Revised: 7/1/10 Laboratory: _____ Inspector(s): _____ Date: _____
Interviewee: _____

S___F___N/A___

PENETRATION OF BITUMINOUS MATERIALS
ASTM D 5-06

6. Apparatus:
6.1. Penetration apparatus, move vertical, penetrate to 0.1 mm, wt. 50.0 ± 0.05 g & 100.0 ± 0.05 g ___
6.1.1. Leveling indicator shall be verified at least annually w/ hand-held level ___
6.2.1. Penetration needle, Grade 440-C, HRC 54-60, std. 50 mm long, long 60 mm long, cone angle 8.7 – 9.7° ___
6.3. Sample container, metal or glass cylindrical, flat-bottom ___
Dimensions, penetration < 50 – dia 33 – 50 mm, 8 – 16 mm deep; < 200 dia – 55 mm, 35 mm deep; 200 – 350 dia – 55 - 75 mm, 45 – 70 mm deep; 350 – 500 dia – 55 mm, 70 mm deep ___
6.4. Water bath, 25 ± 0.1°C (77 ± 0.2°F) w/ supported perforated shelf not < 50 mm from bottom & not < 100 mm below liquid level ___
6.5. Transfer dish, 350 ml, ___
6.6. Timing device, 0.1 sec intervals, accurate to ±0.1 sec over 60 sec ___
6.7. Thermometers conform to ASTM E 1 calibrated, subdivisions & max. scale error 0.1°C (0.2°F) ___
6.7.2. Thermometer for water bath periodically calibrated in accordance w/ ASTM E 77 ___

7. Preparation of test specimen:
7.1. Heat sample not > 60°C above softening pt. of tar, not > 90°C for bitumen, not > 30 min. ___
7.2. Pour into container to depth 10 mm > expected needle penetration ___
7.3. Cool @15-30°C 1-1.5 hr. for small container, & 1.5-2 hr. for larger ___

8. Test conditions:
8.1. Temp., load, time are 25°C (77°F), 100 g, 5 sec. if not specified ___

9. Procedure:
9.1. No water on needle & clean, long needle if penetration > 350, 50-g wt. above needle ___
9.2. Place spl in water bath or transfer dish ___
9.3. Use level indicator to ensure apparatus is level ___
9.4. Position tip to contact surface, read or zero pointer, release for specified time, read tenths of mm ___
9.5. 3 trials, penetration > 200 use 3 needles leaving them in until 3 trials complete ___

10. Report:
10.1. Avg. of 3 to nearest whole unit if values not differ > following:

Penetration	0 - 49	50 - 149	150 - 249	250 – 500
Max. difference between Highest & lowest penetration	2	4	12	20

Data Sheet ___

S___F___N/A___

SOFTENING POINT OF BITUMEN (RING-AND-BALL APPARATUS)
ASTM D 36-09

5. Apparatus:
5.1. Rings, 2 square-shouldered brass rings ___
5.2. Pouring plate, brass, ~ 50 X 75 mm (2 X 3 in.) ___
5.3. Balls, 2 steel, 9.5 mm (3/8 in.) diameter, mass 3.50 ± 0.05 g ___
5.4. Ball-centering guides, 2 brass ___
5.5. Bath, heat-resistant glass, ___
5.6. Ring holder & assembly ___
5.7. Thermometers:
5.7.1. ASTM Low Softening Point, 15C or 15F, -2 to 80°C or 30 to 180°F ___
5.7.2. ASTM High Softening point, 16C or 16F, 30 to 200°C or 85 to 392°C ___
5.7.3. Thermometer suspended w/ bottom of bulb level w/ bottom of rings & w/in 13 mm (0.5 in.) of rings ___

6. Reagents & materials:
6.1.1. Freshly boiled distilled water ___
6.1.2. USP glycerin ___
6.2. Release agents:
6.2.1. Surface of brass pouring plate may be thinly coated w/ silicone oil or grease, a mix of glycerin & dextrin, talc, or china clay to prevent sticking ___

8. Sampling:
8.1. Sample in accordance w/ D 140 ___

9. Test specimens:
9.1. Don't start unless testing of asphalt complete w/in 6 hr. & coal-tar pitch w/in 4 ½ hr. ___
9.1.1. Not > 2 hr to heat asphalt to pouring temp, not > 110°C (200°F) above softening pt. ___
9.1.2. Not > 2 hr to heat to coal-tar pitch to pouring temp, not > 55°C (100°F) above softening pt. ___
9.2. Heat 2 brass rings to ~ pouring temp, place on pouring plate ___
9.3. Pour bitumen into each ring to excess & cool in air 30 min. ___
From time poured, not > 4 hr. shall elapse before end of test ___
9.4. After cooling, trim excess off so each disk flush & level w/ top of ring ___

10. Procedure:
10.1. Select one of following for expected softening point:
10.1.1. Distilled water for softening pts 30 - 80°C (86 - 176°F), use therm 15C or 15F ___
Starting bath temp 5 ± 1°C (41 ± 1°F) ___
10.1.2. Glycerin softening pts 80 -157°C (176 – 315°F), use therm 16C or 16F ___
Starting bath temp 30 ± 1°C (86 ± 2°F) ___
10.1.3. For referee purposes, all softening pts up to 80°C (176°F) determined in water bath & all softening pts above 80°C (176°F) determined in glycerin bath ___
10.2. Assemble apparatus in lab hood ___
10.3. Establish & maintain starting bath temp. 15 min. ___
10.4. Place ball from bottom of bath in each ball-centering guide ___
10.5. Heat @ rate of 5°C (9°F)/min. ___
10.6. Record ball temp. @ instant bitumen touches bottom plate ___

11. Calculation ___

12. Report ___

Data Sheet ___

S___F___N/A___

DENSITY OF SEMI-SOLID BITUMINOUS MATERIALS (PYCNOMETER METHOD)
ASTM D 70-09

6. Apparatus:
6.1. Pycnometer, 24 – 30 ml weighing not > 40 g (Fig 1) ___
6.2. Water bath, maintain temp. w/ in 0.1°C of test temp. ___
6.3. Thermometers, 0.1°C (0.2°F) graduations ___
6.4. Balance - capable of making the req'd measurements accurate to at least 0.001 g ___
6.5. Beaker – ≥ 600ml Griffin low-form ___

7.1 Water, freshly boiled, cooled distilled or deionized ___

9. Sampling:
9.1. Sample in accordance w/ ASTM D 140 ___
9.2. Mix sample, get representative portion ___

10. Preparation of apparatus:
10.1. Partially fill 600-ml Griffin low-form beaker w/ water to level so top of pycnometer immersed to depth not < 40 mm ___
10.2. Partially immerse beaker in water bath, bottom immersed to depth not < 100 mm & top above water level of bath ___
10.3. Maintain water bath temp. w/ in 0.1°C (0.2°F) of test temp. ___

11. Calibration of pycnometer:
11.1. Weigh clean, dry pycnometer to nearest 0.001 g ___
11.2. Remove from bath; fill w/ boiled distilled water, stopper & return to bath ___
11.3. Remain in bath not < 30 min., remove & dry stopper & outside of pycnometer, weigh to 0.001 g ___

12. Procedure:
12.1. Preparation of sample, heat until can pour ___
12.2. Pour in pycnometer to ~ ¾ full, cool not < 40 min., weigh w/ stopper to 0.001 g ___
12.3. Fill w/ boiled distilled water, stopper, place in beaker, return to bath ___
12.4. Remain in bath nor < 30 min., remove, dry & weigh as in paragraph 11.3 ___

13. Calculation:
13.1. Calculate relative density to 0.001 as follows:
Relative density = (C – A)/[(B – A) – (D – C)]
Where:
A = mass of pycnometer (plus stopper),
B = mass of pycnometer filled w/ water,
C = mass of pycnometer partially filled w/ asphalt, and
D = mass of pycnometer plus asphalt plus water.

13.2. Calculate density to 0.001 as follows:
Density = specific gravity X W_T
Where:
W_T = density of water @ test temperature, (Table following)

Temperature, °C	Density of Water, kg/m^3(kg/L
15.0	999.1 (0.9990)
25.0	997.0 (0.9970)

14. Report:
14.1. Report density to nearest 1 kg/m^3 (1 kg/L) & test temperature ___

Data Sheet ___

S___F___N/A___

DUCTILITY OF BITUMINOUS MATERIALS
ASTM D 113-07

4. Apparatus:
4.1. Mold as in Fig 1 ___
4.2. Water bath, maintain test temp, not vary > 0.5°C (0.9°F), spec immersed & supported so spec is surrounded by water___
4.3. Testing machine to pull sample apart, spec to be continuously immersed while the 2 clips pulled apart @ uniform speed (variation of ± 5 % allowed) ___
4.4. Thermometer conform to E 1, range –8 to 32°C ___
4.5. Release agent ___
4.6. Oven capable of maintaining w/in ± 5°C (± 10°F) of temp req'd to heat spl fluid enough to pour ___
4.7. Trimming tool – Straight-edged putty knife or spatula wider than spec ___
4.8. Specific gravity additive ___
4.9. Sieve – No. 50 ___

5. Procedure:
5.1. Assemble testing apparatus, strain melted sample thru No. 50 sieve ___
Stir; pour into mold, cool 30 – 40 min., put in bath @ specified temp 30 – 40 min. ___
Trim excess bitumen w/ hot straightedge ___
5.2. Put brass plate & mold w/ specimen in bath @ specified temp 85 – 95 min. ___
Remove specimen & test immediately ___
5.3. Testing, assemble, pull 2 clips apart @ uniform rate of speed ___
Measure distance in cm the clips are pulled ___

6. Report:
6.1. Normal test pulled out to point or thread where practically no cross-sectional area, report average of 3 normal tests as ductility of sample ___
6.2. If bituminous mat'l comes in contact w/ surface of water or bottom of bath, test not considered normal, adjust G_s of bath w/ alcohol or NaCl to prevent touching ___
6.3. Normal test unobtainable on 3 tests, report ductility as unobtainable ___
6.4. If discrepancy, referee method shall be to perform test using 3 replicates; if discrepancy involves a distillation residue, pour mat'l thru No. 50 sieve that has been preheated to 135 ± 5°C (275 ± 10°F) prior to pouring into test molds; rpt avg. of 3 normal tests as the ductility of spl ___

Data Sheet ___

S___F___N/A___

FLOAT TEST FOR BITUMINOUS MATERIALS
ASTM D 139-07

5. Apparatus:
5.1. Float, aluminum or aluminum alloy to following requirements:

Mass of float, g	Min	Normal	Max
Total height of float, mm	37.70	37.90	28.10
Height of rim above lower side of shoulder, mm	34.00	35.00	36.00
Thickness of shoulder, mm	1.30	1.40	1.50
Diameter of opening, mm	11.00	11.10	11.20

5.2. Collar, brass to following requirements:

	Min	Normal	Max
Mass of collar, g	9.60	9.80	10.00
Over-all height of collar, mm	22.30	22.50	22.70
Inside diameter @ bottom, mm	12.72	12.82	12.92
Inside diameter @ top, mm	9.65	9.70	9.75

