from sample container into flask through the sample line? ..... _____
5. Approx. 500 mL/min [AMRL: 50 ml/ min] (check records) flow of nitrogen or CO_2 begun? ..... _____
6. Distillation flask rotated at approx. 40 rpm? ..... _____
7. Flask lowered into the oil bath? ..... _____
8. Steady, controlled stream of condensed solvent maintained? ..... _____
9. Gas flow discontinued when the amount of solution in the flask is low and more is to be added? ..... _____
10. Remaining asphalt solution drawn into flask and gas flow readjusted? ..... _____
    Note to Assessors: *The equipment may be modified to allow a continuous flow of solution into the distillation flask - the volume in the flask should be maintained at approx. 600 mL [AMRL: ±50 mL/min]. The gas flow should not be started until all the solution has entered the flask.*
11. Flask immersed to depth of 40 mm (1.5 in.) when most of the solvent has been distilled and no condensation is occurring on the condenser? ..... _____
12. Vacuum of 600 mm below atmospheric pressure applied slowly? ..... _____
13. Gas flow increased to approx. 600 mL/min [AMRL: ± 5 rpm]? ..... _____
14. Spin rate of flask increased to approx. 45 rpm (see Note 5)? ..... _____
    Note to Assessors: *A 1 or 2 min delay before applying the vacuum is recommended. Hold or reduce vacuum if foaming occurs. Apply maximum vacuum when foaming stops.*
15. This condition maintained for 15 ± 1 min? ..... _____
16. Distillation flask removed and wiped clean of oil? ..... _____
17. Asphalt poured (or drained) into proper size container? ..... _____

COMMENTS (D5404): (D5404)

INDIRECT TENSILE (IDT) STRENGTH OF BITUMINOUS MIXTURES (D6931)

APPARATUS

Date: _____

1. Loading Device
   - (a) Maker: _____ Serial No. (or I.D. No.)? _____ _____
   - (b) Produces uniform movement of 50 ± 5 mm/min (2.00 ± 0.15 in. /min)? _____
   - (c) Load measuring device:
     - (1) Calibrated? _____
     - (2) Capacity: nominal 20 kN (5000 lb)? _____
     - (3) Sensitivity: minimum 50 N (10 lb)? _____
     - (4) If ring: micrometer dial indicator graduated in increments of 0.0025 mm (0.0001 in.) or finer? _____
2. Loading Strips
   - (a) Concave surface with a radius of curvature equal to the nominal radius of the test specimen? _____
   - (b) Widths:
     - (1) 4 in. diameter specimens, 12.70±0.3 mm (0.50±0.01 in.)? _____
     - (2) 6 in. diameter specimens, 19.05±0.3 mm (0.75±0.01 in.)? _____
   - (c) The length exceeds the thickness of the specimens? _____
   - (d) The outer edges of the loading strips beveled slightly to remove sharp edges? _____
   - (e) Upper loading strip clean and slides freely on the posts? _____
   - (f) Two guide posts perpendicular to base? _____
   - (g) Guide rods free of appreciable binding or loose motion? _____
3. Temperature Control System
   - (a) An air or water bath capable of maintaining the specimens at the specified test temperature within ±1.0°C (±1.8°F)? _____
4. Thermometer
   - (a) Liquid-in-glass thermometer of suitable range or any other thermostatic device of equal accuracy, precision, and sensitivity? _____
   - (b) Subdivisions readable to 0.1°C (0.2°F)? _____
   - (c) Calibrated (verify records)? _____
5. A tape, ruler, or set of calipers for measuring specimens? _____
6. Specimens prepared according to one of the following methods? _____
   - ASTM D1074 (Compressive Strength of Bituminous Mixtures)? _____
   - ASTM D1561 (California Kneading Compactor)? _____
   - ASTM D3387 (USCE Gyratory Testing Machine [GTE])? _____
   - ASTM D3496 (Dynamic Modulus Testing Preparation)? _____
   - ASTM D4013 (Gyratory Shear Compactor)? _____
   - ASTM D6925 / AASHTO T312 (Superpave Gyratory Compactor)? _____
   - ASTM D6926 / AASHTO T245 (Marshall Method)? _____
7. Specimens
   - (a) Specimen size
     - (1) 4 in. diameter specimens - minimum height of 50.8 mm (2 in.)? _____
     - (2) 6 in. diameter specimens - minimum height of 75 mm (2.95 in.)? _____
   - (b) At least 3 specimens prepared for each mixture? _____

     Note: 4-in. specimens are suitable for mixtures with a nominal maximum particle size of 19 mm (3/4 in.) or less. 6-in. specimens are suitable for mixtures with a nominal maximum particle size of 37.5 mm (1.5 in) or less.

COMMENTS (D6931): (D6931)

INDIRECT TENSILE (IDT) STRENGTH OF BITUMINOUS MIXTURES (D6931)

PROCEDURE Date: _____

Procedure

1. Height determination:
   - (a) Height determined according to ASTM D3549? ..... _____
   - (b) Four measurements taken at approximate quarter points using a tape, rule, or calipers?..... _____
   - (c) If using measurement jig, results consistently within ±0.05 in. (±0.13 cm) of those obtained using tape, rule, or calipers?..... _____
   - (d) Measured to the nearest 1 mm (0.05 in)?..... _____
   - (e) Height determined by dividing volume by cross-sectional area?..... _____
     Note to Assessors: Used only with dense paving mixtures (less than 10% air voids)

2. Diameter determination:
   - (a) Measured to the nearest 1 mm (0.05 in)?..... _____
   - (b) Average of four measurements taken at 90° increments? ..... _____
   - (c) Measurements taken at mid-height?..... _____

3. Conditioning:
   - (a) Specimens brought to test temperature ±1°C (±1.8°F) by one of the following methods (recommended temperature is 25°C):
     - (1) Procedure A: Placed in air bath for a minimum of four hours? ..... _____
     - or (2) Procedure B: Placed in heavy duty leak-proof plastic bag and paced in water bath for a minimum of 2 hours?..... _____
     - or (3) Procedure C: Place the specimens in a water bath for 30 to 120 minutes?..... _____

4. Load Determination:
   - (a) Specimen removed from bath or oven and placed in lower segment of loading strip? ..... _____
   - (b) Upper segment placed on specimen? ..... _____
   - (c) Breaking strips are parallel and centered? ..... _____
   - (d) Vertical compressive load applied until maximum load is reached? ..... _____
     Note: recommended rate is 50 ± 5 mm/min [2.00 ±0.15 in./min]?
   - (e) Final load applied within 2 minutes after removal of specimen from bath or oven? ..... _____
   - (f) Maximum load recorded? ..... _____

5. Calculations:
   - (a) IDT Strength calculated as follows:

In kPa $S_t = \dfrac{2000 * P}{Pi * t * D}$

S_t = IDT strength, kPa (psi)
P = maximum load, N (lbf)
t = specimen height immed. before test mm (in.)
D= specimen diameter, mm (in.)

In psi $S_t = \dfrac{2 * P}{Pi * t * D}$

S_t = IDT strength, kPa (psi)
P = maximum load, N (lbf)
t = specimen height immed. before test mm (in.)
D= specimen diameter, mm (in.)

COMMENTS (D6931): (D6931)