5.3. Verification of assembly weighted to 53.2 g float on water w/ rim 8.5 $\pm$ 1.5 mm above water ___
5.4. ASTM Low Softening Point Thermometer, -2 to 80°C (30 to 180°F) ___
Conform to requirements for 15°C or 15°F in accordance w/ E 1 ___
5.4.1. Thermometer of K type 30 AWG gage thermocouple, 25°C (77°F) - 260°C (500°F) ___
Thermocouple 61 – 76 cm (24 – 30 in.) long ___
Thermometer conform to NIST & IEC 584 for K-, J-, & T-type thermocouples ___
5.5. Testing bath, 185 mm internal diameter or 150 mm wide X 300 mm long ___
5.6. Water bath, 5.0 $\pm$ 1.0 °C ___
5.7. Brass pouring plate, 75 X 50 mm, treated ___

6. Precautions:
6.1. Precautions taken to ensure collar fits tightly into float & no seepage of water between collar & float during test ___

7. Procedure:
7.1. Place brass collar w/ small end in coated plate ___
7.2. Melt sample, stir, pour into collar slightly more than level w/ top ___
7.3. Emulsified asphalts, position thermocouple in top center of collar ___
7.3.1. Samples which min temp of 218°C (425°F) not attained, don't test for float ___
7.4. Asphalt & asphalt products, cool 15 – 60 min., 5 min. in water bath, trim excess ___
Place in water bath not $<$ 15 or $>$ 30 min. ___
7.5. Tar products, water bath 5 min., trim excess, place in water bath not $<$ 15 or $>$ 30 min. ___
7.6. Heat water in testing bath to test temp ___
7.7. Remove collar w/ contents & screw into aluminum float ___
Immerse in water bath 1 min., remove water from inside float, float on testing bath ___
7.8. Determine time in sec., between placing on water & water breaking thru material ___

Data Sheet ___

S___F___N/A___

SAMPLING BITUMINOUS MATERIALS
ASTM D 140-09

5. Selection of samples:
5.1. When practicable sample @ pt of mfr or storage ___
5.2. When spls not taken @ pt of mfr or storage, take from shipment immediately on delivery ___

6. Size of samples ___

7. Containers ___

8. Protection and preservation of samples ___

9. Sampling at place of manufacture ___

10. Sampling from tank cars, vehicle tanks, distributor trucks, or recirculating storage tanks ___

11. Sampling from tankers and barges ___

12. Sampling from pipe lines during loading or unloading ___

13. Sampling from drums or barrels ___

14. Sampling semisolid or uncrushed solid mat'ls ___

15. Sampling crushed or powdered mat'ls ___

16. Sampling at point of shipment delivery ___

S___F___N/A___

MINERAL FILLER FOR BITUMINOUS PAVING MIXTURES
ASTM D 242-09

3. General description:
3.1. Consist of finely divided mineral matter, rock dust, slag dust, hydrated lime, hydraulic cement, fly ash,
loess, or other suitable mineral matter that is dry enough to flow freely & free from agglomerations ___

4. Physical requirements:
4.1. Mineral filler graded to the following:

Sieve	% passing by mass
No. 16	100 ___
No. 30	97 to 100 ___
No. 50	95 to 100 ___
No. 200	70 to 100 ___

4.2. Mineral filler from rock dust, slag dust, loess, & other similar mat'ls free from organic impurities & have plasticity index not > 4 ___

5. Methods of sampling and testing:
5.1. Spl according to C 50, C 183, or C 311, except as noted in 5.1.1 ___
5.1.1. Get spls @ random intervals NTE each 300 tons as delivered ___
5.2. Min size field spl of 5.0 kg, reduce to min size of 2.5 kg for testing ___
5.3. Determine grading by D 546 ___
5.4. Determine plasticity index by D 4318 ___

Data Sheet ___

S___F___N/A___

RESIDUE OF SPECIFIED PENETRATION
ASTM D 243-08

5. Apparatus:
5.1.1. Container, flat-bottom, cylindrical seamless, 70 mm (2 ¾ in.) dia X 45 mm (1 ¾ in.) deep ___
5.1.2. Heating bath, cast iron bath, or equal, immersion of container 32 ± 5 mm deep ___
Shall support container 6 ± 2 mm above hot plate ___
5.1.3. Hot plate ___
5.1.4. ASTM Open Flash Thermometer, -6 to 400°C (20 to 760°F) ___
Conform to requirements for thermometer 11C or11F in accordance w/ E 1 ___
5.1.5. Balance readable to 0.01-g ___

6. Preparation of sample:
6.1. Thoroughly stir & agitate sample as received ___

7. Procedure:
7.1. 100 ± 0.1-g sample in container, place in air bath ___
Support thermometer in spl equidistant from the sides ___
7.2. Heat as fast as possible w/o foaming to 249°C (480°F) ___
During evaporation, maintain temp 249°C (480°F) - 260°C (500°F) ___
7.3. When residue ready for penetration, remove from bath, cool & weigh ___
Determination penetration in accordance w/ D 5 ___

8. Report:
8.1.1. % of residue of penetration, stating specified penetration & penetration determined or calculated by interpolation ___

Data Sheet ___

S___F___N/A___

EMULSIFIED ASPHALTS
ASTM D 244-09

3. Sample conditioning for testing:
Viscosity of 50°C heat to 50 ± 3°C in 71°C water bath or oven ___
4.1. **Water Content:** 6. Apparatus & materials ___: 7. Sample in accordance w/ D 140 ___
8. Procedure ___: 9. Calculation & report ___
11.1. **Coating ability & water resistance:** 13. Apparatus ___; 14. Materials ___;15. Sample ___
16. Procedure for test w/ dry agg ___: 17. Procedure for test w wet agg ___; 18. Interpretation of results ___; 19.1. **Examination of residue:** 21. Specific gravity ___; 22. Ash Content ___
23. Solubility in trichloroethylene ___; 24. Penetration ___; 25. Ductility ___; 26. Float test ___
27.1. **Practice for the identification test for rapid-setting cationic emulsified asphalt:** 29. Apparatus ___; 30. Materials ___; 31. Emulsified asphalt (emulsion) sample ___; 32. Sand preparation ___; 33. Procedure ___; 34. Interpretation of results ___;
35.1. **Practice for determining field coating of emulsified asphalts:** 38. Apparatus ___
39. Procedure ___; 40. Report ___; 41.1. **Emulsified asphalt/job aggregate coating practice:**
44. Apparatus ___; 45. Procedure ___; 46. Report ___

Data Sheet ___

S___F___N/A___

DISTILLATION OF CUT-BACK ASPHALTIC (BITUMINOUS) PRODUCTS
ASTM D 402-08

5. Apparatus:
5.1. Distillation flask, 500-ml side-arm ___
5.2. Condenser, glass-jacketed, jacket 200 – 300 mm long, overall length 450 ± 10mm ___
5.3. Adapter, heavy-wall glass ___
5.4. Shield, steel, lined w/ 3-mm fire proof insulation, w/ transparent mica windows ___
5.5. Shield & flask support, 2 15-cm^2 sheets 16-mesh chromel wire gauze on tripod or ring ___
5.6. Heat source:
5.6.1. Adjustable Tirril-type gas burner or equivalent ___
5.6.2. Electric heater, 0 – 750 W ___
Accommodate 500-ml flask w/ ~ 1/8 in. (3 mm) between flask bottom & heating element ___
5.7. Receiver, 100-ml graduate ___
5.8. Residue container, seamless w/ cover, 75 ± 5 mm diameter, 55 ± 5 mm high ___
5.9. Thermometer, ASTM 8C (8F) conform to E 1 or IP 6C conform to IP specifications, -6 to 400°C (20 to 760°F) ___

7. Sampling:
7.1. Stir, warm if needed for homogeneity ___
7.2. If water present causes foaming, dehydrate not < 250 ml by heating in distillation flask ___

8. Preparation of apparatus:
8.1. Calculate weight of 200ml spl from G_s @ 15.6°C (60°F), weigh to ± 0.5 g into 50-ml flask ___
8.2. Place flask in shield supported by 2 sheets of gauze on tripod or ring ___
Connect condenser tube, adjust adapter on end of condenser tube so distance from neck of flask to outlet of adapter is 650 ± 50 mm (Fig 3)___
8.3. Insert thermometer thru cork in flask 6 mm from bottom of flask ___
8.4. Place receiver so adapter not below 100-ml mark, cover graduate ___
8.5. Place Residue container on its cover ___
8.6. Pass cold water thru condenser jackets ___

9. Procedure:
9.1. Correct temps for effect of altitude to Table 1 & 2 ___
If barometric pressure known correct temp to Table 3 ___
9.2. Heat so 1st drop falls in 5 – 15 min. ___
Maintain drop rates to following:
50 – 70 drops/min. to 260°C (500°F), 20 – 70/min. 260 - 316°C (500 - 600°F), Not over 10 min. to complete distillation 316 - 360°C (600 - 680°F) ___
9.2.1. Record volumes of distillate to 0.5 ml @ corrected temps ___
9.3. @ 360°C (680°F) cut off heat, remove flask & thermometer, pour into residue container ___
9.4. Condenser & distillates drain into receiver, record as total distillate to 360°C (680°F) ___
9.5. Cool residue & pour into receptacles for further testing ___

10. Calculation & report ___

Data Sheet ___

S___F___N/A___

SAMPLING BITUMINOUS PAVING MIXTURES
ASTM D 979-01 (06)

5.1. Sampling:

5.1.1. Sampling from a conveyor belt ___
Obtain 3 increments ___
Stop conveyor belt ___
Insert two templates shaped to the belt ___
Scoop all material including fines ___

5.1.2. Sampling from truck transports ___
Obtain 3 increments by random method ___

5.1.3. Sampling from roadway prior to compaction ___
When taking only one spl, obtain 3 increments ___

5.1.3.1. When taking 3 or more spls, obtain 3 increments by random method ___

5.1.3.2. Spl from full depth ___
When needs use templates to exclude underlying material ___

5.1.4. Sampling from a skip conveyor delivering mixture to bin storage ___
Select units to be sampled by random method based on bin's storage capacity ___
Stop conveyor after pug mill discharge ___
Dig furrow 150 mm (6 in) from top to bottom of pile ___
Obtain 3 increments from top, middle, & bottom of furrow ___

5.1.5. Sampling from funnel device feeding conveyor for mixture delivery to storage ___
Select units to be sampled by random method based on bin's maximum storage capacity ___
Obtain 3 increments by passing bucket or suitable container across flow as it drops from funnel device to conveyor ___

5.1.6. Sampling from roadway after compaction ___
Select units to be sampled by random method from material in place ___
Obtain 3 increments ___
Sample from full depth ___

5.1.7. Sampling from bituminous cold mix stockpiles ___
If crust is on surface, remove crust to depth of 100 mm ___
Stir exposed stockpile & obtain 3 increments ___

5.1.7.1. When taking 3 of more spls, sample in accordance with paragraph 5.2.3.1 ___

5.2. Number & quantities of field sample:

5.2.1. The number & size of field spls should be sufficient to give confidence in test results ___

5.2.2. A guide to the quantity of material is in Table 1:

NMSA	Min Mass, kg (lb)
2.36-mm (No. 8)	2 (4)
4.75-mm (No. 4)	2 (4)
9.5-mm (3/8-in.)	4 (8)
12.5-mm (½-in.)	5 (12)
19.0-mm (¾-in.)	7 (16)
25.0-mm (1-in.)	9 (20)
37.5-mm (1½-in.)	11 (25)
50-mm (2-in.)	16 (35)

Data Sheet ___

S___F___N/A___

COMPRESSIVE STRENGTH OF BITUMINOUS MIXTURES
ASTM D 1074-09

4. Apparatus:
4.1. Molds & plungers to in accordance w/ following:
4.1.1. Diameter tolerances, sufficient ht for 4 X 4-in. spec, inside dia. 4 – 4.5-in., ¼-in thick___
4.1.2. Plunger dia. w/in 0.05-in. of mold inside dia., plunger ends ½-in. thick & rt. ∠ to mold wall ___
Top plunger any suitable ht., bottom plunger 2 ± 1/8-in. high ___
4.1.3. Specimens > 4 in., appropriate apparatus may be used in accordance w/ paragraph 6 ___
4.2. Supports, 2 steel bars 1 in. square, 3 in. long ___
4.3. Testing machine, suitable for controlled rates of vertical deformation ___
4.4. Oven, maintain up to 200 ± 3°C (392 ± 5°F) ___
4.5. Hot plate ___
4.6. Hot water bath or oven, if oven temp 93.3 - 135°C (200 - 275°F) ___
4.7. Air bath, 25 ± 0.5°C (77 ± 1.0°F) ___
4.8. Balance, to spec. of ASTM D 4753 for spl or ingredient mass ___
4.9. Mixing machine ___
4.10. Spatulas ___
4.11. Calibrated liquid-in-glass thermometers readable to1ºF (0.5ºC) ___

5. Preparation of test mixtures:
5.1. Limit batches to amount for 1 specimen ___
5.2. Mix initial batch for “buttering”, empty, clean sides w/spatula, do not wipe or wash off solvent ___
5.3. Mold trial specimen to determine correct weight to make specimen to desired height ___
5.4. Aggregates separate into desired size to ASTM C 136, Agency specify which of following sieves (2-in., 1 ½-in., 1-in., ¾-in., ½-in., 3/8-in., Nos. 4, 8, & 10) ___; temp vs kinematic viscosity relationship dictates temp to be used for preparing specs___
Temp of 135°C (275°F) & 163°C (325°F) are convenient ___
5.5. Wet mix for not < 90 sec or not > 2 min. ___
5.6. Bituminous, heat to temp in 5.4, mix until temp 3 - 5°C (5 - 9°F) above compacting temp ___

6. Test specimens:
6.1. Generally 4 in. X 4 in. specimens ___, other than 4 in. may be used provided that:
6.1.1. Height = to diameter w/in ± 2.5 % ___
6.1.2. Diameter not < 4 X nominal diameter of largest aggregate particles ___
6.1.3. Diameter not < 2 in. ___
6.1.4. Unit rate of deformation kept constant during compression ___

7. Making & curing specimens:
7.1. Mold ½ mixture using appropriate techniques & temps ___
7.2. Transfer other ½ to molding cylinder, spade, penetrate w/ spatula ___
7.3. Load according to procedure in this paragraph ___
7.4. Remove specimen w/ ejection device ___
7.5. Cure 24 hr. @ 60°C (140°F) ___

8. Procedure:
8.1. Cool 2 hr., get bulk G_s in accordance w/ D 2726 ___
8.2. Bring to 25 ± 1°C (77 ± 1.8°F) by storage in air bath 4 hr. ___
8.3. Axial compression test, w/o lateral support @ 0.05 mm/min. (0.05 in./min.) ___
For specimens 4 in. high, use 5.08 mm/min. (0.2 in./min.) ___
8.4. Theoretical sp gr by ASTM D 2041 or other approp method ___
8.5. Calculate % air voids by ASTM D3203 ___

9. Report ___

Data Sheet ___

S___F___N/A___

EFFECT OF WATER ON COMPRESSIVE STRENGTH OF COMPACTED BITUMINOUS MIXTURES
ASTM D 1075-07

4. Apparatus:
4.1. 1 or more automatically controlled water baths, control temp to w/ in ±1°C (1.8°F) ___
4.2. Manually or automatically controlled water bath to bring specimens to 25 ± 1°C (77 ± 1.8°F) ___
4.3. Balance & apparatus to weigh in air & water ___
4.4. Flat transfer plates or other non-reactive material ___

5. Test specimens:
5.1. Not < 6 101.6 X 101.6-mm (4 X 4-in.) cylindrical specimens ___
Prepare, mold, & cure in accordance w/ D 1074 ___

6. Determination of bulk specific gravity:
6.1. Cool specimens 2 hr. after removal from curing oven as described in D 1074 ___
Determine bulk specific gravity in accordance w/ D 2726 ___

7. Procedure:
7.1. Sort specimens into 2 groups of 3 so average bulk G_s for each group is ~ same ___
Test group1 as described in 7.1.1, group 2 to 7.1.2 unless alternate method 7.1.3 required ___
7.1.1. Group 1 bring to 25 ± 1°C (77 ± 1.8°F) by storage in air bath 4 hr. ___
Compressive strength in accordance w/ D 1074 ___
7.1.2. Group 2 immerse in water 24 hr. @ 60 ± 1°C (140 ± 1.8°F) ___
Transfer to 2nd water bath 2 hr. @ 25 ± 1°C (77 ± 1.8°F) ___
Compressive strength in accordance w/ D 1074 ___
7.1.3. Group 2, alternate procedure, immerse in water 4 days @ 49 ± 1°C (120.2 ± 1.8°F) ___
Transfer to 2nd water bath 2 hr. @ 25 ± 1°C (77 ± 1.8°F) ___
Compressive strength in accordance w/ D 1074 ___

8. Calculation:
8.1. Calculate numerical index of resistance of bituminous mixtures to detrimental effect of water as % of original strength retained after immersion period as follows:
Index of retained strength, % = (S_2/S_1) X 100
Where:
S_1 = compressive strength of dry specimens (Group 1), and
S_2 = compressive strength of immersed specimens (Group 2)

Data Sheet ___

S___F___N/A___

BULK SPECIFIC GRAVITY AND DENSITY OF COMPACTED BITUMINOUS MIXTURES
USING COATED SAMPLES
ASTM D 1188-07

4. Apparatus:
4.1. Balance w/ apparatus to weigh in water, conform to D 4753 class GP2 ___
4.1.1. Balance should have sensitivity to provide values to 4 significant figures ___
4.2. Water bath ___

5. Materials:
5.1. Parafilm, elastomeric ___
5.2. Polyurethane foam, 50 X 50 cm (20 X 20 in.), & 12.5 mm (0.5 in.) thick ___
5.3. Calibration cylinder, ~ 100-mm (4-in.) diameter by 60-mm (2.5-in.) smooth-sided aluminum ___

6. Test specimens:
6.1. May be lab mixed or cut from pavement ___
6.2. Diameter ≥ 4 X max aggregate, thickness 1 ½ X max aggregate ___
6.3. Pavement specimens w/ core drill, diamond or Carborundum saw, or suitable means ___
6.3.1. Avoid distortion, bending, or cracking, store in safe, cool place ___
6.3.2. Specimens free of foreign materials & if evident remove in accordance w/ 6.3.3 ___

7. Determine if coating of specimen is needed:
7.1. Get bulk G_s of uncoated specimen in accordance w/ D 2726 ___
7.2. Use data in 7.1 to calculate % water absorbed (volume) as follows:

$$\% \text{ Water absorbed by vol.} = (B - A)/(B - C) * 100$$

Where:
A = mass dry specimen in air, g
B = mass SSD specimen in air, g
C = mass specimen in water, g
7.3. If % absorbed > 2, continue w/ paragraph 8, if not > report bulk G_s of uncoated specimen ___

8. Procedure:
8.6. Mass of uncoated specimens, under fan, mass A ___
8.2.1. Cut 2 4 X 4 in. & 1 4 X 8 in. pieces of parafilm ___
8.2.2. Peel backing off 1 4 X 4 in. piece ___
8.2.3. Stretch on both sides until ~ 6 X 6 in. ___
8.2.4. Place stretched film over 1 end of spec. & press sides around spl ___
8.2.5. Place another stretched film on other end ___
8.2.6. Work on foam mat, place piece foam on top of spl ___
8.2.7. Trim excess film from sides of spl ___
8.2.8. Peel backing off other film, stretch to ~ 16 in. ___
8.2.9. Place 1 end over side of spl & roll over film tightly over surface ___
8.2.10. Fold & press edges around & over edges of spl ___
8.2.11. Mass of coated spl in air mass D ___
8.2.12. Mass of coated spl in water bath @ 25°C (77°F), mass E ___
8.3. Get Gs of aluminum with & without parafilm as described in 8.3.1 – 8.3.3 ___

9. Moisture correction ___

10. Calculation ___

11. Report ___

Data Sheet ___

S___F___N/A___

MOISTURE OR VOLATILE DISTILLATES IN BITUMINOUS PAVING MIXTURES
ASTM D 1461-85 (06)

4. Apparatus:
4.1. Metal still, vertical cylindrical still w/ faced flange @ top attached w/ clamp, head copper or brass 1 in. (25.4 mm) inside dia ___
4.2. Water-cooled glass-tube condenser, jacket ≥ 400m (15 ¾ in) long w/ inner tube 9.5 – 12.7 mm (3/8 – in) outside dia ___
4.3. Well-annealed glass trap of one or the following depending on purpose of test:
4.3.1. To determine water in bit. Mixtures, 10 – 25 ml glass trap (Figs 1, 2, 3, & 4 & Table 1) ___
4.3.2. To determine volatile fractions of bit. trap conform to dim. in Fig 5 ___
4.4. Solvent, general use – aromatic solv. preferred or blend of 20 % toluene & 80 % xylene ___
For asphalts & similar petroleum products, a petroleum distillate, 5% boiling between 90 & 100°C (194 & 212°F), & distilling below 210°C (410°F) ___
For coal-tar, water-gas tar, & similar mat'ls the aromatic solvent must be used ___
4.5. Heating device to maintain rate of distillation of 85 – 95 drops/min, ___

5. Sampling:
5.1. Sample according to D 979 ___

6. Test specimens & sample:
6.1. Mix & weigh amt of spl estimated to show % moisture or diluent w/in cap of trap, not< 500 g, thoroughly mix & place in still ___
Place remainder of spl in tightly covered container ___

7. Procedure for determination of moisture:
7.1. Add 200 ml solvent to spl in still & stir ___
7.2. Assemble apparatus as in Fig 6 using trap w/ expected WC, insert heavy paper gasket ___
7.3. Apply heat so reduxing starts in 5 – 10 min, & solvent drips 85 – 95 drops/min ___
Perform distillation until 3 successive rdgs @ 15 min intervals show no increase in condensation ___
7.4. Cool contents in trap to room temp & read vol to nearest division, record & calc in par 9.1 ___

8. Procedure for determination of volatile distillates:
8.1. Add 350 ml H_20 & 3 g Na_2 CO_3 to spl in still & stir, place cover & assemble trap as in par 7.2, except gasket moistened w/ solv. & trap shall be dilution trap in par 4.3.2 ___
8.2. Apply heat so reduxing starts in 5 – 10 min, & solvent drips 85 – 95 drops/min ___
8.3. Do distillation until 3 successive rdgs of upper & lower levels of diluent @ 15 min intervals show no increase in amt collected, remove from heat, cool, stand min ½ hr ___
8.4. Record vol of diluent to nearest div & calc as in par 9.2, use G_s of diluent @ 25°C (77°F) ___

9. Calculation:
10.1. Calculate moisture content as follows:
Water, % = vol of H_20 in trap / weight of spl X 100 ___
10.2. Calculate volatile distillate as follows:
Diluent, % = (vol diluent in trap) (G_s diluent @ 25°C) / weight of spl X 100 ___

10. Report:
10.1. Report moisture content as weight % water content in accordance w/ par 9.1 ___
10.2. Report volatile distillates as weight % diluent content in accordance w/ par 9.2 ___

Data Sheet ___

S___F___N/A___

RESISTANCE TO DEFORMATION & COHESION OF BITUMINOUS MIXTURES USING HVEEM APPARATUS
ASTM D 1560-09

4. Apparatus for resistance to deformation:
4.1. Stabilometer ___
4.2 Compression Testing Machine, min. capacity 10,000 lbf ___
4.3 Test Specimen Push-out Device ___
4.4 Oven 140 ± 5°F (60 ± 3°C) ___
4.5 Calibration Cylinder - 4.000 ± 0.0005-in. (101.6 ± 0.13-mm), OD by 5.5 ± 0.25 in. (140 ± 6.4 mm) high ___
4.6 Rubber Bulb ___
4.7 Follower 3.985-in. (101.2 mm) dia. by 5.5-in. (140 mm) high ___

5. Test specimens:
5.1. Mixed & compacted in accordance w/ procedures normally used ___
5.2. Specimens 4-in. (102 mm) dia & ht. 2.5 ± 0.1 in. (64 ± 3 mm);if ht can't be obtained stabilometer value to be corrected ___

6. Adjustment of stabilometer:
6.1. Adjust base so distance from bottom of upper tapered ring to top of base is 3.5 in. (89 mm) ___
6.2. Place cal cylinder (preheated to 140°F (60°C) in stabilometer, & calibrate ___
6.3. Stabilometer & stage base in position, set test machine rate of load to 0.05 in. 1.3 (mm)/min ___

7. Procedure:
7.1. Heat specimen in oven @ 140 ± 5°F (60 ± 3°C) 3 – 4 hr. ___
7.2. Transfer spec. from mold to stabilometer & perform test in accordance w/ paragraph 7.2 ___

8. Calculation ___

9. Report ___

10. Apparatus for cohesion:
10.1. Cohesiometer ___
10.2. Steel shot, 2000 g, pass No.10 sieve, retained on No. 14 sieve ___
10.3. Oven 140 ± 5°F (60 ± 3°C) ___
10.4. Balance, capacity 10 kg, sensitive to ≤ 1 g ___

11. Test specimens:
11.1. Specimen from stabilometer test, if cored, cut to size w/ saw ___
11.2. Size of specimens, up to 5 in. (127 mm) wide, 1 – 3 in. (25 – 76 mm) high ___

12. Procedure:
12.1. Heat in oven @ 140 ± 5°F (60 ± 3°C) 3 – 4 hr. ___
12.2. Preheat cohesiometer to 140 ± 5°F (60 ± 3°C), test in accordance w/ paragraph 12.2 ___

13. Calculation ___

14. Report ___

Data Sheet ___

S___F___N/A___

PREPARATION OF BITUMINOUS MIXTURE TEST SPECIMENS BY MEANS
OF CALIFORNIA KNEADING COMPACTOR
ASTM D 1561-92 (05)

4. Apparatus:
4.1. California kneading compactor ___
4.2. Compactor foot, ram w/ face shaped like Fig. 2 w/ area ~ 20.059 cm^3 (3.1 $in.^2$) ___
4.3. Mold holder, funnel, & feeder trough ___
4.4. Molds, 101.6 ± 13 mm (4 ± 0.005 in.) inside diameter, 127 mm (5 in.) high ___
4.5. Rod, round-nose steel, 9.5 mm (3/8 in.) diameter ___
4.6. Heavy paper disks, 101.6 mm (4 in.) diameter ___
4.7. Shim, steel, 6.4 mm (1/4 in.) thick, 19.1 mm (3/4 in.) wide, & 63.5 mm (2 ½ in.) high ___
4.8. Metal followers, 2 @ 101.2 mm (3.985 in.) diameter, 1 @ 139.7 mm (5.5 in.) high, the other @ 38.1 mm (1.5 in.) high ___
4.9. Testing machine, compression machine w/ min. capacity 22 kN (50,000 lbf) ___
4.10. Ovens, maintain temps up to 163°C (325°F) ___
4.11. Balance w/ min capacity 5 kg, meet requirements of D 4753 for 0.01-g readability ___
4.12. Sample splitter, riffle-type ___
4.13. Sample mixing apparatus ___
4.14. Miscellaneous, thermometers ___, trowels ___, pans ___, spatulas ___, scoops ___, gloves ___, metal pans ___

5. Test specimen:
5.1. Selection of bitumen content, method commonly used by lab ___
5.2. Preparation of mixtures:
5.2.1. Obtain sieve analysis, separate into appropriate sizes for the mixture ___
5.2.2. Batches weigh 1200 g, heat agg. & weigh bitumen into agg., ___
For asphalt cement, temp of asphalt & agg. @ mixing time to following:

	Temperature Range °C (°F)	
Grade	min	max
AC-2.5, AR1000, or 200-300 Pen	99(210)	121(250)
AC-5, AR2000 or 120-150 Pen	110(230)	135(275)
AC-10, AR4000, or 85-100 Pen	121(250)	149(300)
AC-20, AR8000, or 60-70 Pen	132(270)	163(325)
AC-40, AR16000, or 40-50 Pen	132(270)	163(325)

Mixtures w/ liquid asphalts no heat required, tar heat to desired temp not > 107°C (225°F) ___

5.2.3. Transfer mix to pan, cool 2 – 3 hr. @ 146 ± 3°C (295 ± 5°F) ___
5.3. Compaction of specimens:
5.3.1.1. Liquid-grade asphalts temp @ 60°C (140°F) ___
5.3.1.2. Paving grade asphalts temp @ 110°C (230°F) ___
5.3.1.3. Room temp for liquid-grade when testing w/ whatever moisture is present ___
5.3.2. Molding specimens, place mold in holder w/ paper disk, complete assembly & mold as described in rest of paragraph 5.3.2 ___
5.3.3. Application of static load, place mold & spec. in oven @ 60°C (140°F) for following:
Compacted @ 60°C (140°F) – 1 hr., compacted @ 110°C (230°F) ___
5.3.4. Leveling off load static 56 kN (12,600 lbf) ___

6. Report:
6.1.1. Spec curing procedure ___
6.1.2. Height of spec ___
6.1.3. Temp of compaction in California kneading compactor ___

Data Sheet ___

S___F___N/A___

EFFECTS OF HEAT AND AIR ON ASPHALTIC MATERIALS (THIN-FILM OVEN TEST)
ASTM D 1754-09

5. Apparatus:
5.1. Oven, conform to E 145 Type IB, temps up to 180°C (356°F) ___
5.1.1. Construction, rectangular w/ inside dim. 330 mm (13 in.) min, 535 mm (21in.) max ___
Front tight fitting door w/ clear opening same as inside height & width ___
5.1.2. Rotating shelf, dia. 250 mm (p.8 in.) min & 450 mm (18 in.) max ___
5.2. Thermometer, ASTM Loss on Heat Thermometer, 155 - 170°C range ___
5.3. Container, cylindrical pan, 140 mm (5 ½ in.) inside dia., 9.5 mm (3/8 in.) deep ___
5.4. Balance conforming to ASTM D 4753, Class G2 ___

6. Preparation of oven:
6.1. Thermometric device tip 40 mm (1.5 in.) above top of shelf & centered over arc of rotating pans ___
6.2. Oven level so shelf rotates in horizontal plane; max tilt not >3º ___
6.3. Preheat oven max 2 hr. temp set to 163.0 ± 1°C (325 ± 2°F) ___

7. Preparation of samples:
7.1. Heat sufficient mat'l to fluid condition not > 150°C (302°F) ___
Weigh 50 ± 0.5 g into 2 or more tared containers ___
7.2. At same time pour part into containers for measurement of original asphalt properties ___
7.3. If quantitative value of mass change desired, cool to room temp, weigh to 0.001 g ___
If not required, cool to ~ room temp before placing in oven as in paragraph 7.2 ___

8. Procedure:
8.1. Level oven so shelf rotates in horizontal plane ___
8.2. W/ empty containers on container positions, adjust temp to 163 ± 1°C (325 ± 2°F) ___
8.3. Place spls in predetermined container positions, heat for 5 hr. ___
If mass change not needed, proceed w/ 7.5, if needed, cool, weigh to 0.001 g, calculate mass change ___
8.4. After weighing, place on refractory-board, then on oven shelf, rotate 15 min. ___
8.5. Transfer mat'l into 240-ml (8-oz) ointment tin ___
Complete tests by appropriate ASTM test methods w/in 72 hr. ___

9. Report:
9.1. Report values of original asphalt properties measured in 7.2 & residue property values as measured in 8.3 ___
9.2. Report ductility or other test results in accordance w/ appropriate ASTM test methods ___
9.3. When determined report avg. mass change of mat'l in all containers as mass % of original mat'l (mass loss report as negative & mass gain as positive no. ___

Data Sheet ___

S___F___N/A___

RECOVERY OF ASPHALT FROM SOLUTION BY ABSON METHOD
ASTM D 1856-09

5. Apparatus:
5.1. Centrifuge, batch unit w/ capability of 770 G, or continuous unit w/ capability of 3000 G ___
5.2. Centrifuge tubes, wide-mouth bottles or tubes ___
5.3. Distillation assembly, Fig. 1 ___
5.3.1. Extraction flasks, 2 250-ml wide-mouth ___
5.3.2. Glass tubing, heat-resistant, 10-mm inside dia. gooseneck shape ___
5.3.3. Inlet aeration tube, 180 mm long, 6-mm outside dia. ___
5.3.4. Electric heating mantle, variable transformer ___
5.3.5. Water-jacketed condenser, Allihn type, 200-mm min jacket length ___
5.3.6. Thermometer, ASTM Low Distillation 7E or 7F, -2 to 300°C (30 to 580°F) ___
5.3.7. Gas flowmeter, gas flow up to 1000ml/min. ___
5.3.8. Corks, No. 20 drilled as in Fig. 1 ___
5.3.9. Flexible elastomeric tubing, resistant to chlorinated solvents ___
5.3.10. Separatory funnel (alternative procedure), 125-ml ___

6. Reagents & materials:
6.1. Carbon dioxide gas ___
6.2. Solvent for extracting asphalt form mixtures reagent grade trichloroethylene ___
6.3. Solvent for extracting the asphalt from mixtures may be reagent grade Methylene Chloride ___

8. Sample:
8.1. 75 – 100 g from previous extraction Method A of D 2172 ___
8.2. Important all asphalt extracted ___
8.3. Don't use heavy petroleum distillates ___
8.4. Protect bituminous mixtures from air, store in airtight containers @ temp below 0°C (32°F) ___
Method A of D 2172 place in covered containers in oven @ 110°C (230°F) ___

9. Procedure:
9.1. Entire procedure complete w/in 8 hr. ___
9.2. Centrifuge 30 min. @ 770 G ___
Continuous centrifuge, charge @ rate not > 150 ml/min @ not < 3000 G ___
9.3. Concentrate solution to ~ 200 ml & finish paragraph 9.3 ___
9.3.1. Alternative procedure ___
9.4. If residue highly viscous @ 163°C (325°F), maintain carbon dioxide flow & temp 20 – 22 min. ___
9.5. Recovered asphalt can be heated to reliquefy & other test performed ___

Data Sheet ___

S___F___N/A___

THEORETICAL MAXIMUM SPECIFIC GRAVITY
AND DENSITY
ASTM D 2041-03

6. Apparatus:
6.1. Container:
6.1.1. Vacuum bowls, metal or plastic bowl w/ dia ~ 180 – 260 mm (7 – 10.25 in.) ___
Transparent cover w/ rubber gasket & connection for vacuum line ___
6.1.2. Vacuum flask for weighing in air only, thick-walled vol. glass flask w/ ~ 4000ml capacity ___
6.2. Balance readable to 0.1 g ___
6.3. Vacuum Pump or water aspirator (Capable of 30-mm of Hg.) ___
6.4. Residual pressure manometer or calibrated absolute pressure gage (30-mm of Hg. or less) ___
6.5. Manometer or vacuum gauge at pump (30-mm of Hg.) ___
6.6. Thermometers (± 0.5°C, 0.9°F, suitable range) ___
6.7. Water Bath 25 ± 1°C (77 ± 1.8°F) ___
6.8. Bleeder Valve attached to vacuum train ___
6.9. Mechanical agitation device, capable of gentle but consistent agitation ___
6.10. Oven, maintain 110 ± 5°C (230 ± 9°F) ___

7. Sampling:
7.1. Sample in accordance w/ D 979 ___
7.2. Get spl size per table in this paragraph ___

8. Calibration containers:
8.1. Bowls – determine wt of container in H_2O @ 25 ± 1°C (77 ± 1.8°F), designate as *B* ___
8.1.1. If bowl used to weigh in air, put vol lid on while under H_2O ___
Remove H_2O-filled & lid & dry prior to weighing ___
Repeat 3 times & avg results, designate as *D* ___
8.2. Flasks – get wt of flask filled w/ H_2O & use cover plate @ 25 ± 1°C (77 ± 1.8°F), designate as *D* ___

9. Procedure:
9.1. Spl oven-dried @ 110 ± 5°C (230 ± 9°F) ___
9.2. Separate particles by hand, cool to room temp, put in bowl or flask, weigh, designate as *A* ___
9.3. Add H_2O @ temp of approx. 25°C (77°F), put cover (bowls) or stopper (flask) on container ___
9.4. Place on mech. agitation device, anchor, remove air by gradually increasing vac. until residual pressure manometer reads 3.7 ± 0.3 kPa w/in 2 min., continue vac. & agitation for 15 ± 2 min. ___
9.5. Gradually release vac. Using bleeder valve ___
9.5.1. Weighing in H_2O – suspend bowl & contents (w/o lid) in H_2O 10 ± 1 min., weigh, designate as *C* get temp of H_2O in bath ___
9.5.2. Weighing in air (bowl) – Submerge bowl & spl in the H_2O bath 10 ± 1 min. ___
Slide lid onto bowl & avoid entrapping air, press down on bowl, remove from bath ___
Weigh bowl, spl, & lid, repeat submersion (no need to wait 10 min.) ___
If 2 wts > 1.0 g, repeat until w/in 1.0 g, designate avg as E ___
9.5.3. Weighing in air (flask) – Fill flask w/ H_2O, put in bath 10 ± 1 min. w/o submerging top of flask ___
Get temp of H_2O, fill flask using cover plate used in cal, dry outside of flask ___
Get wt of flask, plate, spl, & H_2O, designate as *E* ___

10. Calculation ___

11. Supplemental procedure for mixtures containing porous aggregate ___

12. Report ___

Data Sheet ___

S___F___N/A___

SOLUBILITY OF ASPHALT MATERIALS IN TRICHLOROETHYLENE
ASTM D 2042-09

5. Apparatus & materials:
5.1.1. Gooch crucible, 44 mm dia. @ top, 36 mm @ bottom, depth of 24 - 28 mm ___
5.1.2. Glass fiber pad, 3.2 cm ___
5.1.3. Filter flask, 250 – 500 ml ___
5.1.4. Filter tube, 40 – 42 mm inside diameter ___
5.1.5. Rubber tubing or adapter ___
5.1.6. Erlenmeyer flask, 125 ml ___
5.1.7. Oven, maintain 110 ± 5°C ___

6. Reagent:
6.1. Trichloroethylene, technical grade ___

8. Preparation of Gooch crucible:
8.1. Place crucible + 1 thickness glass fiber pad in oven @ 110 ± 5°C for 15 min. ___
Cool in dessicator, weigh to 0.1 mg, designate as Mass A ___

9. Sample preparation:
9.1. If spl not fluid, heat above softening point not > 111°C ___

10. Procedure:
10.1. Transfer ~ 2 g into tared Erlenmeyer flask, cool, weigh to 1 mg, designate Mass B ___
Add 100ml trichloroethylene ___
Stopper flask & let sit 15 min. ___
10.2. Place weighed Gooch crucible in filtering tube ___
Decant solution thru glass filter pad of crucible ___
Retain as much insoluble matter as possible ___
Wash insoluble matter w/ solvent until colorless ___
Place crucible on top of oven or steam bath until all trichlorethylene removed ___
Place in oven @ 110 ± 5°C 20 min. ___
Cool in dessicator 30 ± 5 min., weigh to 0.1 mg ___
Repeat drying & weighing until constant mass, designate Mass C ___

11. Calculation & report:
11.1. Calculate % of insoluble matter or % sample soluble in solvent as follows:
% Insoluble = (C – A/B) X 100
% Soluble = [B – (C – A)/B] X 100
Where:
A = mass crucible & filter,
B = mass sample, and
C = mass crucible, filter, & insoluble material.
11.2. % insoluble < 1.0, report to 0.01 % ___; % insoluble ≥ 1.0, report to 0.1 % ___

Data Sheet ___

S___F___N/A___

KINEMATIC VISCOSITY OF ASPHALTS (BUTIMENS)
ASTM D 2170-07

6. Apparatus:
6.1. Viscometers, capillary-type, borosilicate glass, annealed; described in Annex A2 as follows:
6.1.1. Cannon-Fenske viscometer for opaque liquids ___
6.1.2. Zeitfuchs cross-arm viscometer ___
6.1.3. Lantz-Zeitfuchs viscometer ___
6.1.4. BS U-Tube modified reverse flow viscometer ___
6.2. Thermometers, calibrated liquid-in-glass w/ accuracy after correction of 0.04°F (0.02°C) ___
6.2.2. Thermometers calibrated semiannually in accordance w/ Appendix X1 ___
6.3. Bath, suitable for immersion of viscometer ___
6.4. Timer, accurate to 0.05 % over 15 sec intervals, graduated to 0.1 sec ___
6.4.1. Electrical timing devices may be used w/ required accuracy ___

7. Preparation of sample:
7.1.1.1. Allow sealed samples, as received, to reach room temp ___
7.1.1.2. Open container, mix for 30 sec ___
7.1.1.3. Charge viscometer ___
7.1.1.4. For kinematic viscosities @ 140°F (60°C) above 800 cSt, heat 20-ml spl in sealed container in oven or bath @ 145 ± 5°F (63 ± 3°C) until liquid enough to transfer into viscometer ___
7.1.2.1. Asphalt cement, heat to liquid to pour ___
7.1.2.2. Transfer 20 ml into container, heat @ 275 ± 10°F (135 ± 5.5°C) ___

8. Procedure:
8.2. Maintain bath w/in ±0.02°F (±0.01°C) for test temp 140°F (60°C) ___
Maintain bath w/in ±0.05°F (±0.03°C) for test temp 275°F (135°C) ___
8.3. Select viscometer to give efflux time > 60 sec, preheat to test temp ___
8.4. Charge viscometer in accordance w/ Annex A2 ___
8.5. Leave viscometer in bath until test temp reached ___
8.6. Start flow of asphalt in viscometer in accordance w/ Annex A2 ___
8.7. Measure to w/in 0.1 sec leading edge of meniscus passes 1st timing mark to 1 sec ___

9. Calculation:
9.1. Calculate kinematic viscosity to 3 significant figures as follows:
Kinematic viscosity, mm^2/s (cSt) = Ct
Where:
C = calibration constant of viscometer, $mm^2/s/ c^2$ (cSt/s), and
t = efflux time, s

10. Report:
10.1. Always report test temp w/ result ___

Data Sheet ___

S___F___N/A___

VISCOSITY OF ASPHALTS BY VACUUM CAPILLARY VISCOMETER
ASTM D 2171-07

6. Apparatus:
6.1. Viscometers, capillary-type, borosilicate glass, annealed; suitable for test as follows:
6.1.1. Cannon-Manning vacuum viscometer in accordance w/ Appendix X1 ___
6.1.2. Asphalt institute vacuum viscometer in accordance w/ Appendix X2 ___
6.1.3. Modified Koppers vacuum viscometer in accordance w/ Appendix X3 ___
6.2. Thermometers, calibrated liquid-in-glass w/ accuracy after correction 0.04°F (0.02°C) ___
6.2.2. Liquid-in-glass thermometers calibrated periodically in accordance w/ E 77 (Appendix X5) ___
6.3. Bath suitable for immersion of viscometer ___
6.4. Vacuum system, maintain to w/in ±0.5 mm up to & including 300 mm Hg ___
6.5. Timer, accurate to 0.05 % over 15 sec intervals, graduated to 0.1 sec ___
6.5.1. Electrical timing devices may be used w/ required accuracy ___

7. Sample preparation:
7.1. Heat spl to fluid to pour ___
7.2. Transfer 20 ml into container, heat to 275 ± 10°F (135 ± 5.5°C) ___

8. Procedure:
8.1.1. Maintain bath temp w/in ±0.5°F (±0.03°C) ___
8.1.2. Select viscometer to give flow > 60 sec, preheat to 275 ± 10°F (130 ± 5.5°C) ___
8.1.3. Charge viscometer by pouring spl to w/in ±2 mm of fill line E ___
8.1.4. Place viscometer in oven or bath @ 275 ± 10°F (135 ± 5.5°C) for 10 ± 2 min. ___
8.1.5. Remove viscometer & w/in 5 min. insert in holder & position viscometer in bath ___
8.1.6. Establish 300 ± 0.5-mm Hg & connect to viscometer ___
8.1.7. After 30 ± 5 min. start flow of asphalt in viscometer ___
8.1.8. Measure w/in 0.01 sec leading edge of meniscus passes between successive pairs of timing marks ___; report 1st flow time exceeds 60 sec ___

9. Calculation:
9.1. Select calibration factor corresponding to pair if timing marks, calculate & report to 3 significant figures as follows:

Viscosity, Pa · s = (Kt)

Where:
K = selected calibration factor, Pa · s/s, and
t = flow time, s

10. Report:
10.1. Always report test temp & vacuum w/ viscosity test result ___

Data Sheet ___

S___F___N/A___

EXTRACTION OF BITUMEN FROM BITUMINOUS
PAVING MIXTURES
ASTM D 2172-05

5. Apparatus:
5.1. Oven. 110 ± 5°C (230 ± 9°F) ___
5.1. Pan (12in. (305 mm) by 8 in. (203 mm) by 1 in. (25 mm) ___
5.2. Balance (accurate to 0.01 % of sample mass) _____
5.3. Hot plate, electric, 700-W continuous or low, med., & high settings ___
5.4. Small-mouth graduate (1000 or 2000 ml) ___, optional small-mouth graduate (100 ml) ___
5.5. Ignition dish (125 ml) ___
5.6. Dessicator ___
5.7. Analytical balance ___

6. Reagents:
6.1. Reagents of proper grade ___
6.2. Ammonium carbonate [$(NH_4)_2CO_3$)] ___
6.3. Methylene Chloride ___
6.4. Normal propyl bromide (NPB) ___
6.5. Trichloroethylene, technical grade, (Fed. Spec. O-T-634) ___

8. Sampling:
10.2. Obtain samples in accordance w/ D 979 ___
10.3. Preparation of test samples:
8.2.1. If mixture not soft, warm to 230 ± 9°F (110 ± 5°C) ___
8.2.2. Test sample size according to max aggregate – Table 1 ___

10. Test Method A apparatus in addition to Section 5:
10.1.1. Extraction apparatus – bowl & apparatus to revolve bowl up to 4600 rpm ___
10.1.2. Filter rings – felt or paper to fit rim of bowl ___
10.1.3. Low-ash paper rings may be used in place of filter rings ___

11. Procedure ___

12. Calculation of bitumen content ___

13. Test Method B apparatus in addition to Section 5:
13.1.1. Extraction apparatus as in Fig. 2 ___
13.1.1.1. Plain cylindrical glass jar – heat-resistant ___
13.1.1.2. One or 2 cylindrical metal frames ___
13.1.1.3. Condenser ___
13.1.1.4. Medium-grade, fast-filtering filter paper ___
13.1.1.5. Asbestos-coated wire mesh - ~ 3mm thick ___
13.1.1.6. Thermostatically controlled hot plate ___

15. Procedure ___

16. Calculation of bitumen content ___

The remaining test methods are rarely used – see the standard for details.

Data Sheet ___

S___F___N/A___

BULK SPECIFIC GRAVITY ON SATURATED SURFACE DRY SPECIMENS
ASTM D 2726-09

6. Apparatus:
6.1. Balance meeting ASTM D 4753, class GP2, readability of 0.1-g, accurate to 0.2-g or 0.1% ___
Balance must have apparatus to weigh specimens suspended in water (wire basket) ___
6.2. Water Bath capable of 25 ± 1°C (77 ± 1.8°F) with constant water level ___

7. Sampling:
7.1. Spec lab-molded or from bituminous pavements ___
7.2. Spl according to D 979 ___

8. Test specimens:
8.1. Dia. of molded or cored specs. or length of sides of sawed specs. be = to 4 X max agg size & thickness at least 1 ½ X max agg size ___
8.2. Avoid distortion, bending, or cracking & store in cool place ___
8.3. Free of foreign matter & if evident, remove by sawing ___

9. Procedure:
9.1. For cores & other specimens that may contain moisture or solvent as follows:
9.1.1. Mass of specimen in water @ 25 ± 1°C (77 ± 1.8°F) for 3 – 5 min, (C) ___
If spec temp differs from water bath temp > 2°C (3.6°F) leave in water bath 10 – 15 min ___
9.1.2. Mass of SSD Spec. in air, (B) ___
9.1.3. Mass of Oven-Dry Spec., (A) ___
9.1.3.1. May use microwave or other approved methods if spec is not overheated & results are proven equivalent to oven drying ___
9.2. For lab-prepared dry specimens:
9.2.1. Mass dry specimen in air, (A) ___
9.2.2. Mass in water, (C) ___
9.2.3. Mass SSD in air, (B) ___

10. Calculation:
10.1. BSG, bulk spec. grav. = A / (B-C) ____
10.2. Density = bulk spec. grav. X 997.0 (or 62.24) ___
10.3. Percent water absorbed by spec. by volume = B – A / B – C X 100 ___
10.4. If % water absorbed by spec. in 10.3 exceeds 2 %, use D 1188 or D 6752 ___
10.5. Density in lb/ft^3 is acceptable ___

11. Report:
11.1.1. BSG to the third decimal place (@ 25^o C) ____
11.1.2. Density of mixture w/ 4 significant figures in kg/m3 or lb/ft3 as density @ 25^o C ___
11.1.3. Type of mixture ___
11.1.4. Size of spl ___
11.1.5. Water absorption in % ___

Data Sheet ___

S___F___N/A___

EFFECT OF HEAT AND AIR ON A MOVING FILM OF ASPHALT (ROLLING THIN-FILM OVEN TEST)
ASTM D 2872-04

5. Apparatus:
5.1. Oven, double-walled convection ___
Inside 15 in. (381 mm) high, 19 in. (483 mm) wide, & 17 ½ ± ½ in. (445 ± 13 mm) deep ___
Door w/ window w/ 2 sheets glass ___
5.1.1. Oven vented @ top & bottom ___
5.1.2. Oven have air plenum covering side walls & ceiling ___
5.1.3. Oven w/ proportional control thermostat to maintain 325°F (163°C) w/in ± 1.0°F (± 0.5 °C) ___
5.1.4. Thermometer affixed to ceiling 2-in. from right side of oven @ midpoint of oven, thermometer hang in oven so bulb w/in 1-in. of imaginary line level w/ shaft of circular metal carriage, heating controls capable of bringing fully loaded oven back to test temp w/in 10-min. ___
5.1.5. Oven provided w/ 12-in. (304.8-mm) dia. vertical carriage ___
5.1.6. Oven have air jet to blow heated air into each bottle @ lowest point of travel ___
5.2. Flowmeter, to measure airflow @ 4000 ml/min. ___
5.3. ASTM thermometer conform to Thermometer 13C in accordance w/ E 1 ___
5.3.1. Electronic temp measurement system may be used provided 5.3.1.1 – 5.3.1.5 met ___
5.4. Container, heat resistant glass conforming to dimension in Fig. 3 ___
5.5. Cooling rack, wire or sheet metal that allows free flow of air around each container ___

6. Preparation of oven:
6.1. Position air outlet orifice ¼ ± 1/8-in. (6 ± 3mm) from opening of container ___
6.2. Position therm. so that end of bulb w/in 1 in. (25.4 mm) of imaginary level w/ center of shaft ___
6.3. Level oven so that containers are level w/in 1° ___
6.4. Start fan to stay on when heater on & door closed, (fan may be stopped when door is open ___
6.5. Preheat oven 16 hr. @ temp. setting used during test, 325 ± 1°F (163 ± 0.5°C) ___

7. Procedure:
7.1. Spl as received free of water, heat in oven not > 302°F (150°C) until spl completely fluid___
7.2. Pour 35 ± 0.5 g spl into containers ___
7.3. Turn container horizontal & place in cooling rack ___
7.3.1. Cool containers 60 – 180 min. ___
7.3.2. For mass change, use 2 containers, weigh vertically on analytical balance to 0.001 g ___
7.4. W/ oven @ temp. & airflow @ 4000 ± 20 ml/min., arrange containers so carriage is balanced ___
Maintain in oven /w air flowing & rotating 85 min. ___
Temp of 325 ± 1°F (163 ± 0.5°C) reached 1st 10 min. otherwise discontinue test ___
7.5. Remove spls for mass change, place horizontally in cooling rack ___
Remove containers, transfer contents to collection container ___
Transfer complete after pouring out any residue ___
7.6. Stir collection container, test residue w/in 72 hr. of RTFO test ___
7.7. If mass change determined, cool containers 60 – 180 min., weigh on analytical balance to 0.001 g ___

8. Report:
8.1. Report results in terms of physical changes in asphalt brought about by this method ___
8.2. When determined, rpt avg. mass change of mat'l in 2 containers as mass % of original mat'l to 0.001 % ___

Data Sheet ___

S___F___N/A___

DENSITY OF BITUMINOUS CONCRETE IN PLACE BY NUCLEAR METHODS
ASTM D 2950-09

5. Apparatus:
5.1. Nuclear device ___
5.1.1. Gamma source ___
5.1.2. Gamma detector ___
5.2. Reference standard (block) ___
5.3. Site preparation device (guide plate) ___
5.4. Drive pin ___

7. Calibration:
7.1. Calibrate in accordance w/ Annex A1 annually ___
Adjust calibrations as necessary in accordance w/ Annex A2 ___

8. Standardization & reference check:
8.1. Standardize @ start of each day & when measurement in doubt, keep permanent record ___

9. Procedure:
9.1. Turn on, allow to stabilize, leave on during day ___
9.2. Standardize ___
9.3. Select test location ___
9.4. Maximum contact between base & surface ___
9.5. Make hole w/ drive pin & guide plate ___
9.6. Gently pull gage so probe is against side of the hole ___
9.7. Take count ___
9.8. Determine ratio of the reading to std count or the air-gap count ___
From this ratio & cal & adjustment data, determine in-place density ___

10. Calculation ___

11. Report ___

Data Sheet ___

S___F___N/A___

DENSITY OF LIQUID ASPHALTS (HYDROMETER MEHTOD)
ASTM D 3142-05

6. Apparatus:
6.1. Hydrometer, glass graduated in units of G_s, or API gravity, conform to E 100 (Table 1) ___
6.2. Thermometers, calibrated liquid-in-glass, max scale error 0.1°C ___
6.3. Hydrometer cylinder ___
6.4. Constant-temperature bath ___
6.5. Oven, maintain temp to w/in ±3°C __

8. Sampling:
8.1. Samples in accordance w/ D 140 ___

9. Temperature of test:
9.1. Keep temp so spl fluid enough for duration of test (recommended temps Table 2) ___

10. Procedure:
10.1. Heat spl to w/in 3°C of test temp ___
10.2. Transfer spl to hydro cylinder ___
10.3. Place cylinder in pre-heated bath, let spl reach test temp & verify its temp ___
10.4. Gently lower hydro into cylinder ___
10.5. Read hydro @ top of meniscus ___
10.6. After rdg, record temp to 0.2°C ___

11. Calculation:
11.1. Apply relevant corrections ___

12. Report:
12.1. Report as specific gravity 60/60°F, or as density @ 15°C, kg/m^3, or as gravity in degrees API ___

Data Sheet ___

S___F___N/A___

PERCENT AIR VOIDS IN COMPACTED DENSE AND OPEN
BITUMINOUS PAVING MIXTURES
ASTM D 3203-05

5. Sampling:
5.1. Samples from lab compacted mixtures or cores from field compacted mixtures ___

6. Procedure:
6.1. Dense mixtures get bulk G_s by D 1188, D 2726, or D 6752 ___
Get theoretical max G_s by D 2041 or D 6857 from comparable mixture ___
6.2. Open mixtures, regular shape, get density from mass, g, & vol., cm^3 ___
Height of specimens by D 3549, by 4 dia. @ 4 location & average ___
Vol. from average ht. & dia. ___
Theoretical max G_s by D 2041 from comparable mixture ___
6.3. Borderline cases, designate as open mixture if % air voids $\geq$ 10 % ___
6.4. Get bulk G_s & theoretical max G_s on aliquot portions for referee purposes ___

7. Calculation:
7.1. Calculate % air voids as follows:
% air voids = 100 [1 - (bulk G_s/theoretical max G_s)] ___

Data Sheet ___

S___F___N/A___

DENSITY OF SEMI-SOLID AND SOLID BITUNINOUS MATERIALS (NICKEL CRUCIBLE METHOD)
ASTM D 3289-08

6. Apparatus:
6.1. Crucible, nickel, high-form, 30 ml ~ 43-mm high by 41-mm diameter ___
6.2. Constant temp bath ___
6.3. Thermometer, calibrated liquid-in-glass, max scale error 0.1°C, graduations in 0.1°C ___
6.4. Balance, analytical, weigh to 0.001 g, fitted w/ pan straddle & wire basket (Fig 1) ___
6.5. Basket & pan straddle (Fig 1) ___

7. Material:
7.1. Water, freshly boiled & cooled distilled or deionized ___

8. Sampling:
9.1. Samples in accordance w/ D 140 ___
9.2. Thoroughly mix & get representative portion ___

10. Procedure:
10.1. Place crucible in wire basket, weigh to 0.001 g, designate W_1 ___
10.2. Fill 400 ml Griffin low-form beaker w/ distilled water ___
Place on pan straddle, suspend so the crucible immersed in water ___
Weigh to 0.001 g, designate W_2 ___
10.3. Remove crucible & dry ___
10.4. Preparation of sample, heat not $>$ 30 min. until fluid enough to pour ___
10.5. Warm crucible @ 120°C 10 min., fill nearly full w/ sample ___
Cool not $<$ 40 min., suspend in basket, weigh to 0.001 g, designate W ___
10.6. Remove crucible & immerse in water bath 30 min. ___
10.7. Remove from bath & insert it in basket ___
Place & crucible on pan straddle so crucible immersed in water ___
Weigh to 0.001 g, designate W_3 ___

11. Calculation:
11.1. Calculate relative density as follows:
relative density = $(W - W_1)/[(W - W_1) - (W_3 - W_2)]$
Where:
W = mass crucible w/ spl suspended in basket in air, g,
W_1 = apparent mass empty crucible in basket in air, g,
W_2 = mass empty crucible in basket in water, g,
W_3 = apparent mass crucible in basket in water, g.
11.2. Calculate density as follows:
Density = relative density X W_T
Where:
WT = density of water @ test temp ___

12. Report:
12.1. Report density to 1 kg/m_3 (0.001 kg/L), & test temp ___

Data Sheet ___

S___F___N/A___

RANDOM SAMPLING OF CONSTRUCTION MATERIALS
ASTM D 3665-07

5. See paragraphs 4.1 – 4.2.1.2 for Instructions for using the 4-digit table of random nos. (Table 1):

6. Selection Procedures:
6.1. Sampling from belt or flowing stream of mat'l:
6.1.1. Determine length of time, *t*, in min. for lot to be sampled to pass sampling point ___
Determine No. of spls, *n*, to be taken from lot ___
Follow instructions in Table 1; pick *n* Nos. to determine times *t* to select spls ___
6.1.2. Example, look up in the standard.

6.2. Sampling from a windrow of mat'l:
6.2.1. Determine total length of 1 windrow in meters representing a lot of mat'l ___
Determine No. of spls, *n*, to be taken ___
Follow instructions in Table 1; pick *n* Nos. to determine length, *l*, from start of windrow ___
6.2.2. Example, look up in the standard.

6.3. Sampling in-place mat'l:
6.3.1. Determine length of 1 pavement representing a lot of mat'l, the width of pavement, w, & No. of spls needed for each lot, *n* ___
Follow instructions in Table 1; pick (*l)* Nos. corresponding to length of pavement, followed by picking *w* Nos. for width ___
6.3.2. Example, look up in the standard.

6.4. Sampling from a loaded truck:
6.4.1. Determine No. of truck loads to represent a lot of mat'l & the No. of spls, *n*, needed from each lot ___
To determine which trucks to spl, pick *n* Nos. from Table 1 & multiply these Nos. by No. of trucks in lot ___
To determine quadrant in ea truck to be sampled, choose *n* Nos. from Table 1 & multiply by 4 ___
Select quadrant in accordance w/ following criteria. Quadrant locations of truck in Fig 1 ___

Calculated Random Number, N	Quadrant
$N \leq 1.0$	1
$1.0 < N \leq 2.0$	2
$2.0 < N \leq 3.0$	3
$3.0 < N \leq 4.0$	4

6.4.2. Example, look up in the standard.

Data Sheet ___

S___F___N/A___

ASPHALT CONTENT OF BITUMINOUS MIXTURES BY THE NUCLEAR METHOD
ASTM D 4125-05

5. Apparatus:
5.1.1. Neutron source ___
5.1.2. Detectors ___
5.1.3. Read-out instrument ___
5.2.1. Stainless steel pans ___
5.2.2. Balance, 20 kg (44 lb.) capacity, readable to 1 g (0.0002 lb.) ___
5.2.3. Oven capable of heating to 177 ± 3°C (350 ± 5°F) ___
5.2.4. Steel straightedge, ~ 450 mm (18 in.) long ___
5.2.5. Flat plate slightly larger than spl pan ___
5.2.6. Assorted spoons & mixing bowls ___
5.2.7. Thermometer, 10 - 250°C ((50 - 482°F) ___
5.3.1. Molded lab specimen container for test method B ___

7. Sampling:
7.1. Random samples of aggregate in accordance w/ D 75 ___
7.2. Fresh bituminous paving mixture in accordance w/ D 979 ___
7.3. Random spls of bituminous materials in accordance w/ D 140 ___

8. Calibration: ___

9. Background & stability check ___

10. Procedure ___

11. Report ___

Data Sheet ___

S___F___N/A___

EFFECT OF MOISTURE ON ASPHALT CONCRETE PAVING MIXTURES
ASTM D 4867-09

5. Apparatus:
5.1. Use apparatus from 1 of D 1075, 1559, 3887, 3496, 1561, or 4013 ___
5.2. Vacuum pump or water aspirator ___
5.3. Manometer or vacuum gage ___
5.4. Container ___
5.5. Balance in accordance w/ 2726 ___
5.6.1. 1 water bath in accordance w/ D 2726 ___
5.6.2. 1 bath to maintain 60 ± 1.0°C (140 ± 1.8°F) for 24 hr. ___
5.6.3. 1 bath to maintain 25 ± 1.0°C (77 ± 1.8°F) ___
5.7. Loading jack & ring dynamometer in accordance w/ D 1559, or mechanical or hydraulic machine ___
5.8. Loading strips in accordance w/ D 4123 ___

6. Preparation of lab test specimens ___

7. Preparation of field specimens ___

8. Procedure:
8.1. Theoretical max G_s in accordance w/ D 2041 ___
8.2. Specimen height in accordance w/ D 3549 ___
8.3. Bulk Gs in accordance w/ D 2726 ___
8.4. % air voids in accordance w/ D 3203 ___
8.5. Sort specimens into 2 subsets ___
8.6. Partially saturate ___
8.6.1. Partially saturate to 8.6.3 by partial vacuum ___
8.6.2. Volume of partially sat. specimen in accordance w/ D 2726 ___
8.6.3. Determine degree of saturation ___
8.7. Moisture by soaking in distilled water @ 60 ± 1.0°C (140 ± 1.8°F) for 24 hr. ___
8.8. Soak in water bath @ 25 ± 1°C (77 ± 1.8°F) for 1 hr. ___
8.9. Height in accordance w/ D 3549 & volume by D 2726 ___
8.9.1. Water absorption & degree sat. to 8.6.2 & 8.6.3 ___
8.9.2. Determine swell ___
8.10. Soak in bath @ 25 ± 1°C (77 ± 1.8°F) for 20 min. ___
8.11. Tensile strength @ 25 ± 1°C (77 ± 1.8°F) on both subsets ___
8.11.1. Place in loading machine, position strips & load ___
8.11.2. Load until fracture ___
8.11.3. Inspect all surfaces ___

9. Calculation ___

10. Report:
10.1.1. No. of specs. in ea. subset ___
10.1.2. Avg. air voids of ea. subset ___
10.1.3. Avg. degree of saturation after partial saturation & after moisture conditioning ___
10.1.4. Avg. swell after partial saturation & after moisture conditioning ___
10.1.5. Tensile strength of ea. spec. in ea. subset ___
10.1.6. Tensile strength ratio ___
10.1.7. Results of visually-estimated moisture damage observed when spec. fractures ___
10.1.8. Results of fractured or crushed agg. ___

Data Sheet ___

S___F___N/A___

RECOVERY OF ASPHALT FROM SOLUTION USING THE ROTARY EVAPORATOR
ASTM D 5404-03

5. Apparatus:
5.1. Rotary evaporator w/ distillation flask, variable speed motor, condenser, solvent recovery flask, & heated oil bath ___
5.2. Manometer or vacuum gage ___
5.3. Gas flowmeter, w/ gas flow of 1000 ml/min. ___
5.4. Sample container ___
5.5. Vacuum system, maintain vacuum to w/in ± 0.7 kPa (± 5 mmHg) to 80 kPa (600 mm Hg) ___

6. Reagents & materials:
6.1. Nitrogen gas or carbon dioxide gas ___
6.2. Oil, USP White Oil, or Silicone Fluid SWS-101 w/ flash pt above 215°C (420°F) ___
6.3. Solvents:
6.3.1. Reagent grade trichloroethylene or methlyene chloride ___
6.3.2. Normal Propyl Bromides (nPB) ___

8. Sample preparation:
8.1. Obtain in accordance w/ D1856, including procedure for centrifuging from previous extraction ___

9. Procedure:
9.1. Heat oil bath to 140 ± 3°C (285 ± 5°F) ___
9.2. Vacuum of 5.3 ± 0.7 kPa (40 ± 5 mm Hg) ___
Draw ~ 600 ml asphalt solution from spl into distillation flask ___
Nitrogen or carbon dioxide flow @ 500 ml/min. ___
9.3. Stop gas flow when asphalt solution low enough for more can be added ___
9.4. Bulk of solvent is distilled, immerse flask to max depth of 40 mm (1.5 in.) ___
Vacuum of 80 kPa (600 mm Hg) ___
Increase gas flow to ~ 600 ml/min. & spin @ 45 rpm ___
Hold or reduce vacuum if foaming or bubbling, when foaming stops hold for 15 ± 1 min. ___
9.5. Remove flask, clean oil from flask ___
Pour asphalt into container ___
9.6. Portions while still liquid can be taken for other tests ___

Data Sheet ___

S___F___N/A___

MECHANICAL SIZE ANALYSIS OF EXTRACTED AGGREGATE
ASTM D 5444-08

4. Apparatus:
4.1. Balances or scales, readable to 0.1 g, accurate to 0.1 g or 0.1 % of test load ___
4.2. Sieves in accordance w/ E 11 ___
4.3. Mechanical shaker, if used, impart vertical, or lateral & vertical motion ___
4.4. Oven maintain 110 ± 5°C (230 ± 9°F) ___
4.5. Container ___

5. Sample:
5.1. Sample of aggregate from ASTM D 2172 or ASTM D 6307 ___
5.1.1. Agg extracted by ignition method in D 6307 not to be used for gradation analysis if correction factor obtained in D 6307 is > 1.0 (Note 1) ___
5.2. Sample as follows:

Sieve Size, mm (in.)	Max Mass Of sample, kg
4.75 (No. 4)	0.5
9.5 (3/8 in.)	1
12.5 (1/2 in.)	1.5
19.0 (3/4 in.)	2
25.0 (1 in.)	3
37.5 (1 ½ in.)	4

6. Procedure:
6.1. Dry in oven to constant weight to 0.1 % of spl weight ___
6.2. Place in container & soak in water ___
Add wetting agent ___
Agitate & pour over No. 10 & No. 200 sieves ___
6.3. Decant until wetting agent removed & water is clear ___
6.4. Return mat'l to container & dry in oven to constant weight ___
6.5. Sieve over nest of sieves including No. 200 & record weight retained on each sieve & calculate %'s ___
6.6. Nest sieves in decreasing size & place spl on top sieve ___
Agitate by hand or mechanical apparatus for sufficient period ___
6.7. Limit mat'l not to overload sieves ___
6.8. Sieve for sufficient period so that not > 0.5 % passes a sieve for 1 min. hand sieving ___

7. Calculation:
7.1. Calculate total % passing ea sieve, total % ret'd on ea sieve, or % ret'd between consecutive sieves to 0.1 % ___

8. Report:
8.1.1. Total % pass each sieve ___
8.1.2. Total % retained each sieve ___
8.1.3. % mat'l retained between consecutive sieves ___
8.2. % to nearest whole No., except No. 200 report to 0.1 % ___

Data Sheet ___

S___F___N/A___

ASPHALT CONTENT OF HOT-MIX ASPHALT BY IGNITION METHOD
ASTM D 6307-05 (10)

5. Apparatus:
5.1. Balance meeting ASTM D 4753, class GP2, readability of 0.1-g ___
5.2. Sample trays ___
5.3. Catch Pan ___
5.4. Catch pan/sample tray(s) handling apparatus ___
5.5. Assorted spatulas, pans, bowls, and wire brushes ___
5.6. Protective gloves ___
5.7. Ovens, for drying aggregates and HMA mixtures, & preheating HMA mixtures prior to ignition testing ___
5.8. Ignition furnace, as described in 8.1.1 or 11.1.1 ___

7. Sampling:
7.1. Sample aggregates in accordance w/ D 75 ___
7.2. Hot-mix asphalt in accordance w/ D 979 ___
7.3. Preparation of test specimens:
7.3.1. If not soft enough, warm in 110 ± 5°C oven, split or quarter in accordance w/ C 702 ___
7.3.2. Get spl size according to Table 1 ___
7.4. Asphalt cement in accordance w/ D 140 ___

8. Apparatus for Test Method A in addition to section 5:
8.1.1. Ignition furnace, capable of 580°C w/ internal weighing system w/ at least 2500 g capacity ___
8.1.2. Filters, if required ___

9. Calibration (9.1 – 9.15) ___

10. Procedure ___

11. Apparatus for Test Method B in addition to section 5:
11.1.1. Furnace, capable of 580°C, w/ fan to pull air through furnace to expedite test & reduce escape of smoke in lab ___
11.1.2. Filters, if required ___

12. Calibration (12.1 – 12.23) ___

13. Procedure ___

14. Report:
14.1.1. Date ___
14.1.2. Identification of aggregate & mix type ___
14.1.3. Test number ___
14.1.4. Calibration data ___
14.1.5. Mass of HMA spl before & after ignition, to 0.1 g ___
14.1.6. Measured asphalt content, to 0.01 % ___
14.1.7. Aggregate gradation, if performed ___

Data Sheet ___

S___F___N/A___

PREPARATION OF BITUMINOUS SPECIMENS USING MARSHALL APPARATUS
ASTM D 6926-04

4. Apparatus:
4.1. Mold assembly conforming to Fig. 1 ___
4.2. Spec extractor – minimum 3.95-in. dia & ½-in. thick ___
4.3.1. Manually held (Type 1) or fixed (Type 2) compaction hammers, mechanically or hand operated (Fig 2) – 10.0 ± 0.02-lb sliding wt & 18 ± 0.06-in. drop ___
4.3.2. Hammers w/ fixed hammer handle, surcharge on top of handle, constantly rotating base, & mechanically operated w/ same dimensions as 4.3.1 ___
4.4. Compaction pedestal – wooden post (8 X 8 x 18-in.) ___; steel plate (12 X 12 X 1-in.) ___
4.5. Spec mold holder to hold mold assembly in position during compaction ___
4.6. Ovens, heating pots, or hot plates to heat to w/in 3°C (5°F) of required temps ___
4.7. Mixing apparatus – mechanical mixer recommended ___
4.8.1. Containers for heating aggregates ___
4.8.2. Covered containers for heating bituminous mat'l ___
4.8.3. Mixing tools – trowel, spoon, or spatula ___
4.8.4. Calibrated thermometers – 10 - 200°C (50 - 400°F), sensitive to 3°C (5°F) ___
4.8.5. Balance – readable to 0.1 g ___

5. Test Specimens:
5.1. Dry agg. 105 - 110°C (221 - 230°F) ___
5.2.1. Heat asphalt cement to viscosities of 0.17 ± 0.02 Pa's for mixing & 0.28 ± 0.03 Pa's for compacting ___
5.2.2. Heat cutback asphalt to viscosities of 0.17 ± 0.02 Pa's for mixing & 0.28 ± 0.03 Pa's for compacting ___; Get temp for compaction using compositional chart of viscosity vs. % solvent for that cutback asphalt ___
5.2.3. Heat recompacted paving mixtures to w/in 3°C (5°F) of desired compaction temp ___
5.3.1. Batch 1 – 4 specimens (approx 1200, 2400, 3600, 4800 g) ___; Heat to above but NTE mixing temp by > 28°C (50°F) for asphalt cement & tar mixes & 14°C (25°F) for cutback mixes ___; Mix for approx 60 sec for single-spec batches & 120 sec for multiple-spec ___
5.3.2. Place single batches in metal container in oven 8 - 11°C (15 - 20°F) above comp temp for 1- 2 hr ___
5.3.3. Multi batch, place on non-absorptive surface, hand mix ___; Asphalt cements & tar put in metal containers in ventilated oven, heat to temps in 5.3.2 for 1 – 2 hr ___; Cutback heat in mixing bowl to 11°C (20°F) until precalculated wt of 50 % solvent loss or more ___
5.4.1. Heat mold assembly & hammer face to 90 - 150°C (200 - 300°F), put nonabsorbent paper in bottom of mold, put mixture in mold, spade w/heated spatula or trowel 15 X around perimeter & 10 X around interior, temp of mixture w/in limits of compaction temp ___
5.4.2. Compact req'd No. of blows, reverse mold & collar & apply same No. blows on other end ___; Cool in molds, extract from mold & cool to room temp ___

6. Report:
6.1.1. Report spl id ___
6.1.2. Type of bituminous mat'l, source, & content ___
6.1.3. Type(s) of agg, source, & grading ___
6.1.4. Type & time of curing prior to compaction ___
6.1.5. Type of hammer ___
6.1.6. No. of blows/side ___
6.1.7. Mixing temp ___
6.1.8. Compaction temp ___
6.1.9. Type & time of cooling ___

Data Sheet ___

S___F___N/A___

MARSHALL STABILITY AND FLOW OF BITUMINOUS MIXTURES
ASTM D 6927-06

4. Apparatus:
4.1. Breaking head – Fig 1 ___
4.2. Compressive loading machine – uniform movement of 2 ± 0.15 in./min. ___
4.3. Load measuring device, at least 5000 lb. calibrated ring dynamometer w/ sensitivity of 10 lb. ___
4.4. Flowmeter w/ 0.01-in. divisions ___
4.5. Water bath w/ false bottom, deep enough to keep water level 1.25-in. above spec ___; Capable of maintaining test temp w/in ±1°C (2°F) ___
4.6. Oven capable of maintaining test temp w/in ± 1°C (2°F) ___
4.7. Air bath for cutback mixtures @ temp of 25 ± 1°C (77 ± 2°F) ___
4.8. Calibrated thermometers to cover temp range & readable to 0.2°C (0.4°F) ___

5. Procedure:
5.1. Minimum of 3 specs of a given mixture ___
5.2. Get bulk Sp Gr (BSG) in accordance w/ ASTM D 2726, D1188, or D 6752 ___; BSG's of replicate specs for ea binder agree to w/in ±0.020 of mean ___
5.2.1. Measure spec thickness in accordance w/ D 3549 ___
5.3. Testing to be complete w/in 24 hr after compaction ___; Bring to specified temp in water bath for 30 – 40 min. or oven for 120 – 130 min. ___
5.3.1. Breaking head @ temp of 20 - 40°C (70 - 100°F) ___
5.3.2. Put spec in breaking head & put Flowmeter (if used) in position & zero & apply load ___
5.4. Time from removal from water bath to max load NTE 30 sec ___; Load @ constant rate until dial gage releases or load decreases ___
5.5. Method A – release flowmeter sleeve or note micrometer dial rdg if used the instant load decreases ___; Method B stop test when load cell rdg decreases ___
See paragraph 5.5 for Marshall flow determination ___

6. Calculation:
6.1. Lab molded specs shall satisfy thickness requirement of 63.5 ± 2.5-mm (2.50 ± 0.10-in.) ___; Correlation ratio as follows:

$$A = B \times C$$

Where:
A = Corrected stability
B = measure of stability (load)
C = correlation ratio from Table 1

7. Report:
7.1.1. Type of spl tested (lab mixed, plant mixed, or pavement core) ___
7.1.2. Nature of bituminous mixture, include agg type & grading, binder grade, & binder content ___
7.1.3. Individual & avg. BSG's ___
7.1.4. Ht of ea spec to nearest 0.25 mm or 0.01 in. ___
7.1.5. Individual & avg. Marshall stability (uncorrected & corrected) to nearest 50 N or 10 lb ___
7.1.6. Individual & avg. values of Marshall flow in units of 0.25 mm or 0.01 in. ___
7.1.7. Test temp ___

Data Sheet ___

S___F___N/A___

STANDARD METHOD FOR DENSITY AND PERCENT VOIDS
CRD-C 650-95

2. Apparatus:
2.1. Balance, 2-kg (0.1-g) ___
2.2. Wire basket for weighing samples suspended in water ___
2.3. Tank or bucket of sufficient capacity to completely immerse the sample in water. ___

3. Preparation of specimen, mark for ID, air dry ___

4. Procedure:
4.1. Nonporous spls, weigh in air & water ___; get density as follows:
Specific gravity = A/A – B
Where:
A = mass in air, g
B = mass in water, g
4.2. Porous spls, weigh in air, water, then air (SSD) ___

5. Calculations, Gs of both aggregate & asphalt cement & % of each must be known ___
Voids calculated as follows:
Voids = 100 – (G/H) X 100
Where:
G = specific gravity of compacted sample ___
H = theoretical max specific gravity

6. Report ___

Data Sheet ___